The Second State of the Environment Report of the Caspian Sea

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# Introduction

The Caspian Sea is a unique natural reservoir of our planet. It is land locked water body locates on the border of two large parts of the continent of Eurasia. The Caspian Sea is the largest land locked reservoir. It has a total area of 378,400 km2, which is 18 percent of the total area of all the lakes of the globe. The water area of the Caspian Sea is commensurate with the area of the Baltic Sea (387,000 km2) and exceeds the area of the Adriatic Sea (139,000 km2).

Based on the features of the morphological structure and physical and geographical conditions, the Caspian Sea is conventionally divided into three parts: the Northern Sea (25 percent of the area), the Middle (36 percent of the area), and the Southern Caspian (39 percent of the area). The conditional border between the first passes through the island of Chechnya - cape Tyub-Karagansky, between the Middle and South Caspian - along the line Zhiloy - Cape Gan-Gulu. The maximum depth of the southern basin of the sea is 1025 m, and the mean depth calculated on the basis of the bathymetric curve is 208 m. The length of the sea from north to south is 1030 km, the width from east to west is 435 km. The length of the mostly low-lying and smooth coastline is estimated at about 6500-6700 kilometers long, and with islands it is up to 7,000 kilometers long of which 695 kilometers are in Russia, 600 kilometers in Azerbaijan, 820 kilometers in Iran, 650 kilometers in Turkmenistan and 1,600 kilometers in Kazakhstan (Bukharitsin, 1996).

There are two rivers flowing into the Caspian Sea from Azerbaijan. They are the Kura and Samur rivers. The watershed area of the Kura River is 188,000 km2, the annual runoff is 18.0 km3 (River Discharge Data Base Centre, 2011). The watershed area of the River Samur is 4,400 square kilometers, the annual runoff is 2.0 km3 (Sikolov, 1952)

There are two major rivers flow into the Caspian Sea from the territory of Iran. They are Sephidrudu River and the Gorgan River. The catchment area of the Sephidrudu River is about 56,200 km² and the average long-term runoff is 4,1km³. The runoff of the Gorgan River used for irrigation and therefore, it does not have a permanent flow in the Sea (https://www.worldatlas.com).

From the territory of Russia, the following rivers flow into the Sea: Volga, Terek, Sulak and Samur. The latter is the border river with the Republic of Azerbaijan. The average long-term runoff of the Volga River is 255 km3 or about 80 percent of surface runoff in the Sea (Marine Water Pollution Annual Report 2011-2016).

There is one river stemming from the territory of Turkmenistan- the Atrek River. Similar to the Gorgan River in Iran, the runoff of the Atrek River is used for irrigation and therefore it does not have a permanent flow into the Sea (http://cawater-info.net).

The Caspian is a brackish water body. Its salinity varies from 12.6 to 13.2 percent with an average of 12.7 percent. In the north, the range is much wider and varies from 1.0 to 8.0 percent. The water temperature on the sea surface in summer reaches 24-27°C, in winter it ranges from 0°C in the north to 11°C in the south. In summer, hypoxia can be formed in the bottom layer of the northwestern part of the sea (Kosarev AN, 1975).

Oil production, as well as fishing and shipping is inherent to the Caspian Sea. The previously constructed ports (in 2010 there were 21 large and small port facilities, 15 shipbuilding and ship-repair plants) Makhachkala, Bautino, Aktau, Baku, Turkmenbashy and Anzali are currently being reconstructed and expanded. Since the first half of the last century, the offshore oil field was being conducted in the Southern Caspian. Investigations are being continued offshore and on the adjacent territories.

The Caspian region is rich in biological resources and serves as the world's largest spawning grounds of sturgeon; there are approximately 130 species, varieties of fish and rare lotus fields. There are also more than 100 species of bird wetland habitats that serve as nesting and migration grounds. The Caspian Sea is also home to the only marine mammal that lives in the Sea- the endemic Caspian seal.

Industry and agriculture are well developed in the Caspian Sea basin. The western coast of the Caspian Sea is better developed than the eastern one; Baku is the largest port on the Caspian Sea and the largest city on the southern shore of the Absheron peninsula. It covers area of 2,130 km² and accounts more than 2.5 million inhabitants. On the Russian coast of the Caspian Sea, there are several cities with the population of 100 to 600 thousand people. Astrakhan is the largest city of the Northern Caspian and is located on 11 islands in the upper part of the Volga delta. The population of the city is 533,000 inhabitants, Makhachkala (583,000 people), Derbent (121,000) and Kaspiisk (107,000) are on the Dagestan coast (Marine Water Pollution. Annual Report 2011-2016).

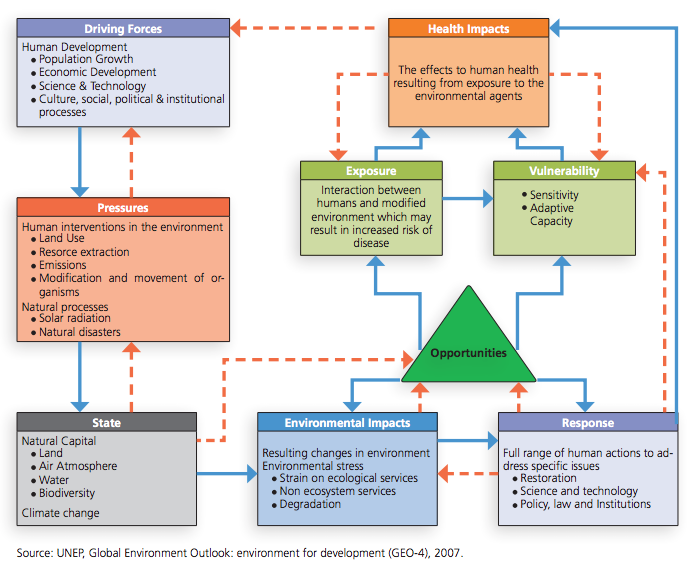
# Methodology

This report aims to describe the overall situation in the whole Caspian Sea, bringing together reports from the five littoral states and other academic sources. The SoE of the Caspian Sea Report is based on recent assessment reports published since 2011. The aim of the report is to describe the overall situation in each chapter and not focus on the specific situation in each country. State of the Environment reports are based upon the Drivers-Pressure-State-Impact-Response (DPSIR) framework, which shows relationships between human activity and the state and trends of the environment and human well-being. This analytical framework helps one to understand connections among the components of the integrated marine assessment.

The DPSIR approach was used in the Caspian Sea report from 2011 and is continued in the updated report. The report will use the results from the 2011 report as the basis and focus on the development from 2010 to 2017.

***Driving Forces*** *(e.g. demographic changes, economic and societal processes) lead to more specific* ***Pressures*** *on the environment (e.g. land use change, resource extraction, emissions of pollutants and waste, as well as modification and movement of organisms). These pressures lead to changes in the* ***State*** *of the environment (e.g. climate change, stratospheric ozone depletion, changes in biodiversity and pollution or degradation of air water and soils), which are in addition to those resulting from natural processes. These changes affect the ecological services that the environment provides to people, such as the provision of clean air and water, food, and protection from ultraviolet radiation, as well as impacts on other aspects of the environment itself, including land degradation, the quality and quantity of habitats, and biodiversity. As a result of changes in ecological services, driven by demographic, social and economic factors,* ***Impacts*** *on the environment and human well-being are expected. The impact is usually indicated by health, economic performance, material assets, good social relations and security. Societal* ***Responses*** *can influence the environmental state and their associated drivers and pressures (either intentionally or unintentionally). Societal responses essentially fall under two categories: responses directed at mitigating exposure to environmental impacts (e.g., through environmental restoration and enhancement); and responses that help society adapt directly to the impacts that occur and/or build the capacity to adapt to changes in the environment. Societal responses include formulating and implementing public policy, laws and establishing/strengthening institutions, as well as promoting advances in science and technology.*

*The exposure to changes in various environmental states, combined with the ability of society to adapt to these changes, determines the degree to which people are vulnerable or are resilient to environmental change (UNEP and IISD 2008). The SoE of the Caspian Sea Report, structured according to the DPSIR framework, includes chapters addressing driving forces referring to fundamental processes in society, pressures focusing on human interventions in the environment, the current state of the environment based on a set of indicators, impact analyses of the influence of environmental factors on human well-being, and concludes with a chapter on responses, assessing possible policy actions, in particular, adaptation and mitigation* (SoE 2011)*.*



***Driving forces of environmental change*** *(e.g. demography, industrial production)*

***Pressures on the environment*** *(e.g. discharges of waste water) State of the environment (e.g. climate change, water)*

***Impacts on population, economy, ecosystems*** *(e.g. water unsuitable for drinking)*

***Response of the society*** *(e.g. watershed protection) (SoE, 2011).*

There are three main methods used for State of the Environment assessments: indicator-based assessments, literature-based assessments and expert-consultation-based assessments.

The three methods do not exclude each other and a combination of the methods can be used; for those chapters in the report where sufficient data and information is available, the indicator or literature based methodology can be applied, while chapters lacking sufficient background data can be based upon expert elicitation.

A decision framework for assessment methodologies has been developed by UNEP (2016). This framework takes into consideration the type of assessment, available time, resources and purpose of the assessment.

The method selected will depend on the type of information available and the budget with consideration of the following questions:

* Are existing assessments available that enable a synthesized approach to be used for the assessment or portions of the assessment?
* Is recent data or literature available that enable an analysis approach to be used for the assessment (or sections of the assessment)?
* Are there knowledgeable experts available on the different subjects in the marine assessment (biodiversity and ecosystems, the physical and socio-economic aspects of the marine environment)?

Existing data from the database in the Caspian Environmental information Centre and new data collected in connection with this report will be used for the indicator based assessment that will form the basis of the report.

# Drivers

## 3.1 Socio-economic situation

Population

The five littoral states have highly uneven population density surrounding the Caspian with some regions with high population levels such as big urban centres like Baku whereas other regions are sparsely populated. Thus, the population density does not exceed 1 person per square kilometer on the eastern coast of the sea while on the western coast it fluctuates from 1,049 in urban areas (Baku) to 77 in rural areas. It should be noted that the population fluctuates following the seasons. Starting from April to September (the high season on the West coast) visitors occupy those touristic centres which mostly locate in Baku. According to the State Statistical Committee of the Republic of Azerbaijan (Azerbaijan, 2017), there is the positive trend and the number of visitors increase by 8.5 percent annually. Similar situation occurs on the South coast. This is the place where the population fluctuates significantly (National Contribution). There is no reliable information on the number of those visiting North-West, North, and East coasts of the Sea. Therefore, it is difficult if impossible to assess the seasonal fluctuation of population there.

The general population distribution along the Caspian costs concentrates around the major urban centers like Absheron Peninsula (Baku), Astrakhan, Makhachkala, and many towns along the south cost of the Caspian See and with very small populations in the nearby rural areas along the northern and eastern costs (see Fig. 3.1 Number of population in the Caspian Sea region per cities and administrative units).



In general, there is an increase in the population and its density in the region for the subsequent years and, most rapidly growing population of urban centres with a simultaneous decline in the population of agricultural and rural regions. For example, the annual average population growth on western coast was from 1 to 1.4 percent and it is 6 percent in urban areas (National contributions).

The biggest increase in the population was recorded on the western coast of the Caspian Sea. Here, the population growth has ranged between 1.1-1.4 percent amounting to 594.4 thousand people over the past six years and the total population reached 9.7 million people. The growth is centered primarily in Baku, which grew by approximately 133, 400 people (6.38 percent) between 2011 and 2016 (The State Statistical Committee of the Republic of Azerbaijan, 2017). In general, the population growth was evenly distributed between urban (6.3 percent) and rural (6.0 percent) areas (National contribution).

Figure 3.1: Number of population in the Caspian Sea region per cities and administrative units.

The South part of the Caspian coast is comprised of the Gilan, Golestan and Mazandaran provinces of Iran. The provinces have experienced respective growth rates of 0.40 percent, 1.01 percent and 1.33 percent since 2011 (Iran Statistical Centre, 2016). On the southern coast of the Caspian Sea, the population demonstrates the coincidence of the outlined general trend. It is the increasing the population in urbanized areas of 1.97 percent over the last 5 years, and a decrease in rural areas up to 0.73 percent over the same period (National contributions).

Kazakhstan’s share of the North-Eastern part of the Caspian coast is comprised of the Mangistau and Atyrau oblasts. According to a 2009 census in Mangistau oblast, the total population was 482.6 thousand people of which 263.1 thousand people (53 percent) lived in urban areas and 222.1 thousand people (47 percent) in rural areas. According to Department of Statistics of Mangistau oblast, in 2016 there were 626.7 thousand people of which 302.1 thousand people (48 percent) lived in urban areas and 324.6 thousand people (52 percent) in rural areas. Thus, from 2009 to 2016 the population grew by 23 percent (National contribution).

According to census of Atyrau oblast in 2009, the total population was 510.3 thousand people of which urban were 238.9 thousand people (47 percent) and rural 271.4 thousand people (53 percent). According to official statistics, the population of the region in 2017 increased to 607.5 thousand people. Thus, from 2009 to 2016 the population growth was 16 percent (National contribution).

Reflecting the overall trend in the Caspian region, Kazakhstan has seen strong population growths in both Atyrau (16 percent) and Mangistau region (23 percent) between 2009 and 2016- both of which are above the national growth rate of 15 percent in the same period. Atyrau accounted for 3.4 percent of the overall population whereas the Mangistau region accounted for approximately 3.5 percent. In 2017, Kazakhstan had a population of approximately 18 million, a land area roughly the size of Western Europe and one of the lowest population densities in the world (Kazakhstan, 2018).

The annual population growth was over 22 percent on the eastern coast was mainly due to the migration inflows and partially in the increase of the birth rate (National Contribution). In general, the population growth reflects and coincides with the growth of the well-being of the population.

Nationally, Russia has been struggling with an aging population towards the core, although the periphery tends to have a lower average age. Dagestan is one of the regions with a particularly young average age of 27.3. This region has also grown by 57 percent since 1989 - the largest increase in any region in Russia due to a combination of natural increase and a high influx of net in-migration (Heleniak, 2014).

Population of the north-western part of the Caspian Sea coast accounts for approximately 1 per cent of the overall population of Russia. The population this area was 1.7 million people in 2017 or 39.5 percent of the total population of the Astrakhan oblast,. On the sea coast of:

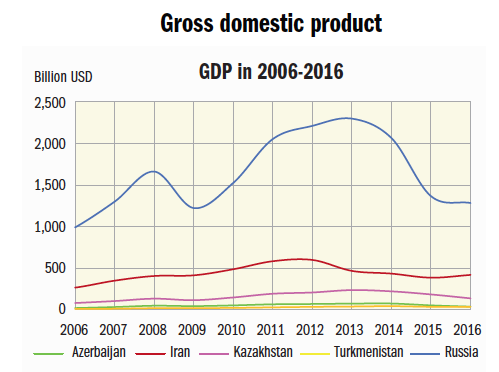
* Astrakhan oblast lived 173.4 thousand people, which is 17.0 percent of the population of the total Astrakhan oblast;
* Republic of Kalmykia lived 18.5 thousand people or 6.6 percent of the total population of the Republic of Kalmykia; and
* Republic of Dagestan lived 1.52 thousand people or 50.0 percent of the population of the Republic of Dagestan.

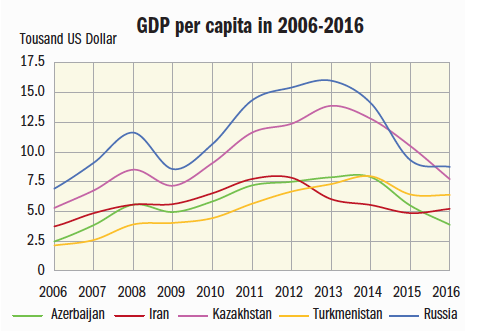
From 2010 to 2017 the population growth was 3 percent but the population growth was uneven - in the Republic of Dagestan the population increased and in the Republic of Kalmykia the population decreased (National contribution).

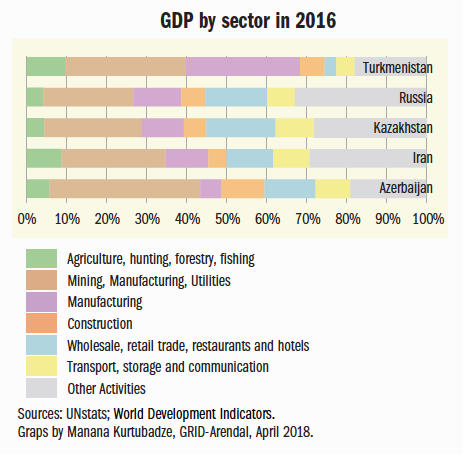
The Balkan region in Turkmenistan makes up the Eastern coast of the Caspian Sea and accounts for 28.4 percent of the country’s landmass but is characterized by a scarce population and less developed infrastructure due to the low concentrations of individuals. This region accounts for approximately 8.4 percent of the total population of the country and is the most sparsely populated region in Turkmenistan. Despite not accounting for a large percentage of the population it is the most urbanized with 79 percent of the region’s population living in an urban environment. The average age of the population is 27.8 years and the number of women and men is in equal proportion (National Contribution).

Economy

Since 2011, all the Caspian littoral states have had to mitigate the effects of global economic fluctuations in the price of hydrocarbons and raw materials because they heavily rely on the export of natural resources but all acknowledge the need to focus on the diversification of their exports and economy. As an example, the Balkan region is expanding upon the tourism sector and therapeutic medicinal springs that are in the region. The Balkan region is the largest oil producing and oil refining region in the country and the fuel industry accounts for more than 80 percent of the structure of industrial output (oil production was approximately 30 percent and over 50 percent for oil processing) is expanding the tourism sector and therapeutic medicinal services (National Contribution).







Azerbaijan has made a conscious effort to diversify the economic portfolio of the country to reduce the negative effects of a global decline in hydrocarbon market. Before 2010, oil continued to be the main diver behind Azerbaijan’s economic growth but between 2010 and 2014 the non-oil sectors were the major contributors to growth. According to the State Statistical Committee, in 2014 the non-oil sector grew by 6.9 percent, construction sector by 8.8 percent, service sector by 7.6 percent. Analysis of the share of these sectors in GDP shows that natural resources contributed 37 percent to the economic growth in 2014 and in the second place is the construction sector with 14 percent. Since 2014, the country has transitioned from a low-income country to a high-middle-income country (National Contribution).

Azerbaijan, despite the global economic downturn and oil demand contraction and fall in oil prices, remained comparatively buoyant and GDP experienced a 10-fold increase between 2003 and 2013 to reach $74.17 billion USD (UNDP, 2016). After adopting Vision 2020, the country focused on economic diversity and inclusive growth, institutional capacities and effective governance, as well as environmental degradation and vulnerability to natural hazards to realize the pathway outlined in the development strategy (UNDP, 2016).

Iran’s Caspian coast has some unique characteristics and unlike some of the other Caspian littoral states the Caspian Sea has not been the primary source for their oil and gas resources. Instead, Iran’s coast is unique in terms of a larger and more established tourist industry with a higher number of secondary home- all of which are more seasonal in nature. In 2016, the World Bank (2017) reports of an annual growth GDP of 13.4 percent compared to the 1.3 percent contraction the year prior. The growth was largely boosted by the industry sector (25 percent) largely due to the 62 percent growth in oil and gas production as a result of sanctions relief. Non-oil GDP grew at 3.3 percent and although it was lower than the oil sector it was still the highest growth since 2011 (World Bank, 2017).

The gross regional product (GRP) of Aktau and Mangystau oblasts for 2016 was USD 5, 070, 000 the real growth of GRP was 99.9 percent. GRP per capita was USD 8 thousand (with the average for the Republic of Kazakhstan – USD $5.2 thousand). The capital investments in Mangistau and Aktau oblasts were over USD $7, 166, 000. In 2016, the Aktau International Sea Trade Port and ferry complex in the port of Kuryk were expanded. The Concept of the Development of the Tourism Industry of the Republic of Kazakhstan until 2020 provides for the development of the tourist cluster of Western Kazakhstan (National Contribution).

The Caspian administrative units of Russia (Asthahan oblast, Dagestan, and Kalmykia) differ significantly from one another in the GRP sectoral structure. In the Astrakhan oblast, the main contribution to GRP is the extraction of oil and gas (25 percent in 2015), in the Republic of Kalmykia, agriculture (32 percent in 2015), and the Republic of Dagestan - wholesale and retail trade (29 percent in 2015). Fishing and agriculture in Kalmykia and Dagestan contribute 0.1 percent to the GRP only, and in the Astrakhan region 0.4 percent. As a whole, in the coastal regions of the Russian Caspian Sea, economic activities are most diverse on the Dagestan coast where agriculture is combined with industry and there is a better, compare to other territories, developed transport infrastructure and better urbanised. Agriculture is developed on the Astrakhan coast, the number of people engaged in fisheries is higher here than in other coastal regions.

Over 22 percent of Turkmenistan’s total investments were directed to the development of the oil and gas industry in 2013. The Balkan region is also the leading territorial unit in Turkmenistan for catching fish and extracting salt. The region has the largest agricultural areas, the vast majority of which are pastures for cattle rearing (National Contribution).

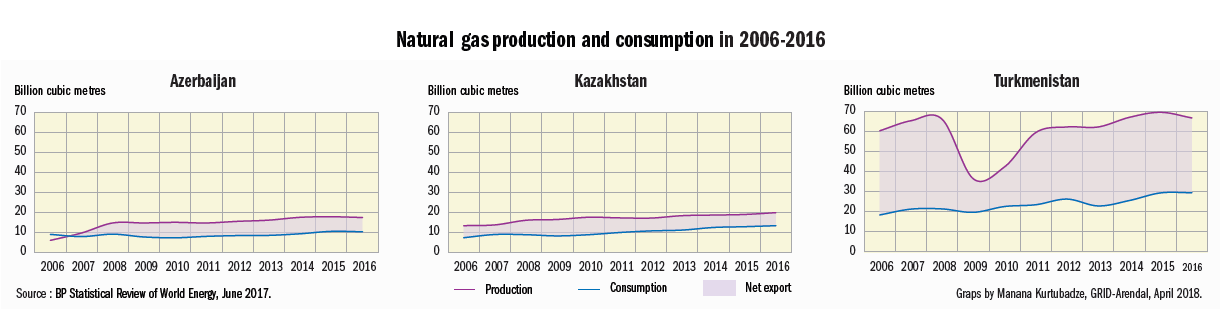
Despite the pressures of the continuing global economic crisis, Turkmenistan continued to grow at 6.2 percent of GDP in 2016 and is expected to be at 6.4 percent in 2017. In response to the impacts of the reduced revenues from the hydrocarbon exports, the Government of Turkmenistan prioritized national economic diversification, started promoting exports of domestic products and import substitution. Turkmenistan’s Balkan region has diverse economic activities from industry and agriculture to transportation; it is also rich in a diverse array of raw materials. The National Program of the President of Turkmenistan on the transformation of the social and living conditions of the population of villages, towns, districts, and district centers for the period to 2020 to improve the socio-economic conditions of individuals living in coastal regions (National Contribution).

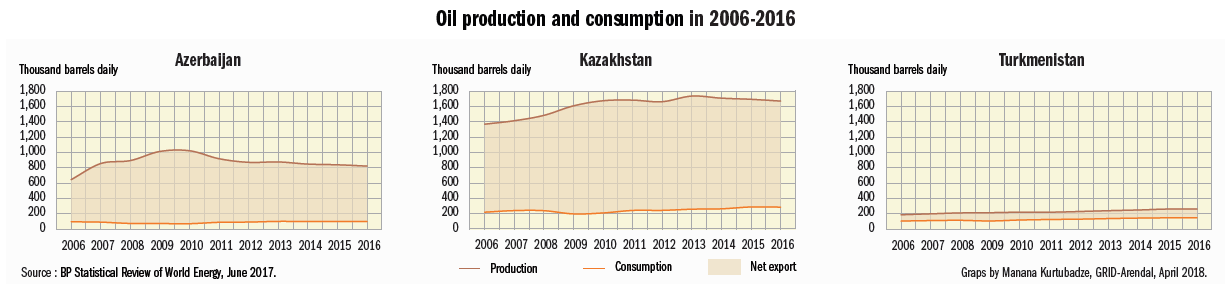
The coastal Balkan region, like other Caspian coastal regions, is characterized by large deposits of fuel and mineral resources (complex ores, coal, lignite, bentonite, and natural stone). The region also has unique climate conditions and large agricultural areas- of which pastures make up the clear majority. In 2016, the farms of the region contained 3.4 percent of the total number of cattle and 7.6 percent of total poultry. The region accounts for 8.4 percent of total meat production, 6.4 percent of eggs, and 15.1 percent of wool. The main agricultural products of the region are wheat (in 2016, 6.0 percent of the total harvest countries). The region accounts for 7.2 percent of the total production of fruits and berries, 3.6 percent of potatoes and 5.4 percent of vegetables (National Contribution).

## 3.2 Direct drivers (sectors)

## Oil and gas

The economies of the Caspian littoral states all rely heavily on the oil and gas sector; they are all currently involved in planning oil or gas fields or extracting oil or gas in the Caspian Sea. The countries have experienced economic challenges related to the dramatic oil price drop in 2014 but the International Monetary Fund is nonetheless expecting positive annual GDP growth in all littoral states over the next few years (IMF, n.a). Oil and gas rents as percentage of GDP[[1]](#footnote-2) has declined on average for all the Caspian countries over the last decade. Turkmenistan has experienced the most dramatic decline in natural gas rents as a percentage of GDP, falling from 42 percent in 2006 to 15 percent in 2015 (World Bank, 2017). Nevertheless, the oil and gas sector is still very important as it contributes to a large share of total exports for all countries.





The oil and gas industries have contributed approximately 30 percent of Russia’s national revenue budget and over 50 percent of export revenues (Simola and Solanko, 2017). Hydrocarbons accounted for 94 percent of Turkmenistan’s exports in 2014 (World Bank, 2015) and Azerbaijan’s total exports accounted for by oil and gas also exceeded 90 percent (International Energy Agency, 2015). In Iran, fuels and mining products accounted for 44.7 percent of total exports in 2015. In Kazakhstan, fuels and mining products accounted for 75.1 percent of total exports in 2015 (WTO, 2016).

Although Azerbaijan's economy observed negative impact of the decline in oil and gas prices on the world commodity markets, the oil and gas sector still is the major contributor to the state budget. According to the State Statistical Committee, the sector’s contribution to the country’s GDP is over 30 percent (Azerbaijan, 2018). The total oil production varies in Azerbaijan from 50.8 million tonnes in 2009 to 41 million tonnes in 2016 (SOCAR Annual Report, 2016) and gas from 17 billion m3 in 2007 to 29.4 billion m3 in 2016.

While the county’s export of crude oil declined from 39 million tonnes in 2011 to 35 million tonnes in 2016 (12 percent decrease), it export of gas increased from 6.8 billion m3 to 8 billion m3 during that period (18 percent increase) (Azerbaijan, 2018).

Azerbaijan’s biggest oil production sites are the Azeri-Chirag-Deepwater Gunashli complex and the Shah Deniz, the latter of which is one of the biggest gas-condensate fields in the world and will soon start increasing its outputs to the Turkish market (Azernews, 2018). In addition to these, the Shafag-Asiman structure is in the exploration planning process supported by a production sharing agreement between BP and SOCAR (BP Azerbaijan, n. a).

The development and condition of oil production makes it possible to classify Kazakhstan as a traditionally oil and gas producing country and the oil and gas industry is one of the leading sectors of Kazakhstan's economy. There are over 490 land and Caspian’s shelf oil and gas fields in Kazakhstan (National Contribution). Kazakhstan’s main oil and gas fields are the Caspian and Turgai depressions (Kostanay oblast), Mangyshlak, and Buzachi (Moangystau oblast). Potential reserves of the Caspian Sea shelf for oil and gas are equal to their total reserves on land in Kazahstan (National contribution). The potential for the offshore zone is estimated between 9 to 26 billion tonnes of oil. This makes Kazakhstan one of the richest countries in terms of oil and gas reserves (Kazakhstan, 2018).

The Kashagan field offshore Kazakhstan eventually was operational by the end of 2013, after having to shut down because a pipeline was cracking and needed to be replaced. This incident confirmed concerns regarding the difficult geological conditions (high reservoir pressure up to 80 Mpa and high - up to 19 percent - content of hydrogen sulphide[[2]](#footnote-3). The high level of hydrogen sulphide content was reason for the pipeline cracking (Nurshayeva, 2014).

Taking into account the real potential of the extractive, oil and gas processing industries, and the net of pipelines, the Astrakhan and Volgograd regions, as well as the Republic of Kalmykia, are the most attractive regions for the development of the oil and gas complex in the Caspian region of Russia (National Contribution). There are more than ten multi-layer oil and gas condensate fields have been discovered on the shelf of the Russian sector of the Caspian Sea.

The number of active oil fields are growing in the Russian part of the Caspian Sea. At the Korchagin field there are 16 production wells. It was discovered in 2000 and put into operation in 2010. The field produced more than 5 million tonnes in 2015, and 7 million tonnes of oil in December 2016. The Filanovsky field located in the northern part of the Caspian Sea, discovered in 2005 has an annual capacity of 6 million tonnes. Khvalynskoye oil and gas condensate field was discovered in 2000. The start of gas production at the Sarmatskoye field is planned to begin in the near future. The Rakushechnoe deposit is located in the Russian part on the shelf of the Northern Caspian. The deposit was discovered in 2001 and is the next project to be implemented. The Central-Astrakhan gas condensate field of federal significance was discovered in 2004 and is located in the Enotayevsky, Kharabalinsk, Narimanovsky and Krasnoyarsk districts of the Astrakhan region in the interfluve of the Volga and Akhtuba rivers. Exploration works continue at the Velikoye field in the Kharabalinsky district in the coastal zone of the Astrakhan region (National Contribution).

The total recoverable reserves of the fields are estimated at 368.3 million tonnes of oil and gas condensate and more than 650 billion m3 of gas in the Russian offshore strip (National Contribution).

The main oil-bearing region in Turkmenistan is the west of the country in the Balkan region. Development of the oil fields began in the late 1890s and regular industrial oil production began in 1933. There are about 200 oil and gas fields explored in Turkmenistan. Potential resources of the country's hydrocarbons are estimated at 71.2 billion tonnes of oil equivalent, of which 53 billion are found inland, and 18. 2 billion tonnes in marine areas (Гусейн Гасанов, 2016). The reserves of the Galkynysh field together with the nearby Yashlar are estimated at 26.2 trillion m3 of gas, and considering the reserves of the newly discovered associated Garakel, which is part of this block, this number increases to 27.4 trillion m3 of gas (Gaffney, 2013).

The Caspian Sea riparian countries have large hydrocarbon resources but the main consumers are located far enough from them. The riparian countries are getting closer to the final agreement on the delineation of the maritime borders which is vitally important for expending economic activities. The prospects of expending transportation nexus relays on exports natural gas of the riparian countries to Europe. Therefore, countries are forced to think about ways to deliver hydrocarbons to consumers.

The cheapest method of delivery is transportation by pipeline. The Trans-Caspian pipeline, proposed by Azerbaijan and Turkmenistan, would stretch 300 km along the Caspian seabed from Turkmenbashy to the Sangachal Gas Terminal on Azerbaijan’s coast. Talks began in 2011, but where halted in 2014 due to “unreconciled differences” (Cason, 2015). However, in 2017 the Azerbaijan and Turkmenistan declared themselves strategic partners; the construction of the pipeline was still considered to be out of reach until signals suggesting an agreement had been made regarding the legal status of the Caspian Sea surfacing at the end of 2017 (O'Byrne, 2017).

## Fisheries

The fisheries sector in the Caspian littoral states is very important for many rural communities living alongside the Caspian shore or rivers flowing into the sea. Relatively low economic development in rural areas coupled with a low degree of law enforcement are important factors contributing to the continuation of pressures on vulnerable resources (Nellemann et al., 2014).

The Russian fisheries sector contributed approximately 0.7 percent of Russian total balanced financial result in 2016, employing 148 000 people, providing jobs to 0.2 percent of the working population (Rosstat, 2017). In Russia, like the other littoral states, there are people employed informally or illegally which is not reflected in official statistics (European Bank of Reconstruction and Development and FAO 2008). Only 2 percent of the official Russian fisheries industry is carried out in the Caspian basin (European Bank of Reconstruction and Development and FAO 2008). In contrast, 11.3 percent of fish catch in the Iranian fishing sector came from the Caspian Sea according to data from 2009 (Strukova et al., 2016). The value of fishery production in the Iranian part of the Caspian Sea has declined during the last few decades owing to a reduction of biological resources, following the same trend as the other Caspian littoral states. Data from FAO showed that fisheries production from the Caspian Sea was only 4.2 percent of total fisheries production in 2014 (FAO, 2015).

Fisheries in all the Caspian littoral states contribute to the overall economy providing employment and food for the local population. For instance, fisheries are one of the most important activities under the agricultural sector in Iran, providing human nutrition and raw material for the food processing industry, creating employment possibilities and generating high potential for export earnings. Iran is the biggest exporter caviar and sturgeon fish meat in the world (Harliogly & Farhadi (Iran), 2017). However, the gross value of fishing in the Caspian Sea has been decreasing in part due to the reduction of bio resources (Strukova et al., 2016).

Looking at Iran, the fisheries sector contributed with 0.4 percent of national GDP, and 4 percent of GDP produced by the agricultural sector. In 2010, the sector employed 189, 900 people in total of which 35, 900 were connected to aquaculture (FAO, 2015). There were only 11, 284 registered fishermen in Iran connected to the Caspian Sea in 2014 (FAO, 2015), showing a substantial reduction from 14, 558 in 2000 (SoE, 2011). The fisheries sector of Turkmenistan is very small, but has contributed to unemployment due to a significant reduction of the fishing fleet between 2000 and 2008 (SoE, 2011).

The total fisheries production in Azerbaijan is even smaller than the 15,000 metric tonnes reported by Turkmenistan, being only 1,100 metric tonnes over the last few years (World Bank, 2017). Fisheries production data from the private sector is not easily attainable, but trends are showing a general decline in total fisheries over the last 20 years. The sector officially provided jobs to approximately 2200-2400 people (excluding processing jobs) mostly located near the sea or other waters (FAO, 2013a). It should also be noted that informality of employment is a nationwide issue (World Bank, 2015). There has been a decline in legal fishing activities due to a combination of depleted resources and complicated attempts to privatize the sector. Many workers have moved from legal fishing activities to poaching (Strukova et al., 2016).

Many of the littoral states have implemented bans or strict quotas on the number of sturgeon and amount kilka fished. Turkmenistan has banned sturgeon fishing and the use of drift nets entirely (Strukova et al., 2016). The protection of fish stocks in Turkmenistan is guided by special Regulations (Presidential Decree, 1998; Bulletin of the Mejlis, 2011)

Iran and Russia have alternative connections to the ocean which provides them with an opportunity to use more options for fishing whereas Turkmenistan, Kazakhstan and Azerbaijan are landlocked. Therefore, they do not have an alternative but stabilizing or increasing the consumption of seafood by using fish farms.

Countries with access to other sources for fishing have reoriented. In 2009, only 11.3 percent of Iran’s capture comes from the Caspian Sea whereas the other 87.7 percent comes from the Persian Gulf and Oman in the South (Strukova et al., 2016).

As one of the landlocked countries surrounding the Caspian Sea, Kazakhstan relies heavily on the Ural-Caspian basin for the biological resources. This area provides approximately 20,000 tonnes ([metric ton](https://www.multitran.ru/c/m.exe?t=5083682_1_2)ne 1,000 kg) of fish catches annually of which sturgeon make up 200-300 tonnes and kilka are 8,000-10,000 tonnes (Mitrofanov & Mamilov, 2015).

Fisheries and the fishing industry are both in decline in the Caspian (Strukova et al., 2016). This was confirmed by downward trend observed in fishing in all the Caspian states. In Azerbaijan sector the total catch in 2015 decrease by 44 percent compare with 2011 (Azeri Statistics, 2017), the total catch from 2011 decrease by 15 percent to 2014 in Iran (National Contribution), the total catch from 2011 decrease by over 60 percent to 2015 in Kazakhstan (Kazakhstan Statistics, 2017), and only in Russia the total catch for the same period increased by 11 percent (National Contribution).

In Azerbaijan, there has been a significant drop in the number of fish farms in recent years. So, for the period from 2015 - 2016 the number of fish farms decreased by 33 percent (Azerbaijan Statistics, 2017). In Iran, the number of fishermen decreased by more than 23 percent, and fishing cooperatives by 43 percent (National Contribution). In Azerbaijan, the decrease in fish stocks along with a lack of pathways to retrain for new employment opportunities has led some individuals from the legal fishing industry to illegal poaching (Strukova et al., 2016).

Between 2011-2016, the number of fishing licenses increased compared to 2005-2010 although the government believes that there has been a reorientation of fish catch from kilka and other endangered species to build a sustainable aquaculture. The government also amended the old law on fisheries in 2014 to introduce new provisions on aquaculture to help ensure sustainable development of aquaculture in rural areas, create new sources of income and to improve the well-being and health of the coastal and local populations (National Contribution).

In Mangistau oblast of Kazakhstan, there were 123 fishing brigades and 434 fishermen involved in coastal fishing in 2015. In 2016, there were 127 fishing brigades and 555 fishermen engaged in coastal fishing (Kazakhstan Statistics, 2017). The reduction in the production by fishing farms can serve as an indicator of the processes in the sector. In Kazakhstan, the total catch of commercial fish by fish farms was about 9.8 thousand tonnes in the 1990s. And since 1990-2005, commercial fish farming stagnated in Kazakhstan. Fish farm production was approximately 150 tonnes in subsequent years (National Contribution).

Sturgeon stocks are an important resource for all 5 of the littoral states and have historically provided employment for individuals along the coast. All the littoral states will lose this valuable resource and the economic benefits if sturgeon stocks fail to recover.

Fisheries contribute about 0.2 percent of Turkmenistan’s industrial production in monetary terms. Fishing is carried out by the production units of the State Committee for Fisheries. The basic type of fishing activity of the State Fishery Commission is marine fishing. Its share in the total catch is about 94 percent. The rest of the catch is provided by the fish farms under "Altynbalyk" (National Contribution).

## Agriculture

Agriculture is an important sector impacting the state of the Caspian environment, as well as national food security and employment, especially in rural areas. Starting from 2004, some Caspian riparian countries have experienced a decline in agriculture as a percentage of GDP, in large part due to increases in industrial production and a decline in governmental subsidies directed at farming (National Contributions). The price fluctuations and uncertainty in the oil and gas industries might be one reason for trends but it should be kept in mind that this relationship can be influenced by a variety of factors specific to each country.

The situation in the agriculture sector of the countries turned to changes alters behaviour during last few years. The aggregate volume of agricultural products increased by 38 percent compared to 2005 in Azerbaijan. The crop output and livestock production increased by 54 percent and by 25 percent correspondingly. The share of agricultural production in GDP increased from 5.5 percent to 6.2 percent from 2010 to 2015. Agriculture’s total added value in Azerbaijan was 2.1 billion USD in 2016, contributing 6 percent of national GDP (World Bank, 2017).

Agricultural production in Russia increased by 72 percent compared with 2005.  Over the past 5 years, the total value of agricultural products in prices in 2015 increased by 28.6 percent, and for 10 years - by 47.4 percent. At the same time, the increase in private farming was 53 percent over the past 5 years and 79 percent over the last 10 years (АB Centre, 2017). Russia’s total value added from agriculture[[3]](#footnote-4) was 54.8 billion USD in 2016, providing 4.74 percent of the Gross Domestic Product (GDP) (World Bank, 2017).

The contribution of agriculture in the coastal regions of Russia is significant. As noted above (see secton 3.1), in the coastal regions of the Russian Caspian Sea, economic activity is most active and diverse on the Dagestan coast, where agriculture is combined with industry and there is a sufficiently developed transport infrastructure. One third of cultivated lands, 39.5 percent of cattle head and 17.8 percent of small ruminants is locates in the Astrakhan oblast. The total area of cultivated lands in the coastal zone (Astrahan oblast, Dagestan, and Kalmykya) is 14.5 million ha. It is 83 percent of total of lands of the Caspian Sea coastal zone or 4 percent of the total area of agricultural land of Russia (Astrahan, 2018).

The agriculture sector in Kazakhstan contributes the same percentage as the Russian agricultural sector at 4.8 percent of total GDP in 2017 (World Bank, 2017). In the coastal region of Kazakhstan, gross agricultural output increased by 1.5 percent in 2016 compared with 2015. During the same time, the number of cattle increased by 15 percent which is the main production in the agriculture of the region.

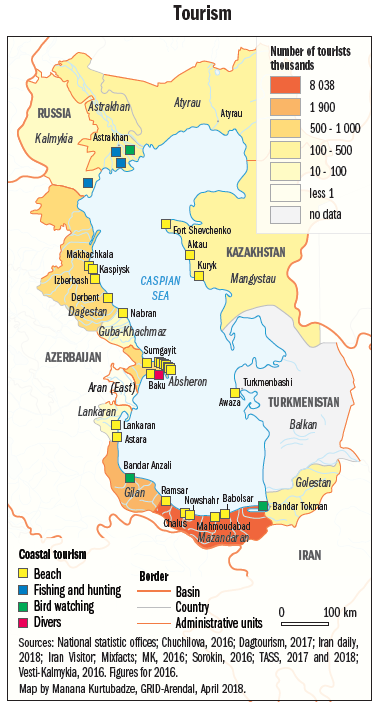
The total area of agricultural land of Turkmenistan is 40.1 million hectares of which irrigated lands cover about 5 percent or 2 million hectares and the rest are pastures. Almost 96 percent of irrigated lands are saline (Science. Gov. Tm, 2017). The Balkan region of Turkmenistan has the largest areas of agricultural land the vast majority of which are pastures. Therefore, the region is predominantly a cattle-breeding region (Nechaeva N.T. and Nikolayev V.N.). There are over 33 percent of the country’s total herd of camels are concentrated here. The Balkan region is fourth in the country in terms of the number of sheep (16.1 percent of the total herd). The region produces 8.4 percent of the country's meat, 6.4 percent of eggs, and 15.1 percent of wool (Socio-economic conditions, 2005). Agricultures total value added in Turkmenistan was 3.3 billion USD in 2015, which was approximately 9.2 percent of its GDP. This shows a continuing downward trend from 11.5 percent in 2010, although the added value from agriculture has increased from 2.6 billion USD in 2010 (World Bank, 2017).

The natural and climatic conditions of the region and lack of fresh water for irrigation are not favourable for the development of irrigated agriculture. However, there are some small areas used to grow fruits and vegetables. The main crop product of the region is wheat (in 2016 - 6.0 percent of the total harvest countries). It also produces 7.2 percent of fruits and berries, 3.6 percent of potatoes and 5.4 percent of vegetables. The risk of pollution of the coast by chemicals is minimal due to the limits to cultivate crops in this region (O. Annamuhamedov, at all, 2014).

Employment as an indicator shows the importance of agriculture for the livelihoods of people and it is sometimes connected to the importance of other sectors for the economy. However, in Azerbaijan, 36.4 percent of total official employment was provided by the agriculture sector in 2015 although the sector is a relatively small contributor to GDP. It explains dependency of employment of agriculture sector. The same relationship can be seen in all littoral states, although the gap between contribution to GDP and contribution to total employment is generally smaller than in Azerbaijan. Official statistics from Russia show that agriculture provided employment to 9.2 percent of the total number of employed people in 2016 (Rosstat, 2017). The agricultural sector employed 18 percent of official employment in Iran in 2015, which is the same percentage as Kazakhstan in 2016. The general trend is a small decline in employment in agriculture as percentage of total employment, with Kazakhstan experiencing the most rapid decline from 30 percent in 2008 to 18 percent in 2017 (World Bank, 2017).

## Tourism

Tourism has a significant importance to the economies of the Caspian littoral states. The travel and tourism industry contribute a few percent of GDP in each nation and the total contribution[[4]](#footnote-5) to each country is estimated above 5 percent[[5]](#footnote-6) in all countries. Looking at Azerbaijan, the country where travel and tourism is of greatest importance to the national economy, it is estimated that the sector in total contributed with 14.6 percent of GDP, providing jobs to 13.2 percent of the total workforce in 2016 (WTTC, 2017a). This is more than three times as much as the direct contribution estimate, a trend that is visible in all countries. Tourism’s share of GDP in Azerbaijan is approximately three times as large as the travel and tourism sector in Russia. Between 2 and 5.4 percent of investment in each country was directed at the travel and tourism sector in 2016. Growth is expected during the next decade, creating tens of thousands of jobs in each country (WTTC, 2017a/b/c/d).



Potential opportunities for the development of tourism in the Russian Caspian region are significant and the tourism industry is developing. According to Rosstat (SC Astrahan, 2017), the number of accommodation facilities increased by 35 percent and the number of visitors by 18 percent from 2012 to 2016. There are more than 70 percent of the total numbers of accommodation facilities locate in the Astrakhan region and it is the most visited Caspian region of Russia.

In Russia, there are several national strategic plans aimed at increasing tourism (Andrades and Dimanche, 2017). There is great potential for job creation in the travel and tourism sector there if investment is allocated, since research shows that 53 jobs are supported for every 1 million USD invested. The sector as a whole supported 4 million jobs in 2014, either by creating them directly or indirectly (Andrades and Dimanche, 2017).

The tourism industry in general works towards domestic holiday-makers. The travel and tourism sector in the region is yet to be prepared for attracting broader international tourists (Andrades and Dimanche, 2017). For example, most tourists arriving in Kazakhstan comes from former Soviet countries. Main challenges facing the industry is poor infrastructure and varying standard of services between segments and regions. The sector has potential for increased tourism which can be realized if strategic partnerships and investments are made (Syzdykbayeva et al., 2015). The Government of Turkmenistan supports and financially participates in major programs for the development of the tourism industry in the Caspian, with a special emphasis on beach tourism and, in the future, ecotourism. The development of this direction requires special attention to the protection of the environment in the Caspian Sea in order to conduct safe tourism and preserve important landscapes, habitats and animal species (National Contribution). Tourism is regulated by the Tourism Committee of Turkmenistan (State Committee for Tourism, n.a).

Turkmenistan’s National Tourist Zone "Avaza" was designed in such a way so as to preserve and expand the beauty of the surrounding nature to have a beneficial ecological impact. The total area of ​​the forest belt Avaza is 500 hectares. There are future plans for the green strip, stretching for many kilometres along the tourist zone, to be supplemented by a new park area, stretched next to the white marble hotels[[6]](#footnote-7).

In 2015, the Southern cost of the Caspian Sea in Iran visited over 33 million tourists, including the most popular Mazandaran, Gilan, and Golestan provinces (8 million, 1.9 million, and 209 thousand correspondingly).

## Indirect drivers

## Climate change

The term climate change must be distinguished from climate variability. According to WMO, Climate Variability is defined as variations in the mean state and other statistics of the climate on all temporal and spatial scales, beyond individual weather events (WMO. n.d.).

Global climate change affecting natural and human systems has been confirmed by the Intergovernmental Panel on Climate Change (IPCC). This has been proven by measuring increases in greenhouse gas concentrations in the atmosphere and global mean temperatures. The temperature of the atmosphere and the oceans has increased, the latter accounting for approximately 90 percent of energy accumulated between 1971 and 2010. 60 percent of that energy is stored in the upper layer (0-700 meters) of seas while the remaining 30 percent is stored below 700m therefore causing sea levels to rise. Additionally, the cryosphere is decreasing at the global scale, also contributing to sea level rise and a loss of albedo effect. Global sea levels are rising faster than it has in the past two millennia (IPCC 2013). In sum, global warming is accelerating and causing ripple effects that will again influence future global warming.

The biggest driver of climate change is positive radiative forcing[[7]](#footnote-8) caused by the burning of fossil fuels emitting greenhouse gases to the atmosphere, followed by land use change. Emissions of CO2 will influence the carbon cycle itself by increasing the amount of CO2 which can be absorbed in the atmosphere. It is also causing ocean acidification because 30 percent of released carbon dioxide is absorbed by oceans (IPCC, 2013). Recent data show that carbon dioxide in the atmosphere is continuing to increase, and reached unprecedented levels in 2016 (United Nations 2016). The cause is mainly anthropogenic influence on carbon and other biogeochemical cycles affecting the global climate (IPCC, 2013). These mechanisms will have significant consequences manifesting in regionally specific ways.

The El Niño Southern Oscillation (ENSO) and the Inter Tropical Convergence Zone is known to influence certain parts of the region (IPCC, 2013). A recent study looking at the south west coast of the Caspian Sea found a clear connection between precipitation and ENSO (Molavi-Arabshahi, Arpe and Leroy 2016). Temperatures are increasing, and climate models have been improving even though the influence of African, European and Asian climates are still not understood. Even though precipitation trends have become less certain, warmer temperatures will very likely have an impact on melting in the springtime, influencing amount and timing (IPCC, 2013).

North and Central Asian countries bordering the Caspian Sea

The northern area is experiencing a warming trend coupled with an increase in heavy precipitation during the winter season. The central parts are experiencing strong warming during summer coupled with a decrease in precipitation. The warming in these regions are stronger than the global average, and it is considered likely that extreme precipitation events will happen more often. It should be noted that there are particular difficulties modelling changes in these regions because of inadequate observational data and difficulties incorporating complex mountain terrains into models used to calculate climatological means (IPCC, 2013).

The length, intensity and frequency of heat waves is very likely to increase in the affected areas. There is high confidence that temperatures in the Caspian regions will continue to rise on average during this century (IPCC, 2013). The Caspian Sea will experience warming, and it has been predicted that its temperature will increase between 3.7 and 4.9 degrees (SoE, 2011). It is important to highlight that climate change is influencing sea levels in the Caspian Sea in a regionally specific way.

During the last decade, the frequency of natural devastating disasters and phenomena have increased in Azerbaijan. There are significant changes in annual dynamics of temperatures, precipitation, and wind. The country suffers from adverse effects of climate change such as floods, floods, droughts, and heat stresses (National Contribution).

According to the National Hydrometeorology Department, 20 percent of administrative regions, 6.7 percent of settlements, 20.1 percent of the population, 3.0 percent of industrial enterprises, 12.3 percent of agricultural enterprises and 14.2 percent of motorways in the country are exposed to floods (National Contribution).

In Kazakhstan, the average temperature during the last decade (2007-2016) was + 6.5 °C and exceeded the average for the period 1961-1990 at 1.01 °C. This is the second big positive anomaly after a record-warm decade of 1997-2006. The average annual air temperature for the last five years 2012 - 2016 reached the highest values (+6,66 ° С) from the beginning of observations in 1941. On the territory of Kazakhstan for the period 1976 - 2016 every 10 years the average annual air temperature rises by 0.34 ºС (National Contribution).

In the West Kazakhstan, Atyrau, Mangistau oblasts, there is a significant tendency to increase the number of days with an air temperature above 35 ° C for 4-8 days every 10 years. Practically throughout the entire territory of Kazakhstan the total duration of heat waves increases by 6-10 days every 10 years. Also, there is a decrease in the frequency of frosty days for 3 to 8 days throughout the country every 10 years (National Contribution).

According to CASPCOM, the global warming has also affected the region of the Caspian Sea. Here, the average air temperature over the last 30 years (1987-2016) has increased in comparison with the average temperature for 1961-1990 in the following way: in Astrakhan from 9.9 to 10.7 °C, in Makhachkala - from 12.2 to 12.5 °C, in Derbent - from 12.7 to 13.5 °C. At the same time, during the first thirty years of the period under review the average air temperature even insignificantly decreased by 0.1-0.2 ° C. According to CASPCOM, the air temperature anomaly was generally positive since the mid-1990s.

Within the framework of the preparation of the First National Communication on Climate Change, the long-term series of thirty meteorological stations located in different physical and geographical zones of the country were analysed to study the temperature regime and atmospheric precipitation in the territory of Turkmenistan. The analysis was carried out for both annual and seasonal. Winters and autumns became colder by 0.2 - 0.6 °C and springs and summers became warmer by 0.3 - 0.9 °C (National Contribution).

## Sea level change

The Caspian Sea is the world’s largest closed body of water and is characterized by significant sea level fluctuations (Rucevska, & Simonett, 2011). The level of the sea has both decreased and increased rapidly during the last century, decreasing by 1.7m from 1933 to 1940 and increasing by 2.5m from 1977 to 1995 (Ozyavas, Khan and Casey, 2010). Changes in river flows, evaporation, precipitation, underground flows into the sea and outflows into the Kara-Bogaz-Gol are contributing factors influencing sea level of the Caspian Sea (Ramiz, 2015). Evaporation is the biggest cause of water loss and surface flow into the sea is the biggest cause of water increase. The biggest decrease occurs when a reduced inflow of water into the sea coincides with an evaporation rate larger than that of precipitation (Renssen et al., 2007). (SoE, 2011).

Increases in sea temperature correlates with a decrease in sea level of the Caspian Sea, connecting sea level fluctuations to anthropogenic climate change through global warming (Ardakanian & Alemohammad, 2008). Another study from 2017 found that evaporation caused by an increase in water surface temperature contributed half of the observed decline in sea level from 1996-2015 (Chen et al., 2017).

Changes in large scale hydro climatic mechanisms caused by climate change will influence sea levels. It will lead to weather changes in some of the Caspian regions influenced by ocean-atmosphere systems such as the North Atlantic Oscillation (NAO) and ENSO. The latter can have a significant influence on sea level through impact on wind patterns and ocean circulation (Arpe et al., 2000) and the NAO affects temperature, moisture and winter storms connected to the Volga Basin and rainfall over the Caspian Basin (Rucevska, & Simonett 2011). Modelling of these mechanisms need further attention (Arpe and Leroy, 2007).

A recent study looking at the south-west coast of the Caspian Sea found a clear connection between precipitation and ENSO (Molavi-Arabshahi et al. 2016). This mechanism will likely intensify due to increased moisture availability, but the natural variations of ENSO makes it very difficult to project specific changes (IPCC 2013).

Another recent study stated that sea level variations in the basin of the Caspian Sea are largely a result of water transportation coming from the North Atlantic (Panin, Vyruchalkina and Solomonova, 2015). It is considered very likely that the NAO will continue to follow trends observed in the past, but the possible implications for the region is uncertain. It is possible that interaction between NAO and ENSO or other modes of variability will change during this century, possibly leading to important changes in regional impact (IPCC 2013).

Further complexity is added when one considers the fact that the Caspian Sea stretches out over Central and North Asia, West Asia and bordering Europe. The local climate is influenced by African, European and Asian climates. It stretches out over various climatic conditions and regions, from arid plains in Kazakhstan to the humid areas of Caucasus (Rucevska, & Simonett 2011). The specific influences of global climate change on regional sea levels are not fully understood, neither is the impacts of African, European and Asian climates and their specific and combined influence on the local climate (IPCC 2013). The variations in climate between the different parts of the Caspian Sea requires local level analysis and adaptation.

However, one study aimed to show that models predicting climate change at the global level can be used to explain and predict local changes for the Caspian Sea (Panin 2010). The basis for this is the fact that hydrometerological conditions such as the wind’s effect on evaporation and precipitation are important determinants of sea level fluctuations. Sea level change has been modelled in various ways, causing predictions ranging from a sea level increase of 6.4 meters (SoE 2011) to a reduction of 4.5 meters in 2100 with a decadal variation of up to 2 meters (Renssen et al. 2007). The wide span of possible scenarios is troubling because sea level fluctuations can have dramatic consequences for ecosystems and economies connected to the Caspian Sea (Elguindi and Giorgi 2006).

New research suggests that the salinity of water can significantly influence sea levels, pointing to the need for more research on how halosteric and thermosteric effects interacts and influences sea levels (Durack, Wiffels and Cleckler 2014). This is interesting because the salinity levels of the Caspian Sea vary greatly in different parts of the sea and at different depths. Variations are most dramatic in the North, and salinity levels increase southwards and from west to east. The salinity levels fluctuate less in the south, where the salinity levels are at the highest (Rekacewicz and Dejouhanet, 2002).

There are also other variables that might influence the Caspian Sea levels at any given time, such as seismic activity (Ozyavas, Khan and Casey 2010), geomorphologic causes, dams and water withdrawal used for irrigation purposes (Rucevska, & Simonett 2011). Observed regional climate variability generally represents a complex convolution of natural and anthropogenic factors, and the response of tropical cyclones to each factor is not yet well understood” (IPCC, 2013)

# Impact and contribution to climate change

Anthropogenic climate change will influence the socio-economic future of all Caspian littoral states. Impacts of climate change such as: increased frequency and intensity of weather extremes have revealed that both human systems and ecosystem are vulnerable to climate change. Degree of vulnerability among humans is significantly influenced by social factors such as marginalization (IPCC 2014). The social cost of climate change is high and closely connected to impact on ecosystems and the economy. Releasing greenhouse gasses in the atmosphere today is a cost-shifting exercise, where the price of emissions will manifest through the known and unknown future consequences of climate change on humans, ecosystems and economies.

The Caspian littoral states are contributing to climate change through greenhouse gas emissions (SoE 2011). The Russian Federation is the world’s fifth largest emitter of CO2, and is thus a very important actor when it comes to limiting climate change (Sharmina, Bows-Larkin and Anderson 2015). Looking at CO2 emission per capita reveals that Kazakhstan releases more CO2 per capita than the Russian Federation. Turkmenistan emits almost exactly as much as the Russian Federation in per capita terms, although the total amount of CO2 released mirrors Azerbaijan. Azerbaijan emits the least amount of CO2 in total and in per capita terms, while Iran is the second largest emitter among the countries, and the second last in per capita terms (World Bank, 2017).

The close relationship between CO2 emissions and Gross Domestic Product (GDP) makes this a complicated issue. This might be especially true in these countries where there are hydrocarbon resources. There is yet to be produced convincing evidence that countries can reduce total CO2 emissions while increasing GDP, although it is possible to emit less CO2 per dollar due to technological improvements and strategic shifts (Jackson 2016).

# Pressures

## Fishing

Dependence on natural resources in the Caspian Sea for livelihoods is common among coastal communities throughout the Caspian region. Fishing is of great importance to these communities and the ecosystem upon which the fisheries industry relies have been influenced by a variety of factors over the years. The interaction of natural and human factors might, in certain conditions, cause particular pressures on bio-resources in the Caspian Sea. This was the case in April to July 2001, when 166 thousand tonnes of fish died, 99 percent of which was anchovy kilka, due to reduced resilience in fish stocks coupled with seismic activity (Abdusamadov and Belyaeva, 2015). The resilience dynamics of the anchovy kilka is influenced by invasive species, pollution, sea level change and overfishing (Fazli et al., 2007). It is possible that previously unseen combinations of factors, including a change in climate, will cause serious incidences in the future, highlighting the necessity for sustainable bio-resource management. This means reducing human made pressures on ecosystems and increasing adaptation capacities in all countries.

Sustainable management of fisheries requires understanding nexus of multiple factors. One example highlighting this is the fisheries sector in Dagestan, Russia. The commercial fish stocks in the area is influenced by natural conditions such as hydrological regime, sea level fluctuations, and direct human actions such as pollution, invasive species, construction of dams and various fishery policies (Abdusamadov and Belyaeva, 2015). **Sea level fluctuations** impact fish fauna, habitats and behavioural patterns in the Caspian Sea. These impacts became evident during sea level fluctuations between 1971 and 1991, when the Kizlyar Bay of Dagestan in Russia experienced large fluctuations in numbers of fish from period to period due to sea level changes at fish spawning grounds (Abdusamadov and Belyaeva, 2015). In addition to these challenges, it is possible to earn 5,000 USD on one illegal catch of sturgeon in the Dagestan region, which makes the illegal fish market highly attractive in one of Russia’s poorest regions (Nellemann et al., 2014).

**Illegal fishing** exacerbates existing vulnerabilities from natural and other anthropogenic influences. In addition to threatening critically endangered fish species such as sturgeon, illegal fishing can also impact whole ecosystems through by-catch from illegal fishing. One qualitative study found that there are significant by-catches of seal when fishing for sturgeon in the North-West areas of the Caspian Sea, which is largely unreported. This can influence entire food chains in ecosystems by significantly reducing a key predator (Dmitrieva et al., 2013).

Overfishing has been a persistent problem for many years, causing the depletion of several types of fish stocks. Overfishing of sturgeon in particular is nothing new, causing a decline of fish stock and catch already as early as in 1914 (Ruban and Khodorevskaya, 2011). A common tendency across the region is that fisheries production based in the Caspian Sea is influenced by a variety of natural, economic, social and political factors. For instance, Kazakhstan’s total production from fisheries dropped by more than half from 1989 to 2007 (World Bank, 2017), caused not only by a dramatic decline in fish stock in the Caspian Sea, but also problems related to the large amount of illegal vessels and the collapse of the Soviet Union. According to the FAO (2010), unreported and unregistered fishing continues to be a major problem in Kazakhstan where it is estimated that less than one-third of fish production is reported (FAO, 2010). However, the Ural-Caspian region has maintained a stable level of fish catch during the last decade due to developments in the bony fisheries (Strukova et al., 2016, (FAO, 2015, SoE, 2011, National Contribution).

The total fisheries production in Azerbaijan is even smaller than the 15,000 metric tonnes and only 1,100 metric tonnes reported by Turkmenistan over the last few years (World Bank, 2017). There is a general difficulty of obtaining data on fisheries production from the private sector, but trends are showing a general decline in total fisheries over the last 20 years. The sector officially provided jobs to approximately 2200-2400 people (excluding processing jobs) mostly located near the sea or other waters (FAO, 2013a). It should also be noted that informality of employment is a nationwide issue (World Bank, 2015).

Whether aquaculture is good for ecosystem management and social development for the Caspian littoral states is the subject of much debate, and the sector differs in importance throughout the Caspian region. Iran is the country of the Caspian littoral states with the largest total amount of aquaculture production measured in metric tons, followed by Russia. Iran produced almost 350,000 metric tons of fish, Russia produced around 153,000, while Kazakhstan produced about 730, Azerbaijan produced 561 and Turkmenistan produced 30 metric tons of fish using aquaculture in 2015 (World Bank, 2017). Generally speaking, all riparian countries have experienced a reduction in aquaculture after the fall of the Union, although Russia now has recovered production to former levels. Azerbaijan, Turkmenistan and Kazakhstan all have very small aquaculture production with possibilities for increased production.

Iran’s total fishery production has increased steadily from 1990 and so has the share of aquaculture production out of total fisheries production which was 35 percent in 2015 (World Bank, 2017). The Iranian fisheries policy is largely focused on moving the industry from fisheries to aquaculture. An important reason for that is that although total fisheries production has increased, they seem to have reached a biological limit to resource extraction (FAO, 2015). This is definitely the case for most types of fishing activities in the Caspian, evident in the everyday lives of Iranian fishermen who are experiencing decreasing numbers of fish caught (Tehran Bureau, 2015). The government’s five year plan for fisheries is nonetheless expecting an increase in total yearly fish catch from 950,000 in 2014 to 1,500,000 metric tonnes in 2020 (FAO, 2015). It is important to note that Iran has substantial aquaculture activities in inland waters and artificial fish farms (Strukova et al., 2016).

The trends in Russian aquaculture production, as in Iran, seems to be towards increased production and encouraging new aquaculture production by issuing available licenses in various parts of the country, investment in aquaculture research and increasing the availability of funds to co-fund aquaculture investment. The Astrakhan oblast is one of the areas in focus and is one of Russia’s largest commercial cultivators of sturgeon and caviar (Adamowski, 2017c, Adamowski, 2017a). An aquaculture feed production site in the Karelia Republic opened recently to help support aquaculture production in several Russian regions. The Russian Deputy Minister of Agriculture stated that this was an important step towards developing the Russian aquaculture industry (Adamowski, 2017b). This industry is considered to have an insignificant impact on the environment and few conflicts with competing industries (FAO, 2013b). The aquaculture industry is relatively small, but has a significant influence on the lives of rural populations in Russia, although the industry only contributed 3.5 percent of total fisheries production over the last few years (World Bank, 2017). This is because almost all farms are located in rural areas, and the aquaculture industry provides the only industrial employment opportunity in some rural areas. In addition, the Russian part of the Caspian Sea provide appropriate conditions for mariculture (FAO, 2013b).

Abdusamadov and Belyaeva (2015) suggested that aquaculture should be pursued in the Dagestan region in order to tackle both ecosystem depletion and the lack of economic opportunities, the latter of which, when coupled with poor conservation management, has led to increases in illegal fishing. Pen culture, a specific type of aquaculture, has been suggested for producing sturgeon and bony fish in the Guilan province of Iran in order to keep pressure on natural resources down and create employment (Zekrgoo and Lafmejani, 2017). Iran and FAO are engaging in a two-year project entitled “Genetic Improvement of rainbow trout in the Islamic Republic of Iran” aimed at increasing availability of farmed rainbow trout to increase food security and livelihood opportunities for the people of the Mazandaran province (FAO, 2016b).

Aquaculture solutions are also being adopted in Azerbaijan. The Blue Marine Foundation is implementing a project in Azerbaijan in an attempt to save certain fish ecosystems through the promotion of aquaculture and tourism as better alternatives to current activities causing pollution and over-exploitation (Blue Marine Foundation, n.a). Aquaculture was not widely used in Azerbaijan before the late twentieth century and it is increasing in importance (FAO, 2013a). Aquaculture production out of total fisheries production in Azerbaijan was about 50 percent in 2015, almost doubling its share in official statistics compared to 2014 (World Bank, 2017).

In contrast, aquaculture production out of total fisheries production in Kazakhstan was a modest 1.7 percent in 2015, continuing the trend of low production in the aquaculture sector (World Bank, 2017). The FAO noted that the primary reasons for the low levels of investment in aquaculture is a lack of incentivizing the regulatory framework and a the lack of funds directed at fisheries and technology development (FAO, 2010). This must be seen in conjunction with general problems facing fishery development in Kazakhstan, such as regulation problems, high taxes and general lack of investment (Strukova et al., 2016). The opportunities in aquaculture can be considered significant, possibly contributing to the preservation of threatened species and economic development through the production of high priced commodities such as caviar (World Bank, 2005). Aquaculture’s share of total fisheries production is even lower in Turkmenistan, contributing approximately 0.2 percent of total fisheries production in 2015 (World Bank 2017). However, the enterprise “Khazar Balyk” is currently operating a fish farm with a possible production capacity of 100 tonnes of fish meat per year, 2 tonnes of black caviar, 170 tonnes of smoked products and 10 million canned products from various types of commercial fish (National Contribution).

It is important to consider the fact that different types of aquaculture can have negative impacts on fisheries. It is not unknown for fishermen to experience a decline in catch near aquaculture production sites, due to pollution and other influences on the local ecosystems (Martinez-Porchas and Martinez-Cordova, 2012). Several possible environmental impacts should be taken into consideration. Creation of aquaculture farms might destroy natural ecosystems, salinize or acidify soils, pollute sources of water originally appropriate for human consumption, cause eutrophication and nitrification of effluent receiving ecosystems, introduce exotic species that might biologically contaminate waters, pollute soils and waters with medication practices, change landscape and hydrological patters which can have unknown impacts on ecosystems, and trap eggs, larvae, juveniles and adults of different organism. There are also concerns regarding high concentrations of toxins and heavy metals, genetic pollution and infestation of non-desirable phytoplankton and zooplankton species (Martinez-Porchas and Martinez-Cordova, 2012). Because of these issues, making aquaculture beneficial for local populations and the environment will be a complicated task requiring consideration of all possible impacts.

Sturgeons are considered more critically endangered than any other group of species (IUCN, 2010). Sturgeons are threatened by “… *overﬁshing, habitat degradation, pollution, and hydroelectric dams which obstruct their attempts to reach breeding grounds, as well as the lack of effective international legal regulation and the presence of organized crime looking for quick proﬁts*” (Apostle, 2017). About 90 percent of sturgeon fishing in the former Soviet Union was conducted on the Volga river, the river which also provides the most important spawning grounds. This commercial fishing combined with hydro-power developments on the Volga are important causes of the dramatic decline of the population over the last decades. It has been suggested that aquaculture production of sturgeon can be a solution to declining fish stocks and illegal fishing (Ruban and Khodorevskaya, 2011).

Another reason sturgeon receive considerable attention in relation to aquaculture is their peculiar genetics, which can be an advantage in order to preserve genetic diversity even in aquaculture production (Apostle, 2017). Russia established national fish-breeding in the Caspian Sea already in the middle of the twentieth century and developments in artificial reproduction of sturgeons dates back to 1869 (FAO, 2013b). The efficacy of these investments is uncertain because of a lack of data, but it has produced some evidence that artificial hatcheries can support populations. Iran is currently increasing their focus on sturgeon cage culture along the coast of the Caspian Sea (FAO, 2015), and Turkmenistan is also producing sturgeon through the Khazar Balyk enterprise (National Contribution).

The basin method, in comparison with natural conditions, reduces the inevitable sifting of larvae and fingerling by 10-15 percent, and accelerates the maturation of caviar producers from seven or eight to five years. Strict adherence to scientific and technical regulations, application of the latest achievements and advanced technologies in the field of aquaculture allowed the production complex of JSC Khazar Balyk to achieve significant results in the breeding of sturgeons after two years.[[8]](#footnote-9).

Aquaculture is not risk free, and the importance of simultaneously restoring natural habitats must not be ignored. It is also important that overfishing halts in order for possible habitat connectivity initiatives to be successful in restoring sturgeon fish stocks (Secor et al., 2000).

Commercial aquaculture is thought to contribute positively to the preservation of sturgeon by providing economic incentives since it is the only legal way to produce sturgeon caviar in large volumes, address market demand, and provide an alternative to illegal caviar. Developing aquaculture to save sturgeon stocks in the Caspian could reduce the attractiveness of illegal fishing by saturating the market and bringing the prices down. It should be mentioned that China produced 75 percent of sturgeon meat until 2011, which means they are the biggest actor in the market (Bronzi et al., 2011). The challenges and possibilities related to aquaculture requires further investigation, since aquaculture could bring new challenges or similar problems faced in other locations (Smederevac-Lalić et al., 2011, Shen et al., 2014).

Known challenges for sturgeon aquaculture for the Caspian littoral countries are the long timeframe for breeding and high capital demands caused by high start-up and production costs, in addition to high energy demand (Apostle, 2017) . Other important factors that need to be considered are issues related to recycling clear water, the future scale of global caviar trade, Chinese presence, free trade obstacles, ethical issues regarding attention to middle- and high class consumers, and relationship with illegal businesses (Apostle, 2017).

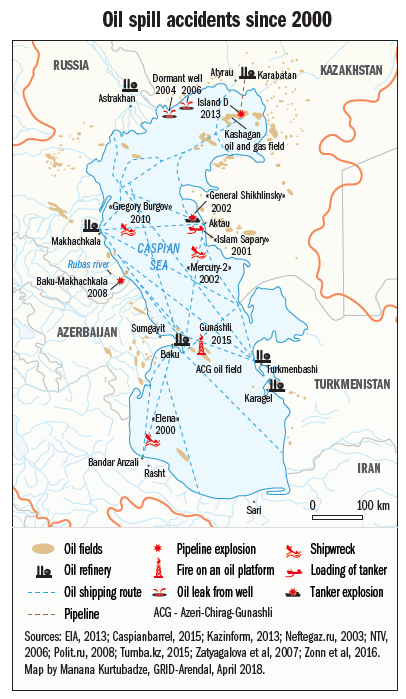
The primary production level has also caused concern; over the last 70 years there has been a 40 percent decrease in the food supply of semi-anadromous fish in the North Caspian (2,679 thousand tonnes in the 1930s to 1,732 thousand tonnes). This drop in the food supply has decreased annual catches of fish in the North Caspian from 299,000 tonnes in the 1930s to 8,000 tonnes in 2012 (Abdusamadov & Belyaeva, 2015).

Fishing in the Western Caspian coast, particularly in the Dagestan waters, dates back to the late 16th to early 17th Century where sturgeons, Terek trout, and other valuable fish were harvested from the Terek and Samur rivers. Extensive fishery development started in the late 19th to early 20th Century and peaked in the 1930’s where annual catches exceeded 60 thousand tonnes (Abdusamadov & Belyaeva, 2015).

Hydraulic construction has led to a sharp decline in the catches of both semi-anadromous and anadromous fish species; the fish stocks in the Terek drainage are almost completely depleted due to the impact of the construction on fish reproduction, feeding and migration (Abdusamadov & Belyaeva, 2015).

## Non-living resources extraction (e.g., shipping)

The Caspian basin contains a significant amount of oil and gas resources and contributed 3.4 percent of the world’s crude oil supply in 2012. An estimated amount of 368 million tonnes of crude oil and lease condensate was produced in 2012, and 35 percent of that came from offshore fields (US Energy Information Administration, 2013). Future growth in the oil and gas sector is expected to come from offshore fields in the Caspian Sea. The best prospects lie in the extraction of natural gas, which has an estimated reservoir of 82.6 million meters3. Russia and Iran already produce a significant amount of natural gas, but their main production sites have not been located in the Caspian Sea. The biggest discoveries in the Caspian Sea lie offshore from Azerbaijan, although there are also significant resources onshore in Turkmenistan and Kazakhstan (US Energy Information Administration, 2013).

It is important to note that there is significant uncertainty regarding the size of oil and gas reserves and estimates have differed greatly between experts. At this point, it is suggested that there are around 10-12 billion tonnes of oil, most of which is owned by Kazakhstan and Turkmenistan (Zhiltsov et al., 2016). However, the EIA estimates that there is about 6.5 million tonnes of oil in the Caspian basin (US Energy Information Administration, 2013).

The oil and gas sector has paid particular attention to sound management practices, including operational standards and safety measures. However, increased transport of petroleum resources and associated extraction materials, due to investments in current and future oil and gas projects, continues to be of concern as potential risks to the environment.

Natural factors also contribute to increased risk in oil and gas extraction and transportation in the Caspian Sea. These can be storms, the ice conditions in the Northern Caspian, sea level change, surges, extreme waves, flooding of coastal zones, and earthquakes (Zonn and Kostianoy, 2016). Additional challenges are mud volcanoes, frequently difficult weather conditions, high-pressure reservoirs, drill-hole instability problems, unstable sediments and shallow-depth drilling hazards (SoE, 2011). There are also considerable risks and challenges posed by anthropogenic activities such as: accidents from tankers or oil platforms, damages to offshore pipelines, enforcement of rules and regulations related to construction, repair or manufacturing of equipment, possible mistakes by operational and maintenance personnel, and various criminal activities including terrorism and sabotage among others (Zonn and Kostianoy, 2016). See the map on oil spill accidents since 2000.

Particularly significant damage is caused by uncontrolled oil and gas wells (open fountains), when oil, gas and gas condensate are poured on the surface of the sea or land for long periods of time (from several days to months). This is the most severe accident that can come from oil exploration. In Turkmenistan, the state of the sea and the coastal security zone is still cause for anxiety, even though the content level of pollutants along the Eastern coast of the Caspian Sea on the territory of Turkmenistan has remained stagnant in recent years. The concern is mainly due to: issues with the technologies of drilling, operation of offshore oil and gas wells, and recycling of industrial waste. In the North part of the Caspian, the problem of historic drills continues (see below).

The Caspian Sea has already experienced pollution caused by the oil and gas sector and continues to experience some deterioration caused by practices such as drilling, maintenance on rigs, transport of oil, and release of oil and gas from drilling operations. Refining, in addition to accidental spills, transport and other industries, also puts pressure on the environment by contaminating the water and air. The Turkmenbashy oil refinery is the single biggest emitter of pollutants released into the air in the Caspian adjacent area in Turkmenistan[[9]](#footnote-10). Seven operational crude oil refineries are located within 200 km of the Caspian Sea. All of Azerbaijan’s and Turkmenistan’s refineries are located in this area. They have two refineries each while the remaining countries have one each (US Energy Information Administration, 2013).

There is another potential threat for the environment which should be taken into consideration. It is the abandoned wells. There were 1,900 oil wells were surveyed within the Kazakhstan sector of the Caspian Sea within the framework of the implementation of the Strategic Plan of the Ministry of Industry and Trade of the Republic of Kazakhstan. All of the wells were inventoried and their cadaster was compiled. As a result of the survey, 110 emergency wells were identified, including 89 wells in Atyrau oblast and 21 wells in Mangistau oblast. An action plan for liquidation of the revealed emergency wells was defined. Following the action plan, state bodies and oil companies routinely monitor the conditions of the wells and carry out work on liquidation and conservation of flooded wells in the coastal zone of the sea (National Contribution).

A recent example from Azerbaijan highlights the risks involved in oil and gas production. A rupture in a gas pipeline connected to a platform built in 1984 from the Gunashli field southeast of the Oil Rocks settlement caused an emergency situation where the crew had to be evacuated, and one of the boats capsized. The fire did not cause any spills into the sea, however it was reported as a serious accident. The cause of the fire is said to be strong winds (RT, 2015).

When it comes to transporting oil and gas, pipelines have been seen as the most beneficial method despite posing serious risks related to installation and operation which need to be put on the agenda. The fact that “… *fertile soil layer is destroyed, trenches are excavated, earth banks are constructed, pile driving speeds up erosion processes, pipelines on river-crossing contaminate river headwaters, relief of mountains and deserts is changed*…” means that pipelines can be damaging to the environment (Huseynzade and Aliyev, 2016). In addition, pipeline construction onshore could cause “… *deforestation and degradation of agricultural lands, historical sites and monuments, nature reserves, and protected areas*” if specific measures are not considered (Zonn and Kostianoy, 2016).

Pipeline projects such as the suggested Trans-Caspian gas pipeline stretching between Turkmenistan and Azerbaijan or the possible pipeline from Turkmenistan through Kazakhstan and Russia along the Caspian coast would have environmental impacts. The regular occurrence of accidents of various sizes is a significant challenge for the environmental protection of the area largely because details are often unknown.

## Pressures from agriculture sector

National Contributions did not provide required information of the pressures from agriculture sector to the environment of the Caspian Sea. Therefore, the section is based on information collected from various available sources.

Agriculture is one of the most important sources of pollution worldwide and this is also the case in the Caspian littoral states. Issues related to harmful pesticides, fertilizer use and poorly treated livestock waste are widespread, the latter two of which might have contributed to eutrophication in the Caspian Sea back in 2005 and 2006. Water quality is especially vulnerable to agriculture waste discharged into rivers running into the Caspian Sea (SoE, 2011).

In general, environmentally harmful pesticides are cheap and readily available for small-scale enterprises and large-scale farms, which they use to ensure adequate production on their agricultural land. Chlorinated pesticides such as DDT and HCHs have been used along the coast of the Caspian Sea and they have also been used in connected freshwater deltas in Azerbaijan, Iran and Turkmenistan. Better alternatives to these chlorinated pesticides do exist, but they are relatively more expensive and therefore not used by poor farmers (SoE, 2011).

Another widespread and well-known problem related to agriculture is nitrate loading as agriculture production is increasing. Nitrate loading in the Iranian Tajan watershed originates primarily from agricultural land where paddy fields and orchards have the most intensive soluble nitrate loss. This demonstrates that there is a relationship between landscape metrics and nitrate loadings to the surrounding environments (Rajaei et al., 2017). In addition, the use of organophosphates in agricultural practices in the southern Caspian basin is a threat to groundwater quality, since they are difficult to degrade under natural conditions as well as harmful to humans and wildlife (Nasrabadi et al., 2011)

## External inputs: Discharges and run-off

More than 85 percent of the surface fresh water runoff to the Caspian Sea enters in the North Caspian and almost 90 percent of the total amount of pollutants is being transported into the Caspian Sea by river flows which are polluted by discharges from communal and irrigation systems as well as by industrial wastewaters (Ежегодник, 2016). Ship discharges, pollution associated with the exploitation and exploration of offshore oil fields, transportation of oil by sea, as well as gas and liquid discharges from the bottom also contribute to the pollution of marine waters.

More than 1,000 chemical compounds of anthropogenic origin enter the marine environment, including toxicants. However, hydrocarbons (crude oil and petroleum products) remain the main pollutants. As it was mentioned above, the main sources of hydrocarbons entering the waters of the Caspian Sea are oil transportation and water transport (fuel leakage or discharge of oily wash and ballast water), seepage from the seabed, industrial discharge of waste waters as well as leakage from offshore oil developments and during the operation of oil and gas wells (Ежегодники, 2011-2016).

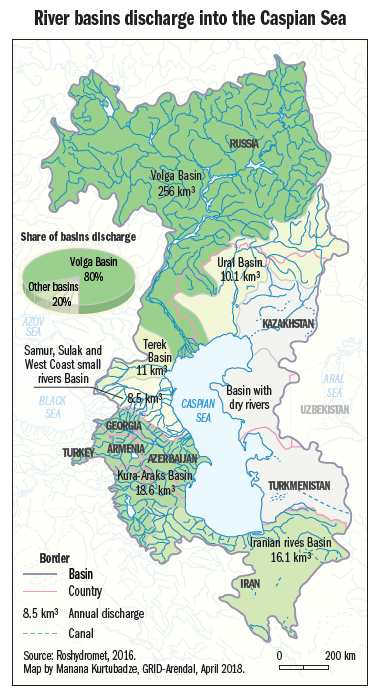
The evidence of the development of oil and gas deposits in the marine environment suggests that even in the standard mode of operations drilling rigs are the sources of pollutions which includes solid, liquid and gaseous components. On average, with the development of offshore fields from 120 to 120 tonnes of oil per year comes from one bore hole (Тарасова Р.А. и др., 2008).

The water quality of the North-eastern sector of the sea is influenced by the flow of the Ural River as well as by flow of a small volume of water coming from the Volga River coming through the branch Kiga. In general, waters of the North-Eastern sector are satisfactory in terms of dissolved oxygen content, nutrients have a long-term downward trend, and sustainable (no trends – fluctuations only) content of hydrocarbons and ions of heavy metal (National Contribution).

Pollutants enter into the North-Western part of the sea with wastewater discharged to the filtration fields, evaporation ponds and directly to water bodies by companies which locates near by the Sea: ErsaiKaspianContractor PLC, KazAzot PLC, Karazhanbasmunay Joint-stock company, Karakudukmunai PLC, MangistauMunaiGas LLP MAEC-Kazatomprom LLP, GKP Kaspiy zhylu, su arnasy, KazGPZ LLP, Ken-Sary LLP, BuzachiOpering Ltd FC. The largest volume (about 90% of the total volume) comes from MAEKKazatomprom LLP which discharges waste water without treatment directly to the Caspian Sea. The discharged effluents are coming from cooling of the heat-power equipment and evaporated brines of desalination plants, cooling, of air conditioning systems as well as with discharges from desalination plants of tow and tanker fleet.

The state communal enterprise "Kaspiy zhylu, su arnasy" discharges sewage into the tailing dump of Koshkarata which, locates in the immediate vicinity of the Sea. The volume of water disposal is from 5.5 to 10.6 million m3 per year. The sewerage systems cover only about 45 percent of Atyrau and about 30 percent of Balykshi. Sewage runs to evaporative fields without treatment (National Contribution).

Currently, the Regional Oil Spill Prevention and Response Plan is being developed for the Kazakhstan sector of the Caspian Sea in Mangistau Oblast (КазЭнерго, 2016).



Turkmenistan pays particular attention to the need of cleaning hotspots like the Soymonov Bay which was heavily polluted by the refinery plant located on the shoreline. Wells were drilled and equipped with pumping and separating equipment to extract polluted ground waters at the territory of the plant. Thus, an effective system for cleaning soil and groundwater from oil pollutants was created. The system extracted over 30 thousand m³ of waste from the groundwater and purified. The implementation of this project has radically changed the situation in the Soymonov Bay to the better. The level of pollution was decreased from 12-15 mg / l to 1-2 mg / l. Construction of new treatment facilities at the refinery plant significantly improved the ecological situation in the region (National Contribution).

## Air emissions

The Caspian region is a large contributor to air emissions, particularly linked to oil and gas extraction, but also the transportation and housing sectors. The countries continue reporting on a regular basis to the UN Framework Convention on Climate Change (UNFCCC) about their greenhouse gases (GHG) inventories, potential climate change scenarios and reporting on progress.

Greenhouse gas (GHG) emissions have increased in the Caspian littoral states since 2000 with some variations influenced by the world’s economic recession and changing crude oil prices. Energy, industry, agriculture and waste are the main sectors contributing to the greenhouse gases.

Oil and gas, transportation, industry development and the agricultural sector account for a large portion of the greenhouse gas emissions in Azerbaijan. The levels of GHG emissions had a significant rise from 40,774 thousand tonnes in 2000 to 51,851 thousand tonnes in 2012; with a growing population and economic activities, it is likely to increase in the future (UNDP Azerbaijan, 2015). The rapid development over the past decades has also had increased effects on the environment due to the excessive exploitation of the country’s natural resources. The energy sector is the biggest contributor to the greenhouse gases that are responsible for 75.9 percent of GHG emissions in Azerbaijan (UNDP, 2016). The agricultural sector is one of the main producers of methane and nitrogen oxide where the former saw an increase from 129 thousand tonnes to 182 thousand tonnes in 2012 from 1990 and the latter saw a slight decrease in the same time period (UNDP, 2016).

No further submission has been made to the UNFCCC by Iran since the initial contribution in 2003. In 2000, CO2 emissions were approximately 375,187 thousand tonnes of which 90 percent came from the energy sector, followed by 8 percent in the industrial sector and 2 percent in forestry (UNDP Iran, 2013). Like the rest of the Caspian littoral states, Iran’s oil and gas industry is a staple in their economy. However, the most recent data for the status of the air emissions in Iran is from 2000 (UNDP Iran, 2013).

Greenhouse gas emissions also increased in Kazakhstan from 162 billion tonnes of CO2 equivalent in 2000 to 271 billion tonnes of CO2 equivalent in 2011 (UNDP, 2013). However, there are some differences between the regions. Due to the strategic efforts the government of Kazakhstan is undertaking, the greenhouse gas emissions are declining in the Mangystau region adjacent to the Caspian Sea. For instance, the total emissions from the industry sector acting as the main emitter reduced from 72.5 thousand tonnes in 2015 to 65.8 thousand tonnes in 2016 (National Contributions). However, in the Atyrau region the air emissions increased from 110.7 thousand tonnes to 167.1thousand tonnes between 2015 and 2016 (National Contributions). Increased production, combustion of associated natural gas and increased oil production are the primary factors behind this increase.

The annual emissions of industrial enterprises in the Atyrau region in 2016 were 167.100 thousand tonnes of which 80 to 85 percent were emissions from the oil and gas sector (National Contribution). The main source of these emissions is the result of associated gas combustion. In 2016, 189 million m3 of associated petroleum gas was flared (National Contribution).

Greenhouse gas emissions at the Federation level in Russia, without Land-Use, Land-Use Change and Forestry (LULUCF), have decreased by 29.6 percent between 1990 and 2015.

For the period from 2012 to 2016, the annual average of pollutions emissions of the Russian Caspian Sea region was 489,000 tonnes, form this amount the Republic of Dagestan portion was 47.6 percent, Astrakhan region - 44.8 percent, and for the Republic of Kalmykia - 7.6 percent (National Contributions).

In the Republic of Dagestan, as well as in Kalmykia, the main source of emissions is motor transport. Its share of emissions in Dagestan and Kalmykia are, respectively, 94 and 89 percent. Emissions from stationary sources prevail in the Astrakhan region. Their contribution to emissions is 57.4 percent. The main source of emissions here is the Astrakhan Gas Processing Plant (National Contribution).

Turkmenistan submitted their second contribution in 2010. From 1998, there was a steep growth in GHG emissions in Turkmenistan, primarily due to the rapid development of industry. Like the other littoral states, the majority of the GHG emissions come from the energy producing industries followed by agriculture and industry. Between 1994 and 2010, Turkmenistan saw a 90 percent increase in GHG emissions without LULUCF; this upward trend has seen a decrease since 1994 although it remains significantly higher than earlier years (UNFCCC, n.d.).

The nine biggest polluters in Turkmenistan’s sector of the Caspian Sea are: the Turkmenbashy complex of oil refineries (TKNPZ), Turkmenbashy Electric Central Heat, Production Association "Garobogazsulfat" in Garabogaz town, Turkmenbashy Plant of Nonmetallic and Construction Materials, Kenar Oil Storage Loading Enterprise, State Enterprise "Balkanbalyk" in Turkmenbashy city, Khazar Chemical Plant in Khazar town, Turkmenbashy International Seaport, Oil and gas production management "Galkynyshknebit" in Khazar town (National Contribution) . Transport is also contributing to the air pollution. Greenhouse gas emissions from those sources have increased from 39. 7 thousand tonnes in 2009 to 42.5 thousand tonnes in 2016 (National Contribution). The increase is attributed to sources by expended operations (the launch of new equipment with additional sources of pollution).

Greenhouse gas emissions are linked to overall economic activities- particularly to carbon intense industries such as the energy and industrial sectors. Kazakhstan and Russia are among the top ten countries with the highest energy intensity at the global level (UNFCCC, n.d.). Meaning there is a great potential to improve energy efficiency and introduce sustainable energy sources.

In Kazakhstan, there is a great political will to move into a new economic and social development era by adopting and implementing the concept of Green Economy, Strategy 2050 and setting concrete targets across the energy, industry, housing and transportation sectors. Direct cuts of CO2 emissions and the dominant greenhouse gases are hoped to reduce CO2 emissions 15 percent by 2030 in the electric power industry sector with many other reductions outlined in other sectors. For instance, Kazakhstan has committed moving away from fossil fuel energy to gas in the transportation and housing sector (National Contribution).

Azerbaijan has implemented a number of laws, state programs and regulatory acts to meet European legislation in recent years. As Azerbaijan´s emissions are expensively linked to the energy sector, the priorities are aiming at improving energy efficiency, energy savings and use of alternative energy sources. The country has looked to alternative energy sources and the development of low-carbon measures in commercial and residential sectors with an aim to reduce carbon emissions by 35 percent by 2030 compared to the base year (1990) (National Contributions). The transfer from liquid fuel to gas has already been completed in the power sector.

Turkmenistan has made attempts to install and use new compressor stations to utilize the earlier flared gas. Any residual associate gas is then funnelled through pipelines to consumers instead of being burned into the atmosphere (UNDP Turkmenistan, 2010). The country has also prioritized the replacement of old energy generating stations with newer and more efficient facilities which have the potential to lower GHG emissions by 67.5 million tonnes in CO2 equivalent in 2010-2030 (UNDP Turkmenistan, 2010).

## Solid waste

Waste generation varies across the region. Although some countries may experience stagnant levels of waste generation there are others with increasing levels due to higher consumption patterns and increased urbanization as more people move to the cities. In addition, Azerbaijan also observes increasing volumes of plastic, polymer materials, and hazardous waste such as electronic and electrical waste.

Generation of industrial waste is linked to the overall regional economic development. The countries are generating immense amounts of industrial waste, which is partly linked to the oil and gas sector. Almost 100 percent of generated waste in Kazakhstan is hazardous waste and the country is one of the largest producers of hazardous waste in the world along with Russia (Nugumanova et al., 2017).

Most of the littoral states inherited a relatively well-organized household waste collection system, which serves as a basis to prevent littering the local marine and terrestrial ecosystems. In the adjacent districts to the Caspian Sea in Kazakhstan, waste management serves about 87 percent of the population (National Contribution).

A common practice of solid waste management is landfills which provide limited options for recycling valuable secondary materials. The landfills are reported to be overexploited, in poor technical conditions and not following sanitary epidemiological requirements; there is little waste being separated and recycled. In Russia, only 2.6 percent of the total household waste is being recycled (National Contribution). Wild or unauthorised dumping is also an issue in the region which leads to littering of the local terrestrial and marine ecosystems. In the adjacent districts to the Caspian Sea in Kazakhstan, there are about 28 landfills, only 8 of which have licenses or operational permits (National Contribution). As of now, there are 764 unregistered solid waste dumps in the Russian part of Caspian region (The Government of Russia 2016; 2016a; 2016b).

The countries are aware of the growing solid waste challenges served by outdated and inadequate infrastructure; therefore, waste management is set as a priority in countries such as Azerbaijan, Kazakhstan, and Russia (The Government of Russia, 2016c). With emphasis on landfill management and waste-to-energy projects, in 2014, Kazakhstan kicked off a Solid Waste Management Program (Kazakhstan, 2014) in Atyrau district with the aim of building 10 new landfills. Since 2012, an incinerator is serving Baku citizens and turning household waste into energy (Azerbaijan, 2012). With the help of the World Bank, Azerbaijan has supported the rehabilitation of the Balakhani landfill as well as the closure and remediation of 154 ha of wild dumps (WB, 2017). In Russia, plans are underway to build 2 new landfills for waste disposal in the coastal areas of the Astrakhan region and Kalmykia, and 4 landfills in in the coastal areas of Dagestan (The Government of Russia 2016; 2016a; 2016b).

There have been some domestic waste recycling efforts; recycling targets are high in Kazakhstan’s Mangystau district and the municipality of Aktau city recently agreed about sorting 40 thousand tonnes of domestic waste, which is almost one third of the total waste generation (National Contributions). To support these efforts, Aktau municipality has installed special collection bins including containers for waste containing mercury. The first solid waste recycling plant in the Mangistau region commenced in 2014 (National Contribution).

**Marine litter**, micro and macro-litter of all human made waste that is discarded into coastal or marine environments, is a largely ignored and increasingly problematic issue for the Caspian region. The problem is growing in certain parts of the sea and no regional action has been taken to address the problem. Marine litter can take a variety of forms, such as textile, rubber, metals and plastics. Sources of marine litter in the Caspian Sea originate from inadequate urban waste management, coastal tourism, improperly disposed hazardous waste, fishing, and shipping. It should also be noted that sea level fluctuations have been an important source of marine litter- most of which is from land-based sources. Since data on marine litter is scarce, it is likely that the extent of marine litter is even greater than visual observation, and that sources such as illegal dumping from vessels might contribute significantly to marine litter (Caspian Environment Programme, 2009). Abandoned, lost or otherwise discarded fish gear is also a significant source of pollution globally.

Plastic is the biggest share of marine litter; it is linked to land-based pollution sources and dumping at sea.

Globally, it is estimated that around 10 percent of marine litter in the oceans stems from the fisheries and aquaculture sector, but this varies greatly from place to place and can be much greater. The principal causes of marine litter from fisheries are adverse weather, operational factors during retrieval, gear conflicts, illegal, unreported and unregulated fishing, vandalism/theft, absence of access to onshore collection facilities as well as lost gear are gillnets with varying mesh size, fyke nets and hook-lines which are used by fishermen in the North-East Caspian Sea (Dmitrieva et al., 2013). The causes are largely undocumented and poorly understood (UNEP and GRID-Arendal, 2016). However, it stands to reason to expect marine litter from the fisheries sector in the Caspian Sea due to the significant challenges related to illegal fishing and the occurrence of harsh weather conditions. In addition, there is inefficiency and inconsistency in waste management systems connected to marine and coastal environments (Caspian Environment Programme, 2009). The fishnets are made from rope, float lines on the top with weight elements at the bottom using nets made of monofilament in between. Gillnets are known for having significant bycatch of various species (Brown, 2016), and seals are often caught as by-catch of illegal sturgeon fishing in the Caspian Sea (Dmitrieva et al., 2013). In addition, ghost fishing (lost equipment catching fish) can be a significant contributor and stressor to already depleted marine resources (FAO, 2016a).

The influence on the amount of marine litter from aquaculture at the global level has not been estimated, but researches at different locations suggest that it can have a significant impact on ecosystems. Litter from aquaculture can come in the form of lost cages, longlines, poles and other floating and fixed items (UNEP and GRID-Arendal, 2016). Micro plastics may also be released into seas through wear and tear of plastic pipes when used in sea-based aquaculture (Naturvernforbundet, 2017). The international scientific community has increased their attention towards the impact of plastics on the marine environment in recent years, specifically the possible socioeconomic costs due to disruption of ecosystem services and potential health risks for humans through the introduction of micro plastics in the fish food chain (UNEP and GRID-Arendal, 2016). These are important factors to consider for the management of current and future aquaculture or other fisheries businesses in or near the Caspian Sea.

Generation of industrial waste is linked to the overall regional industrial development. The littoral states are generating immense amounts of industrial waste, which is partially linked to the oil and gas sector in the Caspian Sea. A steady increase of the volume of plastic and polymer materials, black and non-ferrous metals, electronics, as well as other hazardous waste is observed in Azerbaijan (National Contribution). Kazakhstan is one of the largest producers of hazardous waste in the world along with Russia (Nugumanova et al., 2017). At present, 1.7 million tonnes of industrial, including metallurgy, oil and gas, chemical, pharmaceutical, construction, textile, food-fishing-agrarian processing,  and municipal wastes are generated annually in the Russian Caspian region of which: 30.2 tonnes of the First hazard class (according to the Russian national classification – see (Russia National Standards, 1976, Government of Russia, 2016d); 7.8 thousand tonnes of the Second hazard class; 39.9 thousand tonnes of the Third hazard class; 1.3 million tonnes of the Fourth hazard class; 320 thousand tonnes the Fives hazard class[[10]](#footnote-11) (Russia National Standards, 1976).

Some parts of the Caspian shores are still subject to industrial pollution accumulated after oil and gas extraction activities. The consequences of such pollution are dispersed over 350 thousand ha of land in Mangystau district with similar situations in Atyrau (National contribution). Over the last few years the government of Kazakhstan, together with the private sector, has agreed upon the reclamation of these territories and has undertaken practical steps to remedy the situation in some areas[[11]](#footnote-12). As the result, about 20 ha of polluted land have been remediated by biological methods in Atyrau[[12]](#footnote-13). The intent of this work to prevent, reduce and control pollution to the marine environment and adhere to the policy of "zero discharge" is that it will continue. The process of cleaning oil contaminated areas in Azerbaijan, on the Absheron peninsula as well as other parts of the country, has been initiated and relevant measures are being taken. Remediation of the industrial zone of Baku began in 2007 (National Contribution).

Special attention is given to the drilling work at sea in Turkmenistan and Kazakhstan. Turkmenistan has implemented a "Zero discharge policy”, as required by the environmental legislation of Turkmenistan. Subsidiaries and affiliates of the major companies working in the Caspian sector of Kazakhstan are required to take the necessary measures to prevent, reduce and control pollution of the marine environment and adhere to the policy of "zero discharge".

## Tourism and recreation

The Caspian share of world tourism is quite small. Most tourism in the countries is made up of national or regional tourists. The countries are not considered as big tourism destinations worldwide for a variety of reasons (see section Tourism), however, seasonal fluxes of tourists to the shores of Caspian is an important consideration in the discussion of environmental impacts.

The tourism industry can have both positive and negative social and environmental impacts depending on a variety of factors, such as how it is managed, developed and planned in relation to the local context. An important requirement for sustainable tourism is that it has to evolve and grow within the carrying capacities of the ecosystems on which they depend on. Loss or degradation of cultivatable land, solid waste and waste-water discharges are a few possible negative impacts. Tourism is one of the sources of marine litter in the Caspian Sea. Seasonal tourists mostly coming from Tehran spend their vacation on the shore of the Caspian Sea in Iran, causing large amounts of waste and marine litter (CEP, 2009).

In some cases, tourism might contribute to preservation if the quality and sustainability of the natural environment is pivotal for the existence of the industry. As an example, plastic pollution of beaches could prevent tourists from coming, giving an incentive to clean up beaches. This is often a hidden cost for locals who have to clean up in order for the area to continue being attractive, which is the case in the Caspian coastal area of Iran (CEP, 2009).

On the social side, tourism can negatively affect purchasing power of locals and increase pressures on society through intensive visitation causing stress on local resources and people. It might also increase employment and business opportunities, upgrade infrastructure, attract investment, increase awareness and attract funding for environmental or social purposes (Stanciu et al., 2016). In order for tourism to be sustainable, policies need to address possible environmental and social impacts and specifically focus on the creation and implementation of sustainability (green) policies for tourism development (UNEP and UNWTO, 2011).

Alternatives to high footprint tourism activities is sustainable eco-tourism, which could provide both socially and environmentally sustainable livelihoods.

# State

## Change in bio-resources

In the last 10-15 years, the number and biomass of zooplankton have decreased 5-6 times in the Middle Caspian and approximately 10 times in the Southern Caspian. The biomass and number of Mnemiopsis leidyi comb on the western shelf of the Central and Southern Caspian are significantly increasing from summer to autumn. Thus, the jelly-shaped organism Mnemiopsis leidyi, which was brought to the Caspian Sea through the ballast waters in the late 1990’s, rapidly spread to the sea, directly and seriously damaged the biodiversity of the sea. It consumed large amounts of zooplankton, which is a feed base of sprat, and this has led to a decrease in the food base of Acipenseriformes, predatory Clupeidae, and others along the food chain (National Contribution).

By consuming planktonic larvae of benthic animals (crab, mollusca etc.) mnemiopsis also destroys the food base of benthos-fed fishes such as acipenseriformes and cypriniformes and etc. In 2015 the biomass and number of mnemiopsis on the western coast of the Southern and Central Caspian region was the highest during the last 15 years since 2001. This adversely affects the formation of hunting resources of fishes feeding zooplankton and zoobenthos (National Contribution).

The main part of the benthic animals of the western coast of the Caspian Sea consists of molluscs, crustaceans and worms. The plankton larvae as mitilyaster, abra, balyga, and crab are the victims of the mnemiopsis comb in the South Caspian. Thus, in recent years, abra and crab, which numbers considerably decreased, are rarely or not at all encountered in the benthos. There were no spots created by high biomass of benthos as a result of the massive development of abra, serastoderma, nereis, on the western coast of the Southern Caspian compare with the data of the previous years (National Contribution).

The advantage of abra and crab which created an abundance of the benthos in the South Caspian in previous years, along with nereis and balyanus, has not been recorded in recent years. However, appropriate characteristics of food base of fishes are recorded in the western region of the South Caspian Sea because of the high number of worms and some crustaceans in the benthos fauna. This also shows that there are favourable conditions for feeding fish from all trophic levels in the area (National Contribution). Tables 5.1 – 5.5 below illustrate these facts.

Table 5.1: Biomass of Zoobenthos in the Southern Caspian Sea (g/m2)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Organisms | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** |
| Vermes | 3,25 | 5,16 | 2,11 | 1,47 | 3,98 | 5,34 | 1,02 |
| Crustacea | 2,07 | 4,85 | 12,01 | 7,69 | 9,26 | 8,05 | 8,75 |
| Mollusca | 1,85 | 1,37 | 5,1 | 8,23 | 14,02 | 11,26 | 6,29 |
| Total: | 7,174 | 11,38 | 20,22 | 17,39 | 27,26 | 24,65 | 16,06 |

Source: (National Contribution)

Table 5.2: Biomass of Zoobenthos in the Middle Caspian Sea (g/m2)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Organisms | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** |
| Vermes | 5,5 | 7,93 | 10,8 | 2,81 | 3,48 | 6,53 | 4,13 |
| Crustacea | 10,1 | 13,47 | 17,93 | 10,12 | 12,06 | 9,02 | 8,12 |
| Mollusca | 4,0 | 8,11 | 12,05 | 11,36 | 5,13 | 20,48 | 7,16 |
| Total: | 19,6 | 29,51 | 40,78 | 24,29 | 20,67 | 36,03 | 19,41 |

Source: (National Contribution)

Table 5.3: Number (ex / m3) and biomass (mg / m3) of zooplankton in the Azerbaijani sector of the Caspian Sea

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Years** | **Middle Caspian Sea** | | **South Caspian Sea** | |
| Number  (ex/m3) | Biomass  (mg/m3) | Number  (ex/m3) | Biomass  (mg/m3) |
| **2011** | 10323,2 | 275,4 | 3326,7 | 88,1 |
| **2012** | 10620,8 | 301,8 | 4005,7 | 104,3 |
| **2013** | 12747,5 | 312,9 | 4109,0 | 102,8 |
| **2014** | 11620,5 | 308,6 | 4225,7 | 110,5 |
| **2015** | 12116,4 | 352,4 | 3835,2 | 96,9 |
| **2016** | 11903,3 | 347,8 | 3753,6 | 106,3 |

Source: (National Contribution)

Table 5.4: Number (ex / m3) and biomass (mg / m3) of zooplankton in the Azerbaijani sector of the Middle Caspian Sea

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Indicators** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** |
| Overall mean number | 10323,2 | 10620,8 | 12747,5 | 11620,5 | 12116,4 | 11903,3 |
| Overall mean biomass | 275,4 | 301,8 | 312,9 | 308,6 | 352,4 | 347,8 |

Source: (National Contribution)

Таблица 5.5: Number (ex / m3) and biomass (mg / m3) of zooplankton in the Azerbaijani sector of the South Caspian Sea

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Indicators** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** |
| Overall mean number | 3326,7 | 4005,7 | 4109,0 | 4225,7 | 3835,2 | 3753,6 |
| Overall mean biomass | 88,1 | 104,3 | 102,8 | 110,5 | 96,9 | 106,3 |

Source: (National Contribution)

There is a steady decline in commercial stocks of valuable fish species in the Northern Caspian Sea for the period from 2010 to 2016. For example, the absolute number of beluga has decreased from 0.466 to 0.228 million specimens, and the fishing stock from 8.08 to 4.06 thousand tonnes. A similar trend is typical for commercial stocks of Russian sturgeon: the commercial reserve in 2015 was 5.35 thousand tonnes, which is 2.5 times lower than in 2010. In 2016, the fishing stock continued to decline and did not exceed 3.88 thousand tonnes (National Contribution).

The absolute number of stellate sturgeon in 2016 was estimated at 0.94 million specimens, commercial biomass of 2.46 thousand tonnes, which is 2.4 and 2.0 times less than in 2010. The catch of stellate sturgeon in 2016 did not exceed 0.042 tons. Sterlet is the only species of sturgeon, the stock of which was not as rapid as in beluga, sturgeon and stellate sturgeon; the number of sterlets over the last five years of observations decreased from 0.166 to 0.104 million specimens, commercial biomass from 34.3 to 29.2 tonnes.

Unsustainable seal hunting, even prohibited by law according to the Azerbaijan´s contribution report, is the main reason for the Caspian seal decline coupled with loss in breading ground, loss in habitants and decline of primarily food resources (Goodman et al. 2016). It is also believed that climate change, sea level raise and industrial pollution is contributing to extended pressures. For instance, ice breeding habitats are reducing due global warming (National Contribution).

Compared to 2014, the average density (0.74 specimens / km2) of seals in the spring in the Northern Caspian increased by 14 percent. During the summer period in the water area of the sea, the average feeding concentration of the Caspian seal increased by 42 percent, in autumn - by 232 percent. There has been some improvement in the parasitological state of the Caspian seal. According to the assessment, the toxicological status of the Caspian seal is satisfactory.

Invasive species

During the last 15 years (2001-2016), in 2015 the biomass and number of mnemiopsis on the western coast of the Southern and Central Caspian region has been the highest in all observed years. This adversely affects the formation of hunting resources of fishes feeding zooplankton and zoobenthos.

Table 5.6: Mnemiopsis biomass (g / m3) in the Azerbaijan sector of the Middle and Southern Caspian Sea.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Area** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** |
| Middle Caspian Sea | 1,8 | 3,3 | 2,5 | 5,8 | 8,2 | 7,6 |
| South Caspian Seaa | 6,83 | 5,98 | 4,13 | 9,34 | 11,9 | 6,7 |

Source: (National Contribution).

The interannual dynamics of the taxonomic composition and quantitative indicators of macrozoobenthos in the North-Eastern part of the Caspian Sea fluctuate but insignificantly. The taxonomic composition in the area totaled 53 taxon in summer 2017 against 59 in 2016, in autumn 2017 and in autumn 2016 - 31 taxons. The quantitative numbers of the population in the summer of 2017 were slightly higher than in the summer period of 2016 but the biomass was slightly lower than in 2016. Worms occupied the dominant position in the number of hydrobionts in the summer of 2017 and 2016. Worms and mollusks dominated in the biomass. In the autumn of 2017, the numbers and biomass were slightly higher than in the autumn of 2016. The dynamics of numbers over the past years is characterized by considerable variability, as illustrated in Table 5.7 below.

Таблица 5.7: Main characteristics of macrozoobenthos in the Kazakhstan part of the Caspian Sea.

|  |  |  |  |
| --- | --- | --- | --- |
| **Years** | **Number of species** | **Number** | **Biomass** |
| 2011 | 27 | 3719 | 7,31 |
| 2012 | 41 | 7810 | 19,22 |
| 2013  August  SEptember | 46  25 | 5030  4877 | 8,25  9,83 |
| 2014  July-Agust  September | 42  28 | 5906  5936 | 11,17  16,46 |
| 2015  July  September | 32  25 | 6123  4543 | 13,35  9,64 |
| 2016  July-August  September | 59  31 | 6313  4764 | 17,64  9,10 |
| 2017  May  July  September | 24  53  31 | 7800  9232  6993 | 8,36  16,39  12,23 |

The structure of the community in 2015, as in previous years of research (2007-2014), was characterized by an invariable dominance in the number of worms, and by biomass - by molluscs. The composition of dominant species in the governing groups varied insignificantly.

Thus, qualitative and quantitative indicators of macrozoobenthos in recent yearswere within the limits of fluctuations of long-term values.

## State of marine water quality and incoming fresh water

Systematic monitoring of the state of the environment in the basin of the Caspian Sea, including monitoring of the quality of marine waters and bottom sediments is carried out by the national services for hydrometeorology. In addition, in the Caspian countries regular monitoring is imposed on companies and enterprises whose work can have a negative impact on the environment, such as oil producing, oil refining, chemical industry, and etc.

National Hydrometeorological Department under the Ministry of Ecology and National Resources of Azerbaijan is responsible for the observation and forecasting of hydrometeorological processes at the Western section of the Caspian Sea.

Hydrometeorological monitoring of the Caspian Sea is carried out by the Sea Hydrometeorology Centre of the National Hydrometeorology Department of the Ministry of Ecology and Natural Resources. The Centre holds observation network. The network contains 14 observation posts situated on sea coasts, islands, and platforms. In addition ship expeditions supply hydrometeorological data collected in open sea to the Centre. The Centre conducts hydrometeorological observations, collection, analysis, and generalization of data and compilation of sea annuals. In the recent years, the sea observation network was retooled with modern equipment, including data automation equipment. Daily, monthly and annual data is collocated in the sea annuals (National Contribution).

There are 25 rivers flow to the Caspian Sea through the territory of Azerbaijan. Many of them receive communal, agricultural, and industrial waste waters. A significant cause of the decline in quality of marine waters is the increasing domestic discharge from developing coastal cities and settlements with an almost complete absence of sewage treatment facilities (Abdusamadov & Belyaeva, 2015).

Regional branches the Atyrau and Mangistau of the Kazgidromet monitor the marine waters in the Kazakhstan sector of the Caspian Sea. The Atyrau Oblast Observation Network consists of forty six sampling points: Maritime Canal, Tengiz oil field, Ural River, as well in the Middle and the North Caspian (in the areas of Kurmangazy, Darkhan, Kalamkas, near flooded wells and Kulaly Island) (National Contribution).

The Republican state enterprise Kazhydromet publishes information on the state of sea waters in the Information Bulletin on the state of the environment of the Kazakhstan part of the Caspian Sea and a similar publication dedicated to the special economic zone "Aktau Sea Port (http://eco.gov.kz/ekolog/ekolog). Samples of sea water and bottom sediments are collected at coastal stations, at stations of secular sections and near oil fields on the shelf of the Northern (Atyrau region) and Middle (Mangistau region) Caspian Sea (Figure 5.1)Станции_казахстана_2

Figure 5.1: Sampling stations for sea water and bottom sediments of the Kazakhstan part of the Caspian Sea.

Source: Information Bulletin on the state of the environment of the Kazakhstan part of the Caspian Sea.

The content of suspended solids, pH, soluble oxygen and BOD5, petroleum hydrocarbons, phenols, total chlorine, phosphates, ammonium, nitrite and nitrate nitrogen, metals (copper, manganese, zinc, nickel, lead, total iron and chromium 6 + ) in water samples are analyzed.

The content of the total amount of petroleum hydrocarbons and the concentration of heavy metals: copper, nickel, chromium, manganese, zinc, lead and cadmium in the samples of bottom sediments are analyzed,

Water sampling is carried out only during the navigation period - from May to October at a frequency of once a month. Forty-five indicators are determined in water samples from all monitoring sites. The laboratory of the Atyrau regional branch of the "Kazgidromet" analyzes water samples. JSC KazMunaiGaz conducts background environmental studies, environmental impact assessment and subsequent monitoring during exploration for oil and gas in the Kazakhstan sector of the Caspian Sea. The following indicators are monitored: oil products, phenols, nitrites, nitrates, ammonium nitrogen, iron, phosphates, salt content, BOD-5, dissolved oxygen, temperature, calcium, magnesium, carbonates, hydrocarbons, APAV, CPAV, pH (National Contribution).

The quality of sea water in the Northern Caspian was estimated as "clean", and sea water at coastal stations, near the Karazhanbas and Arman oil fields in the Middle Caspian was estimated as "moderately polluted". In the Karazhanbas area, and the Kenderli-Divichi, Peschanny-Derbent and Mangyshlak-Chechny cuts, the quality of sea water was estimated as "clean" (Fact Sheets, 2011-2016).

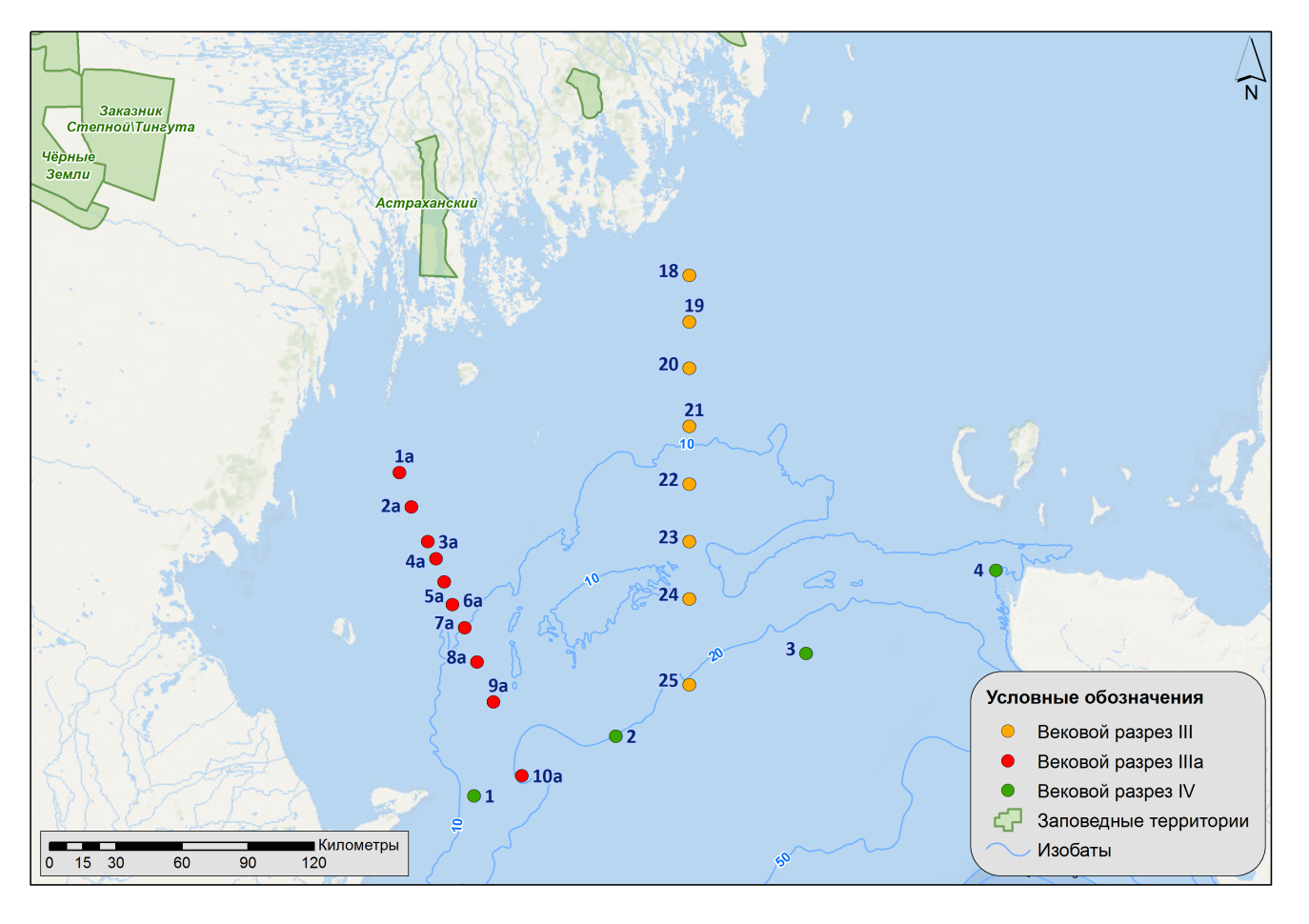
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Figure 5.2: Sampling stations in the water area of the Northern Caspian.

Source: Year Books 2011-2016.



Figure 5.3: Sampling stations at the Dagestan seacoast in 2015.

Source: Year Books 2011-2016.

A comparison of the variability of the main indicators of the chemical composition and the contamination of sea water in the areas of oil and gas objects showed an increase in the concentration of pollutants. The increase in the concentration of oil products in the water in the areas of location of the production facilities of the oil fields was noted in other parts of the Northern Caspian Sea in 2016-2017.

According to Roshydromet, oil products in the flow of the Volga River reached 50 thousand tonnes in 2016, which is 3 times higher than the average for 2001-2015. Currently, seawater in the coastal areas of the Russian part of the Caspian Sea is estimated as "moderately polluted" and "contaminated", and in open areas as "moderately polluted" and "clean" (National Contribution).

Water quality of the South-East sector of the Caspian see is being monitored by the Caspian Environmental Control Service (Kaspecocontrol) of the State Committee on Environment Protection and Land Resources of Turkmenistan. Thus far, waters of the eastern sector contain rather high concentrations of petroleum hydrocarbons and phenols, ions of heavy metals, and a lower content of dissolved oxygen (National Contribution).

The country pays particular attention to the need in cleaning hotspots like the Soymonov Bay which was heavily polluted by the refinery plant located at the shoreline of the Sea. Concentration of hydrocarbons decreased from 12-15 mg/L ito 1-2 mg/L during last 10 years (National Contribution).

Pollution and other environmental indicators in the South sector of the Caspian Sea are being monitored by the Meteorological Department of the Ministry of Roads and Urban Development of the Government of Iran (IRIMO).

## State of air quality

Numerous studies have confirmed the association of a wide range of diseases with air pollution. Pollution of atmospheric air leads to an increase in diseases in respiratory organs and the cardiovascular system.

According to WHO (WHO, 2018):

‘*Ambient (outdoor air pollution) is a major cause of death and disease globally. The health effects range from increased hospital admissions and emergency room visits, to increased risk of premature death.*

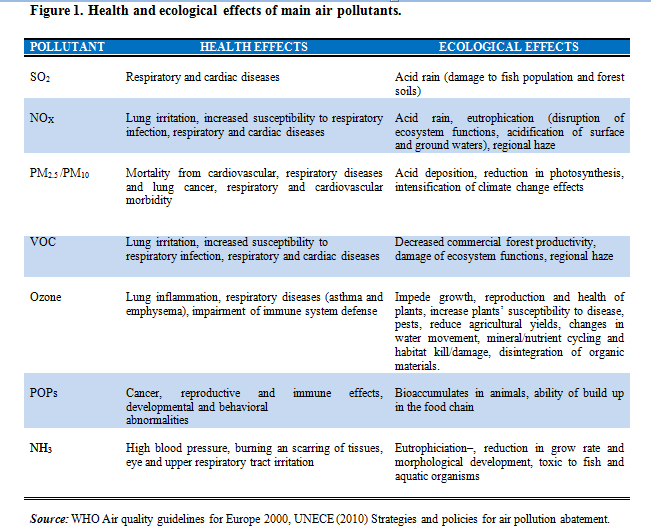
*An estimated 4.2 million premature deaths globally are linked to ambient air pollution, mainly from heart disease, stroke, chronic obstructive pulmonary disease, lung cancer, and acute respiratory infections in children.*

*Worldwide ambient air pollution accounts for:*

* *25 percent of all deaths and disease from lung cancer*
* *17 percent of all deaths and disease from acute lower respiratory infection*
* *16 percent of all deaths from stroke*
* *15 percent of all deaths and disease from ischaemic heart disease*
* *8 percent of all deaths and disease from chronic obstructive pulmonary disease*’.

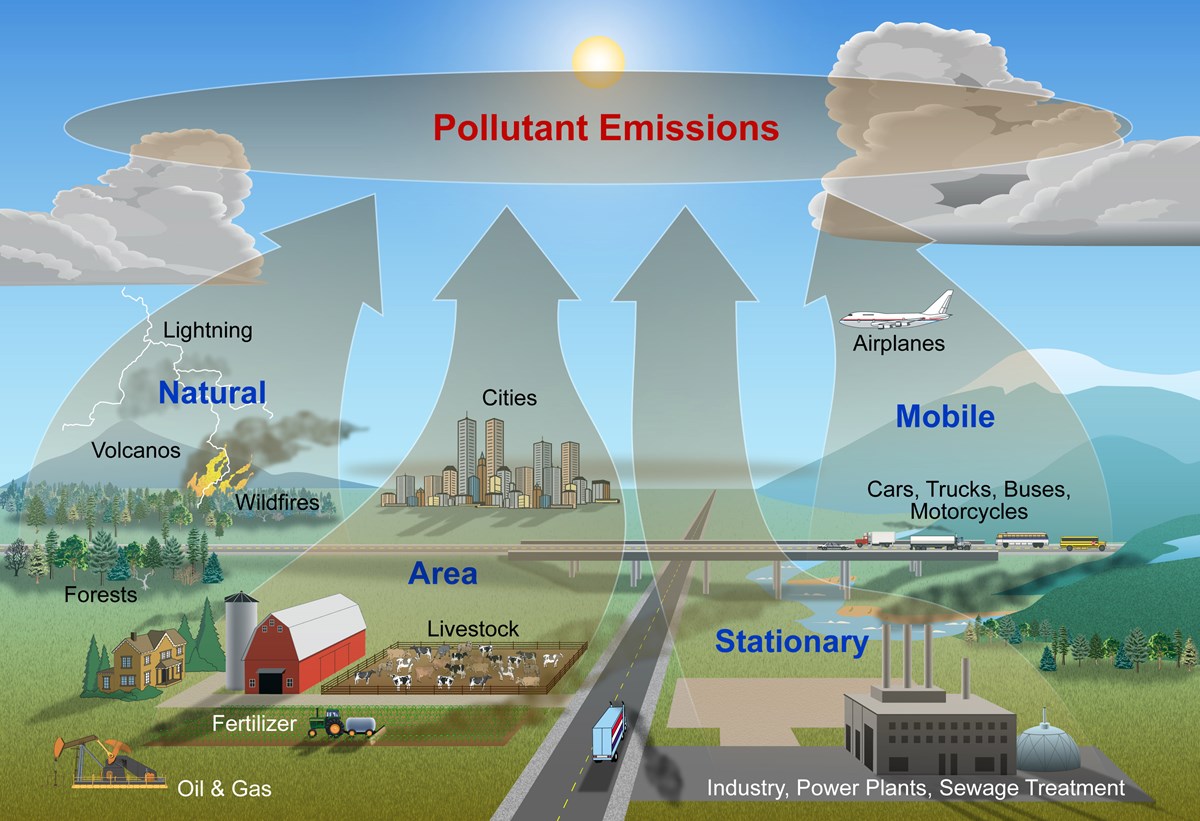
The economic loss of air pollution is estimated to fall between 13-30 billion USD which was more than 2 percent of Iran’s GDP in 2016. In terms of human life, it is estimated that air pollution has been responsible for over 20,000 premature deaths (Mohseni-Cheraghlou, 2018). There are 300 deaths per year in Iran from indoor air pollution and an estimated 9100 deaths/year from outdoor air pollution (UNEP 2, 2018).

Based on WHO data from 2012, Turkmenistan has the highest rate of death per capita due to ambient air pollution (CBC News, 2016)



Air pollution can be classified in two main groups: particulate and gaseous forms; some of them are visible and some invisible. Both have major impacts on human and environment health. Some enhance climate change (Nugumanova et al., 2017). There are four main types of air pollution:

* mobile sources – such as cars, buses, planes, trucks, and trains
* stationary sources – such as power plants, oil refineries, industrial facilities, and factories
* area sources – such as agricultural areas, cities, and wood burning fireplaces
* natural sources – such as wind-blown dust, wildfires, and volcanoes



There is no a unified system of the air quality monitoring in the region. Monitoring is fragmented and data collected by the countries in most of the cases is disparate. Air monitoring activities and its frequency are unevenly distributed across the region. Therefore, it remains difficult to assess air quality in the coastal zone of the Caspian Sea.

All countries confidently note that transport and industrial emissions are the main sources of air pollution (National Contributions). The major concerns of the countries concerning air quality are attributed to the industrial areas and urban centres.

One of the bigger challenges for the region is the change from stationary to mobile sources – where over the last decade mobile sources have had a much bigger percentage of the total air pollution. For Teheran it is between 70-80 percent and 80 percent in Baku (State Statistical Committee of the Republic of Azerbaijan, 2017).

At present, regular monitoring of dust (PM10), sulphur dioxide, carbon monoxide, nitrogen dioxide and nitrogen monoxide is carried out in Azerbaijan. On the coast of Azerbaijan, the air quality is monitored in Baku, Sumgayit, and Lankaran, which represents the major urban areas with high population or important industrial activities. The air quality monitored seems to have improved for a period since 1995 ([www.azstat.org](http://www.azstat.org)) however, air quality remains critical in Baku and Sumgayit.

Air quality in Iran continues to need serious attention and improvement as in 2016, Zabol was listed as the most polluted city in the world with Boshehr and Ahvaz among the top 40 most polluted cities worldwide (Mohseni-Cheraghlou, 2018).

In Mangistau region (Kazakhstan), air pollution monitoring is conducted at 7 stationary posts of the state system in Aktau, Zhanozen and Beineu. According the observations, the level of atmospheric air pollution in the cities of Aktau and Zhanaozen was low and did not exceed the permissible values. According to the data from the fixed network of observations, the level of air in Beyneu was polluted. Here, the air was contaminated with PM-10 suspended particles. The level of air pollution compared to the previous period in the cities of Aktau, Zhanaozen and Beineu did not change (National Contribution).

Kazhydromet conducts occasional observations in Koshkar-Ata and Bautino. Here, the concentrations of suspended particles (PM-10), sulphur dioxide, carbon monoxide, nitrogen dioxide, nitric oxide, soluble sulphates, ammonia, and the sum of hydrocarbons were measured. According to observations, concentrations of the substances were within the permissible range.

According to Kazhydromet, the maximum concentrations of suspended solids, sulphur dioxide, carbon monoxide, nitrogen dioxide, ammonia, sulphuric acid and total hydrocarbon in the Dunga and Zhetybai deposits did not exceed the maximum permissible concentration.

There are 39 observation posts in Atyrau Oblast, including 20 posts on the territory of the NCOC NV Company, 12 posts at the Tengiz field of Tengizchevroil LLP, 4 posts at the Atyrau Refinery, 5 posts in Atyrau and 1 post in Kulsary. Monitoring on the posts of the NCOC NV Company limited to carbon oxide, nitrogen oxide, nitrogen dioxide, hydrogen sulphide, sulphur dioxide; at the posts of LLP Tengizchevroil it is limited to hydrogen sulphide, sulphur dioxide, hydrocarbons (methane), carbon monoxide, nitrogen oxide, nitrogen dioxide; at the posts of the Atyrau refinery - carbon monoxide, nitrogen oxide, nitrogen dioxide, hydrogen sulphide, sulphur dioxide, total hydrocarbons.

Based on the results of monitoring conducted in 2016 in the city of Atyrau and Kulsary, the level of air pollution did not change compared to 2015. According to Kazhydromet (2016), the cases of high and extremely high atmospheric air pollution in the Atyrau region were not observed.

Observations of atmospheric air pollution in the Russian Caspian region are carried out in urban centres, as well as at the Complex Background Monitoring Station (CBMS) located in the Damchik Region of the Astrakhan State Biosphere Reserve on the coast of the Caspian Sea (National Contribution).

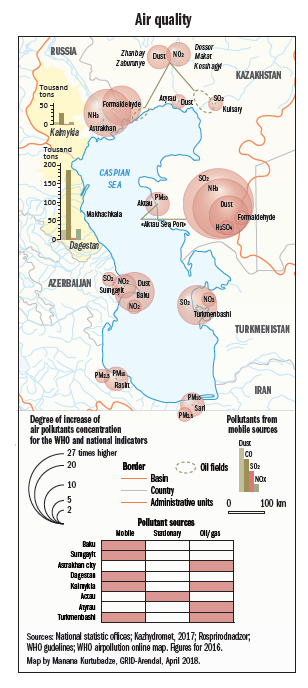
According to Rospotrebnadzor, the number of air samples that do not meet the standards in Makhachkala is lower than the average for the Republic of Dagestan and the number of these kind of the samples decreased in the city and in the Republic between 2012 and 2016. Also, both Rospotrebnadzor and Roshydromet's confirmed that the air quality improved in Astrakhan for the same period. Here, unlike previous years, such samples were not registered in 2015 and 2016. In the Republic of Kalmykia, there was not a single air sample taken in which the concentration of pollutants exceeded the Maximum Permissible Concentration in 2012-2015. However, concentration of pollutants in the cities of the Russian Caspian is much higher than on the coast of the sea far from urban settlements (National Contribution).

According to observations at stations of complex background monitoring located on the coast of the sea, the average Pb concentration in the atmospheric air for the period 2012-2016 was 4.0 ng / m3, Cd = 1.4 ng / m3, SO2, 0.5 μg / m3, NO2, - 1.6 μg / m3, SO4, - 6.6 μg / m3, H2S, - 0.14 μg / m3, suspended matter 45.1 μg / m3, benzene (a) pyrene and benzperylene 0.004 ng / m3. The pollution of atmospheric air on the Russian coast of the Caspian Sea is of a local nature and concentrates over the cities and the Astrakhan gas processing plant. At the same time, the quality of atmospheric air over the period 2012-2016 improved (Roshydromet, 2016).

In Turkmenistan, the primary challenge is from stationary sources. Between 75 to 95 percent of total emissions come from the oil and gas, chemical, manufacturing, construction materials, textiles and cotton processing industries (UNEP (c), 2015).

As it was mentioned above (see section Air Emissions), there are nine main polluting facilities in the coastal zone of the Turkmen sector of the Caspian Sea.

Pollutants from the process of production enter the atmosphere from the smoke stacks of process furnaces, boilers, afterburning ovens, open surfaces of treatment facilities, diffusers of cooling towers of water circulation systems, ventilation systems of production facilities, process units, loading and unloading devices for overpasses, vehicles, sea transport, diesel locomotives, flare plants, conveyors, petroleum coke loading bins, etc. (National Contribution)

According to the first environmental performance report for Turkmenistan in 2012 the air quality standards were exceeded in all big cities and standards are lacking for important pollutants such as PM10 ad PM 2.5. Air quality monitoring is obsolete and uncoordinated resulting in a lack of reliable data which fails to cover relevant emission sources and pollutants (UNECE, 2012).

## State of sediment quality

Northern Caspian Sea

Heavy metals can have both natural and anthropogenic origins. The anthropogenic sources of heavy metals in surface sediments are often from runoff from urban, agricultural and industrial disposal systems near water ecosystems like rivers and lakes (Vosoogh et al. 2017).

When monitoring/measuring heavy metals, it is important to understand the physical characteristics of the sediment since Co and Zn can indicate an increase in silt-size fraction of the sediments suggesting their probable detrital provenance but the Mn, Ni, Cu, Sr, Pb, Cd, and Ag concentrations show a similar trend to distribution of the claysize fraction. Total organic carbon content can either enhance or reduce the heavy metal content of individual components (Pakzad et al. 2016).

Sediments can have an important role in heavy metal concentrations in aquatic environments. Heavy metals, with either anthropogenic or natural (geogenic) origin, are discharged into seas linked with sediment particles by rivers and are mostly retained under physicochemical controls within estuarine, coastal, and shelf regions (Pakzad et al. 2016)

The complexity of hydrochemical reactions occurring in the water column is even greater in the presence of suspended solids deposited on the bottom in the form of bottom sediments. Moreover, the impact of adsorbed pollutants of various nature, including hydrocarbons, heavy metal ions, organic compounds, has not yet been studied sufficiently to make conclusions or assess the quality of sediments. This is the reason that there is no single approach to the regulation of toxicity of pollutants contained in bottom sediments.

Until now, when it comes to the pollution of bottom sediments, most often estimates of trends and assumptions about the possible impact of pollutants on biotic communities are made. There are attempts to reach agreement on the magnitude of the toxic effects of sediments in different countries. For example, in Canada - «Canadian Sediment Quality Guidelines» (retrieved from <https://www.elaw.org/system/files/sediment_summary_table.pdf>) or in USA - «Consensus-Based Sediment Quality Guidelines of Wisconsin Department of Natural Resources» (retrieved from <https://dnr.wi.gov/files/PDF/pubs/rr/RR088.pdf>, and many more. But, there is no single approach to such an assessment until now.

The available information (National contributions) turned out to be disjointed and does not allow to make any substantiated conclusions about the pollution trends in the Caspian Sea bottom sediments. For example, information on pollution of bottom sediments of the Northern and Middle Caspian Sea published in the Information bulletin on the state of the environment of the Kazakhstan part of the Caspian Sea by "Kazhydromet" (Fact Sheets, 2011-2016) and the similar publication dealing with the special economic zone "Aktau Sea Port" concern about samples of bottom sediments selected at coastal stations, at stations of secular sections and near oil fields on the shelf of the Northern (Atyrau region) and Middle (Mangistau region) of the Caspian Sea. In the collected samples of bottom sediments, the content of the total amount of petroleum hydrocarbons and the concentration of heavy metals (copper, nickel, chromium6 +, manganese, zinc, lead and cadmium) were analyzed. As an illustration, the table below shows the results of analysis of samples collected in different water areas.

Table 5.8: Concentration ranges of pollutants in bottom sediments of the Caspian Sea (μg / g).

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Place / Indicator | PH | Cu | Cr6+ | Ni | Mn | Zn | Pb | Cd |
| Maritime Canal | 232-237 | 0.5-0.7 | 0.1-0.2 | 1.37-1.46 | 5.1-5.2 | 2.1-2.2 | 0 | 0 |
| Tengiz oil fieldие | 224-247 | 0.6-1.0 | 0.1-10.9 | 1.37-1.48 | 4.2-5.5 | 2.0-2.5 | 0 | 0 |
| Seashore of the Ural River | 210-275 | 0.8-1.2 | 0.2-0.8 | 1.25-1.43 | 2.56-6.40 | 2.1-2.8 | 0 | 0 |
| Shalygy-Kulaly | 211-345 | 1.0-1.2 | 0.1-0.6 | 1.39-1.99 | 2.4-4.2 | 2.4-3.0 | 0 | 0 |
| Additional cross sections «A» & «B» | 215-268 | 1.1-1.3 | 0.8-1.0 | 1.25-2.00 | 3.6-4.2 | 2.0-3.0 | 0 | 0 |
| Middle Caspian Sea | 140-160 | 0 | 0.01–0.0 | 0.03-0.05 | 1.11-1.20 | 0.09-0.14 | 0.001-0.002 | - |
| To oil field on the shelve | 190-220 | 0 | 0.01–0.0 | 0.047-0.28 | 0.18-0.21 | 0.08-0.09 | 0 | - |
| At the cross sections of Middle Casoin Sea | 226-312 | 1.0-1.3 | 0.8-1.0 | 1.25-2.00 | 3.55-4.25 | 2.0-3.0 | 0 | - |

Source: National Contribution.

As can be seen from the table, the ranges of the concentration of pollutants are rather wide and weakly dependent on the sampling sites, which confirms the conclusions made in the report of Russia (National Contribution).

Pollution of bottom sediments in the North-Western part of the Caspian Sea is determined by lithodynamic processes by which suspended sediments are transferred from the mouth of the river to the deep-water basin of the Middle Caspian Sea. Absorbed pollutants are carried along with the suspended particles (Tarasova and all, 2008).

At present, there are no normatively fixed quality characteristics for bottom sediments in marine areas in Russian territorial waters. The content of pollutants in sediments is not regulated by Russian normative documents. However, it is possible to assess the degree of contamination of bottom sediments on the basis of the compliance of their levels with the criteria for the environmental assessment of soil contamination according to foreign standards, for example, by Neue Niederlandische Liste. Altlasten Spektrum 3/95.

Results of monitoring carried out by Roshydromet in the North-Western part of the Caspian Sea in 2012-2014 at more than 100 stations were used to assess the contamination of bottom sediments. According to the data given in Surveys 2012-2014, the concentration of organic pollutants in the North-Western part of the Caspian Sea is insignificant. In addition, the monitoring data by LUKOIL-Nizhnevolzhskneft in the areas of oil and gas fields development (Annual Reports 2012-2015), Roshydromet data (Yearbooks 2011-2016), as well as information on pollution of sediments in the areas of operating deposits ( Editor A.V. Kuzin, 2017) were used. These data allowed to assess the impact of oil and gas production facilities on the quality of bottom sediments. It should be borne in mind that the historical background characterizes the state and pollution of the marine environment before the fields were put into operation and the modern background characterizes the state and pollution of the marine environment after putting into operation oil fields beyond the potential impact of production facilities on the marine environment.

Based on the data given in the table below the following conclusion could be made: the concentration of organic pollutants in the north-western part of the Caspian Sea in 2012-2014 is relatively low.

Table 5.9: Content of organic pollutants in bottom sediments of the North-Western part of the Caspian Sea in 2012-2014 (mcg / kg).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Pollutant** | **September - October 2012.** | **November - December 2012** | **September - October 2013** | **August-December 2014** |
| Aromatic hydrocarbons | 2,4-242 | 17,3-699 | <0,03-309 | <0,03-531 |
| Polychlorobenzenes | <0,03-6,70 | 0,35-10,8 | <0,03-2,12 | 0,10-2,50 |
| Benzachlor | <0,03-0,2 | <0,03-0,25 | <0,03-0,3 | <0,03-0,40 |
| DDT | <0,03-1,15 | <0,03-4,72 | 0,11-1,74 | <0,03-6,50 |
| Hexachlorocyclohexane | <0,05 | <0,05 | <0,05-0,21 | <0,05-1,80 |
| Phthalate | 380-3920 | | 130-17210 | 70-2320 |

Source: National contribution

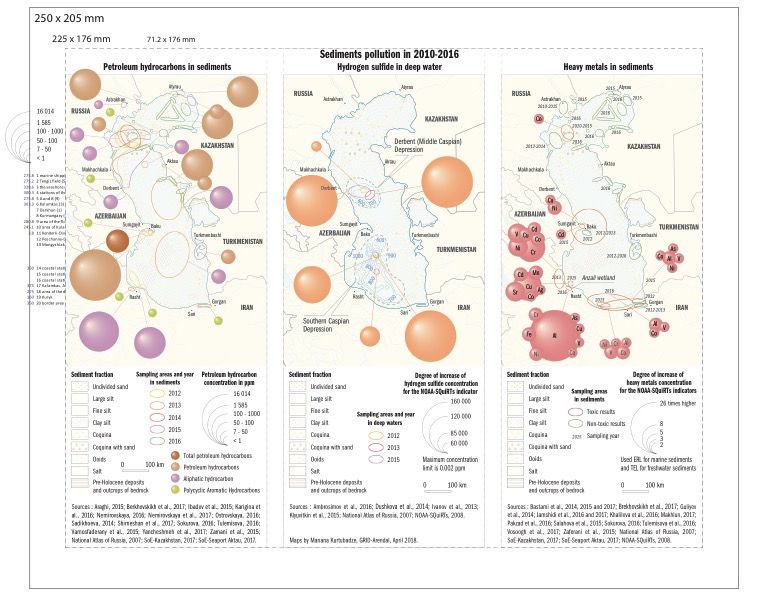
Comparison of the variability ranges of the main indicators of bottom sediment contamination in the areas of oil and gas facilities in 2017 with the background showed that the values of most indicators do not go beyond the limits of the background (National Contribution).

Southwestern Caspian Sea

Mining has increased concentrations of Cu in the water drainage basins from the rivers running into the Southwest part of the Caspian Sea. The average concentrations of the heavy metals in mcg/g are Mn (563), Cu (207.5), Sr (187), Zn (94), Pb (26.3), Ni (14.5), Co (11.5), Cd (2.56), and Ag (1.04) in their order of abundances (Pakzad et al. 2016).

In 2016, Jamshidi and Bastami (2016) looked at concentrations of metals, including As, Cd, Cu, Cr, Co, V, Ni, Pb, and Zn in sediments from the Anzali wetland in relation to sediment properties. Statistical analysis revealed that Al and Fe are effective factors in the distribution of the metals on the sediments. The results implied that Al and Fe are probably responsible for the transportation of heavy metals into the sediments of the Anzali wetland which have a 21% probability of toxicity.

Jamshidi and Bastami (2016) also found higher concentration of As, V, and Cu in the sampling sites than those reported in previous studies. In addition, the contents of Ni, As, Cr, and Cu were higher than those in the Sediment Quality Guidelines (SQGs). This may cause toxicity to certain exposed organisms. The Anzali wetland is facing a serious environmental degradation problem, especially due to metal contamination.



## State of biodiversity

The Caspian biodiversity serves as indicator of overall environmental quality and impacts of anthropogenic pressures.

Caspian seal (pusa caspica) is the only marine mammal and Caspian endemic that can be regarded as a sensitive species listed in the Endangered in the International Union for the Conservation of Nature Red List of Threatened Species in 2008. At the beginning of the twentieth century, the number of Caspian seals amounted to about 1 million individuals, however, at present, there is quite contradictory information about the total population of the Caspian seal, ranging from 111 thousand to 360 thousand individuals (source). It has been observed outbreaks of mass mortality of the Caspian seals caused by canine distemper virus (CDV) in the past. Since the last outbreak in 2000, there was no any case registered in the Caspian States, however CDV is still present in the Caspian seal population (Namroodi et al. 2018).

In February 2015, the main Siberian Caspian seal breeding grounds were located on ice fields with an ice thickness of 10-15 cm both in the Russian and Kazakh sectors of the Northern Caspian. The distribution pattern of the producing females corresponded to the distribution of 2014 when breeding grounds located along the ice edge from East to West. The number of the Caspian seal in the Western part of the Northern Caspian Sea in 2015 varied considerably from season to season: from 19.31 thousand specimens in summer to 68.04 thousand specimens in spring and autumn. According to the results of photography, the number of breeding grounds on sandy shallows was 700 specimen which is 2 times more than in the autumn of 2014 (National contribution).

KaspNIRKh conducted research on the parasitological state and the accumulation of toxicants in the tissues and organs of the Caspian seal in 2015. The main toxicants were heavy metals and aromatic hydrocarbons. The results are as follows: representatives of the Trematoda class (which cause pseudammystamosis in the Caspian seal) occupied the dominant position in parasitofauna.

The analysis of the results on the toxicological and epizootic parameters of the seals allowed to characterize the state of the population as satisfactory. The main biological indicators of the broodstock and young individuals were within the norm for this period in autumn 2015.

The Caspian seal stands at the peak of the ecological pyramid in the sea and usually fed with sprat. Therefore, due to the invasion of the Mnemiopsis leidyi, in comparison with the 1999 year sprat reserves, 10 times reduced, and the decline of the food base of Caspian seal is one of the factors that affect the decrease in its number. The Caspian seal hunt in Azerbaijan has been banned since 1952.

The Caspian Sea is located at the intersection of migration routes of millions of migratory birds. The Northern Caspian is a place of concentration of migrating and breeding in the region waterfowl and waterbirds. Variety of systematic groups of birds: anseriformes, copepods (waterfowl); waterworms - shinewood, sandpipers, seagulls; passerine, day predators and some others participate in the migrations.

The North-West Caspian is a territory of mass wintering of water birds. On wintering, whooper swan, mute swan, tufted duck, common pochard, goosander, magpie diver, bullhead and mallard in warm winters - gray goose, European teal, black coot.

During the counts of 2014 8 species of birds were recorded: herring gull, Pallas's Gull (listed in the Red Book of Russia and the Astrakhan Region), Caspian tern (listed in the Red Book of Russia and the Astrakhan Region), sandwich tern, black cormorant, Dalmatian pelican (listed in the Red Book of Russia and the Astrakhan Region), stint, sky lark (National contribution).

Protected areas

Over that last decade the countries worked hard to protect most valuable areas both on land and in marine environment. For the most part, the number of protected areas have been holding steady in the region since 2011.

Table 5.10: Countries protected areas

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Azerbaijan | Kazakhstan | Russia | Turkmenistan |
| Number of Protected Areas | 37 | 109 | 11,252 | 32 |
| Protected Area Coverage – Terrestrial (% of total area) | 10.16 | 3.31 | 9.73 | 3.25 |
| Protected Area Coverage - Marine (% of total area) | 0.44 | 1.05 | 2.94 | 2.99 |

Source: UNEP-WCMC, 2018 a-d

As a result of the work carried out in Azerbaijan, the total area of the protected areas in the country has reached to 892 546.49 hectares. There are 9 national parks[[13]](#footnote-14), 11 State Nature Reserves and 24 State Nature Sanctuaries established in Azerbaijan. In general, specially protected natural areas cover 10.3% of the country's territory, including national parks - 3.7% (National contribution). Azerbaijan has also created the first Marine Protected Area in the Caspian Sea expending the Gizilaghaj State Reserve to the marine ecosystem in 2018.

Table 5.11: Azerbaijan protected areas (кm2)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Specially protected areas, in Azerbaijan[[14]](#footnote-15)** | | | | | | |
|  | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** |
| **Total space of specially protected areas** | 8807.7 | 8925.5 | 8925.5 | 8925.5 | 8925.5 | 8925.5 |
| of which share by IUCN[[15]](#footnote-16) categories |  | | | | | |
| Strict Nature Reserves Wilderness Area | 23.7 | 23.4 | 23.4 | 23.4 | 23.4 | 23.4 |
| National Park | 35.3 | 36.1 | 36.1 | 36.1 | 36.1 | 36.1 |
| Habitat / Species Management Area | 41 | 40.5 | 40.5 | 40.5 | 40.5 | 40.5 |
| **Total area as share of national territory, in percent** | 10.2 | 10.3 | 10.3 | 10.3 | 10.3 | 10.3 |

Based on the results of monitoring and research conducted by the Institute of Zoology, the number of rare and endangered wildlife species in the Mangistau region was adjusted (Table 5.12)

Table 5.12: Number of rare and endangered species of wild animals in the Mangistau region (thousand individuals).

|  |  |  |  |
| --- | --- | --- | --- |
| **№** | **Species** | **2015** | **2016** |
| 1 | Saiga | NA | 1,9 |
| 2 | Corsican moufflon | 1,4 | 1,5 |
| 3 | Gazella subgutturosa | 0,8 | 1,0 |

Source: National Contribution

There were 7 specially protected areas with a total area of 1 046 746 hectares have been established from 2012 to 2015 to preserve and restore natural ecosystems and biodiversity, maintain ecological balance in Mangystau oblast.

There are three specially protected natural areas on the territory of Atyrau oblast:

* State reserve zone of the northern part of the Caspian Sea with an area of 662.6 thousand ha;
* Novinsky state natural (zoological) sanctuary with an area of 45 thousand hectares, located in the coastal zone of the Caspian Sea;
* State natural reserve "Akzhayik" with an area of 111.5 thousand hectares, located on the territory of Makhambet district.

The State Natural Reserve "Akzhayik" was established in the delta of the Ural River . The total area of the specially protected natural areas of the Akzhayyk reserve is 140,800 ha. The Ural River Delta with the adjacent coast of the Caspian Sea within the boundaries of the reserve is represented by the richest species biodiversity. Here, 292 species of birds were registered of which 110 species nesting, 76 species during winter season, 106 species were registered during migration. Mammals are represented by 48 species, higher plants by 227 species. Ichthyofauna is represented by 65 species. Invertebrates number more than 3,000 species. From the Ural River inhabiting the delta, 36 species of birds, two species of mammals, 3 species of plants and 5 species of fish are listed in the Red Book of Kazakhstan.

The Red Data Book of Azerbaijan (2013) includes 9 species of fish, 6 of which are found in the Caspian Sea: thorn, Caspian salmon, Caspian barbel, South Caspian bream (Abramis sapa), Chekhon, sea pike-perch. These species were rare in the 70-80s of the last century, and since the 90s they are already at the brink of extinction. In recent years, as a result of uncontrolled poaching, commercial stocks of such fish as sturgeon, Caspian salmon, white fish, temple, shmoy, barbel, vimba (Vimba vimba) have significantly decreased. These fish species are under threat of extinction, especially sturgeon and salmon, due to a significant decrease in the output of fingerlings in hatcheries..

Таблица 5.12: Names of fish species included in the Red Book of Azerbaijan

|  |  |  |  |
| --- | --- | --- | --- |
| № | **Scientific (Latin) name** | **Name in Azerbaijani language** | **Name in Russian** |
| 1 | *Acipenser nudiventris* Lovetsky, 1828 | Qaya balığı (kələmo) | Шип |
| 2 | *Salmo trutta caspius* Kessler, 1870 | Xəzər qızılbalığı (kumja) | Каспийский лосось |
| 3 | *Salmo trutta fario* Linneus, 1758 | Çay qızılxallısı | Ручьевая форель |
| 4 | *Rutilus atropatenus* Derjavin, 1937 | Şirvan külməsi | Ширванская плотва |
| 5 | *Lusibarbus capito* (Güldenstaedt, 1773) | Zərdəpər | Усач-чанари |
| 6 | *Lusibarbus brachycephalus caspius* (Berg, 1914) | Xəzər şirbiti | Каспийский усач |
| 7 | *Abramis sapa bergi* Belyaeff, 1929 | Cənubi Xəzər porusu | Южнокаспийская белоглазка |
| 8 | *Pelecus cultratus* (Linnaeus, 1758) | Qılıncbalıq | Чехoнь |
| 9 | *Sander marinus* (Cuvier, 1828) | Dəniz sıfı | Морской судак |

Source: National Contribution

Considering the range of distribution of fish species, it is necessary to distinguish places of reproduction, foraging and wintering. In the Azerbaijan sector, the western coast of the Middle Caspian plays a decisive role in the formation of the ichthyofauna of the entire sea. There are silty-sandy, sandy-silty and silty-shell rocks, which are considered to be the most populated benthic food organisms at depths of 10-50 meters in this part of the sea. Therefore, in this area, the juveniles of passage and semipermeable fishes are concentrated for fattening. In addition, diadromous fish and catadromous fish ready for reproduction accumulate in this area of the Middle Caspian, before the mouth of the rivers Terek and Samur and smaller rivers.

This region has especially great importance in the spring-summer period and to a lesser extent in the autumn period. The herrings and sprats are coming for breeding to the coast of the Middle Caspian in the Yalama-Shabran zone at a depth of 10-50 meters. Here, the young sturgeons are concentrated for feeding in spring. There are wintering and feeding grounds for sturgeon in the areas of the Western coast of the Middle and Southern Caspian with shallow depths of 10-40 meters. Therefore, the entire western coast of the Middle and Southern Caspian can be considered a zone of sensitive for fish habitats (National Contribution).

Analysis of data obtained during trawling and net fishing off the Russian coast showed that traditionally the main concentrations of Russian sturgeon, stellate sturgeon and beluga are noted in the western shallows and in the zone of increasing the depths of the Northern Caspian Sea. The most important feeding area for the Persian sturgeon is still the deep-water part of the Northern Caspian.

The commercial stocks of common sprats, sea herrings, atherins and mullets are stable. Research catches, commercial reserves and biostatistical indices of all these fish species are close to the average long-term characteristics, confirming the stability and high number of their populations (National Contribution).

Invasive species

The jelly-shaped organism, *Mnemiopsis leidyi*, was brought to the Caspian Sea through the ballast waters in the late 1990’s, and rapidly spread to the sea, directly and seriously damaged the biodiversity of the sea. It consumed large amounts of zooplankton, which is a feed base of sprat, and this has led to a decrease in the food base of Acipenseriformes, predatory Clupeidae, and others along the food chain. By consuming planktonic larvae of benthic animals (crab, mollusca etc.) mnemiopsis also destroys the food base of benthos-fed fishes such as Acipenseriformes and Cypriniformes and etc.

The latest knowledge on *Mnemiopsis Leidyi* has been received from Azerbaijan and Iran. Mnemiopsis Leidy's monitoring studies conducted by Azerbaijan over the last 13 years (2001-2013) have identified the principles of distribution of *Mnemiopsis* on western coast of Southern and Central Caspian. About 60 per cent of mnemiopsis is concentrated in the south of the outfall of Kura river. In general, higher concentrations of Mnemiopsis Leidyi is observed at water column closer to the surface. Depthwise, 50 per cent of Mnemiopsis is concentrated at a depth up to 10 meters and 87 per cent up to 75 meters. Younger members of the Mnemiopsis population range 0-5, 6-10 mm are constituted 95 per cent of the population in the Middle Caspian and 91% in the South Caspian Sea. The maximum size of Mnemiopsis in the Middle Caspian is 36-40 mm and 66-70 mm in the South (Azerbaijan Contribution, the reference should be requested).

The highest biomass of Mnemiopsis Leidy has been identified in the South Caspian Sea where according to Paurang´s study the Mnemiopsis leidyi bio-invasion impacts are massive but remains relatively stable over the period of 1996-2010 (Paurang 2014). The biomass and number of Mnemiopsis leidyi comb on the western shelf of the Central and Southern Caspian are significantly increasing from summer to autumn.

# Impact

### Consequences for the social and economic sectors

The Caspian region, due to its heavy reliance on oil and gas exports, is susceptible to changes in global energy prices and natural conditions such as climate change. If unstable global energy prices is combined with the undefined legal status of the Caspian, territorial disputes then there is an option to set up an unstable environment (Anis, 2015). BP highlights some impacts on Azerbaijan due to the oil and gas extraction- specifically as a result of the Shah Deniz 2 Project. These socio-economic impacts can be exemplary of several other areas dependent on natural resource extraction. BP highlighted the following consequences: disruption to road and rail users; access restrictions along the shoreline; community disturbances from artificial lighting; community disturbances from construction yards; and community health and safety from onshore pipeline installation works as their primary results. They also highlight that anti-social behaviour like alcohol and substance abuse, prostitution, domestic violence, desertion and family breakdown may all indirectly result from the project (BP, 2013).

As it was mentioned above (see section Fishing), there has been a decline in legal fishing activities due to a combination of depleted resources and complicated attempts to privatize the sector. Many workers have moved from legal fishing activities to poaching. Reductions in biological resources of the Caspian Sea, specifically the most popular on the market, sturgeon and kilka, have negatively affected all the fishing industries in the region (Strukova et al., 2016). For example, in Azerbaijan the number of fishermen decreased by 33 percent from 2015 to 2016 (National Contribution).

### Consequences on human health

The climate has a strong impact on human health and well-being. With climate change, this effect can be direct (injury or death due to heat stroke, natural disaster) and indirect, through the spread of diseases (mosquitoes, pathogens transmitted by water, quality of water and air, availability and quality of food). Human health depends on the state of the environment, socio-economic conditions, as well as organizational and managerial, technological and adaptation measures aimed at reducing the impact of climate change. In Turkmenistan, the health of citizens is an important indicator of development, the most capacious criterion of their quality of life. Concern for public health is one of the priorities of state policy (National Contribution).

The Caspian region has a particularly large expenditure for pollution-related healthcare therefore contributing to addition health expenditures for individuals and governments. The Caspian region is one of the top three contenders for projected GDP losses stemming from air pollution due to the combination of exposure to high concentrations of pollutants, aging population and relatively high expenditures on health (Lanzi et al., 2018).

In 2012, there were an estimated: 4, 297 deaths in Azerbaijan attributable to ambient air pollution; 26, 267 deaths in Iran attributable to ambient air pollution; 10, 293 deaths in Kazakhstan attributable to ambient air pollution; 140, 851 deaths in Russia attributable to ambient air pollution; and 3, 667 deaths in Turkmenistan attributable to ambient air pollution (WHO, 2018)

In Turkmenistan, the health of citizens is an important indicator of development, the most telling factor of their quality of life. Concern for public health is one of the priorities of state policy. (National Contribution).

### Consequences on economic sectors

Overfishing in the Caspian region, low pay in the legal sector and high payoff from poaching has resulted in many artisanal fishers moving to poaching and the lucrative black market. Although the rate of illegal fishing is reported differently in the littoral states and the rate of illegal fishing differs it is undeniable that the changing pattern of fish stocks has an effect economically on the fishing industry for communities surrounding the Caspian as well as the livelihoods of fishers. This can be seen throughout all the Caspian coastal regions surrounding the Caspian Sea. Azerbaijan amended their previous law on fisheries in 2017 to ensure a sustainable development of aquaculture in rural areas whilst creating an alternative source of income and improve the well-being and health of the coastal population (National Contribution).

Sea level fluctuations have been occurring in the Caspian Sea continuously, throughout its history. Certainly, in some places pastures were flooded or reduced with the rising of the sea level, and spawning grounds degraded with the lowering level, and etc. The regulation of rivers also played a negative role in the fact that the runoff of nutrients and mineral salts, especially phosphates, sharply decreased, without which the primary production of the sea and, together with it, the food base cannot be significantly increased.

Over the past decade, East of Turkmenistan has become one of the industrialized centers of the country. The industrial enterprises of the main oil and gas sector are located in the cities of Balkanabat, Khazar, Turkmenbashy, Bekdash (now Garabogaz) and Gumdag. A rise in sea level can flood oil and gas pipelines that have been stretched to and along the coast, which can cause water contamination at the Khazar and Ekerem coast. The most negative effects may be the possible rise in sea level for the Khazar Peninsula (former Cheleken) in the middle part of the Turkmen coast. With the increase in sea level by 5 m, the present Khazar peninsula can be flooded. And, the peninsula can turn into an island separated from the mainland by a 2-kilometer sea channel (National Contribution).

As temperatures rise, the rate of evaporation in the Caspian Sea is likely to increase and the water level is expected to drop thus amplifying the effects of anthropogenic factors. The climate of the Caspian Sea has an obvious impact on the biodiversity and bioresources of the entire region. But, it is rather difficult to foresee the impact of climate change on the bioresources of the Caspian Sea due to the lack of specific models. If the climate in the region becomes hotter and drier this will lead to a decrease in precipitation in the watersheds of river basins, then the wetland areas are likely to decrease following the decrease in runoff and increased evaporation. This, consequently, will lead to a reduction in areas and possible increase in salinity and changes in the food chain (Anis, 2015).

### Consequences on Livelihoods

Turkmenistan has highlighted that a rise in the Caspian Sea level will not only have a negative impact on human settlements, industry and infrastructure but also on Turkmenistan’s unique coastal biomes (National Contribution).

The impact of climate change on agriculture is highly intertwined with economics and has the ability to negatively affect half the population in Turkmenistan that relies on the agricultural industry for their livelihood (National Contribution).

### Consequences for Agriculture

The National Contributions are lacking the information required. Therefore, this section is based on what was available.

Western Turkmenistan has a "dry" subtropical climate, ideal for growing crops such as olives, figs, pomegranates and grapes; the sea encroachment will undermine the potential agrarian development and, possibly, even the microclimate (National Contribution).

Agriculture accounts for approximately 1/5 of the GDP in Turkmenistan. Climate change is expected to have significant effects on the water supply and agricultural production. It is estimated that a reduction of 30 percent in the glaciers that feed Turkmenistan’s water supply have already been lost in the last century. A 15 percent reduction in the water flow from the Amu Darya is expected by 2030 and will have dramatic consequences for agriculture and food production for the country. Currently, agriculture consumes 92 percent of the total volume of surface water in the country. Therefore, water shortages, as a result of climate change, will have a detrimental effect on Turkmenistan’s GDP, development and agriculture (National Contribution).

## 6.2 Impact on environmental services and bio-resources

### Fisheries

There are several possible environmental impacts on fisheries which should be taken into consideration. Creation of aquaculture farms might destroy natural ecosystems, salinize or acidify soils, pollute sources of water originally appropriate for human consumption, cause eutrophication and nitrification of effluent receiving ecosystems, introduce exotic species that might biologically contaminate waters, pollute soils and waters with medication practices, change landscape and hydrological patters which can have unknown impacts on ecosystems, trap eggs, larvae, juveniles and adults of different organism. There are also concerns regarding the release into the environment high concentrations of toxins and heavy metals, genetic pollution and infestation of non-desirable phytoplankton and zooplankton species (Martinez-Porchas and Martinez-Cordova, 2012). Because of these issues, making aquaculture beneficial for local populations and the environment will be a complicated task requiring consideration of all possible impacts.

In Azerbaijan, between 2011-2016 the number of fishing licenses increased compared to 2005-2010 although the government believes that there has been a reorientation of fish catch from Kilka and other endangered species to build a sustainable aquaculture. The government also amended the old law on fisheries in 2014 to introduce new provisions on aquaculture to help ensure sustainable development of aquaculture in rural areas, create new sources of income and to improve the well-being and health of the coastal and local populations (Azerbaijan contribution). In Azerbaijan, the decrease in fish stocks along with a lack of pathways to retrain for new employment opportunities has led some individuals from the legal fishing industry to illegal poaching (Strukova et al., 2016).

In Iran, the gross value of fishing in the Caspian Sea has been decreasing- in part due to the reduction of bio resources (Strukova et al., 2016).

All the littoral states operate on a licensing system in the Caspian, apart from Kazakhstan, where all commercial fishing and fish processing are privately owned (Strukova et al., 2016).

The Kazakhstan fisheries sector relies more on the Caspian Sea; 40 percent of fish catch in Kazakhstan came from the Ural-Caspian basin, while the rest came from Balkash-Alakol and Zaysan-Irtysh in 2010 (FAO, 2010). It is still a small sector which contributed approximately 0.8 percent of Kazakhstan’s Gross Domestic Product (GDP) in 2010, providing about 17,000 official jobs. A report from the World Bank in 2005 suggested that the informal and unreported part of the fisheries industry exceeds that of the formal sector in Kazakhstan. According to their estimations, there may have been as many as 110,000 people employed in the fisheries sector – most of which work on a seasonal basis in rural areas with few other opportunities. This number suggests that roughly 300,000 people might be dependent on this sector for their livelihoods (World Bank, 2005). Meaning that even though the significance of fisheries in the national economy can seem small, the sector can be very important for communities connected to the Caspian Sea.

Well-organized illegal fishing is commonplace in Kazakhstan due to a variety of factors including, but not limited to: a lack of permanent and complete fishing regulations, fishing periods, areas and catch limits are poorly defined and are not approved in time which is detrimental to areas such as sturgeon reproduction (Strukova et al., 2016).

According to the IUCN, there are currently 6 species of sturgeon that are listed as critically endangered in the Caspian (*Acipenser gueldenstaedtii, Acipenser nudiventris, Acipenser persicus, Acipenser stellatus* and *Huso huso* (IUCN Red List). Ye & Valbo-Jørgensen (2012) paint a bleak picture of Stellate sturgeon extinction by 2042 in the Caspian if current IUU fishing and stock replacement levels remain the same. The authors highlight that if IUU fishing continues in the Caspian then any efforts to restore the sturgeon stocks are doomed to fail (Ye & Valo-Jørgensen, 2012).

There are cases of illegal, unreported, and unregulated fishing throughout the Caspian although exact numbers are not available the number of illegal caviar seizures are available. Russia accounted for 38 percent of the illegal caviar trade seizures worldwide between 1990 and 2014 with Iran accounting for 11 percent, Azerbaijan 8 percent and Kazakhstan 4 percent (Sawe, 2016). Sturgeon stocks are an important resource for all 5 of the littoral states and have historically provided employment for individuals along the coast. If sturgeon stocks fail to recover all the littoral states will lose this valuable resource and the economic benefits. There is little information available on the role of IUU in Turkmenistan. However, according to Turkmenistan’s contribution, poaching is minimal because they have 4 high speed patrol boats monitoring the 1, 200 km coastline, most of which surrounds Turkmenbashy (National Contribution).

### Shipping

The Caspian Sea is positioned between two large trading areas with the Asian market to the east and the European to the west. The geographical location, oil and gas resources and current political situation are all influencing the current growth in the shipping industries connected to the Caspian Sea. The port in Baku, Azerbaijan was and still is an important one, but Kazakhstan and Turkmenistan are both currently expanding their shipping industries and related ports. Iran is also increasing its attention to the potential of the sea, and Russia already has many vessels operating in the sea for various purposes (ITE Transport and Logistics, 2017). The Russian government recently approved a strategy with the aim of building new sea ports in the Caspian as a means to increase cooperation with Caspian countries (The Russian Government, 2017).

Turkmenistan is currently building an international port in Turkmenbashy, which is thought to have great geopolitical importance. This development is taking the ecological state of the Caspian Sea into consideration and is said to abide by the international standards connected to the term “Green port” (Infobad.com, n.a). In addition to upgrading ports with equipment to handle wastewater and other discharges from ships (bio-cleaning equipment), the fleet was upgraded in 2009 with ships that hold international standards and are constructed to prevent pollution regardless of emergencies (National contribution).

The Ministry of Investment and Development of Kazakhstan recently announced that they are working together with relevant organizations in other countries to establish a unified system for state led control of ships in the Caspian Sea ports which will be similar to the system used in the Black and Mediterranean Seas. This initiative is thought to improve security issues related to vessels and reduce the number of accidents by concentrating efforts towards controlling older vessels of low standard (Guliyeva, 2018).

The shipping industry in the Caspian Sea is one of several sources of marine litter. The industry can also be a source of negative effects of marine litter through damaging impact on vessels and their equipment (UNEP and GRID-Arendal, 2016; CEP, 2009).

As it mentioned above ( see section Non-living resources extraction), oil and gas sector has particular attention for sound management practices, including operational standards and safety measures. However, increased transport of petroleum resources and associated extraction materials due to investments in current and future oil and gas projects continues to be a particular concern due potential risks to the environment.

### Ports/harbor infrastructure: more Green ports under planning

Currently most ports in the Caspian are beyond capacity and likely not designed to safely and sustainable handle the amount and variety of waster produced be the expanding shipping activities in the Caspian Sea.

With the Port of Alat being designed as a Green port[[16]](#footnote-17) unwanted discharge to the Caspian sea are likely to be reduces and instead landed and treated in the port facility. Upgrading the old port facility of Baku to a world-class Green Port and logistics center, using the latest innovative Environmental practices[[17]](#footnote-18) can as well have a positive impact on the surrounding environment and biological resources (National Contribution).

Azerbaijan’s action plan to ensure sustainable development of its maritime transport sector could serves to improve the Safe and Efficient Sustainable Transportation System, as well as the prevention of marine pollution, energy efficiency and the protection of natural resources (National Contribution).

In accordance with Presidential Decree No. 725 of January 13, 2014, Kazakhstan adopted the State Program for the Development and Integration of the Infrastructure of the Transport System of the Republic of Kazakhstan until 2020. The program provides for an increase in the share of Kazakhstan in the transportation of cargoes across the Caspian Sea from 58 percent in 2012 to 70 percent in 2020, as at present the share of foreign companies is still high in the transportation of goods by sea. The program also provides for the period from 2016 to 2020 the increase of Kazakhstani sea vessels from 3 to 5, the increase in the level of provision of coastal infrastructure from 45 percent to 50 percent, the reduction in the accident rate per 100 ships of sea and river transport from 1.4 percent to 1.2 percent, the construction of a ship repair and shipbuilding plant by 2020, etc. It is also planned to increase the capacity of the seaport of Aktau in 2020 from 16.8 to 20.5 million tons, for which the dredging will be carried out and construction of three dry cargo terminals will be carried out, loading and unloading operations will be automated. In Atyrau region, ferry crossings will be modernized in the Kurmangazinsky district across the Kigach River (National Contribution).

Turkmenistan has focus on the ecological state of the Caspian Sea when they upgrade and expand their port facilities. Bio-cleaning equipment will be installed in each terminal. The project is developed in accordance with the international standard "Green port". Also, the actual ship-fleet was upgraded (National Contribution).

Turkmenistan has formed its fleet in the last twenty years. It purchased 4 universal dry cargo ships, 6 tankers for transportation of petroleum products, many auxiliary vessels for various purposes and intends to develop further its shipping. All old ships were recycled (National Contribution).

The design of tankers takes into account all special requirements and environmental restrictions of the world's oil companies. Technical and economic parameters of these tankers are significantly improved in comparison with vessels of the same deadweight: control means are automatized, oil products are completely excluded from the sea in an emergency situation and safe working conditions of the crew are worked out at all operating modes of the vessel. All this allows the vessels of this type to work in special ecological areas, which is especially important for the fragile Caspian ecosystem, its biodiversity conservation (National Contribution).

The Development Strategy for the Maritime Activities of the Russian Federation until 2030 (Decree of the Government of the Russian Federation No. 2205-r of 8 December 2010) defined the tasks to increasing port capacities and ensuring the effective development of the port infrastructure to increase capacity of port facilities and ensure effective development of port infrastructure, ensure the safe functioning of the sea port infrastructure and sea transport, create conditions to increase the competitiveness of domestic seaports (National Contribution).

According to the Strategy, the current capacities of the Caspian basin ports are expected to increase by 6.0 million tonnes per year (energy-resource scenario) or by - 9.0 million tonnes per year (the innovative scenario) and by 2030 will be about 30.4 million tonnes (energy-raw materials scenario), and 33.4 million tons (innovative scenario). The main increase will be due to the development of the ports of Olya (the second cargo area) and Makhachkala (National Contribution).

The Strategy of Socio-economic Development of the Southern Federal District for the period until 2020 (Decision of the Government of the Russian Federation No. 1538-r of 05.09.2011) links the development of the oil and gas complex of the Southern Federal District with the development of transport infrastructure for increasing the efficiency of oil, gas and oil products exports as well as diversification of directions, volumes, methods and routes of oil, gas and oil products supplies to internal and external markets (National Contribution).

The development of the Astrakhan transport hub including the ports Astrakhan and Olya, the port railway stations and the Aksaray border station is associated with the formation of the North-South international transport corridor Astrakhan-Baku-Tehran and increasing capacity of the Astrakhan transport hub to 30 million tons per year (National Contribution).

In accordance with the Strategy of social and economic development of the North Caucasus Federal District for the period up to 2025, project for the development of the railway junction of the port station "Makhachkala" and access roads to service the Makhachkala Sea Commercial Port in order to increase freight traffic in rail and sea traffic along the international transport corridor "North-South" is among the most priority directions.

Russia´s approved strategy for new ports comes with development of a legal base through 2018-2019 followed by a two 5-year construction phases between 2020 and 2030. A new Deep-water port should be ready by 2030[[18]](#footnote-19).

### Submarine Cables and pipelines

Planed transport pipeline in the Caspian Sea: Trans-Caspian Pipeline from Turkmenistan to Azerbaijan. Could have both positive and negative environmental impacts. Leak/spill from pipelines could result in contamination of bottom sediments and water column and oil-film on the water surface. This will impact breeding area of aquatic life, reduce food reserves and destroy habitat for the valuable sturgeons and seals (Zhiltsov, S.S., Zonn, I.S. and Kostianoy, A.G. eds., 2016). In this case, it is necessary to take into account factors such as impact on drinking water resources, rising / falling sea level, as well as the withdrawal of land that may be fertile.

Pipelines on land, along the shoreline and at the seabed need to be planned, maintained and administrated very well to be operating with limited impacts on its surroundings. Factors like sea-level rise/fall, occupying land that might will be fertile soils (Zhiltsov, S.S., Zonn, I.S. and Kostianoy, A.G. eds., 2016).

Pipelines often connect subsea wells with each other and from there to a terminals on shore. This easy can accelerate an accident like the 2015 where at natural gas pipeline burst and curt fire and was feed by several wells. This can again lead to technical failure and large hydrocarbon spills impacting the environment irreversible.

# Response

### Regional governance

In the current political and economic environment when the establishment of the legal status of the Caspian is a task for the near future, development of multifaceted international economic cooperation between the Caspian states is prevailing. The Tehran Convention laid the foundation for formalization and a turn to legitimization of the relations between riparian countries. In the current conditions, the Tehran Convention although does not provide full protection of the Caspian Sea. However, it is the only international document protecting the unique sea.

The regional governance is based on the implementation of bilateral and multilateral agreements. The process of legitimization is advancing:

* In 2011, the Protocol concerning regional preparedness, response and cooperation in combating oil pollution incidents was signed in Aktau by Iran, Azerbaijan, Kazakhstan, Russia and Turkmenistan. This was the first protocol to be ratified by all parties and went into effect in 2016.
* In 2012, all 5 of the Caspian littoral states ratified a legally binding agreement (the “Moscow Protocol”) under the Tehran convention to protect the Sea from land-based sources of pollution.
* In 2014, all 5 countries again ratified another Protocol on the Conservation of Biological Diversity (Tehran Convention, 2015).
* The Agreement on the Conversation and Rational Use of the Aquatic Biological Resources of the Caspian Sea, the Agreement on Cooperation in the Field of Hydrometeorology of the Caspian Sea, the Agreement on cooperation in emergency prevention and Response in the Caspian Sea were signed at the 4th summit of the Caspian littoral states' leaders in Astrakhan, Russia in 2014. All the Agreements have been ratified by all the Caspian littoral states.
* The “Conservation and Rational Use of the Biological Resources of the Caspian Sea” and the Agreement on “Hydrometeorology of the Caspian Sea” were ratified by all Caspian littoral states and entered into force in 2016.
* The Agreement “On Cooperation in the Field of Preventing Emergencies and Eliminating their Consequences in the Caspian Sea” has also been ratified by 4 Caspian littoral countries.

The fourth Summit of the Heads of the Caspian states was held in September 2014 in Astrakhan. During the fourth Caspian Summit, the President of Turkmenistan proposed to consider the preparation of the draft "Agreement on trade and economic cooperation between the Caspian states", and also proposed the creation of a permanent Caspian Economic Forum with holding its meetings alternately in the coastal cities of the states (Anis H. Bajrektarevic, 2015)

Turkmenistan developed two Protocols to the Agreement on Security in the Caspian Sea- “On the safety of navigation” and “Combat to poaching”. Iran also proposed the draft Protool to “Combat to drug smuggling” (National Contribution).

It is also important to note that the process is moving forward on the bilateral basis as well:

* In 2014, the inter-state agreement on delineation of bottom of Caspian Sea was signed between Kazakhstan and Turkmenistan (CSEF, 2016). Also in 2014, the Agreement on the Cooperation in the Field of Security in the Caspian Sea was ratified and entered into force (National Contribution).
* By the end of September 2014, Russia and Iran successfully lobbied all parties to reach a unanimous agreement about the inadmissibility of foreign military presence in the Caspian (Anis, 2015).
* In September 2010, Agreement between the Government of the Russian Federation and the Government of the Republic of Azerbaijan on Cooperation in the Field of Rational Use and Protection of Water Resources of the Transboundary Samur River was signed;
* In 2010, Memorandum of Understanding between the Ministry of Natural Resources of Russia and the Organization for the Protection of the Environment of Iran on cooperation in the field of ecology for 2015-2016 and the Working Group on Water Management of the Permanent Russian-Iranian Commission for Trade and Economic Cooperation was signed.
* A follow-up Action Plan to implement the Memorandum of Understanding between the Russian Ministry of Natural Resources and the Organization for the Protection of the Environment of Iran on cooperation in the field of ecology for 2015-2016 was agreed.
* Russia has created a bilateral agreement with the Islamic Republic of Iran within the framework of the Memorandum of Understanding between the Ministry of Natural Resources of Russia and the Organization for the Protection of the Environment of Iran on cooperation in the field of ecology for 2015-2016 and the Working Group on Water Management of the Permanent Russian-Iranian Commission for Trade and Economic Cooperation in such areas as environmental protection, rational use of water resources and biodiversity conservation, monitoring of atmospheric air pollution and reduction of greenhouse gas emissions, as well as in the field of water desalination, estimates of reserves, exploration and monitoring of groundwater (Tehran Convention, 2015).
* In 2010. Agreement between the Government of the Russian Federation and the Government of the Republic of Kazakhstan on the joint use and protection of transboundary water bodies was signed.

Instruments which serve the interests of the riparian countries were established. One of them is the Coordination Committee for Hydrometeorology and Monitoring of Caspian Sea Pollution (CASPCOM). The mandate of CASPCOM includes among other things the facilitation of cooperation in the field of meteorology at the regional level.

During its 20th Session of the CASPCOM recommended that monitoring of pollution of the marine environment of the Caspian Sea and the provision of hydrometeorological information for regular assessment of the state of the Caspian Sea should be considered as the main areas of CASPCOM's interaction with the Tehran Convention. An important task within the framework of the Agreement on cooperation in the field of hydrometeorology of the Caspian Sea was the development of the Intergovernmental Complex Program on Hydrometeorology of the Caspian Sea, which is intended to be an effective instrument for organizing a regional system for receiving and exchanging information on the state of the Caspian Sea in the interests of ensuring safety of life and development of economic activities at sea.

In general, the main results of the activities of CASPCOM in 2014-2016 were:

* Organization of CASPCOM working groups that have started preparing documents necessary for the implementation of the Agreement on Cooperation in the Field of Hydrometeorology of the Caspian Sea;
* Replenishment of new CASPCOM catalogue data (sea level, water temperature, regional atmospheric circulation and surface runoff);
* Preparation of CASPCOM regular information bulletins on the status of the Caspian Sea level, containing an assessment of its actual and expected seasonal changes;
* Enhanced cooperation between national meteorological and hydrological services in the field of hydrometeorology and monitoring of the Caspian Sea
* Consideration and approval of the CASPCOM Strategy and the Caspian Sea Intergovernmental Hydrometeorological Program.

Another instrument which is serving to enhance cooperation between the riparian countries is the Caspian Environmental Program (CEP) which has been operating since 1995. The CEP is being supported by the relevant UN structures and the World Bank. The main objective of the program is to preserve the ecosystem of the Caspian Sea and control the proper use of its resources by the countries adjacent to the Caspian. The activities of the CEP include scientific research, education, capacity building, and training personnel. GEF, UNDP, EU, TACIS have assisted CEP to implement water quality monitoring and pollution projects as well as the coastal zone management. In April 2017, an International Meeting was held in Iran regarding the methods and legal aspects of eliminating possible states of emergency in the Caspian Sea. Particular attention was paid to oil pollution (CEP, 2009).

The mandate of the International Commission for Aquatic Bioresources of the Caspian Sea includes the preservation of the sturgeon population, the assessment of the stocks of bio-resources and the counteracting of poaching. The commission works on the basis of the agreements fixed in the Protocol Decision of the Presidents of the Republic of Azerbaijan, the Islamic Republic of Iran, the Republic of Kazakhstan, the Russian Federation and Turkmenistan following the results of the Third Caspian Summit held on November 18, 2010 in Baku. It was established in accordance with the Agreement, which was signed in Astrakhan in September 2014 by representatives of the five coastal countries. In the spring of 2017, the Agreement was ratified in all participating countries and entered into force.

### National governance

Azerbaijan has just announced plans to create the first Marine Protected Area (MPA) in the Caspian Sea in an attempt to ward off the extinction of 6 significant marine species- including the Beluga sturgeon and the Caspian salmon. This area will expand upon the Gizilaghaj State Reserve to include 100 thousand ha where over one third will be marine (IUCN, 2018).

In 2016, the National Strategy for the Protection and Sustainable Use of Biodiversity in the Republic of Azerbaijan for 2017-2020 was approved. This National Strategy, along with the promotion of reforms in this field, will have a positive impact on the enhancement of cooperation between international organizations and governments in biodiversity and general environmental protection activities (National Contribution).

Azerbaijan 2020: A Look into the Future was ratified in 2012 where the focus of developing renewable energy sources to diversify and strengthen the economy of Azerbaijan for sustainable development (Vidadili et al., 2017). This document targeted at:

* provide incentives for the accelerated development of alternative renewable energy sources (RES),
* create a satisfactory institutional environment,
* reinforce potential in renewable energy sources,
* train experts, raise public awareness about the use of renewable energy sources,
* have flexible tariffs for renewable-based energy products to encourage the involvement of the private sector.

Azerbaijan adopted following targets by 2020 in 2013: – 20 percent share of RES in total energy sector; – 9.7 percent share of RES in total final energy consumption; – 2500 MW installed capacity of renewable-based generation equipment; – 20 percent progress in energy efficiency; – 20 percent reduction of GHG emissions (Vidadili et al., 2017).

Azerbaijan hosted the First Inaugural Session of the Commission for the Conservation and Rational use of Aquatic Biological Resources and Management of Shared Stocks of such Resources on November 21-23 2017 in Baku (National Contribution).

In 2012, the Law “On Energy Saving and Energy Efficiency” passed and introduced new requirements for energy saving and energy efficiency. It also identified authorized government bodies and authorities to ensure compliance with the requirements (Nugumanova & Frey, 2017a).

Iran has plans to develop the Sardar Jangal oil and gas fields in the future. In November 2017, Iran signed a memorandum of understanding with Norway, aiming to cooperate and get access to necessary technology which could boost the attractiveness of Caspian oil and gas fields (Financial Tribune, 2017). However, the Minister of Petroleum stated in 2016 that production of oil from the Caspian Sea is not a priority even if it is on the agenda (Iran-business news, 2016).

“The Paris agreement was adopted on December 12, 2015 at the 21st session of the Conference of Parties to the UNFCCC. Kazakhstan signed the Paris Agreement on August 2, 2016 and ratified it on December 6, 2016 (OECD, 2016)” (Nugumanova & Frey, 2017a).

The Concept for Transition of the Republic of Kazakhstan to a Green Economy” was adopted in 2013 which sets quantitative targets on water use, air pollution and waste reduction and forecasts potential energy efficiency increase by the years 2020, 2030 and 2050 (Nugumanova & Frey, 2017a). The concept provides ambitious aims which include:

* Energy sector: reach 50 percent share of renewable energy
* Increase of energy efficiency: 10 percent by 2015, 25 percent by 2025 in comparison to the base year 2008
* Water resources: solve all the problems with water supply to households by 2020 and to agriculture by 2040
* Waste management: by 2030 ensure a 100 percent household coverage of municipal waste service, 95 percent of sanitary storage of waste, and reach 40 percent share of recycled waste (50 percent by 2050)
* Air pollution reduction: by 2030 reach European level of air pollution (Green Bridge Partnership Program, 2013)

The 6th Five year Development Plan of Iran stipulates that installed renewable energy should grow by 5,000 MW by 2018 (Wheeler & Desai, 2016). Iran has also announced its Intended Nationally Determined Contribution (INDC) of a 4 percent unconditional reduction of Greenhouse Gas Emissions by 2030 below its business as usual scenario (Mobara, 2017).

In the Russian Federation, the implementation of environmental policy is carried out by state authorities headed by the Ministry of Natural Resources and Ecology of the Russian Federation. There are institutional structures for environmental management that meet the constitutional principles of the division of powers between the federal centre and the subject of the federation in the Caspian regions of the Russian Federation.

The task of preserving biological and landscape diversity of the coastal and marine areas of the Caspian region of Russia is among the priorities of environmental management of the relevant administrative units of the Russian Federation and is being solved on the basis of the preservation and development of a system of specially protected natural and water areas.

Analysis of the status of biodiversity allowed to say that the network of protected areas (PAs) in coastal areas of the Caspian region of the Russian Federation covers most of the diversity of landscapes and habitats of protected species, but at the same time requires further improvement of management and ensuring the functional integrity of territorial landscape of ecological complexes.

As of December 2016, the total area of the Astrakhan oblast’s natural parks was 234,353 thousand hectares, the state nature reserves - 159,864 thousand hectares, nature heritage - 34,478 thousand hectares. There are 49 PAs of regional importance, with a total area of 428.6 thousand hectares on the territory of the region (National Contribution).

There are 12 state nature reserves, with a total area of 467.5 thousand hectares under the Ministry of Natural Resources of the Republic of Dagestan. The total area occupied by PAs in Dagestan is more than 600 thousand hectares and is distributed as follows: reserves 0.4% of the territory of Dagestan, reserves of federal and republican significance - 10.4%.

In 2016, special measures were carried out to give the status of protected areas to promising areas for the distribution of rare endemic flora and fauna elements and to optimize the boundaries of existing PAas (National Contribution).

Currently, the area of specially protected natural territories in the Republic of Kalmykia is 1,048,457.10 ha, or about 14% of the territory of the Republic, which exceeds similar indicators of the most of other regions of Russia (National Contribution).

Management in emergency situations in the Russian Federation is based on a single state system for the prevention and elimination of emergency situations. It consists of territorial and functional subsystems and has five levels (federal, regional, territorial, local and sites). The unified system includes the governing bodies, forces and means of the federal executive bodies, executive authorities of the administrative units of the Russian Federation, local self-governmental bodies and organizations whose powers include addressing problems related to protecting the population and territories against and during emergency situations.

There is a three-tiered approach was adopted in the planning of oil spill response operations in Russia. It is based on the Oil Spill Prevention and Response Plan. An organization that operates, uses facilities, structures, submarine pipelines (operating organization) is to coordinate the Plan with the authorized governmental bodies.

The following actions have been implemented in Turkmenistan (National Contribution):

* Establishment of a security regime in the Karabogaz floodplains and lake of Uzboy.
* Strengthening control over hunting and fishing in the Turkmen sector of the Caspian Sea.
* Capacity building of the national environmental service.
* Establishment of a National Park, including sites with different status and different protection regime, combining the functions of recreation and nature protection.
* Reduction of municipal, industrial and agricultural discharges into the Caspian.
* Restoration of the Etrek spawning grounds.

It should be noted that the draft Rules of Procedure of the "Commission on the preservation, rational use of aquatic biological resources and management of their joint reserves", established by the "Agreement on the Conservation and Rational Use of Aquatic Biological Resources of the Caspian Sea", have been finalized. The Rules of Procedure were agreed upon within the framework of the meeting on the development of the "Protocol to Combat Poaching", held in Ashgabat in February 2017. By completing and adopting this document, the cooperation of the Parties in this sphere will be brought to a new level (National contribution).

### Policy and legislation

The main source of income for most of the Caspian littoral states remains raw materials, minerals and other natural resources. While all recognize that the state of environment of the Caspian Sea is an important issue, each finds the balance between the economy and the environment in its own way.

One of the main goals in the transition of Russia to a model of environmentally sustainable development was articulated in the Comprehensive Action Plan for 2017-2025of the Government of the Russian Federation. The Plan is to ensure the effective use of the country's natural capital in the long term, while eliminating the impact of environmental threats in the strategic planning documents and the comprehensive plan of action of the Government of the Russian Federation for 2017-2025.

The basis for ensuring compliance with the obligations of the Russian Federation in implementation of the Tehran Convention is the following documents: the State Program of the Russian Federation "Environmental Protection for 2012-2020", as well as the Regional Environmental Programs of the Astrakhan Oblast, the Republic of Dagestan of the Republic of Kalmykia.

The following strategic documents adopted in 2011 – 2017 are particularly important for the Caspian region of Russia:

* Strategy of environmental safety of the Russian Federation for the period until 2025 (2017);
* Concept of development of specially protected natural areas (PAs) until 2020 (2011);  
  Strategy of conservation of rare and endangered species of animals, plants and fungi in the Russian Federation for the period until 2030 (2014);
* Strategies for socio-economic development of the Southern Federal District for the period until 2020 (2011);
* Strategy of social and economic development of the Republic of Dagestan until 2025(2011);
* The State Program of the Russian Federation "Environmental Protection for 2012-2020(2012).

The main normative legal act of the Russian Federation regulating activities on the seabed is the Federal Law "On Internal Maritime Waters, Territorial Sea and the Adjacent Sea Zone of the Russian Federation" from 1998 as amended in 2016. According to the Law disposal of waste and other materials, as well as the discharge of harmful substances in internal sea waters and in the territorial sea are prohibited.

Within the framework of improving the regulation of water quality, protection of the marine environment and atmospheric air, the following documents were approved:

* List of pollutants[[19]](#footnote-20) for which state regulation measures are applied in the field of environmental protection, and
* List of pollutants[[20]](#footnote-21), whose content in the soil extracted during dredging in concentrations exceeding the chemical characteristics of the soil in the area of its burial before the impact caused by the burial of this soil, its disposal in inland sea waters and in the territorial sea of the Russian Federation is prohibited.

The legislation on the minimization of oil pollution which has a negative impact on the state of biodiversity, including aquatic biological resources is defined by the Regulation on Measures for the Conservation of Aquatic Biological Resources and Their Environment (Decree of the Government of the Russian Federation of April 29, 2013).

The Federal Law "On Fisheries and the Conservation of Aquatic Biological Resources" was supplemented in 2016 with new articles. The articles related to the allocation of quotas for the production (catch) of aquatic biological resources, and volume of the total allowable catch of aquatic biological resources.

Turkmenistan operates on the belief that a reform in the system of accounting and economic valuation of natural resources and a system of payments for natural resources are key to finding an equilibrium between the extraction of raw materials, the environment and the economy (Coulntry Contribution). Regulatory fees for pollution of the environment by enterprises, organizations and institutions of all forms of ownership located on the territory of Turkmenistan was approved by Order of the Ministry of Nature Protection and agreed by the Ministry of Finance in 2014 (National Contribution).

In Turkmenistan, the basic law that guides the direction of environmental protection is the Law “On Nature Protection” which systemises and summarises the main principles and tasks of environmental protection. The law in many respects has expanded the range of norms on nature protection, which is caused by the beginning of awareness of the danger of uncontrolled environmental impact in the process of expanding economic activity and increasing anthropogenic pressure. Thus, over the past years, a lot of work has been done to formulate a regulatory legal framework in the field of environmental protection and rational use of natural resources (National Contribution).

As of January 1, 2018, there are 25 laws related to the environmental protection and nature management were adopted in in Turkmenistan. In addition, there are separate legal acts, which affect the environment to some extent. Recently, new laws have been adopted:

"On Chemical Safety" (21.03.2011), "On Fisheries and Conservation of Aquatic Biological Resources" (21.05.2011), "On Waste" (May 23, 2015), " On the pastures "(August 18, 2015), "On the protection of plants "(June 18, 2016), " On the collection, conservation and rational use of genetic resources of cultivated plants" (4.02.2017), " On Environmental Safety" (3.06.2017) and "On the State Land Cadastre" (25.11.2017).

New versions of the laws was developed and adopted: "On specially protected natural areas" (31.05.2012), "On the plant world" (4.08.2012), "On the animal world" (2.03.2013), "On Environmental Expertise" (August 16, 2014), "On the Protection of Atmospheric Air" (March 26, 2016), the Water Code of Turkmenistan (15.10.2016), and also the law "On Environmental Safety" (June 15, 2018). The process of reforming environmental legislation is going on (National Contribution).

Azerbaijan has adopted “Azerbaijan 2020: A Look into the Future” which was ratified in 2012 where the focus of developing renewable energy sources to diversify and strengthen the economy of Azerbaijan for sustainable development. This document looks to: provide incentives for the accelerated development of alternative renewable energy sources (RES), create a satisfactory institutional environment, reinforce R&D potential in RES, train experts, raise public awareness about the use of RES, have flexible tariffs for renewable-based energy products to encourage the involvement of the private sector (Vidadili et al., 2017). Azerbaijan has also implemented various policies to improve air quality such as: passing Euro IV standard on April 1, 2014, replacing outdated infrastructure, replacing medium sized buses for large ones to increase efficiency & etc. (UNEP, n. d.).

Based on the 6th National Socio-Economic and Cultural Development Plan of the Islamic Republic of Iran and the General Policies notified by the Supreme Leader there are a series of targets interacting with the environment of the Caspian Sea to achieve: average annual growth of 8 percent, investment growth at an average annual rate of 21 percent and reduce unemployment by 0.8 percent annually. Iran subsequently implemented numerous policies and legislations to manage the use, causes and effects of water, the environment, natural resources, energy, transportation, earthquakes, the exploitation of forest and pastures, tourism and other sectors (Iran Contribution). In 2012, the government of Iran dedicated €500 million from the National Development Fund (NDF) for green energy development (Hosseini et al., 2013). As it was mentioned above (see section Policy and Legislation), Iran has also announced its Intended Nationally Determined Contribution (INDC) of a 4 percent unconditional reduction of Greenhouse Gas Emissions by 2030.

According to the Government of Kazakhstan, issues of environmental protection and rational use of natural resources have received much attention. The need to take effective measures in these areas is reflected by several policy documents such as the Strategic Development Plan of the Republic of Kazakhstan until 2020, approved by Presidential Decree No. 922 of February 1, 2010, the Concept on the Transition of the Republic of Kazakhstan to a Green Economy, Decree of the President of Kazakhstan on May 30, 2013 №577, etc. The program provides for the implementation of measures to develop the Aktau agglomeration as an industrial center of the region (production of further refineries of the petrochemical, chemical, metalworking industry); the development of industries to service the oil and gas sector (service and transport services) (National Contribution).

### Fishing

In 2010 at the third Caspian summit in Baku, all 5 littoral states agreed to a five-year ban on sturgeon fishing to help recover the fishing stocks. In May 2015, this ban was extended an additional 2 years. In 2011, Turkmenistan implemented the law “On Fisheries and Conservation of Aquatic Biological Resources” based on the provisions of the Constitution served to:

1) Establishment of security regime in the Kara Bogaz floodplains and Lake of Uzboy;

2) Strengthening the control over hunting and fishing in the Turkmen sector of the Caspian Sea;

3) Strengthening the national environmental service;

4) Establishment of the National Park;

5) Reduce municipal, industrial and agricultural discharges into the Caspian;

6) Restoration of the Etrek spawning grounds.

Iran’s fisheries sector is an important source of foreign exchange. Iran is the largest fishery producer in the region. Challenges are mainly lack of coordination and inadequate link with research, inadequate quality control, processing, conservation and marketing (FAO, n.d.).

The existing legal and policy framework for fishing in Azerbaijan was harmonised with with FAO’ since early 2011 to ensure that the future development of the legal and policy framework for the rapidly developing aquaculture sector is in compliance with the international standards, best practices and agreements.

The Law of the Republic of Azerbaijan "On Making Amendments to the Law of the Republic of Azerbaijan on Fishing" dated June 27, 2014 was developed with FAO’s technical assistance (National contribution)

Azerbaijan has just announced plans to create the first Marine Protected Area (MPA) in the Caspian Sea in an attempt to ward off the extinction of 6 significant marine species- including the Beluga sturgeon and the Caspian salmon. This area will expand upon the Gizilaghaj State Reserve to include 100,000 where over one third will be marine (IUCN, 2018).

In 2016, the “Statue on Water Bioresources Development, Rehabilitation and Protection Fund” was approved. In connection with amendments to the Law of the Republic of Azerbaijan "On fishing", the following regulations were adopted by the Cabinet of Ministers during 2016-2017:

* Registration form and rules for conducting registration of fishery subjects,
* Regulations and Cases for releasing new types and hybrid forms of fish and other aquatic bioresources into natural fishing water objects,
* Regulations for the transport of acclimatization objects and acclimatization of fish and other aquatic bioresources,
* Regulations on the application of special protection regime of fish and other aquatic bioresources in water protection zones and coastguard strips,
* Regulation for list of important fishing water objects and the restriction of water use, Regulations for hunting of fish and other aquatic bioresources,
* Regulation of implementation of aquaculture, Regulation of conducting fishery expertise.

Turkmenistan has implemented a law “On Fisheries and the Conservation of Aquatic Biological Resources” in 2011 along with a host of other environmental policies and legislations to bolster the impact of the Law “On Nature Protection” which fixes the main direction of environmental protection in the country (National Contribution).

### Waste

According to Nugumanova et al., (2017b) Kazakhstan’s “Green Growth” concept presents current environmental priorities that one of which outlines the goal that by 2030, there will be a 100 percent household coverage of municipal waste service, 95 percent sanitary storage of waste and reach 40 percent share of recycled waste (50 percent by 2050).

The Russian federal legislation related to the waste management was radically changed in 2014 - 2016 to regulate this sector at the regional level. The reform of environmental legislation mainly dealt with two federal laws: "On Environmental Protection" and "On Production and Consumption Wastes". Particular attention was paid to the processing and recycling of wastes (National Contribution).

The management of ship-generated waste in seaports is carried out in accordance with the Ship Waste Management Plan, which regulates the handling of them in seaports (National Contribution).

Turkmenistan has also implemented a law “On Waste” in 2015, along with a variety of others, to strengthen the legislation in the field of environmental protection and management (National Contribution).

### Run-off

In 2012, all 5 of the Caspian littoral states ratified a legally binding agreement (the “Moscow Protocol”) under the Tehran convention to protect the Sea from land-based sources of pollution. In 2014, all 5 countries ratified another Protocol on the Conservation of Biological Diversity (Tehran Convention, 2015).

At the national level, Turkmenistan has implemented the regulatory fees for pollution of the environment by enterprises, organisations and institutions of all forms of ownership located on the territory of Turkmenistan (Approved by Order of the Ministry of Nature Protection, Agreed by the Ministry of Finance, 2014). The wetland environment on the Turkmenistan coast of the Caspian Sea is home to unique fauna and in 2012 the government passed the Law of Turkmenistan “On Specially Protected Natural Territories” and the Law “On Fauna” in 2013 (National Contribution).

In addition to the bilateral and multilateral agreements that Iran has with the other littoral states, the country has implemented a number of policies to reduce the impact of wastewater runoff, including development and implementation of collection, treatment of communal and industrial wastewater through contracts of sale or disposal of waste water from facilities.

Russia has also created a bilateral agreement with the Republic of Kazakhstan within the framework of the Agreement between the Government of the Russian Federation and the Government of the Republic of Kazakhstan on the joint use and protection of transboundary water bodies (in such areas as monitoring on transboundary water bodies, including the Ural river, improving the quality of transboundary water resources, EIA in a transboundary context, construction of a reservoir for the Bolshaya and Maly Uzeni rivers (Tehran Convention, 2015).

### Air Emissions

Kazakhstan’s “Green Growth” Concept presents current environmental priorities, including the goal to reach the European level of air pollution by 2030 (Green Bridge Partnership Program, 2013).

Russia and the Islamic Republic of Iran have created a bilateral agreement within the framework of the Memorandum of Understanding between the Ministry of Natural Resources of Russia and the Organization for the Protection of the Environment of Iran on cooperation in the field of ecology for 2015-2016. and the Working Group on Water Management of the Permanent Russian-Iranian Commission for Trade and Economic Cooperation in such areas as environmental protection, rational use of water resources and biodiversity conservation, monitoring of atmospheric air pollution and reduction of greenhouse gas emissions, as well as in the field of water desalination, estimates of reserves, exploration and monitoring of groundwater.

### Solid Waste

Solid waste continues to be a challenge for the Caspian littoral states along the coast. There are plans for better waste management systems along the coast. As an example, in Iran Article 38e stipulates the supervision of the implementation of comprehensive waste management plans, particularly on the shores of the seas, rivers, forests and plains of the wetlands and managing at least 20 percent of the existing waste volume with the appropriate method (Iran contribution).

# 8 Monitoring and compliance

It is widely recognized that environmental protection, understanding of pressures, state, impact and response of ecosystems and the development of measures to prevent or mitigate undesirable changes should be based on a properly arranged monitoring and compliance system.

International environmental conventions, treaties, agreements, resolutions on issues related to the protection and management of natural resource are the most important tool which establishes the foundation for the global environmental policy. Currently there are about 500 international agreements on various aspects of environmental protection.

The biggest part of international legal instruments relating to the protection of the environment belongs to the UN General Assembly resolutions and the World Charter for Nature. They play a key role in the implementation of the principles and provisions of the international legal environmental cooperation. These instruments cover almost all types of natural resources and the most hazardous human activities.

The Russian Federation actively participates in the international cooperation related to the environmental protection, including marine environment. This is reflected in the signing, ratification and implementation of relevant conventions. However, Russia did not acceded to the Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (Aarhus) and did not expressed its consent to be bound to the Convention on Environmental Impact Assessment in Transboundary Context (Espoo). This has a negative impact on the exchange of important environmental information.

The legal framework of the monitoring and compliance based on the following main laws:

• On Environmental protection

• On Hydrometeorological Services

• Water Code

• On Fishery and Protection of Water-biological Resources

• On the Internal Sea Waters, Territorial Sea and Contiguous Zone

• On Exclusive Economic Zone

• On the Continental Shelf

and Decrees of the Government:

• On Organisation and Operation of the State Environmental Monitoring System

• On Approval of Regulations on Implementation of the State Monitoring of Water Bodies

• On Implementation of the State Monitoring of Biological Resources and its Data Use

• On the State Monitoring and Pollution of Environment

The governmental types of monitoring are carried out by two federal executive bodies: Rosprirodnadzor and Federal Fishery Agency (Rosrybolovstvo) in Russia.

Rosprirodnadzor is the federal governmental body which carries out control and supervision over observance and compliance of the legislation of the Russian Federation and international norms and standards in the field of the marine environment, natural resources of inland sea waters, territorial sea and in the exclusive economic zone. It acts as the administrative body for the Convention on International Trade in Endangered Species of Wild Fauna and Flora.

Rosrybolovstvo (Fishery) is the federal executive body that is responsible for the federal state control (supervision) in the field of fisheries and the conservation of aquatic biological resources in inland waters of the Russian Federation.

Changes introduced into the Federal Law "On Fisheries and the Conservation of Aquatic Biological Resources" in 2016. touched upon issues related to implementation of federal state control (supervision) of fisheries and conservation of marine bioresources, improving the allocation of quotas for the production (catch) of aquatic biological resources.

In Turkmenistan, the following laws were recently adopted On Chemical Safety "(21.03.2011)" On Fisheries and Conservation of Aquatic Biological Resources "(21.05.2011)," On Waste "(May 23, 2015), "On pastures" (18.08. 2015), "On the protection of plants" (18.06.2016), "On the collection, conservation and rational use of genetic resources of cultivated plants" (4.02.2017), "On the ecological Safety "(06.03.2017) and" On State Land Cadastre "(25.11.2017 g). Instead of acting earlier, new versions of laws were developed and adopted: "On Hydrocarbon Resources" (18.08.2008), "On Specially Protected Natural Territories" (31.05.2012), "On Flora" (4.08.2012. ), On Fauna (2.03.2013), On Nature Protection (1.03.2014), On Environmental Expert Review (August 16, 2014), On the Protection of Atmospheric Air (26.03. 2016), the Forest Code (25.03.2011) The Water Code of Turkmenistan (15.10.2016), as well as the Law on Environmental Safety (June 15, 2018).

The State Committee for Environmental Protection and Land Resources (SCEP & LR) was established by the Presidential Decree of 8 January, 2016. The Committee is responsible for the over control of environmental legislation compliance and enforcement. Within the Committee, the Department of Environment Protection carries out state control of the environmental legislation compliance, including air pollution, surface and ground waters, circulation of industrial wastes, as well as conducts state monitoring of environment and natural resources. Caspecocontol Service monitors compliance with environmental protection legislation, the state and efficiency of water and air treatment facilities, including control of air pollution, surface waters, as well as control over the dredging in coastal zone of the Caspian Sea (National Contribution).

# 9 Participation and outreach (private sector, and information sharing)

A number of active non-governmental organizations engaged in a variety of environmental activities are operating in the near Caspian region of Russia[[21]](#footnote-22). Long-established branches of all-Russian environmental associations and societies (geographic, bird conservation, nature protection), local student organizations, and environmentally oriented children's educational institutions are working here.

Important educational work is carried out by universities and reserves.

The following environmentally oriented non-governmental organizations are actively operating in Astrakhan oblast:

* Astrakhan Branch of the Russian Bird Conservation Union;
* Center for Environmental Policy and Culture;
* Astrakhan Regional Branch of the All-Russian Society for Nature Conservation;
* Astrakhan Regional Branch of the Russian Geographical Society.

Public organizations for the Caspian protection of the Republic of Dagestan are represented by the following organizations: Dagestan Republican Branch of the Russian Geographical Society; Institute of Applied Ecology; “Green Cross” and “Legion of Greens” organizations; Institute of Socio-Economic Monitoring, Strategic Research and Development; Scientific Ornithological Association of Students “Berkut”; Regional Department of the Public Russian Movement “Green Planet”; and Center for Environmental Policy and Culture.

The Regional Branch of the All-Russian Public Organization “Center for Environmental Policy and Culture”, Scientific and Analytical Center “Normative” LLC, and Kalmyk Regional Branch of the Russian Bird Conservation Union are working in the Republic of Kalmykia.

The activity of public organizations operating in the near Caspian region of Russia is closely linked with the main activities of the state universities and state natural reserves located in the region. In most cases, public structures are organized under their assistance and are mainly focused on education, scientific research and awareness raising. Public organizations rarely participate in the dissemination of information, public monitoring and control. Their role and participation in EIA procedures, sociological studies, etc. is insignificant.

Kazakhstan has ratified the Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (Aarhus Convention). Pursuant to the provisions of the Environmental Code, the state authorities of Kazakhstan are obliged to disseminate environmental information through mass media, including information related to the state of the environment, as well as drafts of regulatory legal acts and international agreements related to environmental protection.

There is the Aarhus Centre operating in Atyrau, which cooperates with non-governmental organizations, including the EcoForum of NGOs of Kazakhstan. In Kazakhstan, National Reports on the State of the Environment are published annually, the texts of which are posted on the website of the Ministry of Energy (National contribution).

# 10 Measures to address

Sea level changes threatened existing settlements, industrial, cultural and household objects. In order to save money, long-term operations, conservation the ecological balance, it is advisable to organize compulsory geological expertise for all large facilities under construction on the territory of Turkmenistan and this is the imperative of the times. The unfavorable impact of geological processes is not always the same, so it is advisable to place the objects under construction taking into account the geological structure of a particular area in order to avoid the destructive impact of various geological processes (National Contribution).

Taking into account the probability of decreasing available water resources with new sources of water being a limited or nonexistent option it becomes imperative to improve efficiency of water use (National Contribution).

According to the National Contributions of Iran, to improve the environmental conditions the government shall act on followings:

* The development of the National and Provincial Spatial Plan
* The development of at least 54 rural business clusters, the construction and commissioning of 98 rural industrial areas and the creation of 1,914,000 jobs in villages and nomadic areas through the construction and development of competitive and export-oriented enterprises in the private sector
* Identification of villages at risk of natural disasters, development and implementation of actions in cooperation with responsible authorities and participation of people and local institutions in such a way that at least one third (30%) of villages are not at risk
* Feasibility study, design and development of solid waste collection systems for rural areas
* Development and implementation of wastewater treatment facilities in priority villages located near rivers, wetlands, dams and villages experiencing difficulties with wastewater disposal through the private sector
* Development of conservative agriculture;
* Convert 500,000 hectares from sloping lands to gardens
* Ensuring the optimal use of pesticides, plant protection products and chemical fertilizers, and the wider use of organic fertilizers (compost) and biofuels, and the establishment of rules for the use of fertilizers and chemicals
* The development of the cultivation of healthy products and organic products, introduction of national standards for quality control of agricultural products, expansion of combined pest and plant disease control, optimal use of materials, including the use of chemicals and fertilizers, and support for plant protection organizations to promote public health
* Prohibition of any release, production, import and consumption of genetically modified crops in the framework of the Biosafety Law of the Islamic Republic of Iran.

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1. Oil and natural gas rents are the difference between the value of crude oil or natural gas production at world prices and total costs of production (World Bank, 2017). Oil rents as a percentage of GDP reveals economic contribution from oil extraction to national economies. [↑](#footnote-ref-2)
2. Hydrogen sulphide is very aggressive hydrosulfuric acid which destroys unprotected steel pipes very rapidly. [↑](#footnote-ref-3)
3. “Agriculture corresponds to ISIC divisions 1-5 and includes forestry, hunting, and fishing, as well as cultivation of crops and livestock production. Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs. It is calculated without making deductions for depreciation of fabricated assets or depletion and degradation of natural resources. Data are in current U. S. dollars.” (World Bank, 2017) [↑](#footnote-ref-4)
4. Total contributed also account for indirect and induced impacts on the economy due to the travel and tourism activities. [↑](#footnote-ref-5)
5. Excluding Turkmenistan, for which there were no numbers available from the World Travel and Tourism Council. [↑](#footnote-ref-6)
6. Source: The information comes from a specialist of State Committee on environment protection and land resources [↑](#footnote-ref-7)
7. Positive radiative forcing means that the earth is radiating less energy out to space compared to what it receives from the sun. The burning of fossil fuels enhances this discrepancy which making the atmosphere warmer. [↑](#footnote-ref-8)
8. 7. www.turkmenistan.gow.tm Mikhail Bobkin / 10/17/2017 / Economics [↑](#footnote-ref-9)
9. Information provided by “Caspecocontrol” of Turkmenistan [↑](#footnote-ref-10)
10. Hazard classes according to GOST 12.1.007-76 "Hazardous substances: Classification and general safety requirements" [↑](#footnote-ref-11)
11. The Memorandum of Agreement between the Government of Kazakhstan and «Kazmunaigaz» in 2014. Agreement between the Government of Kazakhstan and “Mangistaumunaigaz” [↑](#footnote-ref-12)
12. The Joint Stock Company Karazhanbasmunai has reclaimed 20 hectares of historically polluted land. [↑](#footnote-ref-13)
13. Shirvan, Zangazur National Park (established in 2012) named after academician Hasan Aliyev, Hirkan, Altiaghac, Aggol, Absheron, Shahdag, Goygol, Samur-Yalama National Parks [↑](#footnote-ref-14)
14. Based on information of the Ministry of Ecology and Natural Resources [↑](#footnote-ref-15)
15. IUCN - International Union for Conservation of Nature and Natural Resources [↑](#footnote-ref-16)
16. Source: www.portofbaku.com [↑](#footnote-ref-17)
17. Source: www.portofbaku.com [↑](#footnote-ref-18)
18. Source: https://port.today/russia-plans-develop-caspian-ports/ [↑](#footnote-ref-19)
19. Order of the Government of the Russian Federation of 08.07.2015 No. 1316-r "Order of the Government of the Russian Federation of July 8, 2015 No. 1316-r "On the approval of the list of pollutants in respect of which measures of state regulation in the field of environmental protection." [↑](#footnote-ref-20)
20. Decree of the Government of the Russian Federation No. 2753-r of December 30, 2015 "On Approval of the List of Pollutants in Soil Obtained during Dredging". [↑](#footnote-ref-21)
21. The Russia related information is based on the National Contribution. [↑](#footnote-ref-22)