

Study on the Environmental Impact of Oil and Gas Field Development on the Ecological Red Line Area

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Abstract To cooperate with the five ministries and commissions of the state to carry out joint investigation on the environmentally sensitive areas involved in oil and gas exploration and development, for the problems found in survey, containing complex type and numerous amount of ecologically sensitive space and ecological red line involved in oil and gas field enterprises, scientific nature of delimitation, lack of strong support of laws and regulations for forced withdrawal of oil and gas production facilities in these areas, some countermeasures and suggestions were proposed, such as further evaluating and combing scope and functional zoning of existing environmentally sensitive areas and ecological red lines, treating differently, enhancing pertinence of prohibition in ecologically sensitive regions, declining blindness of the withdrawal of oil and gas facilities in environmentally sensitive areas, strengthening seriousness of approval of exploration and mining rights of oil and gas resources, and establishing strategic reserve exploration and hierarchical development mechanism. Moreover, oil and gas field enterprises should integrate more efforts to ① accelerate to find out the current situation of environmental quality, ② adhere to developing in protection, and protecting in development, ③ increase attention and participation strengthen of providing technical support for national oil and gas exploration and development strategy evaluation, ④ accelerate communication and docking with local governments on the ecological red line, ⑤ actively strive to be included in the positive list management of local governments, ⑥ accelerate to establish and perfect primary database of oil and gas production and facilities construction, and ⑦ document management information system of the ecological red line.

Key words Oil and gas fields; Exploration and development; Ecological red line; Environmentally sensitive area; Environmental effect

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Since the 18th and 19th CPC National Congress, general secretary Xi Jinping has repeatedly stressed that ecological civilization was the basic plan for the sustainable development of the Chinese nation. The Department of Ecological Environment is making unprecedented strict laws and regulations on ecological environment protection, and implementing the strictest supervision and accountability of ecological, environmental protection. Among them, the red line system of environmental protection is one of the most severe systems of ecological environment protection. How to solve the contradictions between oil and gas exploration and development increasing storage, enlarging capacity, maintaining production, improving efficiency and environmental protection, especially the contradictions with environmentally sensitive areas, ecological red lines, and the protection of nature reserves under reform, becomes one of the bottleneck problems restricting the development of oil and gas fields under the current situation.

In July of 2018, general secretary Xi Jinping made important instructions on "vigorously improving exploration and development efforts and ensuring energy security". In order to efficiently implement the critical directive spirit of general secretary Xi and cooperate with five ministries and commissions of the state (National Development and Reform Commission, Ministry of Natural Resources, Ministry of Ecological Environment, National Forestry and Grass Administration, and National Energy Administration) in completing the joint investigation of environmentally sensitive areas

as involved in oil and gas exploration and development. CNPC Research Institute of Safety & Environment Technology has been leading and responsible for carrying out the work of the *Study on the Environmental Impact of Oil and Gas Exploration and Development on Environmentally Sensitive Areas* in 2019. It could provide strong technical support for the research team of the five national ministries and commissions submitting the suggestions on the adjustment of policies for the environmentally sensitive areas and ecological red lines involved in oil and gas exploration and development to the State Council. The research is a reasonable attempt to adhering to the construction of ecological civilization, guaranteeing national energy security, and formulating national energy policy^[1-5].

1 Main problems

1.1 Complex type and numerous amount of involved environmental sensitive area and ecological protection red line 16 oil and gas field enterprises were surveyed, involving 148 environmentally sensitive areas. Among them, there were 43 natural reserves, 81 water source protection areas, two geoparks, two forest parks, nine scenic attractions, and 11 other environmentally sensitive areas.

1.2 The particularity of oil and gas exploration and development projects not be treated differently Compared with the exploitation of substantial mineral resources, oil and gas exploration and development have the characteristics of small ecological disturbance, little pollution, and stable operation. Meanwhile, measures of clean production and environmental protection in oil

and gas exploration and development, such as pollutants not falling to the ground, have made continuous progress with the development of science and technology, which further declined the impact on the ecological environment. However, when oil and gas exploration and development involved environmentally sensitive areas, relevant laws, and regulations of environmental protection, supervision, and management of environmental protection did not fully consider the above differences and progress of environmental protection technology such as cleaner production, causing that it was difficult to carry out oil and gas exploration and development projects smoothly.

1.3 Outstanding scientific problem of delimiting the environmentally sensitive area and the ecological red line In the survey process by five ministries and commissions of the state, it was found that there were the following outstanding problems in some environmentally sensitive areas and ecological red lines, especially delimiting the ecologically sensitive areas and ecological red lines of local provinces, cities and below level.

First, the necessity and scientific argumentation of delimiting environmentally sensitive regions and ecological red lines was insufficient, and the scope was delimited at will. When relevant research and management departments delimited ecologically sensitive areas and environmental red lines, they often worked on the map. They even overlaid the map, and combined field investigation according to the *National Ecological Function Division*. It caused that environmentally sensitive area and ecological red lines were too large, and functional division of ecologically sensitive regions was unreasonable. One of the outstanding issues was that core and buffer areas of nature reserve were too large.

Second, when relevant research and management departments delimited environmentally sensitive areas and ecological red lines, in-depth field research was insufficient, and there lacked scientific monitoring and analysis. The state key construction projects and oil and gas exploration and development projects with legal mining rights in the area to be delimited were unclear or detailed, but they were not valued. The development idea of "protecting in development, and developing in protection" was not implemented. In some regions, above national key construction projects were classified into environmentally sensitive areas. It caused the regional relationship between oil and gas exploration and development projects and ecologically sensitive areas; ecological red lines changed from avoidable to unavoidable and small-scale overlapping to large-scale overlapping.

1.4 Projects involving environmentally sensitive areas and ecological red lines challenging to be carried out normally With the tightening of national environmental and environmental protection policies, governments at all levels were more strict in approving oil and gas exploration and development projects with the idea of "oil and gas exploration and development first, environmentally sensitive areas and ecological red lines second". They even were more cautious for projects customarily permitted to be constructed following laws and regulations. It increased the intensity of the re-

view and made it difficult to carry out usually the project.

1.5 The forced withdrawal of oil and gas production facilities involving environmentally sensitive areas and ecological red lines lacking strong legal and regulatory support First, regardless of the historical fact that the oil and gas production facilities were built before the environmentally sensitive areas and the ecological red lines, local governments at all levels adopted the approach of "cutting it even at one stroke" to the oil and gas production facilities involving the environmentally sensitive areas and required full withdrawal. It not only affected oil and gas production but also formed a hidden danger of safety and environmental protection due to hasty exit.

Second, for the experimental area of a nature reserve, three-level protection area or quasi protection area of a water source, and they belonged to the situation of "the development and production of oil and gas first, and the designation of protected area second", there lacked strong legal basis when it forced withdrawal of oil and gas production facilities.

Third, it lacked the basis of laws and regulations for the withdrawal of oil and gas production facilities within the ecological red line. At present, the state has not yet promulgated the relevant rules and regulations on the management and control of the ecological red line^[3-6].

2 Leading suggestions and countermeasures proposed by in the research report

2.1 Further assessing and combing scope and functional zoning of existing environmentally sensitive areas and ecological red lines Due to historic legacy and other reasons, the scope demonstration of some ecologically sensitive areas and ecological red lines was not sufficient, and boundary division was too large. It caused that the exploration and mining rights of oil and gas field enterprises to overlapped more with the environmentally sensitive areas and ecological red lines, especially nature reserve and water source reserve, which significantly restricted space expansion of national energy strategy. It was suggested that relevant national departments should carry out further research and scientific demonstration, and explore the possibility of adjusting the scope and functional areas of environmentally sensitive areas, and the range of the ecological red line under the premise of sufficiently guaranteeing energy safety. The suggestion could provide strong technical support for the five ministries and commissions submitting to the State Council the recommendations on the adjustment of policies for the environmentally sensitive areas and ecological red lines involved in oil and gas exploration and development with the report of *Study on Environmental Impact of Oil and Gas Exploration and Development on Environmentally Sensitive Areas* submitted to the State Energy Administration and other ministries and commissions.

To implement important instructions of leading comrades of the State Council on assessing ecological red line, the general office of the Ministry of Natural Resources and the general office of the Ministry of Ecological Environment issued the *Letter on Carry-*

ing out the Assessment Work of Ecological Red Line (ZRZBH [2019]1125) to the general office of the people's government of each province, autonomous region and municipality directly under the central government on June 29, 2019, attached by the *Work Plan of Ecological Red Line Assessment*. The comprehensive department of the National Energy Administration issued an urgent letter (the *Letter on Docking with Relevant Departments of Local Governments on the Assessment Work of Ecological Red Line*) to CNPC, Sinopec and CNOOC on July 23, 2019.

The document of ZRZBH[2019]1125 has made clear that each province (district and city) should scientifically evaluate the delimitation of ecological red line, adjust and perfect division results, and ensure ecological red line authoritative, scientific and executable. In the *Work Plan of Ecological Red Line Assessment*, it was required verifying the situations of significant infrastructure projects, legal mining rights, strategic mineral resources area, etc. in the red line area of ecological protection, and proposing rules and methods to solve conflicts^[5-7].

2.2 Treating differently and strengthening the pertinence of prohibition in environmentally sensitive areas

It was suggested that experts in the fields of law, ecological environment, etc. should treat different situations in another way, instead of "cutting it even at one stroke" For example, it should correct or revise "prohibited acts" involving environmentally sensitive areas in relevant laws, regulations, and department rules, such as the *Law of the People's Republic of China on the Prevention and Control of Water Pollution*, the *Regulations on Prevention and Control of Pollution in Drinking Water Source Protection Area*, and the *Regulations on Nature Reserves*.

2.2.1 Treating solid ore and oil and gas ore differently. Due to the vast difference between oil and gas exploration and development and substantial mine exploration and development, it was suggested making clear mineral species included in the *Regulations of the People's Republic of China on Natural Reserves* and the *Regulations on Scenic Spots*.

2.2.2 Treating two different stages of oil and gas exploration and development differently. The analysis found that the technology of oil and gas exploration and development is different, and the degree of impact on the environment is also other. The process of oil and gas exploration has little effect on the ground, which is temporary. It also suggested that the restrictions on oil and gas exploration activities should be released conditionally in the core and buffer areas of the natural reserves and primary and secondary water source protection areas. In the experimental measurement of the nature reserve, quasi protection area of water source reserve, and other environmentally sensitive areas, it should fully liberalize restrictions on oil and gas exploration activities.

2.2.3 Treating oil field development and gas field development differently. The development of gas fields, especially the construction of conventional gas fields and gas storage, had relatively little impact on the environment. In addition to the partial environmental effects caused by the construction period, the environmental

impact during the operation period was mainly concentrated in the joint treatment station. It was primarily environmental air pollution, and the development block was free of pollutants. Therefore, it was correctly suggested relaxing conventional gas field development activities in environmentally sensitive areas. For example, conventional gas field development and gas storage construction should be allowed in the secondary site and quasi protection area of water source protection area, experimental area of natural protection area and non-core area or other environmentally sensitive areas, and the restrictions on oilfield development should be liberalized.

2.3 Respecting history and reducing blindness of oil and gas facilities withdrawal in environmentally sensitive areas

For the situation that "oil and gas exploration and development occurred before delimitation of environmentally sensitive areas" it was suggested adjusting the scope and functional division of environmentally sensitive areas. For the situation that "delimitation of environmentally sensitive areas occurred before oil and gas exploration and development", it should suspend the withdrawal mechanism of oil and gas production facilities under the premise of strictly guaranteeing not increasing environmental disturbance and environmental impact. Via a further assessment, it should scientifically make a withdrawal plan or detailed ecological protection requirements for continuous production, and not make an arbitrary decision.

2.4 Controlling strictly and enhancing the seriousness of approval of exploration and mining rights of oil and gas resources

Large state-owned enterprises have a strong sense and responsibility for environmental protection, and there is a sufficient guarantee for investment in environmental protection. Therefore, it was suggested large state-owned enterprises continuing to hold exploration and mining rights of oil and gas resources, which was favorable for realizing coordinated development of oil and gas exploration and development and environmental protection.

2.5 Managing and controlling hierarchically, and establishing strategic reserve exploration and hierarchical development mechanism

It should fully carry out national oil and gas resources exploration (containing environmentally sensitive areas), and strengthen the foundation of strategic energy reserve. Based on determining the distribution of oil and gas reserves, it should make the standard for classified development of oil and gas resources. According to the dependence of oil and gas resources on foreign countries, international situations, and the situations of problematic environmental sensitive areas, hierarchical development, management, and control mechanisms should be established.

3 Related suggestions on oil and gas field enterprises

3.1 Accelerating to find out the current situation of environmental quality It should combine the latest national management and control requirements of the ecological red line, survey and monitor soil and groundwater in the development area of oil

and gas field, essential areas of environmental function involving important water conservation, biodiversity maintenance, soil and water conservation, windbreak and sand fixation, and current data of ecological quality and ecological environment in sensitive and vulnerable areas of the ecological environment such as soil erosion, land desertification, rock desertification, and salinization. It could provide crucial environmental background situations for delimitation and control of the ecological red line.

3.2 Adhering to "developing in protection, and protecting in development" It should further enhance report and communication with Ministry of Ecological Environment, National Energy Administration and other national ministries and commissions, timely and accurately grasp the trend of national environmental protection policies, strengthen the connection of production and system, improve prediction accuracy in the decision-making of oil and gas production and infrastructure planning, increase the fitness of planning scheme and national policy, and grasp the initiative. It should adhere to "developing in the protection and protecting in the development" which guarantees not only national energy security but also realizes coordinated development of oil and gas production and ecological environment protection.

3.3 Further increasing the emphasis and participation in providing technical support for national oil and gas exploration and development strategy evaluation It should closely follow the direction of national ecological environment policy and the practice of oil and gas exploration and development, and actively undertake particular tasks, policy research, and standard formulation entrusted by national ministries and commissions. Taking actual achievements as technical support, it should show the corporate image of oil and gas field enterprises shouldering the responsibility of national energy security guaranteeing, ecological environment protection and social and economic development, and continuously improve voice and influence.

3.4 Accelerating the communication and connection with local governments on the ecological red line According to relevant national requirements, the exploration and demarcation of the environmental red line should be completed entirely in the whole country by the end of 2020, and the ecological red line system also should be established.

According to the requirements of state management in implementing "*Technical Specification for Exploration and Demarcation Bid of Ecological Red Line*" issued jointly by general offices of the Ministry of Ecological Environment and the Ministry of Natural Resources on August 26, 2019, any projects should check the boundaries of the area involving mining rights (exploration and mining rights), national planned mining areas and mineral land with strategic mineral reserves above medium-sized within the ecological red line. They should also guarantee "three control lines" not cross or overlap, and reserve development space. Each oil and gas field enterprise should leverage the opportunity of ecological red line assessment by provinces (districts and cities) accordingly and continue to track the delimitation, exploration and demarca-

tion progress of ecological red line in oil and gas field areas. Corresponding countermeasures and measure should be taken^[8-9].

First, oil and gas field enterprises in provinces, cities, and counties that have not been yet finalized the ecological red line should accelerate the coordination with local governments, correctly solve the relationship between delimitation of ecological red line and development of oil and gas resources, and realize organic combination of resource development and ecological environment protection.

Second, oil and gas field enterprises in the provinces, cities, and counties that have defined and announced the ecological red line should timely grasp whether there are oil and gas production facilities or mineral rights that are included in the environmental red line in the oil and gas field development area. For the oil and gas production facilities or mineral rights that have been included in the ecological red line area, it should combine closely with local government, strive to propose the adjustment scheme for delimitation of ecological red line involving oil and gas production facilities or mining right scope through consultation during the assessment, exploration, and demarcation of the environmental red line carried out by the local government.

3.5 Actively striving to be included in the positive list management of local governments In principle, the red line area of environmental protection is managed according to the prohibited development area, but it is not an "unmanned area". According to the *National Main Function Division*, the restricted development area is that prohibiting industrialization and urbanization development, not all human activities.

At present, to standardize various activities of the ecological red line, some local governments should use the manner of the positive list for management, clear the fields, industries, technologies, scales, *etc.* allowed to be invested and operated within the ecological red line, and propose corresponding environmental control measures, thereby simplifying the resource utilization and management in environmental red line area.

3.6 Speeding up the establishment and improvement of the primary database of oil and gas production and facilities construction By sufficiently using satellite remote sensing, ecological comparison, big data analysis, and other advanced technical means, it should objectively and accurately analyze and judge the impact of oil and gas exploration and development on different types of environmentally sensitive areas, thereby providing scientific and significant technical support for effectively solving the problems in the process of oil and gas exploration and development, which involved ecologically sensitive areas, nature reserves, and ecological red lines.

3.7 Establishing information system of ecological red line management In the existing HSE management information system, it should increase information management content of ecological red line in oil and gas field development area, containing distribution scope and coordinate of the ecological red line, the num-

and carbon disulfide in the Pearl River Delta of southern China: Impact of anthropogenic and biogenic sources[J]. *Atmospheric Environment*, 2010, 44(31): 3805–3813.

- [17] XIE CJ, GAO QZ, TAO Z. Review and perspectives of the study on chemical weathering and hydrochemistry in river basin[J]. *Tropical Geography*, 2012, 32(4): 331–337, 356.
- [18] XIAO JY, ZHAO P, LI WH. Spatial characteristic and controlling factors of surface water hydrochemistry in the Tarim River Basin[J]. *Arid Land Geography*, 2016, 39(1): 33–40.
- [19] ZHANG LC, CHEN X, ZHANG ZC, *et al.* Analysis of hydrochemical characteristics and water–rock interaction in Karst basin—A case study of Houzhai River basin[J]. *Earth and Environment*, 2018, 46(2): 114–120.
- [20] WU JX. Analysis of the variation characteristics of hydrological elements in the Heihe River basin, Xi'an[J]. *Water Conservancy Science and Technology and Economy*, 2008, 14(11): 874–875.
- [21] LIU X. Variation characteristics of hydrogen and oxygen stable isotopes in different water bodies in the Heihe River basin of Shaanxi[D]. Xi'an: Shaanxi Normal University, 2016.
- [22] MITAMURA O, SEIKEY Y, KONDOK K, *et al.* First investigation of ultratrophic alpine Lake Pum a Yumco in the pre-Himalaya, China[J]. *Limnology*, 2003, 4(3): 167–175.
- [23] MURAKAMIT, TERAHI, YOSHIYAMAY, *et al.* The second investigation of

Lake Pum a Yumco located in the Southern Tibetan Plateau, China[J]. *Limnology*, 2007, 8(3): 331–335.

- [24] WEI ZS. *Environmental water chemistry* [M]. Beijing: Chemical Industry Press, 2001: 82–84.
- [25] WU XB, LI QL, He JQ, *et al.* Hydrochemical characteristics and inner-year process of upper Heihe River in summer half year[J]. *Journal of Desert Research*, 2008, 28(6): 1191–1196.
- [26] MEYBECKM. Global chemical weathering of silicic rocks estimated from river dissolved loads[J]. *American Journal of Science*, 1987, 287(5): 400–427.
- [27] ZHANG GX, DENG W, HE Y, *et al.* Hydrochemical characteristics and evolution laws of groundwater in Songnen Plain, Northeast China[J]. *Advances in Water Science*, 2006, 17(1): 20–28.
- [28] SU YH, ZHU GF, FENG Q, *et al.* Environmental isotopic and hydrochemical study of groundwater in the Ejina Basin, northwest China[J]. *Environmental Geology*, 2009, 58: 601–614.
- [29] ZHANG T, CAI WT, LI YZ, *et al.* Major ionic features and their possible controls in the water of the Niyang River basin[J]. *Chinese Journal of Environmental Science*, 2017, 38(11): 4537–4545.
- [30] QIN JH, HUH Y, EDMOND JM, *et al.* Chemical and physical weathering in the Min Jiang, a headwater tributary of the Yangtze River[J]. *Chemical Geology*, 2006, 227(1): 53–69.

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ber of oil and gas production facilities such as oil and gas wells, oil and gas reserves, monitoring data of soil and groundwater, laws and regulations and strict control requirements on ecological red line by national and local governments.

References

- [1] Decision on comprehensively deepening the reform of several major issues by the Central Committee of the Communist Party of China[EB/OL]. (2013–11–15)[2019–11–20]. <https://baike.baidu.com/item/%E4%B8%AD%E5%85%B1%E4%B8%AD%E5%A4%AE%E5%85%B3%E4%BA%8E%E5%85%A8%E9%9D%A2%E6%B7%B1%E5%8C%96%E6%94%B9%E9%9D%A9%E8%8B%A5%E5%B9%B2%E9%87%8D%E5%A4%A7%E9%97%AE%E9%A2%98%E7%9A%84%E5%86%B3%E5%AE%9A/12276370?fr=Aladdin>.
- [2] Technical guide for delimiting national ecological red line: Ecological function baseline (trial) [EB/OL]. (2014–02–11)[2019–11–20]. http://cn.chinagate.cn/environment/2014-02/11/content_31431598.htm.
- [3] Opinions of the CPC Central Committee and the State Council on accelerating the construction of ecological civilization[EB/OL]. (2015–05–05)[2019–11–20]. <http://www.gov.cn/xinwen/2015-05/05/>

content_2857363.htm.

- [4] Opinions on the general office of the CPC Central Committee and the general office of the State Council on delimiting and strictly observing the red line of ecological protection[EB/OL]. (2017–02–07)[2019–11–20]. http://www.gov.cn/zhengce/2017-02/07/content_5166291.htm.
- [5] Guide to delimitation of ecological protection red line[EB/OL]. (2017–07–27)[2019–11–20]. <http://www.hnep.gov.cn/xxgk/hby-wxxgk/zrst/stbh/sthx/webinfo/2017/07/1510134721853018.htm>.
- [6] MIN QW, MA N. The difference and connection between ecological red line and natural protection land system[J]. *Environmental Protection*, 2017(23): 26–30.
- [7] General Office of the Ministry of Ecological Environment and General Office of the Ministry of Natural Resources. Letter on assessment of ecological red line(ZRZBH[2019]1125)[EB/OL]. 2019.
- [8] General Office of the Ministry of Ecological Environment and General Office of the Ministry of Natural Resources. Notice on printing and issuing the *Technical Specification for Demarcation and Calibration of Ecological Red Line*[EB/OL]. (2019–09–10)[2019–11–20]. http://www.sohu.com/a/340152708_656705.
- [9] XIONG YS. Countermeasures and suggestions for the problem of the red line of ecological protection in oil and gas field development[J]. *Environmental Protection of Oil & Gas Fields*, 2018, 28(6): 1–3.

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