Large projects and small communities: the influence of industrial development on remote villages in Eastern Siberia

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Abstract. Nowadays, the development of oil and gas extractive activities and logging industry are occurring actively in Eastern Siberia. These industrial activities transform the habitat of indigenous and other local peoples in Eastern Siberia, who live in remote areas and are engaged in traditional activities. Therefore, the issue of sustainable development of these remote areas acquires special relevance. This article examines the issues of sustainability of such areas in the theoretical framework of the concept of social-ecological systems and their adaptive abilities in changing conditions. On the example of the northern municipality in the Irkutsk Region, we consider the influence of industrial activities on remote small communities and study their adaptive abilities. On the one hand, these communities adapt to changing conditions, continuing to be engaged in traditional activities, but, on the other hand, the growing impact of industrial activities on the natural environment limits these opportunities in the future, as it reduces the reproductive functions of local ecosystems.

1. Introduction

In the 21st century, industrial development of Eastern Siberia continues actively. First of all, these are oil and gas extractive activities and logging, which move to more and more remote areas, where indigenous peoples of the North live, who continue to be engaged in traditional types of activities: hunting, reindeer herding, fishing, and gathering. Since activities of industrial companies cause significant negative impact to the natural environment that may affect traditional nature management and cultural practices of indigenous peoples [1], the issue of sustainable development of these remote areas acquires particular relevance. Can the traditional activities, lifestyle and cultural practices of indigenous peoples be preserved under the development of extractive sectors? Whether are small remote communities adapting to new conditions nowadays, and how can it contribute to sustainable development? The article examines these issues in the theoretical framework of the concept of social-ecological systems (SES) and their adaptive abilities in changing conditions.

SES is as a territorial system that includes both natural and social components, including the economy [2, 3]. One of the parameters of SES resilience is the ability to adapt to changing conditions [4, 5]. The adaptive abilities of SES depend on various factors: the most stressed components of the system, nature, duration, genesis of influences (internal or external), etc. Adaptive components allow systems to change and develop over time in response to feedback and changes in system context [6]. The article discusses the effect of industrial activity on remote settlements and the adaptive abilities of SES on the example of the area located in the north of the Irkutsk Region.
2. Materials and methods
The research is based on materials from fieldworks that were conducted in the study area in 2014, 2016, 2018, and 2020. The data were collected using semi-structured interviews and conversation with local residents and experts as well as participant observations. Additionally, reports of local authorities, socioeconomic statistics and other open administrative documents were used.

3. Study area
Katangsky District, including the Nepa municipality, is one of the most remote and inaccessible areas of the Irkutsk Region. According to Russian legislation, the area belongs to the Far North by natural and climatic conditions. There are four villages in the area of the Nepa municipality: Tokma, Bur, Ika, and Nepa. The population is 442 people. The area of the municipality is 37.5 thousand km². This territory is divided between two indigenous non-governmental enterprises (obshchinas) "Tokma" and "Ika". Members of these obshchinas are engaged in traditional activities within the boundaries of their lands: hunting, fishing, and gathering. Along with the indigenous peoples of the Evenks, Russian old-settlers are engaged in traditional activities. They largely adopted the methods of life support and the experience of nature management from the Evenks [7]. Traditional activities were the basis of the economy in Katangsky District before and during the Soviet time [8]. In the crisis of 1990s, state hunting enterprises decayed and closed. In the early 2000s, obshchinas were organized for preserving traditional activities and lifestyle of local residents that has allowed to them obtain long-term licenses (rights) for hunting and acting as an official legal entity for interacting with industrial companies. At present, for many families of the study area, traditional activities are the main source of food and financial income, mainly from the sable fur sale. Moreover, the products of traditional activities, such as meat, fish, and berries, are one of the aspects of establishing trade and exchange relations with the population of other areas. However, incomes from the sale of traditional activities products are seasonal and irregular due to the influence of various external and internal factors. Membership in the obshchinas does not mean official employment of hunters; therefore, they are actually considered unemployed if they do not work in any other organizations. Almost all officially employed people work in the public sector (administration, education, healthcare, etc.). Local business is poorly represented, with only four entrepreneurs. This is largely due to the remoteness of settlements and the difficulty of doing business without significant governmental support. There are no public year-round highways in the municipality, and regular communication is provided only by helicopter. Winter roads function in the cold season when rivers and wetlands are frozen, usually during three months from the end of December till the beginning of April.

The study area is in the zone of influence of two large infrastructural projects aimed at enhancing industrial activity in the north of the Irkutsk Region and the Republic of Sakha (Yakutia). These are the Eastern Siberia-Pacific Ocean oil pipeline (ESPO) and the Vilyui highway.

The route of the ESPO pipeline passes through the neighboring districts: Ust-Kutsky and Kirensky, but despite this, its influence on the Katangsky District and especially the Nepa municipality is extremely high. In the mid-2000s, the implementation of the project led to the intensification of geological exploration in the region and the beginning of the development of oil fields. Consequently, the number of oil and gas fields in the Irkutsk Region increased from 11 in 2006 to 42 in 2018. Around 15 fields are already in operation, 5 of which are located in the southern part of the Katangsky District [9]. The operating oil fields are connected to the ESPO by a network of pipelines, and they are served not only by air but also ground transport along technological roads, including technological all-year roads. Geological exploration of hydrocarbons continues at the present time; new fields are being discovered, and the network of technological roads is expanding every year.

The final version of the federal year-round highway Vilyui A331 route runs directly through the southern part of the Katangsky District, near the village of Bur, crossing the municipal center, the village of Nepa, passing along the federal Mirninsky winter road connecting the Irkutsk Region (Ust-Kut) and the Republic of Sakha (Yakutia) (Mirny). This route version was adopted in 2009, but so far, in the Irkutsk Region, the road has a year-round status only to the Verkhnemarkovo village of the Ust-
Kutsky District. Despite this, industrial companies already partially use the Mirninsky winter road throughout the year north of Verkhnemarkovo, including in the southern area of the Katangsky District.

It is important to note that in addition to these projects, private logging companies are actively forming their infrastructure network of seasonal and year-round technological roads in the area of the Nepa municipality [10].

4. Results and discussion

SES of the study area characterized by close "human-nature" relationships where nature is not only habitat but also a source of life support, traditional and cultural practices of indigenous people. On the one hand, such SESs are an example of high resilience, as usually, they exist for a long time. However, SESs are open systems that are constantly influenced by various external factors: politics, including geopolitics, technological changes, markets, etc. [11]. In the epoch of global climatic and socioeconomic transformations, SESs with traditional activity of indigenous people are becoming the most vulnerable [12]. Although there are examples of arctic SES demonstrating high resilience under the influence of significant anthropogenic and climatic changes, in such cases it is important to determine the potential of the ecosystems to maintain its functions in the future [13].

This study focuses on the analysis of the effects of external factors of the industrial development on the municipality's natural resources related to geopolitics and new technology. Primarily, it was the project of pipeline ESPO aimed at state geopolitics, which triggered the active industrial development of hydrocarbon resources of Eastern Siberia. Furthermore, advances in technology and techniques have allowed logging companies to move to this northern area. The externality of extractive activities and logging related to the SES also results from the analysis that revealed the weak integration of these industries into the local economy. This situation is primarily due to the institutional framework, including the procedure of distribution of taxes from industrial activities between different administrative levels and tender policy for attracting contractors [14] as well as due to internal factors, such as the weak transport connections between settlements and the lack of qualified specialists among the locals to work in new sectors of the economy.

The effects of industrial development on the SES occurs both through the construction of linear and areal infrastructural facilities in the developed region and the establishment of formal and informal relationships with society (administrative structures, obshchinas, public organizations, and personal communications of industrial workers with locals). These relationships determine different mechanisms of benefit-sharing, including the development of the network of informal roads [15]. The local population adopts this aspect of industrial development in the best way. New technological paths and roads have different meanings for the locals. Some of them that have no value for the activity of locals will be abandoned after the industrial exploitation. In this case, the impact on the SES appears through the functions of the ecosystem. However, new roads may have value in a traditional activity; hunters use them to move around the area by snowmobile and also for hunting activities, for example, for setting sable traps. Some roads are used for communications between settlements, and social interactions have crucial significance for remote villages [10]. For example, due to a weak supply of local grocery and other stores, it is important to find ways of self-sufficiency through the nearest settlements where there are necessary goods. Thus, the social meaning of the informal roads [16, 10] and their accessibility for the local population determine the adaptive abilities of the SES to new conditions.

The effects of the industrial activity on remote small villages of the study area are structured by the objects of impact in the SES. The first one in the system of relations is "human-human"; the second one is "human-nature". The consequences for the “human-human” one are the transformation of social ties and mobility of local residents, who use technological roads [10]. For example, the construction of a year-round road by a forest company near the village of Tokma has led to a transformation of the social interactions of locals with other settlements. Before the appearance of this road, local residents had close social relations with the residents of the Ust-Kutsky District by official winter roads;
howbeit the construction of a technological year-round road by a logging company contributed to the growth of social interaction locals with residents of Novaya Igirma in the Nizhneilimsky District.

An increase in load on the public winter roads, primarily, Mirinsky road, due to the intensification of industrial activity in the region has led to the development of small local businesses specializing in the provision of roadside services: food, trade, etc. However, due to the seasonality of work and irregular road loading, this type of small business is unstable. In the future, with the construction of the year-round Vilyui highway, this activity of locals may bring more stable incomes.

Finally, the effect on traditional activities, on the one hand, is manifested in the relation "human-human" system: adaptation of informal roads for hunting, fishing, and gathering activities; obshchina receive financial and material supports from industrial companies as part of CSR (corporative social responsibility) policy. On the other hand, the negative impact of industrial development on the natural environment leads to a decrease in hunting ground productivities and restricts the opportunities to be engaged in traditional activities. The intensification of industrial work leads to the forests lost not only from felling but also due to numerous wildfires in recent years. A decrease in the forest cover of the study area leads to more active snowmelt in the spring and a rapid water level rise in rivers, which leads to flooding of outbuildings and dwellings, which damages the economy of locals. Research in the relation "human-nature" system requires further detailed interdisciplinary studies, since the reasons for the activation of various natural hazards can be a consequence of not only local transformations in the natural environment but also global climatic transformations. Nevertheless, currently, natural hazards intensify in the SES and significantly affect its functioning.

However, since human action dominates in SES, the adaptability of the system is primarily a function of the social component, including the group of individuals, who manage the system. Their actions affect the resilience of a system, and the collective ability to manage resilience determines whether they can avoid system transformation [4].

5. Conclusion

In the past decade, the SES of the study area has been under the influence of developing industrial sectors oil and gas extractive activities and logging. These new sectors of activity have no significant effect on the economic growth of the Nepa municipality and incomes of residents, but at the same time, they pose challenges for the system to maintain properties in changing conditions. The impacts of industries are manifested in the relation "human-human" and "human-nature" systems. The best adaptive capabilities are demonstrated by the relation "human-human" system, which means that social components have the best adaptive ability, and is typical of SES [4]. Adaptation is successful if the system retains its basic properties, but the system may transform when threshold values are reached [17]. Therefore, to define the adaptation of society, it should be taken into account that natural components are under a strong negative impact of industry, which was emphasized in the "human-nature" system of relations. However, the social components of SES are responsible for identifying threshold states and the vector of development of this system. Consequently, SES management is based on the understanding that society should be actively involved in maintaining ecosystem functions [4]. The lack of conservation and restoration measures adequate to the level of impact on the ecosystem will lead to the transformation of the SES. The importance of avoiding such events in terms of the concept of sustainable development lies in the understanding that the conservation and adaptive management of such SES is not only the preservation of the indigenous communities and their culture but also the conservation of the whole ecosystems within which they are engaged in their traditional activities.

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