

# INFLUENCE OF NATURAL DISASTERS ON TERRITORIAL ORGANIZATION OF FUEL INDUSTRY IN AZERBAIJAN

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## **Abstract**

*Oil- and gas industry is the one of most important economic areas, affected by natural disasters in Azerbaijan Republic. The conducted research found that approximately 2% of the country's total land as well as 81,2% (64 thousand km<sup>2</sup>) of Azerbaijani sector of the Caspian Sea are oily and gaseous areas. About 60-70% of the lands with 165 thousand hectares of total area has become completely useless due to wastes of petroleum industry as well as industrial and underground waters. The oil and gas industry sees damage at 2,5-3,0 million AZN in average each year because of fires at oil- and gas fields; strong winds and hurricanes; and also natural disasters and technogenic accidents on oil and gas pipelines. In particular, natural disasters, occurring in the territories of high concentration of petroleum facilities create great challenges for production considerably because of inefficient use of carbohydrogenic resources; extraction of oil and gas increasingly from deeper layers, and also indifferent attitude to the environment. In this regard, it seems scientifically and practically important to study the territorial organization of fuel industry of the Republic of Azerbaijan from economic, social and geographical views taking into consideration the natural and socioeconomic condition of the country. This article deals with the study of influence of natural disasters on oil- and gas production as well as relation of this influence and environmental problems both by onshore and offshore fields.*

The occurrence of natural disasters creates more problems in the oil and gas industry compared to other economic areas because of the specific characteristics of the noted industrial area. Territorial organization of oil- and gas industry encompasses interrelations among various processing areas, and natural disasters may influence on all this system of interrelation. From this view, facilities of oil- and gas industry are operating under the continuing risk of emergence of natural disasters.

The oil- and gas industry is a key area of Azerbaijan's economy. It directly contributed to the establishment and development of petroleum engineering, instrument-making manufacturing, and ferrous metallurgy as well as petrochemical and chemical industries in the country. 54 out of 67 discovered onshore oil- and gas fields as well as 18 out of 28 offshore fields are under exploitation whereas 24 fields, or 29,3% is regularly being exposed to natural disasters.

There are 5 onshore zones of oil and gas condensate in the territory Azerbaijan, namely Absheron peninsula, Lower and Medium Kura, Guba, Pre-Caspian territories, and Shamakhi-Gobustan, which are being operated. These zones include 43 oil-, gas- and condensate fields, of which 38 fields are suitable for exploitation. In 2005-2011, the share of oil and gas production within Azerbaijani economy increased from 53,4% to 63,8%, reaching 78% by 2011. The production in this area made 26055 million AZN whereas it was at 1623 million AZN in 2000, or 2 times much more. It is estimated that 60 million ton of oil will be exported in the next future.

#### Production of oil and gas by the regions of Azerbaijan

Economic areas and their resources		2000	2002	2004	2005	2008	2011
Absheron	Oil, thousand ton	13564,5	14538	14613,8	21252,8	43512	44652
	Gas, mln. cubic meter	5537,3	4989,7	4858	5611	16279	25653
Aran	Oil, thousand ton	352,1	700,3	843,4	873,4	850,7	663,7
	Gas, mln. cubic meter	64	117,1	134,8	131,8	76,9	55,8
Guba-Khachmaz	Oil, thousand ton	58,2	50,2	48,9	42,2	48,5	48,4
	Gas, mln. cubic meter	39,7	37,2	19,7	18,3	10,8	10,5
Total	Oil, thousand ton	13974,8	15288,8	15506,1	22168,4	44514	45626
	Gas, mln. cubic meter	5642	5144	4995	5732	23399	25728

This table is based on data of 'Industry of Azerbaijan' (The statistical yearbook of Azerbaijan Republic) by 2000-2012 years.

Distribution and production of oil resources is different by the regions of Azerbaijan. 57% of offshore resources and 87% of onshore resources have been exploited (Pashayev, Ayyubov, Eminov, 2010).

The use of oil reserves in the territory of Azerbaijan Republic has a long and ancient history. Absheron is considered to be the chief territory of oil industry at all periods of development of Azerbaijan. Over 80% of oil reserves in the country are concentrated in Absheron Peninsula, Baku and Absheron Archipelago, and at 3000-4000 m depth of the pre-Caspian shelf zone. Oil reserves, formed in deposit rocks, are dated to Cainozoic era. Oil production is connected with exploitation works, managed at Balakhani-Sabunchu-Ramana onshore fields as well as Bibi-Heybat offshore fields.

Oil- and gas producing facilities under the State Oil Company of Azerbaijan Republic are regularly exposed to risk of being damaged by natural disaster in the territory of Absheron economic area. 61,4 thousand ha, or 10,5% of the territory falls to the share of areas, occupied by oil- and gas fields and facilities. Approximately 6-8% of the overall territory of Absheron economic area are polluted by wastes of petroleum industry, and occupied with oily ponds as a result of which, soil cover became useless in agriculture.

Bibiheybat Oil and Gas Producing Department (OGPD) is one of enterprises, operating under the threat of natural disaster for a long period in Absheron. The mentioned industrial object is located near Baku Bay,

and covers oil- and gas extracting areas of Bibiheybat and Badamdar. Bibiheybat OGPD has a territory with 526 ha of area, of which over 400 ha or 76% became useless due to oil wastes. There are 3 oily ponds in this large territory, which emerged due to industrial and underground waters, and has 1.5-2 ha of area. These noted territories are characterized with repeat of heavy winds, hurricanes and landslides. The number of windy days reaches 160-170 a year, the average speed of which makes up 15-26 m/sec. Oil refinery facilities, oil terminals, luggage- and passenger terminals as well bridges and ferry lines crossingshoreline zone of Baku Bay regularly face damage because of different natural disasters. The height of waves, arising as a result of heavy winds is at 2-10 m as usual. Hesitation of level of the Caspian Sea is also reasonable factor, damaging the coastal zone and its economic facilities at pre-Caspian territories. Heavy rains and hurricanes emerging in these territories create considerable challenges in particular during spring and autumn although there are a few outlet channels in Bayil Bay, 25 channels in Khatai district, 41 channels in Sabail district, 2 channels in Narimanov district, and 19 channels in Bayil settlement of Greater Baku, which allow discharge water towards Coastal National Park (Mirzayev, Shikhaliyev, 2012). Therefore, natural processes along with the coastal zone of Baku Bay must be effectively managed. Particularly, provision of treatment facilities and creation of additional water-conducting pipelines is seemed as necessary in order to effectively discharge sewage and accumulated water from Sabail and Khatai districts to the Baku Bay.

Another enterprise exposed to risk of natural disaster for decades, is N. Tagiyev OGPD. This industrial object encompasses large area (120 ha), and its territory includes Gala and Buzovna settlements of Khazar district. Heavy winds, hurricanes and earthquakes negatively influence on territorial organization of oil- and gas exploitation, and may even cause to death among workers and population. 85 ha or 71% of the overall territory of Tagiyev OGPD became useless in connection with accumulation of technogenic and well waters, and small ponds that emerged due to oil industry. The adjacent and neighboring territories also became naturally and ecologically unfit.

Another facility of oil industry – the OGPD named on A. Amirov, encompasses 2110 ha of area and situates in the territory of Garadag district of Baku city. The large territory of this industrial object includes Puta, Korgoz, Lokbatan, Gizil-Tepe, Gushkhana, Shongar, Pirsaat settlements as well as Atashgah, Shabandag, Bandovan areas which have onshore oil reserves. These fields have been being developed and exploited for more than 50 years. Due to natural and technogenic accidents, 80% of the overall territories became completely useless, including 0,5 ha in Atashgah, 20 ha in Shabandag, Shubany and Yasamal, 24 ha in Umbaku, 0,5 ha in Kalmaz, and 0,7 ha in Bandovan. Soil cover has seriously been damaged because of oil wastes and industrial waters. The environmentally polluted lakes of Puta and Girmizi are created due to natural processes and man-made water basins.

“Garachukhur Operation Company” is functioning in south-eastern part of Absheron Peninsula. This oil field covers 1150 ha of area, and includes over 120 drilled wells, of which only 48 are usable. Ponds which cover 20-30 sq. m of area have been emerged here because of underground and well water as well as natural and technogenic accidents. Repair works are managed by open method at the operating wells, and this factor promotes to pollution of the environment with oil waste. 185 ha of area owned by “Surakhani Oil” Operating Company became completely useless due to natural and man-made accidents as well as rise of level of underground waters.

The territory of “Absheron” Operating Company (6,5 thousand ha) includes areas of Zigh and Hovsan oil fields, situated at the coast of the Caspian Sea. Till now, about 200 oil wells have been drilled here as a result of which, pollution by oil wastes turned to serious problem. Currently, there are 10 operating derricks in this territory. In the meantime, 3 oily ponds with 3 ha of area emerged following the implemented exploitation works. Oil- and gas field of the Hovsan area are operating since 1948. The area of the Hovsan exploitation territory is 795 ha, including 450 ha by onshore and 345 ha by offshore resources. The number

of previously and presently drilled oil- and gas wells is about 70 but only 22 of them are operating. The ponds of industrial origin with 10 ha of area in total have been emerged on the right side of the Baku-Hovsan highway (Mirzayev, Shikhaliyev, 2012), and they still exist in the noted territory. Because of operating under the hard natural condition for decades, 60-80% of the territory became completely useless due to rise of underground water as well as oil wastes and oily ponds in large amount, emerged following the exploitation process. Despite that polluted layer water is conducted to large oil tanks of "Gum adasi", adverse environmental effect is still obvious here.

The Dubandi oil terminal – the significant center of industrial importance is among the objects influenced by natural disaster. The terminal's territory area is 60 sq.km. It is created in order to purify polluted industrial waters that emerge as a result of cooling of oil-conducting pipes. The main works here include management of oil spills and wastes as well as desalinization of seawater in order to efficiently use water resources.

Balakhani OGPD includes the oil- and gas-rich territories near the settlements of Balakhani, Zabrat, Sabunchu, and Ramana (the total territory area is 1511 ha), and has been operating under the risk of natural disasters for a long period. There are 1200 previously drilled wells here, of which 22% is operating while 77,5% is closed. The territory of Balakhani OGPD, including usable lands has seen serious damage because of emergence and spread of oil wastes or rise of underground waters. 80% of this territory is contaminated and useless. 23,2% of these useless lands (over 280 ha) is occupied by the population. The fields in Sabunchu and Ramana are situated at geographically lower parts in relation to other parts of the peninsula. Therefore, not only underground waters but also industrial and domestic sewage as well as also rain waters negatively influences on the mentioned territories. There are a few small and relatively large oily ponds near Balakhani, Zabrat and Sabunchu settlements.

Most of oil- and gas wells are cancelled in the territory of 'Balakhanineft' OGPD whereas the population continued to settle. Wastes discharged from iodine plants near Ramana Lake and also industrial and municipal facilities are widely spread as usual, in particular after heavy rainfall and wind. This damages human health in this territory.

'Surakhani Oil' Operating Company covers 1300 hectare of area, of which 567 hectare or 43,6% are at the useless condition because of fuel wastes and underground waters. The total territory area of 3 oily ponds, created in the lower area called 'Hovsan', exceeds 80 hectare. Population grows even near the fields, particularly in Surakhani and Hovsan – the areas of intensive oil extraction. Some part of the polluted territories is settled as well. Over 400 hectare of exploitation territory (76%) is polluted (Mirzayev, Shikhaliyev, 2012).

'Binagadi Oil Company' (territory area is 2,8 thousand hectare) includes Binagadi, Sulutepe, Chakhnaglar, Girmanji, Shabahndagh, Siyansor, Mahammadli and Masazir oily areas. Oil contamination encompasses the territories near Balakhani, Binagadi and Mehdiabad settlements. Field- and layer waters are responsible in arising of the oily lake with 0,5 hectare of area. Oil- and gas fields of Binagadi-Khirdalan-Kechaldagh territory are covered by Masazir and Binagadi Lakes, the Digah village, the Girmakhchi to the north, and Shabandagh to the east. The northern and southern parts include oily ponds and salt-ridden lands. This relatively large territory also is a place of mud volcanoes, such as Boyukdagh, Kichikdagh, Abih, Zigilpir, Keyraki and Kechaldagh. 170 hectare or 4,4% of the overall territory is exposed to the oil contamination.

Pirallahi, Gurgandeniz, NeftDashlari, Darwin banks, Gum-deniz, Absheron bank, Sangachal-Duvanni-KharaZire, Bahar, Bulla-deniz, Gunashli, Chirag, Azeri, Kapaz, Shahdaniz and other oil- and gas condensate fields are regularly exposed to different natural disasters. 'Absheronneft' OGPD is functioning since 1936 when oil- and gas production firstly managed in the Pirallahi Island. Currently, exploitation works are underway at 'Gurgan-deniz', 'Absheron bank', 'Darvin bank', and 'Western Absheron' fields. The island has fresh water resources and this contributed to production of oil and gas at earlier period (1907). Since the

construction of bridge and management of direct connection, oil and gas production is highly developing in this territory. The Pirallahi Island is connected with the Absheron peninsula via the bridge of 11 km in length and 4 km in width (Mirzayev, Shikhaliyev, 2012). The population number of the Pirallahi Island is 14 thousand persons. The territory was given the status of district. 12,3% of the island's territory is under the subordination of 'Absherinneft' OGPD. The population is engaged in oil production and fishing. The territory area of land destined for oil and gas production and the transportation is 530 hectare in the island whereas only 11,5 hectare are used for housing and other purposes. 1,7% (9,2 hectare) of the territory of Pirallahi-based OGPD is settled by the population. As a result of mistakes made in the process of production of oil and gas, some part of the territory (about 5 hectare) became useless due to oil wastes, underground- and field waters.

Pirallahi Island is characterized with prevailing of heavy winds (120-130 days within a year) and hurricanes which are responsible for the damage. The population and employees of oil- and gas industry are dwelling and working under the threat of natural disaster and environmental risk near the Absheron OGPD which have many oily ponds.

Another OGPD, located in the Pirallhi Island is '28 May' that includes 'Gunashli', 'Chilov' and 'Janub' offshore fields. The territory area of Chilov Island is 35 sq. km. The island is a place of regularly observed heavy winds and hurricanes which may result in emergence of 3-5 height waves. The coastal part of the Chilov Island has become frozen twice within the last 10 years (2011 and 2013). Moreover, the island may be exposed to the influence of ices brought from the north via the Volga River. The administrative building of the '28 May' OGPD is situated in Chilov Island, and it regulates oil and gas production, and also exploitation and reconstruction works as well as assembling and transportation of the crude fuel by the offshore 'Gunashli', 'Chilov' and 'Janub' fields. These works are implemented under the risk of different natural disasters. Moreover, hard-blowing winds and hurricanes as well as hesitation of the Caspian Sea and impact of mud volcanoes may affect fields such as 'Sangachal-deniz', 'Duvanni-deniz', 'Khara-Zira Island' situated at the northern part of Baku Archipelago.

The discovery and operation of 'NeftDashlari' (meaning 'Oil Stones') – the first oil city, founded at the sea, was the new era in the history of development of petroleum industry of Azerbaijan. Situated 110 km off the coast, 'NeftDashlari' implements important operations, including drilling or construction of over 2 thousand wells, more than 180 km long piers and more than 170 km industrial square as well as construction of hundreds of oil-, gas- and water pipelines. However, the production output fell down over time as oil resources became less in amount. Heavy winds, landslide, and the rise of the level of the Caspian Sea affect negatively on production process.

Since 1978, rise of the level of the Caspian Sea created a number of problems in the Absheron peninsula. The new fields like Pirallahi-Neftdashlari, Jiloy and Gum islands, Kurdahani-Mashtaga-Buzovna, Jongar-Zarat, Siyazan-Nardaran and others have seen damage in different periods due to rise of the sea level (1,4-1,8 m). Territories of Jiloy and Gum islands were partially exposed to negative influence, and the economic damage made \$ 6,3 million (Pashayev, Ayyubov, Eminov, 2010). Some piers were replaced, and other measures on preventing waves' attack were implemented due to considerable finding of renovation works and improvement of technology.

The OGPD named on N.Narimanov is also operating under the risk of natural disaster. This enterprise is situated in the territory of Garadagh administrative region and includes onshore and in part offshore fields (Sangachal-Duvanni-KharaZire, Alat-deniz, 8<sup>th</sup> March, Bulla-deniz, and Umid). 'Dashgil' field of Narimanov OGPD is located in the territory of Shikhlar settlement and covers 35 hectare of area. This territory is characterized with degradation of soils due to natural and man-made accidents, and also

underground layer waters. Over 60% of soil cover became completely useless. Disasters of natural and man-made origin regularly affect oil- and gas fields, resulting in huge economic and environmental damage.

Aran economic region is the country's second region behind Absheron for oil reserves and production in this area. 26% of oil and gas reserves falls to the share of Aran economic region. Oil production is being managed here since 1930. 'Garasu' Operating Company is one of the largest industrial enterprise that manage oil production at Mishovdagh and Kamaladdin oil- and gas fields (4,5 thousand hectare).

Mishovdag field is situated at the western part of the Kura River, 8-10 km off Shirvan city. The oil- and gas resources are under exploitation in the territory with 4 ha of area. Kamaladdin field is situated 9-10 km off Pashali settlement, covering the Akhtarma-Pashali mud volcanos' territory near the Gubali village. Oily and polluted waters may be flowed to open territories when the wells are being reconstructed. 0,5-0,7 ha of area is polluted by oil wastes.

The total territory area of 'Salyan Oil' Operating Company is 2,7 thousand hectare. The company manages oil- and gas production by Kursangi, Kirovdagh and Garabagli areas. The territories with 24 hectare of area are useless due to wastes of industrial and underground waters. Therefore, assembling and treatment of these waters as well as reconstruction of the wells and washing of pipelines must be managed at close condition.

'Neftchala' OGPD includes Neftchala and Khilli oil- and gas fields as well as Durovdagh gas fields, total territory of which is 25 thousand hectare. Three petroleum facilities are functioning and 14 hectares of area became completely useless in the territory of 'Neftchala' OGPD. The polluted territories make up 800 hectare (80% of the overall territory). The oil fields are situated in Shirvan and south-eastern Shirvan planes. Right side of bank of Kura River includes Babazanan, Bandovan, Durovdag, Jarli, Saatli, Garasu, Agjabedi, Barda and some other parts of 'Neftchala' OGPD that are known as oily territories. 9,3% of the resources are situated at 3000 m as well as 43,6% at 3000-5000 m depth and 11,4% at deeper than 5000 m. Although oil reserves are typical for deeper layers, oil production continues to be managed in Aran economic region as it was in previous decades. 2,8% of exploited offshore oil resources and 0,8% of natural gas resources of Azerbaijan is shared by this region. In 2011, oil production was at 663,7 thousand ton, and gas production made 55,8 million cubic meter by Aran economic region, whereas in 2000 the corresponding indicators were equated to 352,1 thousand ton and 64 million cubic meter. However, Aran economic region and its fuel businesses regularly sees damage due to different natural disasters, in particular inundation and influence of surface water (Pashayev, Ayyubov, Eminov, 2010).

Guba-Khachmaz economic region is situated on the north-eastern part of Azerbaijan. The main oil fields of Guba-Khachmaz include Keshchay, Siyazan-Nardaran, Amirjan, Zagli-Zeyva and Tangi oily territories that belong to 'Siyazanneft' OGPD. Exploitation works are underway since 1938. The noted field make up 6,7% of the oil- and condensate resources of Azerbaijan. The region shares 0,2% of onshore oil- and gas resources of the country. Saadan, Bayimdag-Tagchay, Gizilburun-deniz, Zarat-deniz fields are considered to be more perspective. Within the territory of 'Siyazanneft' OGPD, 74,2% of the territory are of Siyazan, 22,5% of Shabran, 2% of Guba and 0,35% of Khizi administrative regions. Out of 1070 drilled wells, 34,2% have stopped their functioning in the territory of 'Siyazanneft'. Industrial and layer waters are being flowed into underground soil wells and adjacent territories. These waters are being absorbed easily and therefore, oily ponds are not been created here with the exception of a few ones.

The first industrial zone of 'Siyazanneft' includes Jahandar-Zarat and Siyazan-Nardaran oily territories from coasts of the Caspian Sea, Atachay River basin to Sadan (655 hectare). There are three oil refining plants in this zone. 38,5% of the territory (550 hectare) are exposed to the influence of natural disasters which caused to heavy land degradation. The special store and well, created for collecting of drilling and underground waters, was unable to prevent emergence of the sewage lake of 960 sq. m of area on the right side of Samur-Absheronwater channel. The oily pond with 60 sq. m of area was created on the left side of Atachay River.

The second industrial territory of 'Siyazanneft' encompasses Sadan and Gil-gil settlements. 27% of this territory (or 211 hectare) is polluted. The third territory of oil production within 'Siyazanneft' is Pirabadil and Zagli-Zeyva, 39,5% of which (456 hectare) became useless due to different natural disaster. Oily water discharged from oil wells as oil spillage, and also polluted layer waters are being flowed into the river of Shabran and the surrounding springs. Oil- and gas-rich territories are characterized with risk of landslide and inundation in the territory of Guba-Khachmaz economic region.

As for Ganja-Gazakh economic region, its oil and gas resources are not under industrial exploitation. The main fields, exposed to the influence of flooding and inundation are: Gazanbulag, Dalimammadli, Borsunlu, Duzdag, Ajidere, Tarsdallar, Jeyranchol as well as the unique Naftalanoil field. Terter oil fields in YukhariGarabagalso may be exposed to the mentioned kind of natural disaster.

### **Conclusion**

The following recommendations are necessary and important in order to provide sustainable development of oil- and gas industry, and management of natural disasters in the country:

- Programs on management of natural and technogenic accidents in oil- and gas industry should be developed in order to effectively benefiting production;
- Management of natural disasters in the oil- and gas industry should be assisted at state level;
- Improvement of material and technical supply oil machinery in accordance with modern standards is needed with taking into consideration effective management of natural disaster.
- Factor of natural disaster should be practically regarded as considerable and influential when territorially organizing oil- and gas producing facilities.
- Development of measures on protecting of oil- and gas-producing facilities as well as the population from the influence and risk of natural disasters is necessary.

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