

Causal chain analysis

This section aims to identify the root causes of the environmental and socio-economic impacts resulting from those issues and concerns that were prioritised during the assessment, so that appropriate policy interventions can be developed and focused where they will yield the greatest benefits for the region. In order to achieve this aim, the analysis involves a step-by-step process that identifies the most important causal links between the environmental and socio-economic impacts, their immediate causes, the human activities and economic sectors responsible and, finally, the root causes that determine the behaviour of those sectors. The GIWA Causal chain analysis also recognises that, within each region, there is often enormous variation in capacity and great social, cultural, political and environmental diversity. In order to ensure that the final outcomes of the GIWA are viable options for future remediation, the Causal chain analyses of the GIWA adopt relatively simple and practical analytical models and focus on specific sites within the region. For further details on the methodology, please refer to the GIWA methodology chapter.

The issues identified in the assessment as having the highest priority for the region are chemical pollution, oil spills, and modification of neritic ecosystems, lagoons and estuaries in the Kara Sea sub-system. The aim of the Causal chain analysis is to determine the root causes of chemical pollution, oil spills and habitat modification, in order to enable policy makers to prioritise actions in the region. The identified root causes will form the basis for the Policy option analysis in the next section.

The increased water-borne inputs of chemical pollution and oil spills, atmospheric inputs of chemical pollutants are closely connected with oil and gas production, the mining and metallurgy industry, and sea and inland water transport. The modification of the Russian Arctic's ecosystems is a result of chemical pollution and oil spills.

Modification of neritic ecosystems in Kara Sea

Figure 17 shows the causal chain diagram for modification of neritic ecosystems in the Kara Sea sub-system.

Environmental and socio-economic impacts

Changes in the region's marine and freshwater ecosystems, and their degradation as a result of anthropogenic impacts, are manifested by the following negative effects; decreased species diversity, changes in species and the dimensional structure of communities, decreases in the total number and biomass of organisms (especially of benthofauna), a pronounced predominance of species most resistant to pollution, and a decreased intensity and seasonal instability in biological processes (especially of production/destruction).

Because lands have been expropriated for industrial uses and are tainted by pollution, the rural population has lost not only its pastures but also hunting lands and fishing sites, as well as territories where wild berries and mushrooms can be gathered. The indigenous population must therefore abandon their traditional lifestyles and places of residence. Serious conflicts with indigenous population and oil companies because of hunting and fishing sites have occurred (see Annex V).

The conditions in the Arctic region are unfavourable for human health. Morbidity can be directly connected with chemical and oil spills and the overall pollution in the catchments of the Kara Sea. The mortality rate in the region from different diseases is higher than the Russian average. Poverty and growth of unemployment is closely connected with indigenous peoples' loss of their traditional and sustainable relationship with the land. About 25-35% of the area's indigenous population are without a permanent job and survive only by gathering wild berries and mushrooms. The unemployment level is especially high for women

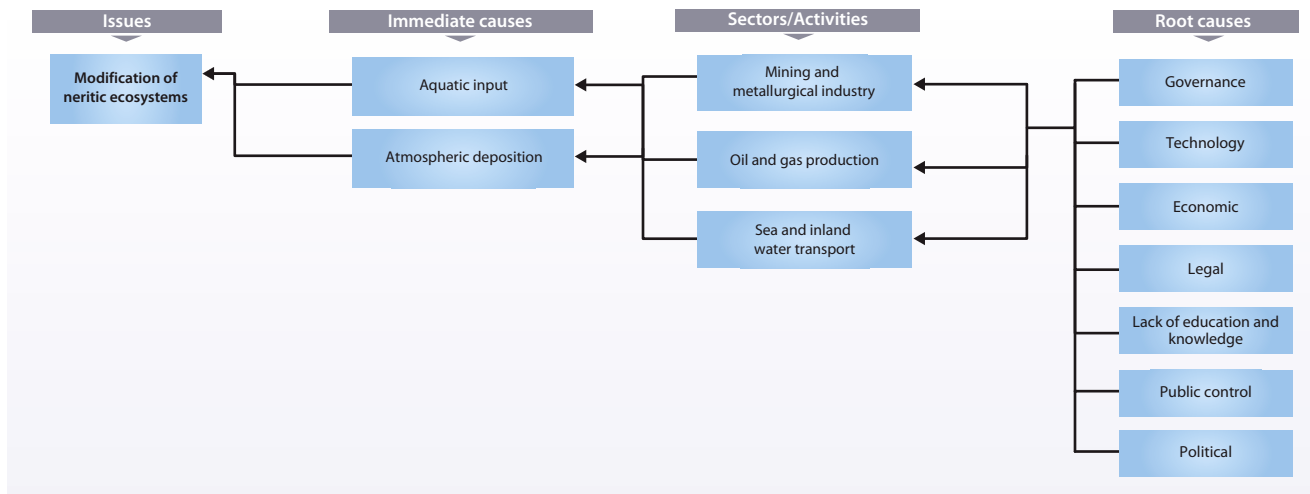


Figure 17 Causal chain diagram illustrating the causal links for modification of neritic ecosystems in Kara Sea.

and young people. As much as 15% of the unemployed indigenous population has stopped looking for a job.

Immediate causes

The immediate causes of the modification of the neritic, lagoons and estuarine ecosystems of the Kara Sea are: (i) Increased water-borne inputs of chemical pollution and oil spills; and (ii) Increased atmospheric inputs of chemical pollution. The following processes are mainly responsible:

- Pollution by petroleum hydrocarbons including polyaromatic ones (benzo(a)pyrene);
- Pollution by persistent organic pollutants (chlorinated hydrocarbons) of agricultural, industrial and community origin;
- Pollution by heavy metals, discharged into the environment by mining and metallurgy enterprises;
- Pollution by other chemical agents including oxides of sulphur, nitrogen and carbon, ammonium, hydrogen sulphide, phenols, nitrogen and phosphorus.

Sectors

The modification of highly vulnerable water ecosystems in the Kara Sea sub-system is a result of the rapid industrial development of the Russian Arctic region after the 1970s. The growth in oil and gas sector was facilitated by the construction of pipelines, roads and ports. Oil and gas development and extraction result in the following kinds of pollution: (i) release of drilling slurry; (ii) occasional and permanent leaks of fuel, lubricants, gas condensate, drilling and other washing liquids; (iii) chemical pollution of water and bottom sediments; (iv) construction of artificial structures (i.e. underwater pipelines); (v) noise and vibration caused by drilling rigs that scare animals; (vi) thermal

impact on environment; and (vii) alterations in habitats for fish and migrant birds. All these factors cause serious damage to many natural resources. Many once-natural ecosystems have been affected by these impacts, which can be seen over a large part of the region (including sea, lake and swamp ecosystems).

Other sectors involved in the modification of neritic ecosystems are the mining and metallurgical industry as well as sea and inland water transports.

Root causes

Economy

Economic causes are linked with inadequate funding of environmental needs such as the reconstruction and modernisation of water treatment plants to control pollution discharged to Siberian rivers, treatment of industrial air discharges, restoration of natural ecosystems, and the provision of nature protection services (Andreev 2001). Poor integration of environmental protection problems with socio-economic planning also leads to water ecosystems degradation. A comprehensive monetary estimation of the natural resources potential (natural capital) in a single state accounting system has never been conducted. The result is a growth in corruption and illegal deals; income is hidden from taxation, which means there is less public money for social and economic needs; and corporate interests tend to dominate strategic problems (Barsegov et al. 2000). Other economic root causes of the modification of ecosystems are similar to the root causes of chemical pollution and oil spills.

Technology

Many of the oil, gas and mineral extracting and metallurgic companies use physically outdated equipment and technologies. Transport vessels

are also outdated, which increases the risk of oil spills. Companies use outdated technologies to neutralise or control industrial wastes. (Andreev 2001).

Governance

In the Kara Sea sub-system control over environmental conditions is weakened due to low level of funding for control services, including funding for modern equipment. New owners of oil, mining, metallurgic and transporting companies that pollute reservoirs are not being forced by the government to completely follow environmental protection legislation and regulations, including paying compensation for damage done to the environment. The need to balance economic demands and the ecological capacity of fragile northern ecosystems is ignored by company managers (Andreev 2001).

Public control

Control over the activity of oil, mining, transporting and other industrial companies by the local population (especially indigenous peoples) is insufficient. The ability of non-governmental ecological organisations to influence decisions about new oil, gas and mineral field development and the construction of industrial infrastructures is extremely limited.

Lack of knowledge and education

Oil and gas administrators and the local population, particularly the rural and indigenous population have insufficient knowledge about current environmental legislation and the principles of sustainable development as described by Agenda 21. The problems caused by chemical and other pollution in Arctic seas ecosystems have been poorly studied. For example there has been little scientific examination of the ecological capacity of the fragile sea and freshwater ecosystems. There is a lack of information to allow the simulation of basic hydrological and ecological processes in Arctic seas, particularly with respect to the estimation of the possible consequences of petroleum product spills and other problems (Annex V) (Denisov 2002).

Legal and regulatory causes

Recently, a series of legislative acts, presidential decrees and long-term governmental programmes has been enacted to regulate the socio-economic and environmental situation in the Arctic and the Russian North (see Annex VII). However the existing legislation is not adequate for solving the region's problems. One of the main root causes of the negative trends in the socio-economic and environmental situation is that there are no regulations or legislation that reflect an agreed-upon definition of sustainable development in the region (Andreev 2001).

Political causes

The precepts of sustainable development have not yet been implemented in concrete international programmes and projects in the Arctic. Indicators of sustainable development that are common for all the Arctic countries have not been agreed to. These indicators should be aimed at reducing the total anthropogenic impact to an acceptable level.

Chemical pollution in Kara Sea

Figure 18 shows the causal chain diagram for chemical pollution in the Kara Sea sub-system.

Environmental and socio-economic impacts

Assessment analysis of the concern Pollution showed that the long-range atmospheric transfer of persistent toxic organic chemicals and pollution via river run-off are very harmful for the marine ecosystem. A decrease of the number and variety of macrophytes and zoobenthos, changes in ecological processes, changes in ethological reactions, bioaccumulation of toxic chemicals, pathological manifestations of contamination and increased mortality are the consequences of anthropogenic impact.

Increasing chemical pollution causes contamination of drinking water and local foodstuffs, such as deer meat, fish, and wild berries that have traditionally occupied an important place in the diets of indigenous and old settlers populations in the Russian Arctic. Different pollution-related illnesses result in a regional mortality rate that is 2.5 times higher than the Russian average. Costs for mitigating this problems are increasing. Because lands are expropriated for industrial uses and are tainted by pollution, the rural population loses its pastures, hunting lands and fishing sites, as well as territories where wild berries and mushrooms can be gathered. The indigenous population must therefore abandon their traditional lifestyles and places of residence, leading to increased unemployment.

Immediate causes

Pollutants are transported into the Kara Sea by currents from the Barents Sea, river run-off from industrial regions in its catchment area, and via long-range atmospheric transport from western Europe and the East. It is important to emphasise the sources of the different kinds of pollutants and to identify the ones that have the most influence. It is also important to define the kinds of activities in the territories of western Siberia that contaminate the Kara Sea sub-system. The

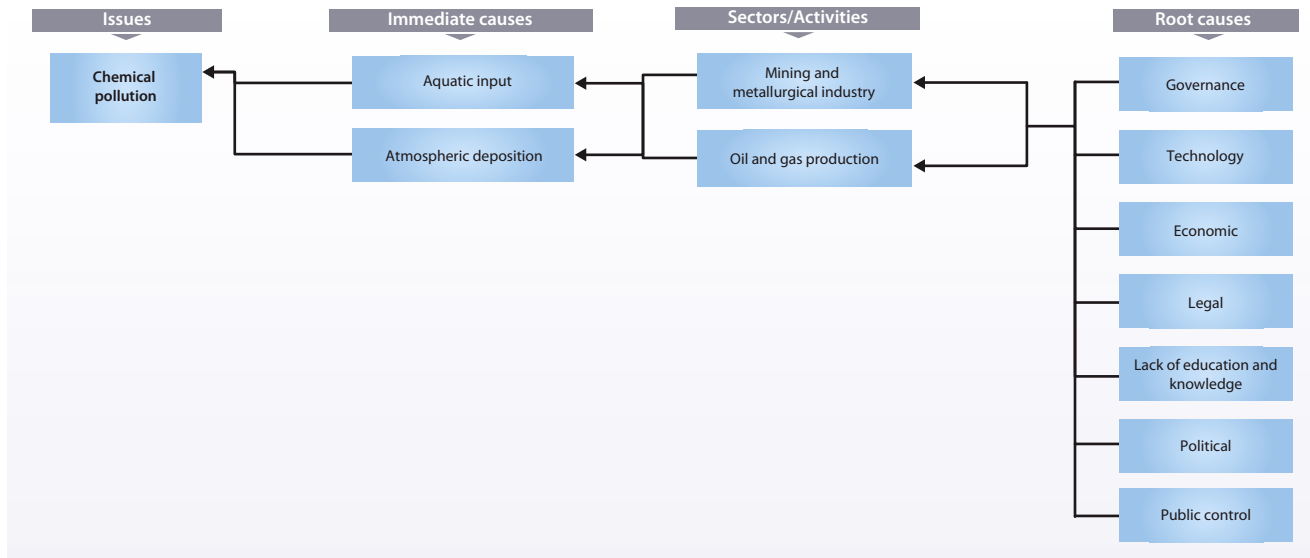


Figure 18 Causal chain diagram illustrating the causal links for chemical pollution in Kara Sea.

immediate causes of chemical pollution are increased aquatic inputs and atmospheric deposition.

Analyses have shown that the major source of contamination in Kara Sea is the mineral resource industry and oil and gas production. In the autonomous districts situated on the shores of the Kara Sea (Nenets, Yamalo-Nenets and Taimyr (Dolgano-Nenets)), more than 95% of the industrial production is accounted for by the fuel industry, and the mining, and smelting and processing industry. Nowadays every fourth cubic metre of the world's gas is extracted in Yamalo-Nenets AD. Oil and gas development poses a significant threat to environment due to pollution from oil and gas extraction, and oil and gas spills from pipeline breaks.

However a much more dangerous threat to water bodies is posed by the chemical pollution from the mining and metallurgy industry. At present, the Norilsk industrial metallurgical complex, in the Taimyr Territory (Dolgano-Nenets) AD provides up to 20% of the world's nickel and cobalt, 65-70% of the copper and 100% the world's platinum metals (Anon. 1998). Point sources of pollution in Norilsk vent 31 different substances including sulphur dioxide; 40 000 tonnes of dust are vented every year, of which 18% is pure nickel. An estimated 5 kg of chemicals and contaminants falls on every square metre of Norilsk. These substances eventually find their way to the water.

The air emissions from the Norilsk industrial complex are nearly three times greater than those from all the shoreline industries in the region (Table 18). In fact, this industrial complex holds the dubious distinction

Table 18 Air pollution in the Russian Arctic region.

Administrative unit	1992	1995	2000	2001
Nenets AD	ND	24 000	8 000	8 000
Yamalo-Nenets AD	ND	757 000	576 000	587 000
Taimyr (Dolgano-Nenets) AD	ND	22 000	16 000	12 000
Republic of Sakha (Yakutia)	ND	120 000	134 000	130 000
Norilsk metallurgical complex, Taimyr Territory (Dolgano-Nenets) AD	2 208 300	2 041 400	2 149 100	2 114 800

ND = No Data.

(Source: Regions of Russia 2002, Goskomstat 2002)

of emitting the most amount of pollution of any industry or activity in all of Russia. The Norilsk region is currently considered to be ecologically unstable.

Sectors

The main threat of chemical air and water pollution in the Kara Sea sub-system is posed by the mining and metallurgical industry (Norilsk industrial complex), particularly as a result of air emissions from the complex. All other industries in the region are undeveloped and tend to be of the service type. Transboundary atmospheric transport of chemicals poses a significant additional threat to Arctic seas. Oil and gas production industries in the region also contribute to pollution.

Root causes

Economy

Failures in market reform

The shock of the transition from a centralised state system to liberal market relations in Russia in 1992 hampered the creation of sustainable

market structures and an adequate system for supporting communities in the north. When the reforms began many of the state supports for the population were eliminated. The failure of these reforms sharply decreased both production and tax incomes in Russia. But the most serious consequences of the crisis were in the north, where the very survival of the population was threatened. The abrupt decrease in production and the associated drops in tax incomes and business investments were combined with a dramatic increase in consumer costs after 1990. As a result, the financing of social and environmental needs has been greatly reduced.

The majority of newer state programmes dating from the mid-1990s and designed for the social and economic development of the northern Russia up to the year 2000 were never completed due to lack of money. Improvements in the socio-economic situation in the north were evident only after 2000. The reforms have meant that the financing of nature conservation measures has been drastically decreased (Regions of Russia 2002).

During the economic crisis, it was impossible for the state to regulate polluting industries and force them to clean up because to do so would have resulted in mass bankruptcies and a growth in social tensions. Additionally, a powerful industrial lobbying group hindered the Russian government in its efforts to toughening environmental protection and monitoring of mining operations. Industry has preferred to pay to pollute rather than to invest in clean-up and treatment technologies. Local authorities, under pressure from new business owners, have sometimes even decreased or eliminated pollution payments, even though this is prohibited by federal legislation. There are even cases in which these pollution payments have been used inappropriately on expenditures other than for the mitigation of industrial environmental impacts (Barsegov et al. 2000).

Strategic forecast failures

When market reforms were first introduced, the state had not performed complex long-term strategic forecasts for some time for socio-economic development in the north. Consequently, when northern industries were first purchased by new owners, the owners thought only about momentary gains, without concomitant spending on social and ecological needs.

Federal programmes from the mid-1990s onward were designed to encourage socio-economic development in northern Russia up until the year 2000, but these programmes did not establish a dependable system of environment protection.

The Russian government still does not accept a long-term federal strategy that would enable the Arctic zone to make the transition to an economy that is based on the principles of sustainable development. The main parts of the Arctic development strategy have already been created by the Council of Industrial Forces Relocation (Andreev 2001), but the strategy does not achieve the goals set by Agenda 21 and other international targets agreed to at the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro 1992 and World Summit on Sustainable Development (WSSD) in Johannesburg 2002.

Technology

Many of the mining and metallurgical plants operated by Norilsk and other industrial complexes in the Kara Sea sub-system use aging and worn-out equipment and technologies that date from the 1940s and 1950s. This explains why more than 2 500 000 tonnes of pollution is discharged into the air and water every year. There is an urgent need for industrial renovation, pollution treatment facilities and wastewater treatment and recycling systems. However, these investments are very difficult to achieve due to lack of finances (Regions of Russia 2002, Barsegov et al. 2000).

Governance

The regulation of polluting industries in order to protect the environment is weak in the Kara Sea sub-system due to lack of financing for control systems, including the replacement of outdated equipment with modern equipment with pollution control systems. The payments that industries make to pollute the environment are unreasonably low and are not effective economic regulators (Barsegov et al. 2000).

Public control

The local population, particularly the indigenous population, has insufficient say or control over environmental protection issues. Non-governmental ecological organisations have virtually no effect on economic decisions (Barsegov et al. 2000).

Lack of education and knowledge

The local population, particularly the rural and indigenous population, know little about existing ecological laws and principles of sustainable development, such as are described in Agenda 21. It can be difficult for them to gain access to current, accurate environmental information in order to aid decision-making. Most parts of northern Siberia have no computer network with Internet access; indeed, a considerable part of the population has had difficulty getting access to newspapers and journals during the period of reforms. The overall levels of public education declined radically. Atmosphere and climate monitoring



Figure 19 Kara Sea.
(Photo: NASA)

services were cut back. Financing of ocean research expeditions was reduced, so that the long-term ecological monitoring data set was interrupted (Barsegov et al. 2000).

Legal

Recently a series of legislative acts, presidential decrees and long-term governmental programmes have been enacted to regulate the socio-economic and environmental situation in the Russian Arctic (see Annexes III and IV). However these efforts are insufficient in terms of sustainable development in the Arctic because there is no agreed-upon approach to sustainable development for the Russian Arctic region. It testifies to absence of system approach of the legislative base of the Russian legislation conformably to Arctic from the point of the sustainable development (Andreev 2001).

Political

A large part of chemical pollution of the Arctic seas comes from European and Asian countries as well as the US as a result of transboundary air and water flows. The annual amount of sulphur and nitric oxides transported to the Arctic from Europe amounts more than 400 000 tonnes, and from Siberia, the Far East, Kazakhstan, China and Middle Asian countries, the amount is estimated to be as much as to 230 000 tonnes (Barsegov

et al. 2000). International efforts and multinational cooperation will be required to limit this flow of pollution to the Arctic.

Conclusion

This causal chain analysis demonstrates the clear links between environmental and socio-economic impacts, immediate causes and root causes underlying the increase of chemical pollution in the Kara Sea sub-system and other Arctic sea basins. These links are shown in Figure 18. The root causes of chemical pollution that have been identified as a result of this assessment cannot be overcome over the short-term. Time and significant resources will be required.

Oil spills in Kara Sea

Figure 20 shows the causal chain diagram for oil spills in the Kara Sea sub-system.

Environmental and socio-economic impacts

The exploitation of oil fields in the Kara Sea sub-system and the transport of this oil, whether by boat or pipeline, have increased

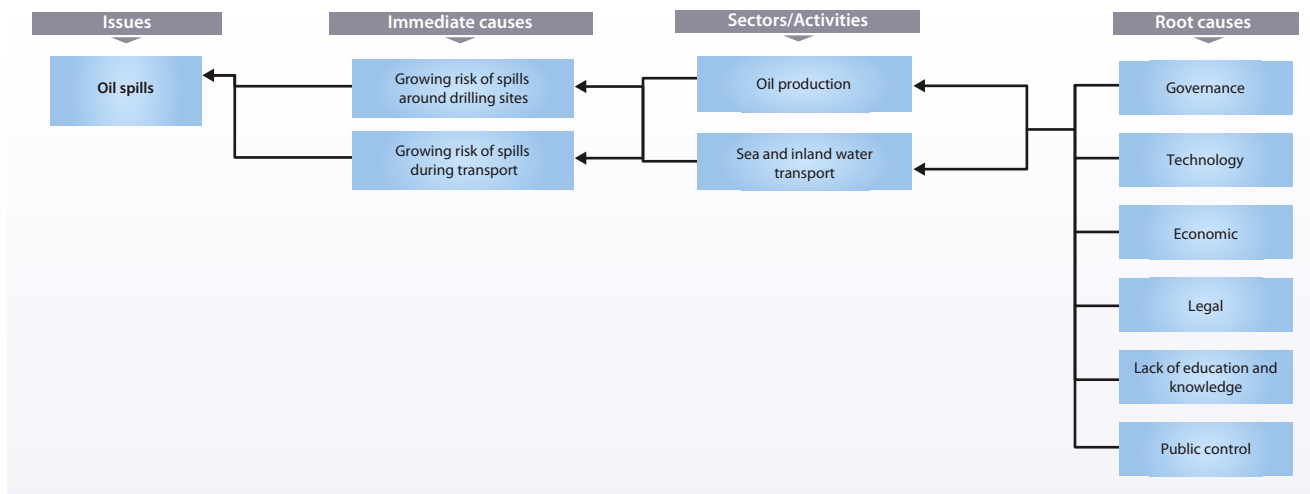


Figure 20 Causal chain diagram illustrating the causal links for oil spills in Kara Sea.

the risk of oil spills, which are harmful for marine communities and organisms. The larger spills result in injury and death of birds and mammals in the vicinity of the spill (Borisov et al. 2001). The microbiological population changes both in number and genetic characteristics as a result of oil spill pollution. Furthermore, bioaccumulation of hydrocarbons, and changes in behaviour of fish and benthic organisms occurs. Finally, the ecosystem's functioning is disturbed.

The high concentration of petroleum products in the region's waters destroys the quality of river and lake fish, and can affect berries and mushrooms (Yevseev 1996). Because lands have been expropriated for industrial uses and are tainted by pollution, the rural population has lost not only its pastures but also hunting lands and fishing sites, as well as territories where wild berries and mushrooms can be gathered. The indigenous population must therefore abandon their traditional lifestyles and places of residence. About 25-35% of the area's indigenous population traditionally survived due to gathering wild berries and mushrooms. The generally unprofitable nature of traditional trades worsens the unemployment problem. Oil pollution is also attributed with the higher-than-average levels of morbidity and mortality in the population. The mortality rate from different diseases in the Russian Arctic region is significantly higher than the Russian average. Additionally, the mortality of indigenous population exceeds the mortality of newer arrivals to the region.

Immediate causes

Several kinds of oil pollution disturb the Kara Sea sub-system, divided into two main immediate causes:

- The increasing risk of oil spills near and around drilling sites as well as occasional and permanent leaks from ground-based (near-shore) and undersea oil fields ;
- The increasing risk of spills during transportation such as pipeline accidents, occasional or deliberate release of dirty water, lubricating fluids and fuel from all kinds of transport into the sea and river ports and when transporting cargo along the Northern Sea Route NSR, accidents with cargo vessels (tankers) and equipment.

The intense development of oil fields in the Kara Sea sub-system began in the early 1970s. Until recently, oil wells have been land-based, and the oil is mainly transported via pipelines. Oil spills often occur during drilling, which results in soil pollution of soil and ultimately rivers and lakes. The peak extraction levels were reached by the end of 1980s. From 1992-2000 extraction decreased by about 1.5 times. During the same period transport along the NSR dropped nearly to zero; the number of sea transporting vessels in the Arctic decreased by five times, while the number of trips decreased two-fold. Researchers have noted that the drop in oil production has led to an improvement in water quality in Siberian rivers and restoration of fish stocks (Anon. 2000).

But the goal of the "Energy strategy for Russia until 2020" from the Russian Federal Council (2002) is for an increase oil extraction, including drilling on Arctic continental shelf. The plan also calls for a growth in sea and river transportation, particularly for oil transport, which makes the threat of oil spills more real. Different statistical sources report that an average of 130-160 tonnes is lost for every million tonnes of oil transported (Borisov et al. 2001). The energy strategy also calls for increases in the level of oil extraction in the Kara Sea sub-system to 40-

50 million tonnes in 20 years. This means as much as 8 000 tonnes of oil could be lost in transport, or an amount that is equivalent to what could be lost in a large tanker accident. But unlike a tanker accident, these spills will occur over a long period and will be spread along the vast area of the Arctic seas. In sum, the main pollution threat to the Kara Sea sub-systems from the oil industry and associated sea and river transportation.

Root causes

Economy

Failures in market reforms

The shock of the transition from a centralised state system to liberal market relations in Russia in 1992 hampered the creation of sustainable market structures in the oil industry. The economic crisis caused by failures during this transition period sharply decreased the levels of both oil extraction and tax incomes. As a result, financing for social and environmental needs was greatly decreased. The export-oriented Russian economy is sometimes perceived as the main reason for the press to increase in oil and gas exploitation and transportation in the Arctic seas without an adequate attention to ecological safety. As a result, the risk of accidents and oil spills may increase (Barsegov et al. 2000, Lvov 2002).

Corruption

Even though it has been over 10 years since the introduction of market reforms, there still is no effective state regulation of the monopolies that exploit publicly owned oil, coal and mineral fields. The profits from these privately owned companies, which are estimated to be in the trillions of US dollars, are hidden from taxation, and company owners profited greatly. The magnitude of these profits was evident even in the earliest years of market reforms when a huge disparity in incomes was common. This situation jeopardises for sustainable development. More than half of Russia's population had to struggle to survive. The natural resources extraction sector became highly corrupt (Lvov 2002).

Domination of corporate control over strategic problems

Most of the Russian oil companies allow short-term profits to dominate over the long-term ones. These companies do not put sufficient investments into the kinds of infrastructure that allow for clean oil extraction and transportation, nor do they fund environment protection measures, such as information centres, emergency services, and monitoring systems. The absence of a long-range well-coordinated plan for the development of petroleum production in the Russian Arctic prevents oil companies from investing in programmes for environmental protection. Instead, when the oil wells run dry, oil companies leave nothing but destroyed ecosystems and social crises.

A similar situation exists with respect to transport services, which have been transferred to private ship-owners, who are not interested in modernising their aging fleets. This increases the threat of oil spills. There is no single Arctic policy designed to solve the problems posed by the use of the Northern Sea Route (NSR). Such a policy was implemented under the planned economy but currently the state does nothing to support the NSR, even though it is a very significant route for the Russian Arctic.

Technology

Many oil companies use outdated equipment and technologies (pipelines in particular). The different Russian Arctic emergency services are equipped with the equipment to clean up relatively small oil spills (up to 500 tonnes) not far from the Arctic coastline. However, these organisations are unable to cope with large-scale oil spills in remote ice covered Arctic seas (Patin 2001).

Governance

The sustainable development of the Arctic is impossible without reliable data, including the monitoring of natural systems, hydrometeorological conditions and ecological situations. An arctic monitoring network must include stationary research stations and other structures, research vessels and satellites for remote monitoring. However in the 1990s, financing for the environmental monitoring network in the Kara Sea sub-system was severely cut back. Air quality observations were cut by nearly five-fold, and the sea hydrometeorological network was cut by more than 30%. This reduced the quality of the forecasts for storm and ice conditions, ship-icing and consequently increased the risk of dangerous situations, including oil spills (Andreev 2001). New owners of oil and transport companies that cause oil spills are not forced by the government to follow the ecological legislation and regulations or to pay compensation for the damage done to the environment (Barsegov et al. 2000).

Public control

The public has insufficient control over the environmental impacts from the level of activity of oil extraction and transport companies. The local population has little or no control or influence over the conditions and restrictions on new oil field development.

Lack of knowledge and education

The local population, particularly the rural and indigenous populations, does not have enough information about existing environmental protection legislation and the principles of sustainable development as described in Agenda 21. Gaining access to this information is also difficult. Tanker transportation in Arctic conditions entails a complex

of natural factors (polar night, seasonal ice, frequent storms). All this presupposes special knowledge and skills on the part of the crew. With the decrease of cargo traffic along the NSR, the lack of experience in large-tonnage tanker navigation in Arctic conditions is more and more evident (Andreev 2001).

Legal

Recently, a series of legislative acts, presidential decrees and long-term governmental programmes has been enacted to regulate the socio-economic and environmental situation in the Arctic and the Russian North (see Annexes III and IV). But these efforts are insufficient in terms of sustainable development in the Arctic because there is no agreed-upon approach to sustainable development for the region. It testifies to absence of system approach of the legislative base of the Russian legislation conformably to Arctic from the point of the sustainable development (Andreev 2001). Environmental Impact Assessments (EIA) procedures for providing emergency clean-up equipment for complex oil and gas installations are not common practice in Russia.

Conclusion

Sustainable development in the Arctic will require the balanced coordination of economic, social and ecological aspects of development, with an emphasis on human welfare, particularly because

threats to the environment also threaten the well-being of indigenous minorities. Because the Arctic environment is extremely vulnerable, the capacity of the environment to absorb or withstand the negative effects of pollution must be taken into account during oil and gas production. However, until now, the Russian government has not adopted a long-range state strategy to allow the transition of the Russian Arctic region to sustainable development, even though the main components of such a strategy have already been created by the Council of Productive Forces Relocation (Andreev 2001).

As rapid industrial development is predicted for the region, the adoption of this strategy should be given priority. The existence of the strategy demonstrates that the Russian government has the ability to meet the sustainable development goals set by Agenda 21 and other international targets agreed to at the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro 1992 and World Summit on Sustainable Development (WSSD) in Johannesburg 2002. Nonetheless, Arctic countries must also participate in defining a strategy for Arctic sustainable development given the fragile ecosystems and unique cultural heritage. Russia has in principle declared support for the concept idea of sustainable development in decrees from the president and the government (see Annex IV). At the same time the living conditions in Arctic are so extraordinary, that the practical realisation of sustainable development will require not only special national programs, but international efforts.