School of Mining and Geosciences

Course: Thesis Literature Review (BSc in ME)

Impact of Covid-19 on the Mining Sector in Kazakhstan

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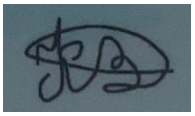
Declaration

I hereby declare that this literature review on the topic “An integrated web-based automated open stope design tool” is the result of my own work and all sources of information including figures, tables and other materials contained within the paper have been duly acknowledged.

Zere Kabdygaliyeva 

Abstract

The COVID-19 pandemic significantly affected various industrial fields worldwide. This thesis review report will discuss the impact of the outbreak on the mining industry. Despite the cautionary and restrictive measures undertaken immediately by the mining corporations to take the situation under their control, the industry experienced losses and difficulties. The major ones concerned the well-being of employees, their employment status, maintenance of supply chains and rates of export, issues with logistics, funding and unplanned expenses. The local economies of the countries that heavily depend on mining suffered extensively due to their Gross Domestic Product values dropping significantly. The aim of this review report is to provide a thorough analysis of the impact of the COVID-19 outbreak on the above-mentioned realms of the mining industry based on the examination of the cases of Kazakhstan, India, Brazil, South America, the USA, Mongolia, African and European countries. The thesis will provide the analysis of the local Kazakhstani mining companies' strategies to overcome COVID-19 crisis and difficulties they faced. The thorough examination of the dominant six minerals on Kazakhstan's mining market, namely aluminum, chromium, lead, coal, iron and copper, that were affected by the pandemic will be based on the analysis of the data from the official sources. The pie charts, tables, and graphs are created based on the data taken from the Bureau of national statistics of the Agency for strategic planning and reforms of the Republic of Kazakhstan. The analysis is done by evaluating the causes of deviation of prices on the ores and minerals, delays in production, exploration, transportation, and fieldworks accompanied with the strategies to resolve the occurring issues. The situation in the global mining market at the beginning of the pandemic, including the specific situation within Kazakhstan's market, is provided in detail and compared to the current one. The correlations between the flow of the COVID-19 and the drop in mining production rates are included. Based on the analysis, the forecasts about the future of the mining industry and the speed of the recovery process are covered as well.

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1 INTRODUCTION

1.1 Background

The mining industry involves a wide range of processes. The main ones are production and exploration stages, which include the fieldwork. At this stage the extraction and processing of the ores and minerals and preparation of them to the export is done. The mining industry has been functioning flawlessly until the 2020 when the COVID-19 suddenly occurred and negatively affected the industry by delaying and even shutting down some of the stages. For instance, due to the drop in prices and demand of certain ores like aluminum, the exploration and production of this metal stopped. Furthermore, the production and supply of coal has been significantly shortened (Simon M. Jowitt, 2020). The same scenario has been viewed in the market of magnesium, cooper and other mineral ores. My analysis is focused on Kazakhstan and European mining industry analysis during Covid-19.

On the global market the leading countries, which, in turn, appeared to be the significantly damaged ones are India, Brazil, South America, the USA, Mongolia, African and some European countries. From the analysis and review of the available literature and official data, it was noticed that the market of gold was the one experiencing the least damage and deviation in prices, leaving the African mining industry less impacted by the consequences of pandemic.When it comes to the European countries, especially Germany, it was observed that these countries were the first to successfully implement the restrictive measures and reduce the COVID-19 cases significantly among their employees.

Regarding Kazakhstan's mining realm, there was conducted an analysis of the six main minerals. These are aluminum, chromium, lead, coal, iron and copper. Among them iron and copper ores experienced a peak in production during the pandemic and only aluminum, chromium, lead, and coal had declines in production and extraction rates. The copper and coal ores are extracted from East Kazakhstan, Pavlodar, Karaganda regions, iron, aluminum, and lead mainly from Kostanay, and chromium from Aktobe regions. The thesis further provides a deep analysis of the effect of pandemic on each of these regions.

1.2 Problem Statement

There were several consequences of the pandemic that heavily affected the mining industry that need to be addressed:

- The employees issue

  Human morbidity and mortality are still of primary importance. The number of workers in the industry at the beginning of the pandemic shortened significantly. As a result, some of the factories stopped functioning.

- Low export and production rates

  Due to the shift to the online format of working and impossibility to maintain the usual functioning of factories, the amount of the mining products that were expected to be delivered on the international supply chains were shortened.

- Transportation delays

  The issues with the logistics due to the limitations because of COVID-19 were worsened by the unexpected transport delays. This, on the other hand, negatively affected the funding and financial management of the industry.

- Unexpected financial risks

  The restrictive measures undertaken by the mining corporations led to major unexpected financial expenses. This negatively affected the funding opportunities of the industry making the stakeholders and major mining companies experience almost a financial crisis.

1.3 Research Objectives

The main aim of this thesis report is to assess the impact of the COVID-19 outbreak on the mining industry of various countries worldwide, including the examination of the functioning of Kazakhstan's mining corporations. The analysis covers the following areas:

- Impact of pandemic on the economic situation of the countries worldwide.
- The evaluation of the efficiency of the strategies that were implemented to overcome the issues caused by the COVID-19 specifically to Kazakhstan's mining corporations.
- The analysis of the data about the mining production rates of the six minerals in Kazakhstan, including the construction of tables, pie charts, and graphs.
- The forecasts about the recovery process of the whole industry.

1.4 Project’s significance to the industry

The review report is of great importance since it offers a wide range of benefits to the industry. First of all, it provides the assessment of the efficiency of the strategies to overcome the financial, productional, socio-economic and human resources crises of the mining industry caused by the global pandemic. The summary, description and detailed analysis of these strategies can be considered as options to help Kazakhstan's mining industry to recover. The pandemic will take a long time to recede, so the mining sector in KZ has to adapt to the new environment as fast as possible. This review report can provide the ways to do this in a most safe and successful way. Moreover, the examination of the current situation on the global mining arena can serve as a valuable tool for creation of the plan for the local Kazakhstani mining stakeholders to get the most profit from the current situation and minimize the future risks for the local industry.

2 LITERATURE REVIEW

2.1 Impact of COVID-19 on employees morbidity and mortality

One of the impactful consequences of the COVID-19 pandemic on the mining industry included the human morbidity and mortality issue. As a result, production was reduced, some companies had to temporarily close their factories due to a shortage of workers at the beginning of the pandemic (Andrzej Gała´s et al., 2021).

In European countries, the mining corporations did not stop functioning and allowed employees to continue working, but under certain restrictions (Andrzej Gała´s et al., 2021). Companies in Chile, Canada, and Argentina were cutting production and the number of workers in coal, copper projects (Timothy Laing, 2020). In addition, the increase in mortality of the people due to the COVID-19 outbreak significantly slowed down the production rates, despite the taken safety measures during the first couple of months (Timothy Laing, 2020). However, as time passed by, the situation improved.

For instance, West Africa, where workers were better aware of the isolation of people and were equipped with screening devices, because of the Ebola epidemic can be considered as an example. This industry has been fortunate in terms of working far from the population and the possibility of a small number of people being in the mine. As a result, the rates of human mortality were lower than in European and South American countries. (Simon M. Jowitt, 2020). Nevertheless, as discussed by Lone A. S. and Ahmad A. (2020), the situation differs in the South African mining industry. Thousands of workers in that region because of the underground working conditions are more exposed to becoming COVID-19 catalysts, which makes the negative impact on industry almost unavoidable (Lone, S. A., and Ahmad, A., 2020).

Considering the most industrialized part of Poland - Upper Silesia, the coal mines there were located in a small area here and, as a result, the number of infected people increased sharply at the very beginning of the pandemic, which led to a sharp decrease in income of the mining corporations. These high rates of the COVID-19 spread in Silesia can be explained by the high number of older people working on the mining corporations, having not enough socio-economic facilities available for the detection and prevention of the disease, as argued by Robert Krzysztofik et al. (2020). Because the miners were quick to react and cope in the early stages, mining in Poland did not stop and profits

were restored, the losses for the previous year were not global and did not affect the level of the country's raw material security as mentioned by Andrzej Gała´s et al. (2021).

Overall, despite the mortality and morbidity issue of the staff, the majority of the goals of the worldwide mining industries were met on time, as the response to the spread of COVID-19 was quick and orderly. It was also decided to switch many employees to remote work and hold meetings online. However, at the same time, the efficiency of mining workers remained unchanged (Javad Sattarvand, 2021).

2.2 Impact of COVID-19 on the employment status of mining workers

Despite the issue of human mortality and morbidity being resolved as the situation with COVID-19 progressed, the risks of employees losing their job position was still present and caused significant concerns among the workers of the industry. Several major mining companies all over the world started to put certain restrictions on the employees and their working conditions, which was one of the causes of increased unemployment in this sector (Cassells R. et al., 2021).

In April 2020, an online survey by the Irish Research Center of 1,000 mining workers from 55 countries found that around 65% of people in this sector were affected by COVID-19. The results were the following. It was identified that approximately 18% of laborers from the mineral exploration sector and 24% of laborers from the mining industry have experienced decreased hours of job. Moreover, 45% of miners in Africa were laid off or were temporarily suspended from their work. Miners from South America came second after Africa with 34% in the change in employment status to negative. The strongest performance was in Europe, where 70% of respondents continued to have positive employment status. Miners over 45 were more susceptible to shorter working hours (22%) relative to the younger group (14%). This survey was conducted to understand the differences between official statistics and actual employee experience in the midst of the initial wave of the pandemic (Murray Hitzman et al., 2020).

Considering the case of sub-Saharan Africa, 89.2 percent of the population are employed in agriculture and mining. In addition, it provides financing used to improve conditions in agriculture and creates a huge number of jobs related to the mining industry, such as laborers in the processing industry, suppliers of equipment and goods, product sellers. Compared to the rest of the world, these places resolved the problem of employee mortality faster. However, these regions are still under great stress due to the risks of stopping work at the mine, unintentionally breaking off relations between the

enterprises, and not complying with agreements within the entire ASM network as discussed by Gavin Hilson et al. (2021). Moreover, J. N. Muthuri et al. (2021) argues that the improvement of the overall situation in the African region can be further delayed due to the migration of the workers and artisans who leave the industry because of the crisis. In addition, R. N. Naidoo et al. (2021) points out the long-term consequence of the pandemic on the sub-Saharan mining industry to be lack of investment into the exploration works, technologies, and increase in tax rates.

As a result, the mining industry suffers from an economic point of view due to restrictions such as the impossibility of free movement of vehicles, physical distancing, and staff reduction. Due to the fact that there is no formalization in the sub-Saharan Africa region, some companies cannot obtain proper permission, which is necessary to work with banks and other organizations that can provide support, which may lead to a significant reduction of the job positions and raising the rates of unemployment (Gavin Hilson et al., 2021). In addition, as mentioned by Warren Bernauer and Gabrielle Slowey (2020), several mining corporations used the crisis in their own interests to reduce the benefits of their employees such that of those who were suffering from black lung due to COVID-19.

In total, by conducting a survey among workers in the mining industry, which can be used as additional information to official statistics, results that were obtained regarding the impact of COVID-19 on changes in employment status showed a high level of public concern but still stayed in the range of inconclusiveness (Murray Hitzman et al., 2020).

2.3 Strategies to cope with COVID-19 impact and unplanned expenses

Since the COVID-19 pandemic, as discussed above, caused significant difficulties in the employment status of workers, their mortality and morbidity, it required a more strategic approach to cope with all these consequences and related unplanned expenses.

There was a case in Mongolia that made the government start the implementation of the restrictive measures. A number of limitations were imposed on the border with China and Russia at the very beginning of the pandemic after a driver who came from Russia tested positive for COVID-19. At the same time, tracking of COVID-19 cases began in countries around the world simultaneously, where it turned out that the number of infected people and deaths was growing rapidly. Accordingly, certain regulations were taken to work at the mine, since this already started to seriously affect the local economies of the countries that depend on the mining industry (Namuun Tsegmid, 2021).

Such strategies mainly included such limitations as compliance with safety regulations such as regular

disinfection, temperature control; use of antiseptics, wearing masks; social distancing, reduction of travel expenses for the fieldworks. This became a difficult experience for some mining companies and led to unplanned expenses. As a result, it was necessary to lower the number of infected people. Hence, to reduce the possibility of infection of people, enterprises had to divide laborers in the mine into groups that work at different times and increase the number of vehicles to transport their staff. The timely isolation of employees in case of infection, a ban on business trips, observance of curfews, and, if possible, remote work were included. Moreover, the testing system has been improved to identify infected workers (Namuun Tsegmid, 2021). As discussed by Iqra Atif et al (2020), there were implemented several modern digital technologies for early pre-screening of the infected people, which made the industry less vulnerable.

Although in European Countries, such as Austria, Poland, Serbia and Sweden, as well as India, and Brazil mining companies experienced large unplanned expenses for the support of workers, medical services, protocols, equipment for health testing, after the decline in prices, there was a slow recovery of the processes of the mining life cycle. This was possible because of changing the restrictive measures and starting to recover the pre-COVID functioning of mining corporations (Andrzej Gała´s et al., 2021). As noted by Ramaganesh Marimuthu et al (2021), it was also important to keep ecological sustainability while recovering the functioning of the industry. That is why several eco-innovative practices were implemented as well (Marimuthu, R. et al., 2021).

For instance, in the beginning, the companies wanted to close out-of-state goods production because the demand for ore had fallen and hold the majority of the meetings online. Presently, the restrictive measures were loosened. Many countries did not stop mining and allowed workers to continue working. This appears to be the only effective strategy for current days to cope with the COVID-19 and maintain the functioning of the corporation along with ensuring the safety of the personnel (Javad Sattarvand, 2021).

To sum up, the strategies of coping with the unexpected expenses that appeared during the COVID-19 pandemic mainly focused on reducing the number of infected workers and included strict measures combined with almost a full shift to the online work mode. However, as the situation with the pandemic became better worldwide, the companies started to gradually recover the normal work process.

2.4 Aid and support needed by the employees of the mining industry

The consequences of the COVID-19 outbreak hit the workers, employers, and employees of the

mining corporation all over the world. Hence, the support and help these people need are a primary priority.

It is worth taking into account the situation with the COVID-19 outbreak in the USA and the state of Nevada in particular. The pandemic has become not only a problem for the economy of this state but also an opportunity to develop mining even in a crisis, by changing the way of interaction between workers, putting first and foremost the safety and health of workers (Javad Sattarvand, 2021).

For instance, Nevada mining companies support each other and help local people by donating millions of dollars to education, small businesses, and vulnerable communities. Nevada enterprises in 2020 managed to achieve profits that were more than planned, without losing employees and serious production problems (Javad Sattarvand, 2021).

However, not in every country, the situation is as pleasant as in the case with Nevada mining corporations. It is important to consider the case study of the situation in Mongolia, which is known for its dynamic artisanal and small-scale gold mining (ASGM). Since the income of a large part of the ASGM population depends on daily mining, isolation undermines the economic situation of the people. In June 2020, research about the influence of COVID-19 on the mining industry was conducted, which found that 67% of 371 artisanal gold workers had lost income, although 98% of them affirm that the price of gold had not changed. PlanetGOLD found out that due to delays in obtaining permits and registrations, the number of illegal mining operations has increased (Namuun Tsegmid, 2021). Because of the circumstance that many miners have loans that need to be paid off to refineries on time that were reaching the sums of about 2 to 10 million MNT, workers have to look for new jobs or continue illegal gold mining (Namuun Tsegmid, 2021). Nevertheless, measures are already being taken to improve the situation in Mongolia, namely vaccination of workers and rapid testing for COVID-19. The author argues that in the future, supply chains should be stabilized so that employees can recover their salaries after the pandemic (Namuun Tsegmid, 2021).

Taking the case of the sub-Saharan Africa region, according to economic forecasts, in 2021, the profits will decrease by more than 23% as ore production is decreasing due to the pandemic. The regions of sub-Saharan Africa are going through a tough time because there are many vulnerable groups of the population, a small budget and there are 27 of the world's 28 poorest countries. It was analyzed by Lu, H. et al. (2020) that the employment issue in the African mining industry caused low rates in mineral demand on the global market. At the present time, it is very important to ensure economic stability, employment of people, and reduce poverty in those places.

Overall, the employees of the mining sector are experiencing hard times with employment status,

loans, decreased salaries, and even unemployment. In some regions of the world, the situation is improving through vaccination and safe working space. However, this trend is not positive worldwide. Luis Escalante (2021) discussed that the change of the work format of the employees to the remote one has also caused a deep crisis in the industry. In addition, B. Y. A. Asare (2021) stated that the mental well-being of the mining corporation's employees has been affected by the COVID-19 restrictions and new life conditions leading to decline in overall productivity of the labor forces. Hilson argues in his article that the mining sector can resolve this issue efficiently if it continues to develop during this difficult period and integrate the innovative safety measures to come back to the Pre-COVID-19 functioning state (Gavin Hilson et al., 2021).

2.5 Impact of COVID-19 on mining industry's production costs

The COVID-19 global pandemic had complicated consequences that significantly affected the mining sector's production costs resulting in the shut down of the work of many enterprises. This is further discussed in detail in the paper "The economic impact of the Coronavirus 2019: Implications for the mining industry" clarifies the potential impacts of Covid-19 on the mining industry from an economic point of view (Timothy Laing, 2020).

Timothy Laing pointed out that during the time, when the demand for ore in the UK has declined in March 2020, the prices of some metals and minerals fell sharply, notably aluminum and copper, and this, in turn, affected the mining sector (Timothy Laing, 2020). Consequently, shares of large multinational mining companies such as BHP Billiton and Rio Tinto fell and the price dropped to 45% and 40%. This period for multinational mining companies has been compared to the Great Financial Crash of 2008 - 2009 (GFC) when BHP lost 68%, and Rio Tinto lost 88% of its share value. In terms of gold mining, these two periods are different, as gold prices rose to 156% after the GFC, whereas in March 2020 prices decreased during Covid-19 (Timothy Laing, 2020). For comparison purposes, as noted by J. M. Dixon et al. (2021), the prices for the gold of the Australian were reduced by more than half of the average decline in the UK.

For instance, gold mining company Ashanti Gold noted the share price increase during the GFC period, while from February to March 2020, the share price fell by 38%, and it is slowly recovering to this day. In addition to falling prices, stock prices, reduction in investments in exploration, technology, and conservation of existing mines may lead to a deterioration in the state of the mining industry (Timothy Laing, 2020).

It was pointed out by Laing, that in different stages of the mining life cycle: Exploration and discovery, Feasibility and development, Production, and Mine closure, the impact of the pandemic was observed through the workers on-site and changes in prices for goods required for mining activities (Timothy Laing, 2020). To be precise, at the production stage, a pandemic could impact the economy of the mining industry through a reduction in production, which can happen due to a decrease in demand for raw materials or problems with disruption to global supply chains (Andrzej Gała´s et al., 2021).

In some countries, where companies continued to mine ore during COVID-19, metal production was still reduced due to the above-mentioned restrictive measures that were implemented to ensure the safety of the workers. Thus, it was expected to have negative consequences in the short term, as metal prices will decline but this does not apply to gold (Simon M. Jowitt, 2020).

In conclusion, the main effect of the global pandemic on the production resulted in the decline in demand for the ores, regardless of the restrictive measures or the distant work format. This, consequently, led to the prices for metals to sharply decrease, as well as the share and stock prices of the mining corporations, putting the industry into the state of the financial crisis.

2.6 Impact of the COVID-19 on the supply chains of the mining industry

Since the labor force of the mining sector was not functioning properly due to the consequences and negative impact of the pandemic, the supply chains of the mining sectors experienced stagnation as well. Moreover, the importance of the issue regarding the development of exploration and the opening of new mines were also raised, due to the possibility of infection of people with COVID-19 when supplying mining products to other countries. The disruption to global supply chains has affected the local economy of the countries significantly, where the mining industry is one of the key sectors (Andrzej Gała´s et al., 2021).

To thoroughly assess the damage of the pandemic on the stagnation of the exploration, production and supply chains of the mining ores, the contribution of the mining sector to the development of the local economies of various countries, namely European countries, Brazil, India, and North America was evaluated. It was assessed on the examples of the production of minerals and coal attempting to explain the overall contribution of this sector to the GDP value of the country (Simon M. Jowitt, 2020). For instance, it was found that the pandemic resulted in a significant decrease in the consumption and supply chains of the Indian mining sector. This led to USD 282 billion being lost

from their market capitalization (Chakraborty B. et al., 2020). Sidhu G.S. Rai et al (2020) also noted that the process of restoring the inner economy of India that has been damaged by the issues in the mining sector would not be a fast but rather complicated process.

It is worth assessing the impact of the COVID-19 pandemic on the sectors of coal and key minerals since the supply of these mining ores was affected most significantly (Timothy Laing, 2020). For instance, in the case of India, regardless of the preventive measures of the Ministry of Coal, the off-take of it experienced a dramatic drop in March 2020 resulting in -16% of the growth of the production rates of coal and key minerals (Chakraborty B. et al., 2020). Hence, the Covid-19 has contributed to the loss of almost 7% of the demand in the sector of non-coking coal. It was mentioned by H. Rajput (2021) that the supply of 20% of copper and 17% zink from an Indian mining area was unavailable for a global market.

The other key mineral block, namely aluminum, has its price dropped by 16% (Timothy Laing, 2020). The export of aluminum was also delayed and slowed due to the pandemic. The same negative trend in the production and export of limestone, manganese ore and chromite ore can be observed. De-growth in Q1 and Q2 is expected in the sectors of the other minor minerals (Chakraborty B. et al., 2020).

The pandemic influenced the export and supply chains of the mining corporation all over the globe to a certain extent leading to the damage of the construction sector, decline in energy consumption along with break-ups of the export (Chakraborty B. et al., 2020). It was suggested to consider the readjustment of the supply chain and the workforce to balance out the supply chain functioning as for pre-COVID-19 times. There is expected a positive trend in the export of the key minerals, like aluminum, manganese ore and chromite (Timothy Laing, 2020).

To sum up, the impact of the COVID-19 pandemic on the supply chains of the mining industry lead to the stagnation of the exploration and field works. This, on the other hand, resulted in the drop of the GDP value of the majority of the countries whose economies rely on the mining industry; especially India experiences a dramatic decrease. Consequently, the export rates slowed down, and the prices for the key minerals like aluminum, manganese ore and chromite experienced a significant drop.

2.7 Impact of the COVID-19 on stakeholders and funding of the mining industry

The unplanned expenses associated with the safety measures needed to ensure the work on the mining

factories and continuing explorations as well as the delays in the export and supply of the minerals and ores heavily impacted the funding of the mining sector raising concerns among the stakeholders. With the global pandemic, the mining industry faced liquidity challenges, namely when the mining corporations were not able to pay off all the short-term debts and redemptions in a given period. The question of reconsidering the future financial budgets to fit the new conditions due to the COVID-19 pandemic is raised. For instance, it is important to assess major capital investments and re-plan the expenditures for commercial agreements as well (Namuun Tsegmid, 2021).

Especially heavy financial damage was seen in the case of the Australian mining sector. The shares market of Australia went through a drastic downfall due to the global pandemic, affecting the metrics for pricing and for deal evaluation. The Australian mining industry was able to minimize the damage of work and export delays by adopting the innovative technological approach to allow the mining sector to function properly compared to other countries (Johnson, M. et al., 2020). Despite such a fast and organized response to the critical situation with employees and unexpected expenses, the investment part keeps experiencing the significant losses that resulted in the shutting down of the major mining explorations (Johnson, M. et al., 2020).

To resolve the financial issue of the mining sector, there has been conducted strategies aimed at engaging with the key stakeholders and taking a proactive position regarding the funding possibilities. The COVID-19 affected the mining industry of Australia significantly and unexpectedly but the mining sector is still considered as the main support of the local economy of a number of countries worldwide. There has been recently documented positive upward trends in iron, gold, coal, and petroleum exports (Johnson, M. et al., 2020).

Another possible way to resolve the issue of funding and finances is to consider the auctions strategy implemented by India. The auctions held in the year 2020 in Odisha state were successful; resulting in 23 completed operating iron, chromite and magnesium ore mining leases out of 25. However, the situation is not as good in other regions of India as in Odisha. The governmental exchequers are experiencing a significant decline in functioning due to the lack of high revenues to support auctioning new coal and mineral blocks. Instability with the auction mines of iron, chromite and magnesium ore also sequentially affected the fresh auctions of coal and other mineral blocks, causing low demand, delays in the organization, and a drop in price. The challenges are also present in the Mine-Developer Operators and Mine Operators (Chakraborty B. et al., 2020).

It is important to mention the challenges in the business sector as well. It is likely to expect the capital for Corporate Social Responsibility to be cut. The most damage will be experienced by the marginal stakeholders. After a thorough analysis of the COVID-19 impact on the entire mining sector, it is

concluded that it will take longer for the mining operations to normalize (Chakraborty B. et al., 2020). In addition, as was noted by Gujrati, R., and Uygun, H. (2020), the defaults in loans and shortage of investment opportunities may also cause delays in the stabilization of the financial situation in the industry.

Overall, the situation with the funding is showing a positive trend and is expected to be resolved in the near future. To speed up this process and meanwhile resolve the problem of supply chain delay, it is recommended to reconsider the issue of logistics and transportation (Namuun Tsegmid, 2021).

2.8 Impact of the COVID-19 on the consumers

The mining sector is an important contributor to the economy not only of local countries that produce and export mining ores but also of the countries worldwide whose economy also heavily depend on the import of various minerals, ores, etc. The general impact of COVID-19 is slow growth in demand for metals and a slow rise in prices after a downturn. Since countries are taking different actions to mitigate the effects of the pandemic, it is still unclear how this crisis will affect the industry (Simon M. Jowitt, 2020).

On the other side, other consequences of the COVID-19 pandemic on the consumer countries were the drastic decrease of the cost of the ores due to the significant drop in the demand for the export of these ores (Ferreira de Castro et al., 2020). Considering the case of Brazil, in the first quarter of the year 2020, the production of the Brazilian minerals went down by 17.7% resulting in just 220.4 million tons compared to the 267.8 tons produced during the fourth quarter of the year 2019. However, the gold did not experience a drop in price and conversely increased by 14.4% in 2020 compared to the year 2019 (Ferreira de Castro et al., 2020).

It is worth mentioning that the global economic crisis in the mining sector due to the delays in export, the problem with the labor force, and transportation led to the mining ore reserves to increase whereas inquiry for metals as well as prices for them decreased, as was analyzed by Javad Sattarvand (2021). In addition, as noted by H. Rajput (2021) the supply chains of metals and ores have been damaged significantly because of the pandemic mitigation measures being undertaken. This can be a positive scenario for the countries that import metals and ores. However, it may lead to significant financial damage to the countries, economies of which depend on the export rates. M. K. Anser (2021) mentions that the main metal and mineral ores that were significantly impacted by the pandemic and

its consequences were zinc, iron, lead, aluminum, and coal.

In general, according to Tsegmid, there was a decline in worldwide demand for minerals, and products of mining export, which led to falling prices for all ores, with the exception of gold (Namuun Tsegmid, 2021). Thus, some mining corporations such as Nevada enterprises focused on gold mining and overcame the crisis successfully making the impact of COVID-19 on the industry minimal (Javad Sattarvand, 2021). However, in Mongolia, the situation differs from the rest of the world. Due to the fact that the pandemic has restricted movement, this has led to a decline in gold prices in the country. This, in turn, influenced the economic instability of the country, while, in contrast, benefiting certain importing countries to save finances on the gold (Namuun Tsegmid, 2021).

Overall, the COVID-19 caused the demand for mining ores export worldwide to decrease which eventually resulted in a significant drop in prices for minerals. The situation was better in a gold market, which allowed several gold-oriented companies to actually benefit from the pandemic. Hence, it is recommended to reconsider the issue of the supply chains and logistics to stabilize the import market and recover the mining industry.

2.9 Impact of the COVID-19 on the transportation and logistics

As it has been mentioned earlier, the issue with transportation and logistics is of primary importance since the functioning of the supply chains, fieldwork, and process of the exploration of new mining ores as well as export and import heavily depend on it.

The impact of the pandemic on transportation and logistics areas of the mining industry have been discussed by Murray Hitzman et al. (2020). It was found that the negative influence on this industry led to the impossibility of the proper functioning of the employees on the explorations due to travel restrictions and quarantine measures. In addition, as discussed by Perkumienė, D. et al. (2021), other challenges that occurred due to transportation delays were improper functioning of strict import and export logistics, changes in customer-corporation relationships, and issues with the management of the important facilities in the mining industry. This led to temporal shut down of many factories, explorations, and even mining corporations.

To understand the ways to cope with transportation delays, it is worth evaluating the case of Australian logistics. Due to the rising uncertainties in the supply chain area that became sharper with the pandemic, the Australian Competition and Consumer Commission (ACCC) proceeded with a

thorough interim authorization for the representatives of the mining sector of the country. This allowed the revision of current contracts and obligations that are supposed to reduce and avoid delays in transportation as well as any disruption in the work of supply chains (Johnson, M. et al., 2020). Regarding the contractual performance, it has been suggested for mining businesses of Australia to ensure the lawful completion of the obligations and fair commitment in accordance with the commonwealth or governments legislation (Johnson, M. et al., 2020).

For the detailed consideration of the possible suggestions, it is valuable to refer to the case of India. To normalize the processes in the mining sector in India faster and with fewer losses, it is suggested to facilitate smooth operation, ease the liquidity crunch, increase the export demand and reduce the imports (Chakraborty B. et al., 2020). Special attention needs to be given to consumer demand, business management, and thorough planning of future business operations, as well as implementing innovative and precise logistic strategies.

2.10 Predictions and forecasts about the future development of the mining industry

There has been conducted an intense analysis and forecasting of possible scenarios in which the further development of the mining industry may take place in various countries worldwide. In general, there is a positive trend to the recovery of the industry in the near future.

In the case of the future of mining in Kazakhstan, in the presence of supportive measures from the government the GDP value is expected to go down by 3.1% in the year of pandemic, namely 2020, and rebound by 4.6% in 2021 (Aigazin Z., 2021). The major drop will take place in the export sector, resulting in an almost 27% decrease. In 2021, the economic situation significantly improves. If no support is present, then the GDP value for 2020 dropped drastically compared to scenario two, resulting in a 4.6% contraction. Not only exports and imports suffer but also the income of the population of Kazakhstan experiences severe drops. The export sector dropped dramatically by 28%, which is worse compared to the results in the second scenario (Aigazin Z., 2021). This, in fact, provides the analysis of the governmental support policies positively affecting the overall economic situation in the country and contributed to the smoothening of the major consequences of the COVID-19 (Aigazin Z., 2021).

In the case of Brazil, in the first quarter of the year 2020, the production of the Brazilian minerals went down by 17.7% resulting in just 220.4 million tons compared to the 267.8 tons produced during the fourth quarter of the year 2019 (Ferreira de Castro et al., 2020). However, the gold prices remain

stable. Hence, if the logistics and demand issues will be successfully resolved, the mining sector of Brazil is about to stabilize in the near future.

In the case of Australia, the main heavy consequence of the pandemic was in the financial sector. To resolve the financial issue of the mining sector, there has been conducted strategies aimed at engaging with the key stakeholders and taking a proactive position regarding the funding possibilities. The COVID-19 hit the mining industry of the country significantly and unexpectedly but the mining sector is still considered as the main support of the local economy. There have been recently documented positive upward trends in iron, gold, coal, and petroleum exports as analyzed by Johnson, M. et al. (2020). In addition, Rempel, A., and Gupta, J. (2021) noted that the prices on coal ores have stabilized when the mitigation measures were taken into account.

In general, by the end of 2020 and the beginning of 2021 with the adaptation to the current realities, the exploration and fieldwork started to function as normal, the supply chains showed a potential to stabilize in the nearest future, if the funding strategies were successfully implemented as well as safety measures. The mining sector in a majority of the countries documented a positive trend in the recovery.

3 METHODOLOGY

3.1 Project Plan

3.1.1 First stage

During the first stage there was conducted a review of several papers that were related to the topic. This included finding and analyzing the information from various sources and creating a newly updated document that covered all this information. It was an important step that allowed us to efficiently understand and then explain to what extent the industry has suffered in different regions around the world and in Kazakhstan, including the information on how we can mitigate the consequences.

3.1.2 Second stage

At the second stage the systematization of various articles consisting of the pandemic effects on the mining sector of such countries as India, Brazil, South America, the USA, Mongolia, African, Kazakhstan, and Europe was done. In order to do that, all the papers that have been reviewed were then thoroughly analyzed and the common themes were identified. The main topics covered were logistics and transportation, supply chain management, production and extraction rates of the ores, effect of the pandemic on the employees and their employment status, mitigation measures undertaken by corporations, and the forecasts of scientists and specialists on the future recovery of the mining industry.

3.1.3 Third stage

In the next stage, statistical data on mining production was gathered and examined in order to assess how the pandemic affects the mining sector in Kazakhstan. The aim that was achieved included the determination whether mine output has decreased since the COVID-19 began. For this, the Excel file from the Kazakhstan Statistics Agency was reviewed, which contained data on the cumulative monthly output of different minerals for different cities for the year 2020.

3.1.4 Fourth stage

During the fourth step the literature review section of the final report was written. This section was constructed in such a way so that it contains subheadings, such as the influence of Covid-19 on the mining labor force, the impact on production costs, and the negative effect on customers from the mining corporations worldwide, including Kazakhstan, India, Africa, Europe. The detailed description of the impact and evidence from reviewed papers was reported for each subheading. Moreover, cohesion and coherence was ensured to make connections between different paragraphs and sentences.

3.1.5 Fifth stage

At the fifth stage the statistical data taken from the Bureau of national statistics of the Agency for strategic planning and reforms of the Republic of Kazakhstan was analyzed. Based on this data the pie charts, tables, and graphs depicting the trends in the production rates of six minerals, namely aluminum, chromium, lead, coal, iron and copper, were constructed. This allowed us to get a better understanding of the effect of the pandemic on Kazakhstan's mining sector. The detailed description of causes and possible reasons for these consequences was done along with the examination of the recovery process of the country's industry.

3.1.6 Sixth stage

During this stage there was conducted a case study of the effect of pandemic on such Kazakhstani mining corporations as "KAZ Minerals'', ''Kazatomprom", "Bogatyr Komir", ''Kazzinc", and "Kazakhmys Group'' based on the information taken from the official web-sources of these companies. The analysis included the expansion of the possible difficulties caused by pandemic, analysis of financial and news reports, explanation of the mitigation measures taken by the corporation's board teams as well as the changes in working conditions for the employees.

3.2 The Analysis of Kazakhstan's mining corporation's official reports

The data was taken from the official websites of the "Kazatomprom", "Kazakhmys Group", "KAZ Minerals", "Kazzinc", "Bogatyr Komir" corporations. The data sources included the news digests, productional and financial reports. The main goal of the analysis of Kazakhstan's mining corporations' official reports was to assess the impact of COVID-19 on their functioning. This

included the investigation of the additional preventative measures, protection of the employees and their rights, the changes in working shifts and working modes, delays in logistics, production and supply rates.

The information about the statistical data on the impact of the pandemic on the mining industry has been taken from the website of the “Kazakhstan Statistics Agency”. During the analysis, the information about the overall production rates for each month of such minerals as coal, copper, iron ore, aluminum, lead and chromium in the year of 2020 were assessed and converted into tables, pie charts, and graphs. The goal of this analysis of the statistical data was to conduct a thorough examination of the general trend of the production rates since the beginning of the pandemic. In addition, it is worth mentioning that despite copper and iron ores’ supply and demand rates on the global market actually peaked during the pandemic, the aluminum, chromium, lead, and coal ores’ production rates were, indeed, impacted negatively. For instance, in the case of chromium, the overall amount of the ore mined in 2020 was 6326.5 thousand tonnes, which is 692.4 thousand tonnes less than in 2019. The situation continued to worsen until September 2021, when the preventive measures were implemented. This resulted in an overall short-cut in the amount of the shares and investment in the exploitation works for these minerals (Kazakhstan National Statistics Bureau, 2021).

4 RESULTS

4.1 Impact of a pandemic on the economic situation of the countries and the strategies to overcome the issues caused by the COVID-19

A detailed examination of the many publications on the impact of the pandemic on the global mining sector of nations like India, Brazil, South America, the United States, Mongolia, Africa, Kazakhstan, and Europe has been carried out. Based on this study, a literature review was conducted about the difficulties of unanticipated financial charges, a drop in export and production rates, employees issues and stagnation of supply chains. Thus, it caused the growth of financial risk in many countries.

For instance, it was identified that regardless of restrictive measures or the distant work format, it was still a decline in demand for the ores. Consequently, it leads to a sharply decreasing in prices for metals, as well as in the share and stock prices of the mining corporations (Timothy Laing, 2020). Considering the employees issues, mining corporations in the European countries did not stop functioning there, it was only the restrictive measures in the countries like Germany. However, it was cut in production and the number of workers due to the pandemic (Andrzej Gała´s et al., 2021). Nevertheless, African countries could resolve this challenge faster than others, because they have already had the Ebola epidemic before and they were ready to work in an online format, workers well knew about safety measures, worked isolated and far from the population, and were equipped by screening devices left from the Ebola epidemic (Lone, S. A., and Ahmad, A., 2020). Regarding Transportation delays, the Stagnation of supply chains was a huge problem during the Covid-19. However, Australian Logistics could resolve this issue. Thus, Australian Competition and Consumer Commission (ACCC) proceeded with interim authorization for the representatives of the mining sector of the country. This allowed the revision of current contracts and obligations that are supposed to reduce delays in transportation. Moreover, it is suggested to facilitate a smooth operation and ease the liquidity crunch (Johnson, M. et al., 2020). Financial risks, including supply chains disruptions, the decline in demand and prices for ores, decreasing the share and stock prices of the mining corporations, and unplanned expenses for the support of workers, such as medical services, protocols, equipment for health testing, could be minimized according to the example of the Australian Mining Industry. The first solution that article gives us was the Innovative technological approach (Johnson, M. et al., 2020). Moreover, the auctions strategy was implemented, aimed at engaging with the key stakeholders. (Chakraborty B. et al., 2020).

4.2 The Analysis of the data about the mining production rates of the six minerals in Kazakhstan

Background information

I reviewed papers on how the mining industry has suffered in different countries of the world. The Systematization of articles, common themes, and analysis of global and local mining markets helped me deeply understand the issues that led to financial crises worldwide due to the pandemic. Kazakhstan is top in producing many ores. However, there were no detailed articles describing the mining industry in Kazakhstan during the pandemic. I started to consider the Statistical data on mining production and assess the pandemic effects on Kazakhstan. Analysis of the data was taken from the statistical agency of Kazakhstan (Kazakhstan National Statistics Bureau, 2021).

The numerical analysis using descriptive statistical analysis was covered. I focused on analyzing the impact of COVID-19 on several minerals, namely aluminum, chromium, lead, coal, iron and copper. In this regard, it is necessary to note that aluminum, chromium, lead, and coal ores have decreased in extraction rates, whereas iron and copper ores experienced a peaked in production. Deep analysis of the effect of pandemic on these minerals will be discussed further, considering the different regions of Kazakhstan.

Iron ores

The Kostanay region appears to own the largest share of iron core productions within Kazakhstan accumulating almost 70.85% in the year 2019. The region remained the dominant one the year later with only the slightest drop of 0.71% in the number of shares. The regional distribution of the iron production among the Karaganda and Aktobe areas showed positive changes. The former region increased its shares by 0.5% while the latter experienced a rise of about 1% in the year 2020 compared to 2019, respectively (see Fig.1). The Turkistan region remains to hold less than 1% of shares in both years (see Fig.1).

Between the years 2008 to 2021, the extraction rates of iron core production escalated significantly. In 2008 the amount produced was equivalent to 21420.4 thousand tons, while by the end of 2021 it was replaced by 38699.5 thousand tons resulting in the overall extension of the amount extracted to 17279,1 thousand tons (see Fig.2). Between the 2014 and 2016 years there could be observed a gradual decline in the amounts of iron produced. It reached its minimum in 2016 was about 16357.8 thousand tons (see Fig.3). The peak, as discussed earlier, was traced to 2021 and amounted

to 38699.5 thousand tons (see Fig.3). Nevertheless, during the period between 2019 and 2020 when the COVID-19 pandemic started and peaked, the amount of ore produced did not drop but stayed stable (see Fig.6).

In January of 2008, the number of iron ore pellets was 713 thousand tons (see Fig.4). By the end of the same year, this number dropped dramatically and equaled 106 thousand tons (see Fig.4). In December of 2009, the situation stabilized and the overall number of ore pellets reached almost 745 thousand tons within that month (see Fig.4). This was 32 thousand tons greater than extracted in January the year before. The situation with the iron ore pellets deviated insignificantly within the next five years and then experienced a drastic drop in 2015 of 3283.6 thousand tons being extracted compared to the year of 2014 when twice the amount of ore was mined resulting in 6250.5 thousand tons (see Fig.5). Then the situation slightly improved in 2016 when the amount of 3387 thousand tons of ore was produced (see Fig.5). The reasons for such a dramatic decrease in iron ore production during this period rates remain yet unknown.

	2020	
The Republic of Kazakhstan	21984.3	Share, %
Aktobe Region	715	3.25%
Karaganda Region	5646.1	25.68%
Kostanay Region	15576.4	70.85%
Turkistan Region	46.8	0.21%
	2019	
The Republic of Kazakhstan	21967.3	Sgare, %
Aktobe Region	724.1	3.30%
Karaganda Region	5796.6	26.39%
Kostanay Region	15407.9	70.14%
Turkistan Region	38.7	0.18%

Figure 1. Regional Distribution in 2019 and 2020, percents.

	January	February	March	April	May	June	July	August	September	October	November	December
2008	2037.2	1713.6	1943.2	2006.9	1998.4	2081	2064	2062.4	1833.6	1600	867.5	1212.6
2009	1356.8	1454.1	1584.8	1785.1	1719.7	1954.2	2085.7	2089.3	2100.6	2178	2044.8	1936.5
2010	1973.7	1725.5	1996.4	1910.2	2116	2098.3	2178.8	1978.3	2131.1	2159.6	1957.9	2003.3
2011	1947.1	1780.6	2073.4	2060.7	2096.8	2030.5	2317.3	2171.8	2266.3	2122.5	1949.2	1996.6
2012	2014.8	1699.7	2125.8	2233	1960.1	2151.6	2225.2	2214.8	2283.2	2514.2	2286.9	2288.5
2013	1815.9	2017.3	2096.8	2323.8	2228.3	2134.8	1980.9	2080.4	2076	2078.5	2247.3	2161.8
2014	1,938.30	1677.3	2020.1	2131.1	2097	1995.3	1977.3	2129.8	2156.9	2241.2	2018.8	2245.2
2015	2546.3	1764	1901.7	1767.3	1621.6	1179.5	1257.5	1311.5	1048.8	971.8	999	1162.2
2016	929.6	1322.9	1187	1433.9	1464.2	1415.5	1350.8	1400.1	1262.8	1622.1	1516.2	1452.7
2017	1381.2	1415.1	1658.8	1668.6	1460.4	1532	1487.4	1716.1	1528.5	1534.6	1487.8	1460.4
2018	1468.3	1415.7	1664	1678.3	1801	1671.1	1653.7	1780.2	1694.8	1877.7	1651.3	1595.9
2019	1702.7	1449.3	1468.2	1784.2	1936.4	1747.2	1906.7	1869.4	1863.5	2155	2017.1	2067.6
2020	1865.6	1812.3	1895.1	1746.9	1771.2	1586.1	1633.9	1976	1890.7	2030.1	1941.1	1835.3
2021	3231.1	2671.4	3227.3	3536.2	3540.4	3312.9	3270.3	3223.2	3054.5	3163	3314.5	3154.7

Figure 2. Agglomerated and non-agglomerated iron ores, thousand tons.

Year	Total
2008	21420.4
2009	22289.6
2010	24229.1
2011	24812.8
2012	25997.8
2013	25241.8
2014	24628.3
2015	17531.2
2016	16357.8
2017	18330.9
2018	19952
2019	21967.3
2020	21984.3
2021	38699.5

Figure 3. Agglomerated and non-agglomerated iron ores, thousand tons.

	January	February	March	April	May	June	July	August	September	October	November	December
2008	713	581	686	690.5	711	582.8	657.7	662	539.7	716.6	305.5	106
2009	158.8	293	318	405.6	385.2	468	600.7	608.5	649.6	750	800	745
2010	738.9	673.2	758.4	687.5	706.1	640.9	505.5	518.1	656.3	730	701	701.4
2011	749.1	683	796	820.9	697.5	675.5	835	516.4	356.2	474.5	485	714.1
2012	586	603	745	703	556.3	591	687	444.3	553.4	635.2	601.8	654.3
2013	650.6	614	701	775	559.6	620.5	377.4	401.8	401.6	580.6	591.6	646
2014	636.8	517.9	610.3	561.3	607.9	477.6	528.7	448.2	389.5	542	415.8	514.5
2015	521	403.5	416.5	406.2	240.1	163.7	0	0	262.8	256.4	287.4	326
2016	188.8	249.5	261	227.2	312.7	294.5	251.9	371.3	253.9	315.1	374.4	286.7

Figure 4. Iron ore pellets, thousand tons.

Year	Total
2008	6951.8
2009	6023.6
2010	8017.3
2011	7803.2
2012	7360.3
2013	6919.7
2014	6250.5
2015	3283.6
2016	3387

Figure 5. Iron ore pellets, thousand tons.

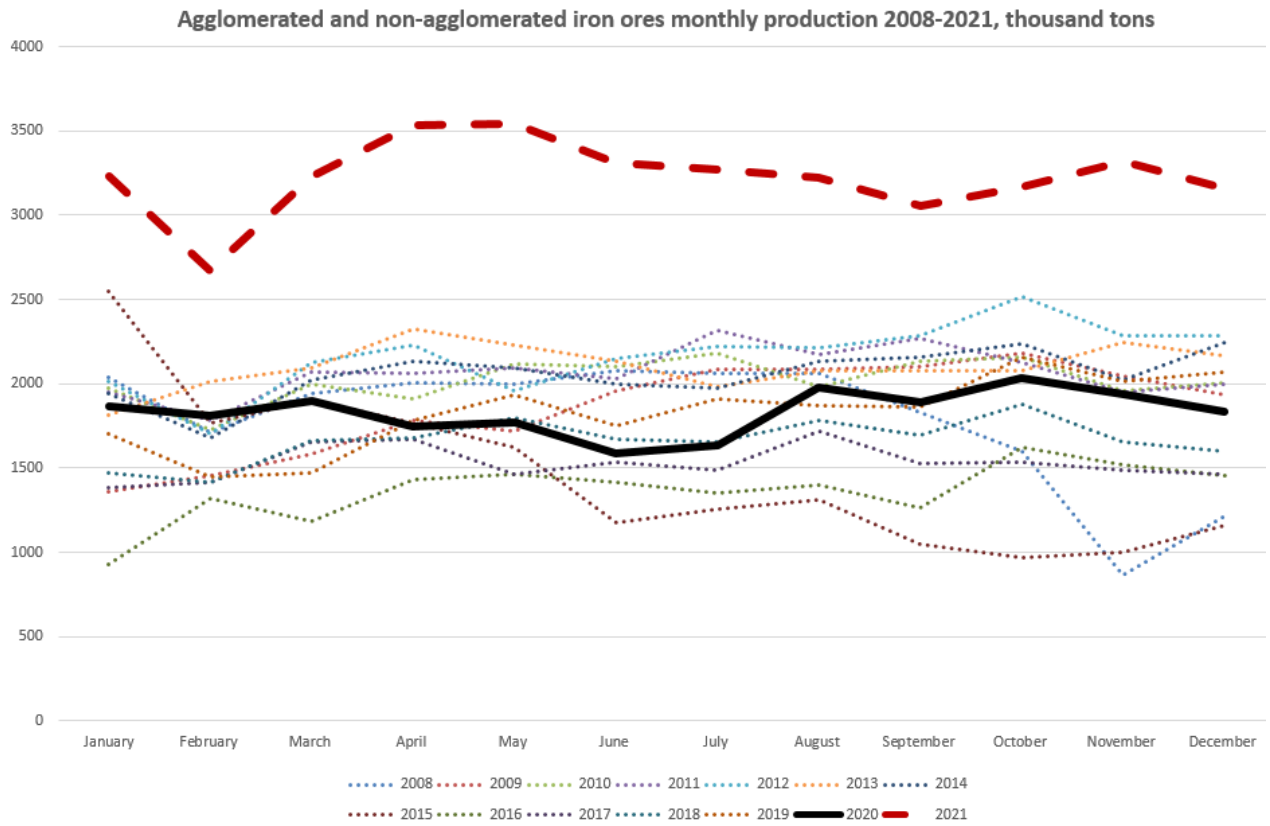

Figure 6. Agglomerated and non-agglomerated iron ores monthly production 2008-2021, thousand tons.

Cooper ores

If to consider the regional distribution of the copper ores, it is evident that three regions, namely East Kazakhstan, Pavlodar, and Karaganda, are owning almost equivalently the major portions of cooper ore shares. In 2018 East Kazakhstan region owned 36.87% of shares, while the Pavlodar and Karaganda regions earned 29.82% and 28.11% respectively (see Fig.9). In 2020 the dominance of these regions remained the same, while the percentage of the shares of the Aktobe region fell dramatically from 3.62% to 0.62% (see Fig.10). It is also worth noting that Jambyl and Akmola, compared to the Aktobe region, managed to save the level of their shares almost unchanged during these two years (see Fig.9 and Fig.10).

From the year 2008 up to 2011, the amount of copper ore production appeared to stay stable resulting in 31710 thousand tons per year on average (see Fig.8). The amount produced within each month of these years showed minor fluctuations but remained around the 2782.2 thousand tons per month (see Fig.7). The extraction rates continued to gradually increase during the next period of five years resulting in a major increase of about 34558 thousand tons in 2016 compared to the year

before (see Fig.8). The peak of the production could be observed in 2021 resulting in 124809.2 thousand tons of ore (see Fig.8). It can be seen that the consequences of the COVID-19 pandemic did not cause major damage to the copper ore extraction industry. In the year 2020, the amount produced was around 121904.5 thousand tons, which shows the escalation of the amount of copper ore production compared to the pre-covid year (see Fig.8).

A similar trend is observed in the extraction of the cooper and zinc ore pellets within the period from 2008 up to 2016 (see Fig.11). Overall, the number of pellets produced experienced only a gradual and steady increase including minor oscillations. In 2010 the number of ore produced was around 4785.8 which is 248,3 thousand tons less than in the previous year (see Fig.12). Its peak was accumulated in 2015 being about 6274.1 thousand tons (see Fig.12).

	January	February	March	April	May	June	July	August	September	October	November	December
2008	2475.9	2336	2725.2	2747	2861.1	2869.4	2795.8	2782.2	3414.1	2601.1	2327.6	2511.9
2009	2408.9	2333.9	2508.7	2485	2913.6	3362	2406.1	2430.3	2496.1	2624.4	2592.6	2663.2
2010	2663.2	2018.5	2467.8	2578.6	2771.4	2762.4	2812.8	2881.5	2744	2896.8	2595.2	2517.8
2011	2647.5	2305.9	2840.6	2811.1	3009.8	2888.4	3026.2	3023.1	2872	2989.5	3034	3043.5
2012	2775.3	2624.1	3109.4	2933	2925.9	3026	3527	3553.8	3647	3456.3	3482.8	3292.3
2013	3357.4	3088.9	3905.9	3591.8	3397.3	3177	3645.1	3677.8	3508.8	3558.4	3482.3	3341
2014	3,380.30	2684.8	2986.4	2974.3	3433.8	3521.9	3464.1	3417.5	3359.1	3244.4	3135.4	3058.6
2015	2983.7	2579.7	2746.6	2598.9	2532.2	2730.2	2909.5	3117	2680.6	6740	5651.2	6668.5
2016	5426.4	3857.3	6195.5	6880.3	6693.7	6553.1	7238.4	7290.5	7403.3	7540.2	7162.1	6255.3
2017	7182.9	7364.7	7911	8689	8911.7	8468.8	8418.2	8607.6	7963	7633.1	7409.9	6783.3
2018	7338.4	7354.4	8539	9347	8788.8	8608	9128.6	9055.8	8262.9	9090.2	9192.2	8467.8
2019	8211.4	9621.8	9459	9537.4	9843.9	12243.4	9872.8	10394.2	10248.2	10039.7	9534.5	10770.4
2020	10671	8569.2	9138.2	8754.2	7821.2	6891.6	7161	7999.4	13582.9	10050.8	15320.1	15944.9
2021	9816.8	10987.2	10787.2	10351.8	10519.8	10296.9	8840.7	9820.5	9944.8	9641	13433.4	10369.1

Figure 7. Copper ores, thousand tons.

Year	Total
2008	32447.3
2009	31224.8
2010	31710
2011	34491.6
2012	38352.9
2013	41731.7
2014	38660.6
2015	43938.1
2016	78496.1
2017	95343.2
2018	103173.1
2019	119776.7
2020	121904.5
2021	124809.2

Figure 8. Copper ores, thousand tons.

	2018	
The Republic of Kazakhstan	103173.1	Share, %
Akmola Region	506.3	0.49%
Aktobe Region	3732.8	3.62%
Jambyl Region	561.4	0.54%
Karaganda Region	28997.6	28.11%
Kostanay Region	560.7	0.54%
Pavlodar Region	30769.8	29.82%
East Kazakhstan Region	38044.5	36.87%

Figure 9. Regional distribution in 2018, percents.

	2020	
The Republic of Kazakhstan	121904.5	share, %
Akmola Region	740.4	0.61%
Aktobe Region	757.8	0.62%
Jambyl Region	670.4	0.55%
Karaganda Region	34148.1	28.01%
Kostanay Region	0.6	0.00%
Pavlodar Region	33605.5	27.57%
East Kazakhstan Region	51981.7	42.64%

Figure 10. Regional distribution in 2020, percents.

	January	February	March	April	May	June	July	August	September	October	November	December
2008	356.5	309.1	314.3	349	421	429.6	489.7	504.9	444.3	468.2	485.9	477
2009	433.7	367.3	415.8	380.6	410.2	551.8	421.3	405.4	396.6	407.7	463.3	380.4
2010	380.4	474	431.9	433.7	405.2	418.9	407.1	385	308.7	348.4	392.2	400.3
2011	348.7	353.9	380	407.3	400.2	404	402.7	431.4	463.5	469.4	364.6	431.9
2012	375.9	449.6	429.8	405.7	417.8	380.2	396	370.6	461.1	417.3	389.8	311.8
2013	350.4	373.9	361.3	424.6	496.3	444.7	451.4	489.3	435.3	372.2	367.9	342.6
2014	335.9	303.1	429.4	508.6	520.2	561.2	513.9	413.4	393.7	441.1	416.1	423.6
2015	509.2	529.5	654	590.5	536	515.5	467.7	523.1	479.1	487.2	527.9	454.4
2016	342.9	344.4	380.1	464.6	491.2	569.2	498.5	633.2	491.6	588.2	522.5	444.2

Figure 11. Copper and zinc ores, thousand tons.

Year	Total
2008	5049.5
2009	5034.1
2010	4785.8
2011	4857.6
2012	4805.6
2013	4909.9
2014	5260.2
2015	6274.1
2016	5770.6

Figure 12. Copper and zinc ores, thousand tons.

Coal ores

The regional distribution of the coal ores shows that the major amount of the ore production is

concentrated in the regions of Pavlodar, Karaganda, and East Kazakhstan. The dominant one out of all three regions appears to be the Pavlodar region, which held around 60% of shares in 2018 (see Fig.15). Worth mentioning that in 2020 this percentage decreased by 1% which may be a consequence of the COVID-19 pandemic (see Fig.16). The Karaganda and East Kazakhstan regions held about 33% and 7% respectively (see Fig.15 and Fig.16). The number of shares in these two regions remained unchanged two years later.

The overall trend of the coal production rates during the whole period from 2008 up to 2021 is deviating but at the end of each year was showing a steadily increasing pattern (see Fig.17). Nevertheless, there are several drops in extraction rates of the ore that were detected in June during the years of 2015 and 2009 and another drop could be observed in September of 2017 (see Fig.13). Between the years 2019 and 2020, the amount of coal ore produced was 115440 and 113174.8 thousand tons respectively (see Fig.14). The decrease of 2266 thousand tons during this period could be explained by the difficulties and delays in the production process caused by the COVID-19 pandemic (see Fig.14).

The highest amount of coal produced appeared in 2012 resulting in 120510.9 thousand tons (see Fig.14). However, during the next period of four years from 2013 up to 2016, the production amount was gradually decreasing until the next escalation period from 2017 up to 2018 when the amount of production reached 117789.3 thousand tons (see Fig.14 and Fig.13). Overall, it can be concluded that the coal ore production had experienced the negative consequences of the pandemic but managed to effectively cope with them without significant losses in production rates since the amount of ore extracted in 2021 was about 115693.9 thousand tons, which is almost the same as in the pre-pandemic year of 2019 (see Fig.14).

Knowing the elements that influence coal demand is critical for developing effective measures that might reduce the negative effects of coal consumption on the environment. A majority of Kazakhstan's population, including 70% of rural households, still relied on coal for space heating in 2012. Depending on the location, the average yearly use of coal by households climbed by 44 per cent from 2002 to 2012 (Howie, and Atakhanova, 2017). However, the graph represents a drop in coal production during the summer season, mainly because the demand for coal decreases every year due to the fact that there is no need to heat residential buildings during this period (see Fig.17).

	January	February	March	April	May	June	July	August	September	October	November	December
2008	10173.8	9588.1	9692.6	8313.4	8080.3	8107.3	7969	8956.9	9061.5	10932.4	10269.5	8859
2009	8045.1	7883.6	8432.9	6665.2	7833.9	4562.3	8048.2	8658.7	8732.6	10750.3	10990.9	10920.5
2010	9195.7	8799.2	9409.8	9162.9	8334.9	7734.7	8402.2	8684.5	8408.6	10062.1	10787.1	11824.2
2011	11132.6	9979	9762.7	8661.1	8444.5	7655.1	8474.3	9573.3	9780.1	10528.2	10792.4	11559.8
2012	11114.4	10637.3	9996.1	8668.5	7618.3	7696	8718.5	10121.6	11098.4	11821.4	11923.3	11097.1
2013	11166.1	10008	9428.2	8431	7948.6	7693.3	9048.2	9637.7	10290.9	11297.8	12787.2	12123.1
2014	9657.00	9271.1	8797.9	7345.3	7015.9	7614.6	8711.3	9659.7	10086.2	11431.1	12160.4	12093
2015	9166.4	9171	8789.1	7740.9	7450.4	5598.7	7532.9	8889.7	10210.3	11008.3	11325.7	10305.5
2016	8154	8458.2	7918.1	6431.1	6895.8	6914.6	7302	8736.9	9540.9	10927.5	10467.3	11312.6
2017	10003.2	9427.6	9957.9	8295.1	7451	7482.1	8733.2	8634.1	6194.3	9846.2	9869.2	10071
2018	9731.3	10030	10111.7	8960.1	8147.3	8033.8	8450.3	10147.7	10829	10714.3	11077.9	11555.9
2019	10104.8	9861.6	9736.9	8517.6	7338.1	8399.3	8457.3	9534.1	10301.6	10506.9	11323.3	11358.5
2020	9959.5	9321.8	9876.5	9251.7	8304.7	8025.7	8340.6	8660.4	9101.2	10271.1	10620.9	11440.7
2021	10526.3	8933.3	9464.2	8595.1	8593.8	8032.5	8621.3	9056	10228.2	10548.4	11113.7	11981.1

Figure 13. Coal ores, thousand tones.

Year	Total
2008	110003.8
2009	101524.2
2010	110805.9
2011	116343.1
2012	120510.9
2013	119860.1
2014	113843.5
2015	107188.9
2016	103059
2017	105964.9
2018	117789.3
2019	115440
2020	113174.8
2021	115693.9

Figure 14. Coal ores, thousand tons.

	2018	
The Republic of Kazakhstan	**117789.30**	Share, %
Almaty Region	42.40	0%
Jambyl Region	51.00	0%
Karaganda Region	39073.20	33%
Kostanay Region	7.50	0%
Pavlodar Region	70325.20	60%
East Kazakhstan Region	8290.00	7%

Figure 15. Regional distribution in 2018, percents.

Coal, including lignite and coal concentrate, thousand tons	**2020**	
The Republic of Kazakhstan	**113 174.8**	Share, %
Akmola Region	50.9	0%
Almaty Region	38.7	0%
Jambyl Region	84.7	0%
Karaganda Region	37 561.8	33%
Pavlodar Region	67 049.9	59%
East Kazakhstan Region	8 388.8	7%

Figure 16. Regional distribution in 2020, percents.

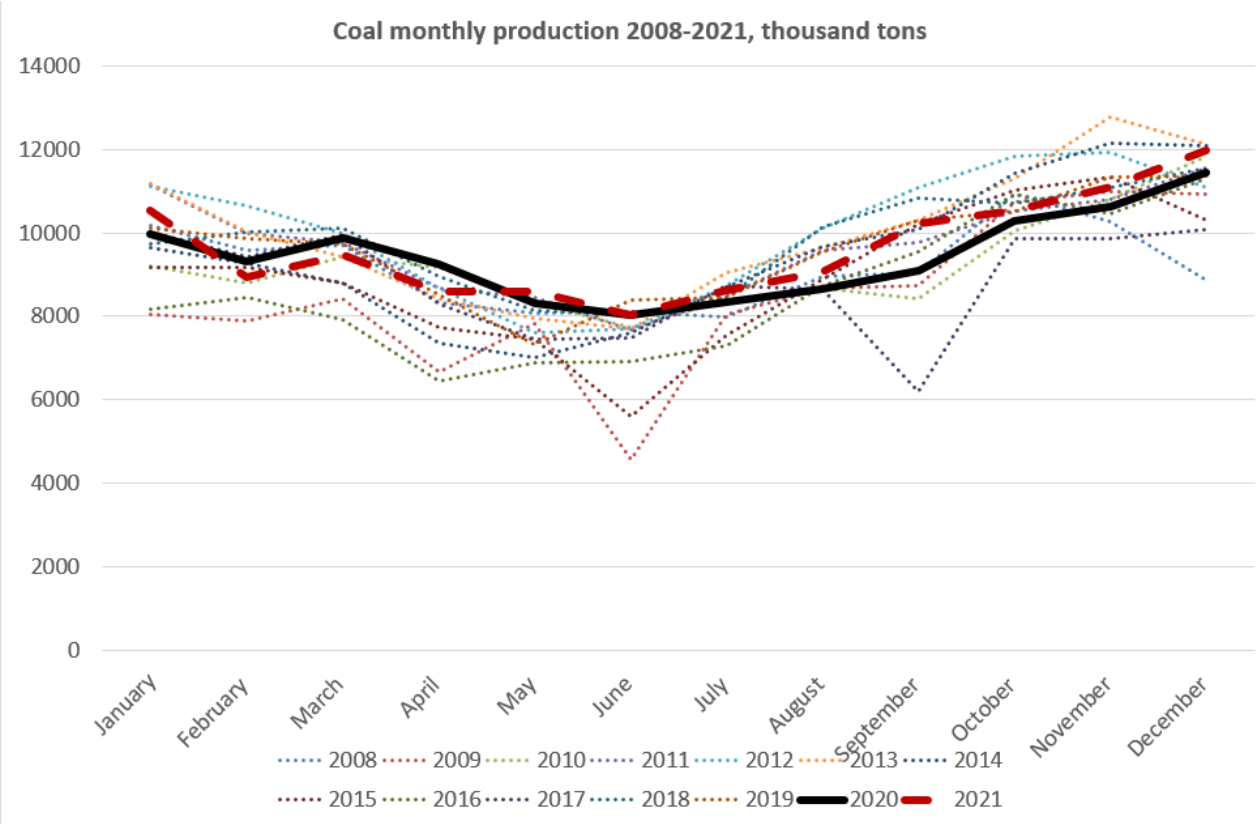

Figure 17. Coal monthly production 2008-2021, thousand tons.

Aluminum ores

Kostanay city was the dominant region of the extraction of aluminum cores in Kazakhstan. There could be observed the high rates of aluminum production in the period between 2008 and 2013 resulting in 5170.3 thousand tons of ore on average (see Fig.19). During this period more than 5000 thousand tons of aluminum per year were produced (see Fig.19). The amount of the ore produced within each month also remained approximately the same without any significant oscillations (see Fig.18). In 2014 there was a slight decline in ore production resulting in 4514.6

thousand tons (see Fig19). From 2015 the production rates began to rise until 2018 when the amount of aluminum mined reached its peak of 6104.2 thousand tons (see Fig.19).

However, in 2019 there was a sharp decline in production, which occurred most likely due to the COVID-19 pandemic (see Fig.21). In 2019 it could be observed that 3811.7 thousand tons of ore were mined (see Fig.19). During the last month of this year, it could be noted that the production rate began to fall rapidly (see Fig.21). The graph shows that during the initial 4 months of 2020, the ore production rate also started to show decreasing behavior but, fortunately, it began to recover and show higher rates (see Fig.18). As a result, aluminum production stabilized in the second half of 2020 (see Fig.21).

If we compare the total production in the Kostanay region for the years of 2019 and 2020, in 2020 aluminum production increased slightly and became almost 4057.7 thousand tons for the whole year (see Fig.19). It means that although Covid-19 had an impact on ore production, the Kostanay region managed to restore the usual amount of ore production in a year. For aluminum, data for 2021 has not yet been released, but it can be assumed that production has stabilized, leading to relatively satisfying and stable results.

	January	February	March	April	May	June	July	August	September	October	November	December
2008	436.1	412.5	427.4	404.2	453.3	452.2	451.3	449.7	433.2	426.1	415.2	398.9
2009	408.1	382	384.3	380.1	460.2	466.4	473.3	476	464.4	411.2	408.9	415.1
2010	415.1	443.1	447	432	455.6	452.6	454.6	450.7	449.6	446.2	437.7	426.2
2011	463.1	414	457.1	443.1	458.1	453	463.1	463.4	458.8	463.7	470.4	487.5
2012	482.1	396.1	380.1	370.1	465.3	474.3	477.5	477.7	473.8	464.6	390.4	318.3
2013	434.2	395.1	441.2	444	459.1	444	474.3	459.6	456.7	400.9	386	397.7
2014	380	344.2	380	381.1	394.5	361.6	411.8	411	398.8	355.7	338.2	357.7
2015	408.1	366.9	394.1	380	395.1	382.4	396.7	400.7	383.9	398.4	386.2	390.5
2016	406	381	404.9	391.9	405.1	392.4	405.4	405.2	392.3	408.3	398.2	410.6
2017	409.5	369.4	409.5	398.1	420	427.1	427.4	427.5	417.6	413.4	341	382.7
2018	429.1	386.7	426.7	388.9	446	478.3	563	613.1	504.8	528.3	585.2	754.1
2019	323.5	335.8	300.8	314.8	342	465.3	388.8	333.5	363.1	231.8	218.1	194.2
2020	295.6	291.7	257.1	195.5	374.9	375.8	408.5	323.2	372.8	333.7	385.8	443.1

Figure 18. Aluminum ores (bauxite), thousand tons.

Year	Total
2008	5160.1
2009	5130
2010	5310.4
2011	5495.
2012	5170.3
2013	5192.8
2014	4514.6
2015	4683
2016	4801.3
2017	4843.2
2018	6104.2
2019	3811.7
2020	4057.7

Figure 19. Aluminum ores (bauxite), thousand tons.

Aluminum ores, thousand tons	2020	Share, %
The Republic of Kazakhstan	4057.7	
Kostanay Region	4057.7	100.00%
Aluminum ores, thousand tons	2018	Share, %
The Republic of Kazakhstan	**6 104.2**	
Kostanay Region	6 104.2	100.00%

Figure 20. Regional distribution in 2020, percents.

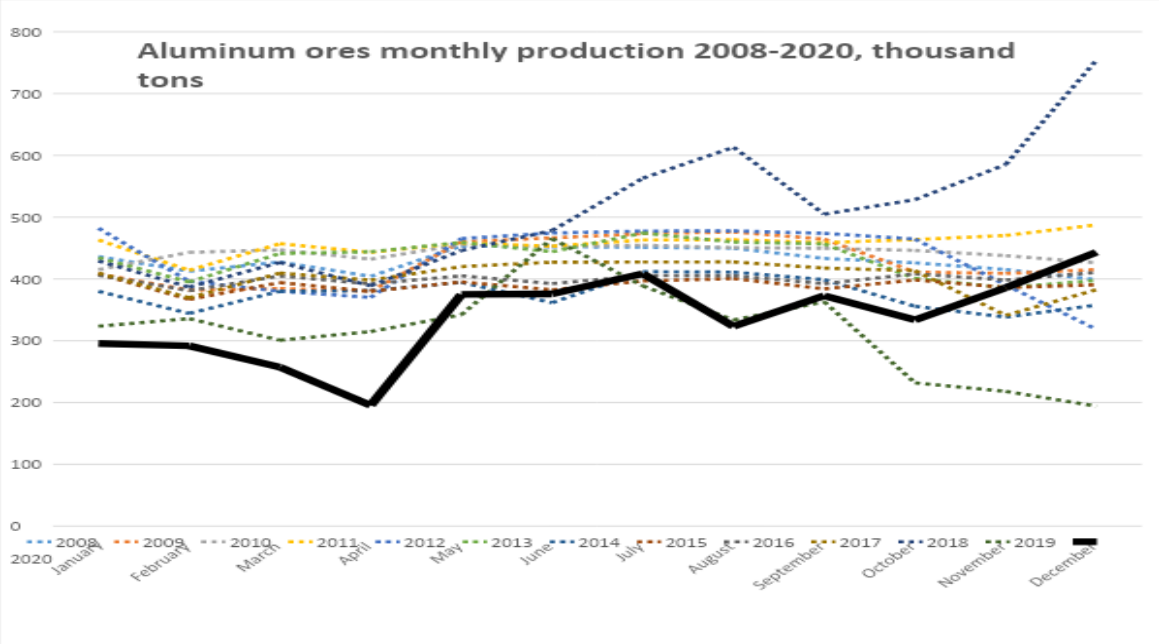

Figure 21. Aluminum ores monthly production 2008-2020, thousand tons.

Chromium ores

As for chromium ores, the graph shows that for Kazakhstan the extraction of these ores was concentrated only in the Aktobe region. Every year the level of ore extraction has been steadily increasing up to 2020 (see Fig.25). For example, in 2018 and 2019 their production rates were stable without any significant deviations resulting in more than 500,000 tons being produced every month (see Fig.22). Furthermore, it was observed that even larger amounts of chromium were mined in 2019 that was equal to almost 7018.9 thousand tons compared to the year 2018 when about 6688.7 thousand tons were extracted (see Fig.23).

However, the total amount of 6326.5 thousand tons of chromium ore was mined in 2020 which was significantly less than in 2019 (see Fig.23). Worth mentioning that in 2021 around 6193.2 thousand tons of the mineral were produced whose amount was less compared to the year 2020 (see Fig 23). The graph shows that the general trend in chromium production remained stable up to October of 2020 (see Fig 25). At the end of 2020 and until mid-2021 there was a noticeable decline in ore production, though, in September, ore production began to increase (see Fig.25). October 2021 was one of the highest chromium production months for all years resulting in 705,000 tons being mined (see Fig.22). After that, until 2022, there was a stable production rate.

Chromium concentrates began to be produced in 2010 and appear to be inferior in terms of the number of chromium ores mined. In Kazakhstan, their production was settled in both Aktobe and Pavlodar regions, although according to the pie chart almost all concentrates are produced solely in the former one (see Fig.24). Based on this chart, the total amount of chromium concentrates produced in 2019 were about 5102 thousand tons which was significantly higher than in 2020 when 4131 thousand tons were produced (see Fig.26 and Fig.27).

Therefore, it can be argued that with the spread of Covid-19 in Kazakhstan, the level of extraction of chromium ores and production of chromium concentrates has decreased, but due to the measures taken, it has begun to stabilize and show better results.

	January	February	March	April	May	June	July	August	September	October	November	December
2008	36.8	32.3	27.8	25	39.9	19	33.9	23.5	28.5	68.5	13.1	0
2009				59	30.1	416.3	421.2	459	461.7	436.9	1471.4	922.4
2010	382.2	406.1	450.8	387.5	434	464.2	405.4	450.3	385.9	453.8	430.9	440.7
2011	442.5	434.3	455.7	438.7	456.8	431.2	446.6	445	384.3	345.4	390.6	387.1
2012	437.7	380.6	392.5	441.5	470.5	496.6	450.5	411.8	451	430.5	434.6	435.3
2013	397.8	429.6	447.5	433.1	453.6	458.9	473.3	442.3	419.3	401.6	441.3	456.7
2014	420.4	420.8	440	456.9	450.8	456.7	467.4	469.6	457.2	466.3	449.3	455
2015	448.9	451.5	460.2	468.2	465.5	460.1	435.5	451.2	448	459.3	435.2	399.3
2016	399.2	415	403.7	435.5	472	493	499.4	483.2	481.9	483.8	479.6	496.6
2017	531.6	508.4	509.8	527.5	507.4	510.9	528.6	509	521.8	503.1	551.2	628.2
2018	520.1	551.3	556.9	556.8	578.6	569	564.1	597.9	578.5	543.4	528.2	543.9
2019	575.2	560.1	592.1	609.4	595.7	600.4	586.5	584.8	590.1	574.3	570.6	579.7
2020	525.1	555.4	543.8	540.1	538	551.1	505.1	568.9	537.9	511.8	485.7	463.6
2021	451.1	413	481.9	484.5	497	506	467	414	675	705	561	537.7

Figure 22. Chromium ores, thousand tons.

Year	Total
2008	348.3
2009	4678
2010	5091.8
2011	5058.2
2012	5233.1
2013	5255
2014	5410.4
2015	5382.9
2016	5542.9
2017	6337.5
2018	6688.7
2019	7018.9
2020	6326.5
2021	6193.2

Figure 23. Chromium ores, thousand tons.

Chromium ores, thousand tons	2020	
The Republic of Kazakhstan	6326.5	share, %
Aktobe Region	6326.5	100%
Chromium ores, thousand tons	2019	
The Republic of Kazakhstan	7018.9	share, %
Aktobe Region	7018.9	100%

Figure 24. Regional distribution in 2019 and 2020, percents.

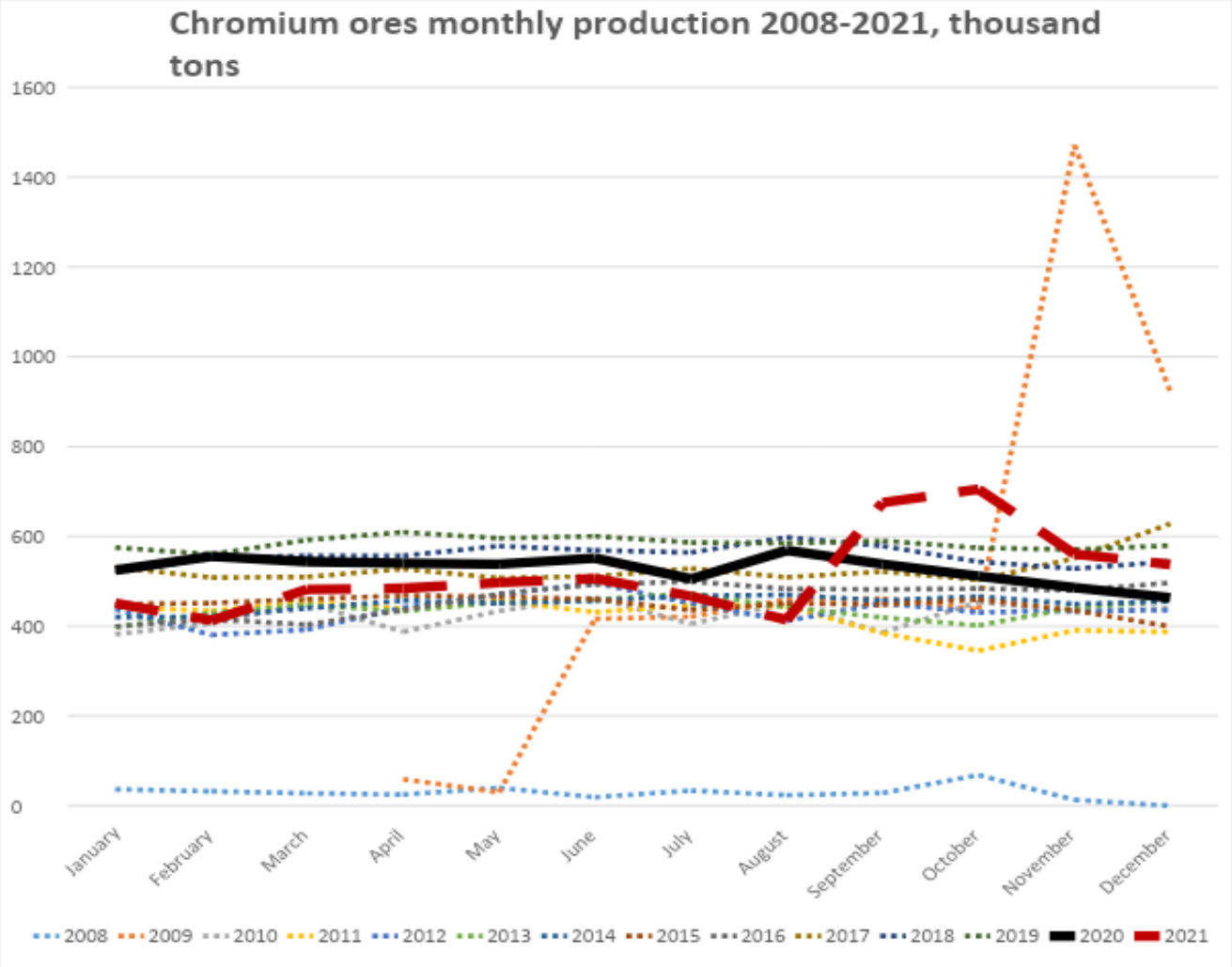

Figure 25. Chromium ores monthly production 2008-2021, thousand tons.

	January	February	March	April	May	June	July	August	September	October	November	December
2010	270.70	301.80	238.40	273.60	274.60	254.00	297.80	299.70	276.80	323.90	341.30	349.40
2011	321.1	303.1	322.1	333.6	363.8	282.5	320.7	309.8	327.8	270.5	234.4	278.8
2012	288.5	243.4	279.9	284.7	394.2	350.3	288.4	359.6	389.4	374.5	360.2	320.9
2013	306.6	348	355.5	345.5	333.9	352.9	328	382.3	344.8	361.2	366.4	368.1
2014	333.7	265.2	371.1	395.6	402	419.7	424.5	380.2	335	394.6	387.3	367.2
2015	361	332.4	349	364.4	389.8	360.3	361	331.7	325.1	356.5	322.1	306.3
2016	289	289.7	314.1	352.1	368.8	375	373.8	356.8	376.6	364.2	302.2	386.6
2017	356.6	311.7	363.1	380.5	404.1	392.9	418.2	400.3	400.5	343.9	414.4	393.1
2018	344.2	333.9	391.1	392.3	454.5	437.9	438.2	448.1	440.9	422.8	440.4	405.6
2019	381	362.6	458	440.4	429.1	415.8	453.1	460.9	423.3	461.2	373.9	442.7
2020	291.4	331	347.8	378.6	380.3	383.1	383.4	400.7	333.4	313.2	311	277.1

Figure 26. Chromium concentrates, thousand tons.

Year	Total
2010	3502.0
2011	3668.2
2012	3934.0
2013	4193.2
2014	4476.1
2015	4159.6
2016	4148.9
2017	4579.3
2018	4949.9
2019	5102.0
2020	4131.0

Figure 27. Chromium concentrates, thousand tons.

Lead ores

Lead in lead concentrate was produced in small quantities during the period from 2008 to 2020 relative to other minerals (see Fig.31). For example, before 2013, less than 40 thousand tons of ore were mined (see Fig.29). Then, from 2014 to 2017, the level of production steadily increased, reaching its peak of 112.3 thousand tons in 2017 (see Fig.29). In 2018, production fell slightly and amounted to 86 thousand tons, but the pandemic was not the reason for this decrease (see Fig.31). As could be seen from the table, the COVID-19 pandemic led to an even greater drop in the production of lead ore. For instance, in 2019 the production rate decreased to 55.6 thousand tons while in 2020 it amounted to 30.3 thousand tons (see Fig.28 and Fig.29).

According to the pie chart, in 2019 the distribution of lead in the regions of Karaganda and East Kazakhstan were almost equal in terms of production. Karaganda produced 27 thousand tons of ore which is equivalent to holding 48.56% of shares while East Kazakhstan produced 28.6 thousand tons of lead and owned 51.44% of shares (see Fig.30). This accounted for a larger percentage of the total production across Kazakhstan being equal to 55.6 thousand tons overall (see Fig. 30). In 2020, in the city of Karaganda, ore production decreased by more than 2 times and became 12.7 thousand tons or 41.91% in terms of shares, and in the East Kazakhstan Region, it decreased to 17.6 thousand tons (see Fig.30). Consequently, East Kazakhstan has become the leader based on its production rates this year, although it is clear that the total production in Kazakhstan fell to 30.3 thousand tons, due to the rapid spread of the pandemic (see Fig 29).

In August 2020, the minimum amount of ore was mined for the entire period of lead production resulting in 1.1 thousand tons (see Fig.28). The value of the mined ore fluctuated throughout all

months of 2020-2021. It only began to stabilize by the end of 2021, reaching its highest value of 3.6 thousand tons in December of 2021, which appears to be the best result during these 2 years (see Fig.28). In 2021, slightly less lead was mined than in 2020, namely 29.3 thousand tons, which gives a clear indication that the situation has begun to improve, presumably because measures have been taken to mitigate the pandemic (see Fig.29 and Fig.31).

	January	February	March	April	May	June	July	August	September	October	November	December
2008	2.9	3.3	3.5	2.6	4	2.3	3.7	2.8	4.5	2.9	3.6	2.9
2009	3.2	3	2.7	2.7	2.8	10.4	1.5	1.9	2.5	3	3.1	2.6
2010	2.5	2.4	2.5	2.3	2.2	2.8	3.9	3.2	3.1	3.1	4	4.1
2011	3.4	3.4	3.4	3.3	2.8	1.9	2.2	3.1	2.5	3	2.6	3
2012	3.2	3	2.9	3.1	2.8	2.7	2.5	2.9	2.5	4.3	4.9	3.7
2013	2.6	3.2	2.8	3.5	3.2	3.7	3.4	2.7	4.1	3.5	3.3	4.8
2014	3.7	2.8	4.1	3	2	1.9	3.7	3.1	3.8	3.1	3.2	3.4
2015	2.9	2.6	12.3	5.5	3.1	2.9	3.9	4.8	5.4	2.8	3.6	2.6
2016	4.2	4.7	5	4.8	4.9	7.2	6.9	5.6	5.5	6.3	5.4	10
2017	7.4	6.4	8.7	9	10.7	11.2	11.1	11.9	10.9	8.5	8.3	8.2
2018	6.6	8.4	8.9	7	6.4	3.1	10.8	4.1	6.5	7.7	8.2	8.3
2019	6	7.8	8.8	7.2	4.1	2.2	3.9	3.4	3.3	3.4	2.6	2.9
2020	2.1	3.2	3.2	1.9	3.4	2.7	2.5	1.1	2.7	2.8	2.7	2
2021	1.7	2.3	2.8	1.6	3	3.1	1.2	2.6	2.1	2.9	2.4	3.6

Figure 28. Lead in lead concentrate, thousand tons.

Year	Total
2008	39
2009	39.4
2010	36.1
2011	34.6
2012	38.5
2013	40.8
2014	37.8
2015	52.4
2016	70.5
2017	112.3
2018	86
2019	55.6
2020	30.3
2021	29.3

Figure 29. Lead in lead concentrate, thousand tons.

Lead in lead concentrate, thousand tons	2020	
The Republic of Kazakhstan	30.3	Share, %
Karaganda Region	12.7	41.91%
East Kazakhstan Region	17.6	58.09%
Lead in lead concentrate, thousand tons	2019	
The Republic of Kazakhstan	55.6	Share, %
Karaganda Region	27	48.56%
East Kazakhstan Region	28.6	51.44%

Figure 30. Regional distribution in 2020, percents.

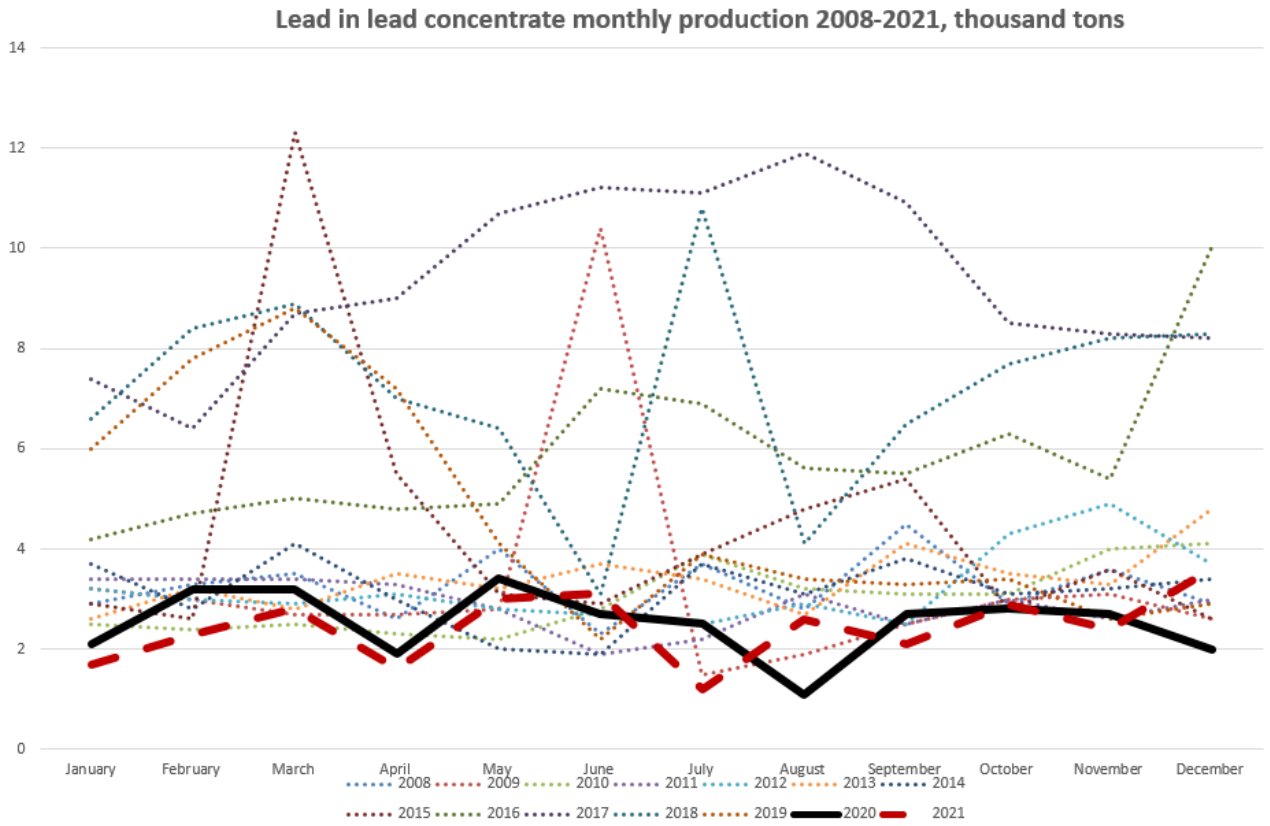

Figure 31. Lead in lead concentrate monthly production 2008-2021, thousand tons.

4.3 The Case Studies

4.3.1 The ''Kazatomprom'' Mining Corporation

The ''Kazatomprom'', according to its official news reports and digests on the effect of COVID-19 on their functioning, state that the pandemic did not have a significant impact on their production rates. Additional and urgent expenses that were integrated into the budget of the year 2020

included the implementation of the PCR tests, reorganization of the workplaces, introducing the hotlines for the employees' consultation and the enforcement of the longer working shifts (Kazatomprom, 2021). Nevertheless, the company experienced a shortage in the available labour force due to the isolation for a period of a month or greater of the infected personnel. This caused minor delays in transportation rates of the ores and the production plan for the year 2020 (Kazatomprom, 2021). However, the on-time reaction of the company and mitigation of the pandemic crisis allowed it to catch up with the extraction and production work and do not experience any major financial losses.

4.3.2 The "Kazakhmys Group'' Mining Corporation

The "Kazakhmys Group'' Mining Corporation in Kazakhstan reported that the company was forced to implement several limitations on the work process along with new regulations. Even during the peak of the pandemic, almost 37 thousand employees were working on both explorations and indoors taking into account all the preventive measures (Kazakhmys, 2021). The additional expenses of the company included the medical equipment, medicines, and PCR tests. Moreover, similarly to the ''Kazatomprom'' company's strategy, the ''Kazakhmys Group" incorporated the hotlines to ensure the mental well-being of their personnel. The supply chain of the copper was not affected at all. In contrast, a slight increase in demand for this ore has been observed on the global market (Kazakhmys, 2021). Under the thorough guidance of the leader board, the company managed to reduce the unexpected expenses on the medical equipment, reorganize the work by introducing both indoor and remote working modes, and avoid major logistical and productional delays and losses. In addition, the company was one of the first ones in the field to return back to the initial production rates in the whole country (Kazakhmys, 2021).

4.3.3 The "KAZ Minerals'' Mining Corporation

The "KAZ Minerals" mining corporation stated that the COVID-19 allowed them to totally reconsider the functioning of the company and introduce major changes in their working policies. The company experienced some difficulties and financial losses due to the implementation of comprehensive preventive measures like hotlines, face masks for the indoor employees, medical leave compensation, and biweekly free rapid and PCR testing kits for personnel (KAZ Minerals, 2021). As a result, the transmission of the virus among the present faculty was reduced to the bearable minimum but the production rates and exploration workers were forced to pause for some time. Nevertheless, when the adaptation to new circumstances came to an end, the operations were reloaded through the overtime shifts and remote work mode. By the end of 2020, the company

reported no material impacts of the coronavirus on the Group’s operations (KAZ Minerals, 2021). Lastly, no current shortages in any resources are observed by the company, it is expected to experience longer lead times to obtain supplies for the next year.

4.3.4 The “'Kazzinc’' Mining Corporation

The “Kazzinc’' corporation reported on November 10, 2020, that they invested about 42 million KZT into a test laboratory in the Medical Center in Ust-Kamenogorsk to conduct COVID-19 PCR (polymerase chain reaction) tests. The company appears to be the largest metallurgical complex in the region. Additional expenses included 30 units of advanced biomedical test equipment and required furniture. The only major task faced by the corporation was to reduce the circulation of the virus among the indoor personnel that were not eligible for the shift into the remote work mode. The “Kazzinc’' corporation states that no significant productional delays, logistical issues or supply chain disruptions occurred during the 2020 pandemic (Kazzinc, 2021).

4.3.5 The "Bogatyr Komir" Mining Corporation

The "Bogatyr Komir" corporation, according to their news digests, reports that they have introduced periodical meetings with the staff and faculty to discuss the new regulations regarding the vaccination, PCR testing, and new preventative measures introduced in the company ("Bogatyr Komir", 2021). Additionally, there were introduced extra protection measures of the technical equipment in offices and exploration states due to the shift to the remote work mode and significant reduction of the personnel available indoors. These measures included ordering an additional amount of CCTV cameras and extending the duration of the shifts of the security guards, which as well helped to minimize the interaction between the employees and reduce the spread of the virus among the personnel ("Bogatyr Komir", 2021).

4.4 The forecasts about the recovery process of the whole mining industry in Kazakhstan

To sum up, all of these results helped me to analyze how the mining industry has been changing during the pandemic situation in the world, and in Kazakhstan in particular, and how we can mitigate the consequences. The forecasts about the recovery process of the whole industry around the world are fortunate. In Kazakhstan, most of the minerals have already returned back to the initial production rates. It will be further considered in the discussion part.

4.5 Project's significance for the future of the mining industry

Coronavirus will not be the last pandemic in our lifetime. The risk of a new pandemic is higher now than ever before and we have to be prepared for it. I believe that my thesis has high significance in terms of determination of how companies around the world can mitigate the impact of future pandemics, provide the tools to effectively reduce the morbidity of workers, help in slowing the spread of the virus, and resolve disrupted local supply chain disruptions. It will help in decreasing the unexpected financial expenses, as corporations have already spent a lot of money to research the coronavirus, and they will be better aware of the spreading of such type of virus. Workers have already equipped with screening devices and they will know how to quickly react to another pandemic, and follow the restrictive safety measures such as isolation of people while working on the mine site or working in the online format. Corporations will know how to react to future financial crises, on the example of some companies of countries that have experienced an economic recovery.

5 DISCUSSION

There has been conducted a thorough analysis of the various articles about the effect of the pandemic on the global mining industry of such countries as India, Brazil, South America, the USA, Mongolia, African, Kazakhstan, and Europe. Based on this analysis the literature review was written concerning the issues of the unexpected financial expenses, delays in transportations, and decline in production rates.

In order to investigate how the pandemic affects the mining industry, statistical data on mining output was collected and analyzed. The goal was to see if mine production has fallen or not since the beginning of the pandemic. According to the file from the Kazakhstan Statistics Agency, which covered the information on cumulative monthly production of various minerals during 2020, it was possible to extract the data for the production rates for each month of the year during the period from 2008 up to 2021. The data included the extraction of such minerals as coal, copper, iron ore, aluminum, lead, and chromium in all regions of Kazakhstan.

The analysis was done primarily in Excel sheet such that in each cell a reference formula to the original table was entered. This way of solving has been done also for other years: from 2008 to 2021. It helps to see how the situation changed since the Covid-19 started (Kazakhstan National Statistics Bureau, 2021). Based on this information we were able to observe that some minerals

experienced dramatic drops in production rates, like aluminum and copper, while others like iron ores, on the contrary, peaked in production. Thus, it can be concluded that the consequences of the COVID-19 pandemic have significantly impacted the production rates of such mineral ores as aluminium, chromium, lead, and coal in a negative and such minerals as iron and copper in a positive way.

During the last month of 2019, there could be observed a sharp decline in the production rates of aluminium, which was followed by the short-cut in the amount of the shares as well. However, the situation stabilized during the next quarter of 2020 showing a positive trend in production rates. In the case of chromium, the overall amount of the ore mined in 2020 was 6326.5 thousand tonnes, which is 692.4 thousand tonnes less than in 2019. The situation continued to worsen until September 2021, when the preventive measures were implemented. The lead ore production was also negatively affected by the pandemic. There was a great drop in 2020 when only 30.3 thousand tonnes were mined compared to 2019 when about 55.6 thousand tonnes of ore were produced. The coal ores also experienced significant losses in both production rates, which led to a shortage in a share amount as well. The Pavlodar region's shares decreased by 1% in 2020 from the original amount of 60% in 2018. Furthermore, between the years of 2019 and 2020, there could be observed a drop in production of almost 2266 thousand tons. The possible explanations are the difficulties and delays in the production processes caused by the COVID-19 pandemic. In general, the main reasons for such mineral ores as aluminum, chromium, lead, and coal to experience the heavy consequences of the global pandemic are the shortage of labor-power, transportation delays and issues with the extraction of the ore. During the period from 2019 up until 2020, the various preventive measures were tested and implemented so that by the year 2021 the production rates of almost all of these mineral ores stabilized.

When it comes to the cases of iron and copper ores, it can be noted that these minerals did not experience significant damage in their production rates. In contrast, the peak of the production rate of the copper ore happened in 2021 reaching 124809.2 thousand tons which were more ore mined compared to even the pre-covid year. A similar pattern was observed in the iron ore production rates. The peak was also noted in 2021 and amounted to 38699.5 thousand tons of ore being extracted. It can be seen that the consequences of the COVID-19 pandemic did not cause major damage to the copper and iron ores extraction industry.

About the Case Studies of the Kazakhstan's largest mining corporation and the impact COVID-19 had on their functioning, it can be concluded that the "KAZ Minerals''and the ''Kazatomprom'' corporations were the ones to experience the financial difficulties, while the "Bogatyr Komir" and

The ‘‘''Kazzinc'' corporations reported that they did not faced any difficulties and adapted into the new working conditions efficiently and fast. The “Kazakhmys Group’’ company, on the other hand, showed a positive upward trend in their production rates since the start of the pandemic and held the leading position among all other mining companies of Kazakhstan. All the information used for the analysis of the case studies of these companies was extracted from the official websites, including the official news reports.

6 CONCLUSION

This report has completed the review of the studies describing the COVID-19 consequences on the mining industry to better understand the current worldwide. The analysis included the assessment of the effect of the pandemic on the production and extraction rates, on the supply chain management of the minerals and ores, as well as the employment issues on the global mining industry in such countries as India, Brazil, South America, the USA, Mongolia, Africa, and Europe. A special attention was given to the examination of the Kazakhstan’s mining industry and the functioning of the local mining corporations like “KAZ Minerals’’, ‘‘Kazatomprom’' , "Bogatyr Komir", ‘‘'Kazzinc'', and “Kazakhmys Group’’. Moreover, the analysis of the production rates of the six minerals in Kazakhstan, namely coal, copper, iron ore, aluminum, lead, and chromium, was provided as well.

It was concluded that the employees of the mining sector are going through hard times with employment status and low salaries. In some countries, the situation is better due to vaccination and safety measures but this does not relate to all mining-oriented industries. It can be argued that the strategy of shifting the work format to the online one is a satisfactory solution to the human morbidity and mortality issue, as it was considered in the example of European countries (Andrzej Gała´s et al., 2021). In combination with strict safety measures and limitations during the work on the fields and exploration, it was possible to reduce the negative impact of the pandemic on the production. However, the decline in demand for ores still took place on the global market. This caused the prices for the metals to decrease dramatically. As a result, the industry is currently experiencing the financial crisis which led to the shutting down of several mining factories in major mining countries worldwide. In general, the situation with the funding is improving and is expected to be resolved in the near future. Unexpectedly, the gold market did not experience any significant deviation in pricing. Thus, another possible suggestion to speed up the recovery of the local mining

industries can be the consideration of the expansion on the gold market. Overall, the mining sector in a majority of the countries documented a positive trend in the recovery.

Regarding the analysis of the six minerals on Kazakhstan's local mining field, it was found that the consequences of the COVID-19 pandemic have significantly impacted the production rates of such mineral ores as aluminum, chromium, lead, and coal in a negative way. The main reasons for such mineral ores as aluminum, chromium, lead, and coal to experience the heavy consequences of the global pandemic are the shortage of labor-power, transportation delays and issues with the extraction of the ore. During the period from 2019 up until 2020, the various preventive measures were tested and implemented so that by the year 2021 the production rates of almost all of these mineral ores stabilized. When it comes to the cases of iron and copper ores, it can be noted that these minerals did not experience significant damage in their production rates. In contrast, the peak of the production rate of the copper ore happened in 2021 reaching 124809.2 thousand tons which were more ore mined compared to even the pre-covid year. A similar pattern was observed in the iron ore production rates. The peak was also noted in 2021 and amounted to 38699.5 thousand tons of ore being extracted. It can be seen that the consequences of the COVID-19 pandemic did not cause major damage to the copper and iron ores extraction industry.

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8 APPENDIX

8.1 Regional distribution of production of key minerals

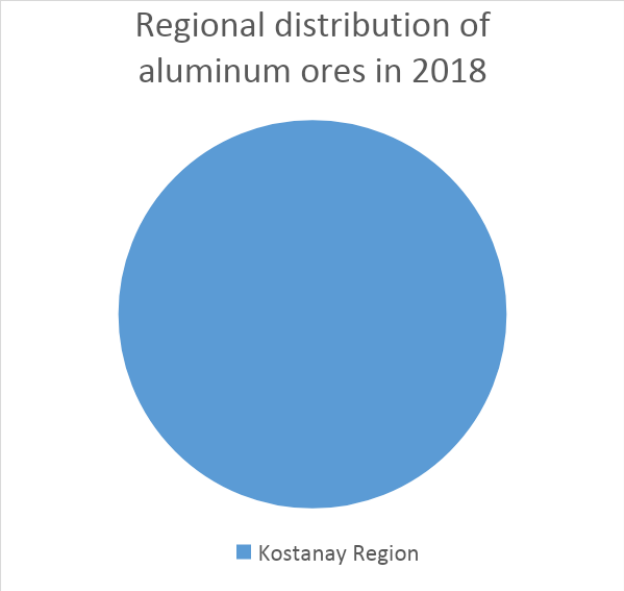


Figure 32. Regional distribution of aluminum ores in 2018

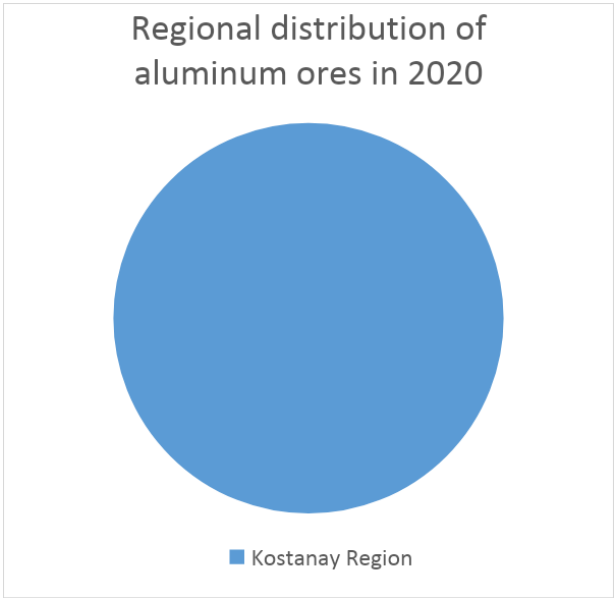


Figure 32. Regional distribution of aluminum ores in 2020

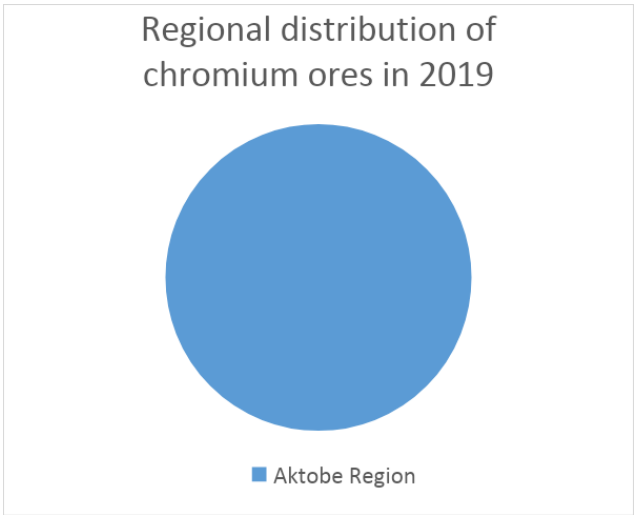


Figure 32. Regional distribution of chromium ores in 2019

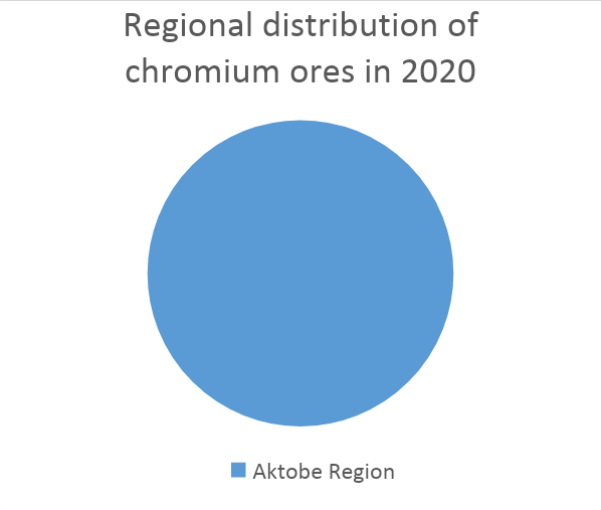


Figure 32. Regional distribution of chromium ores in 2020

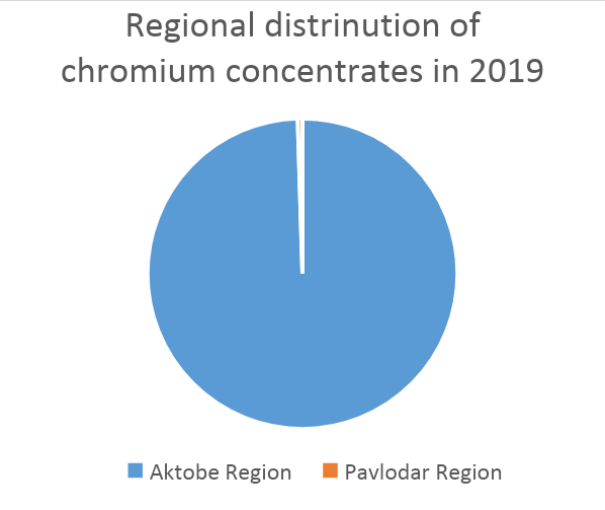


Figure 32. Regional distribution of chromium concentrates in 2019

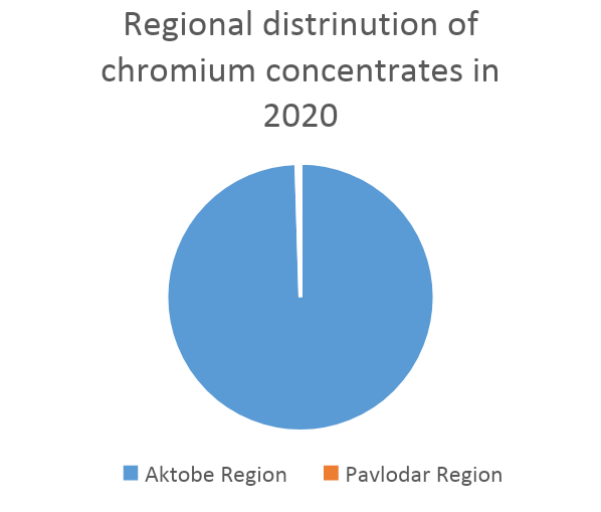


Figure 32. Regional distribution of chromium concentrates in 2020

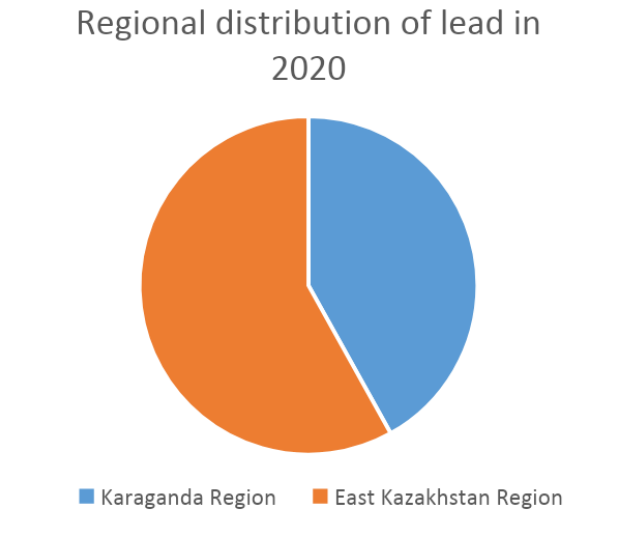
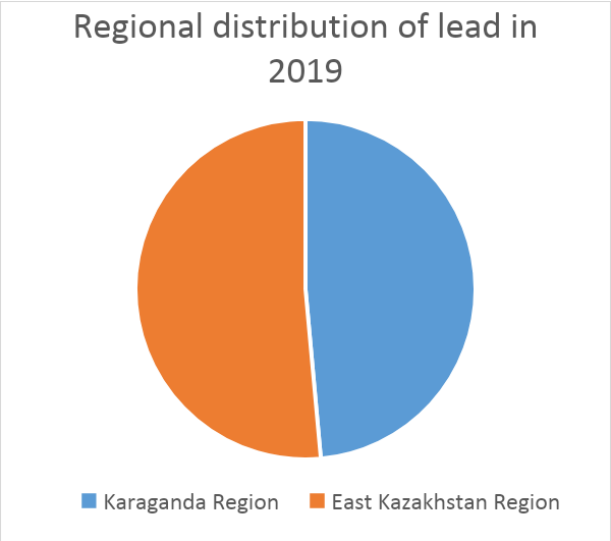


Figure 32. Regional distribution of lead in 2020



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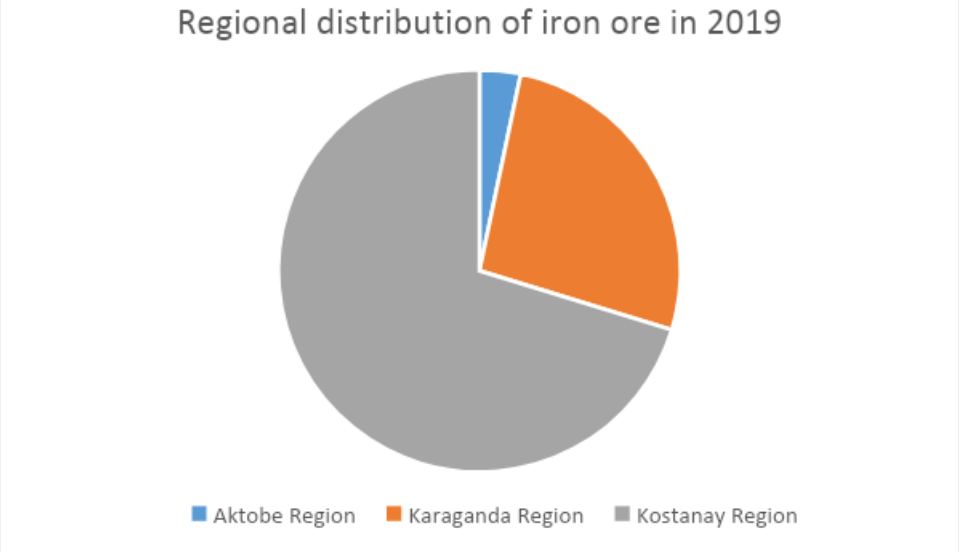

Figure 32. Regional distribution of iron ores in 2019

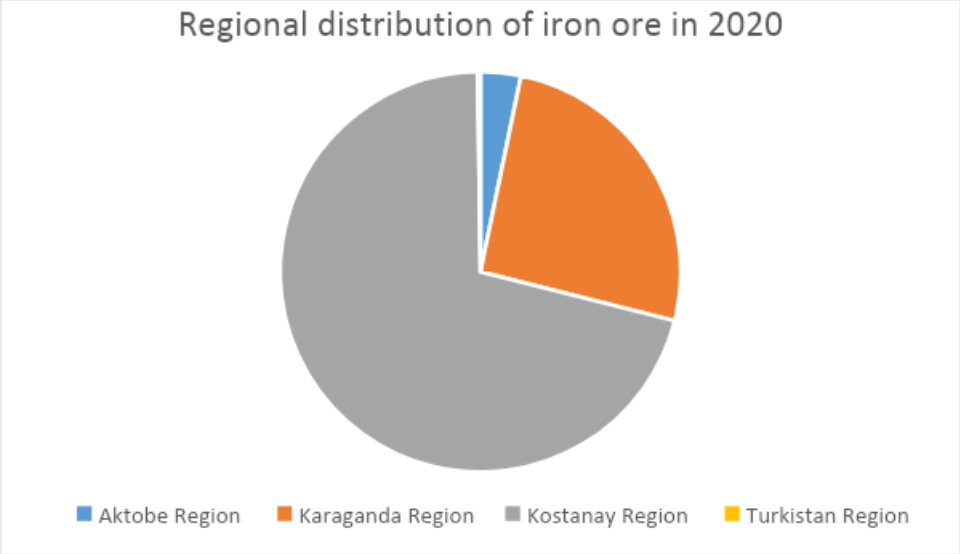

Figure 32. Regional distribution of iron ores in 2020

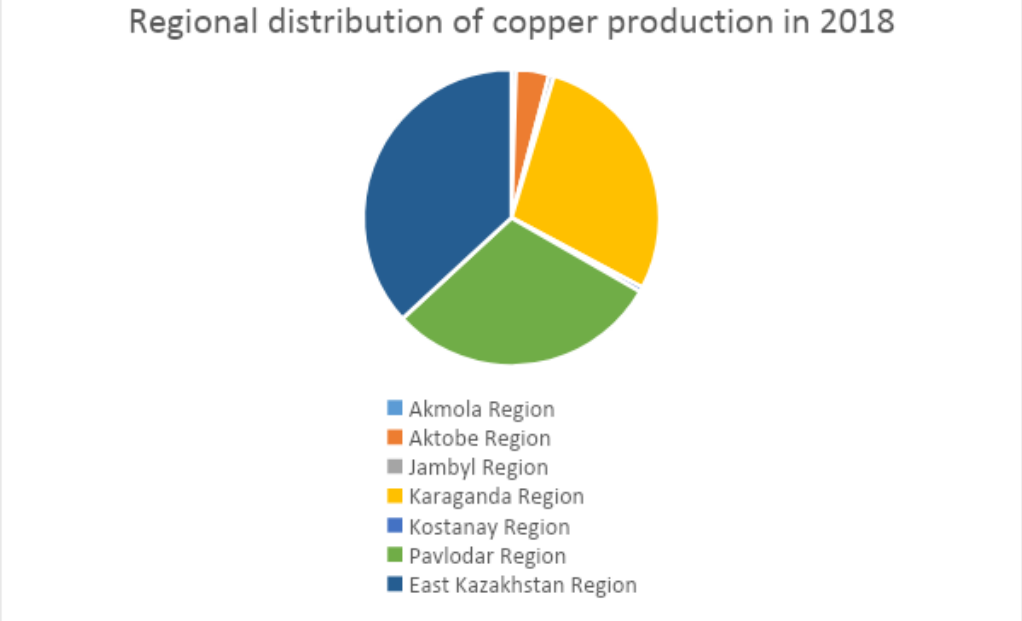

Figure 32. Regional distribution of copper production in 2018

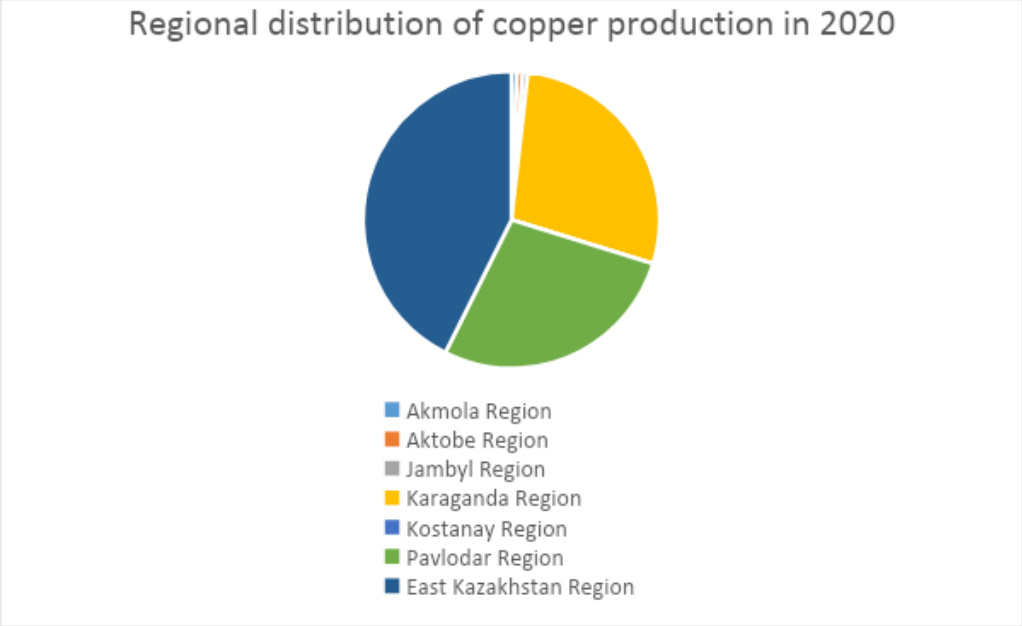

Figure 32. Regional distribution of copper production in 2020

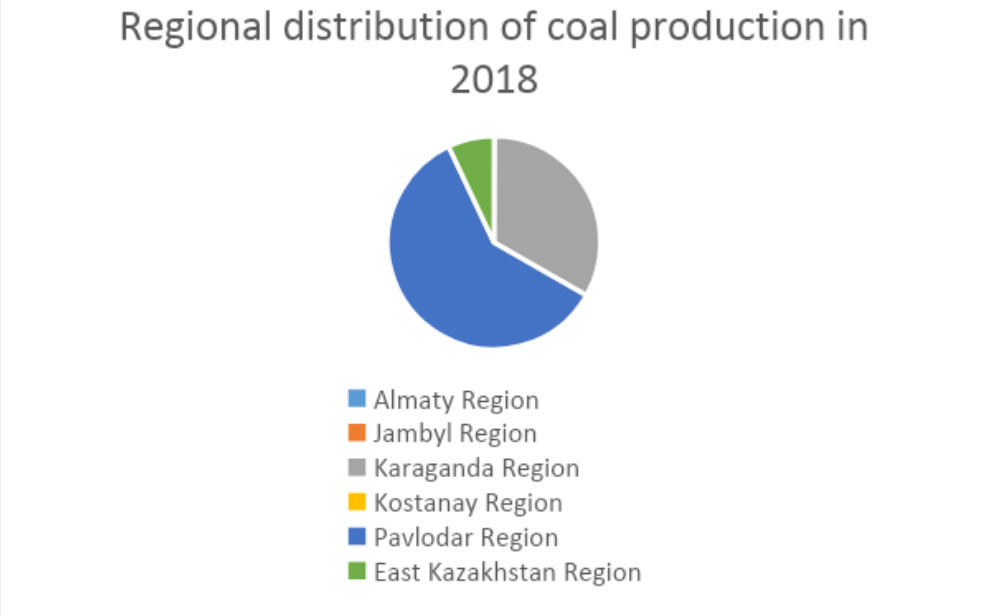

Figure 32. Regional distribution of coal production in 2018

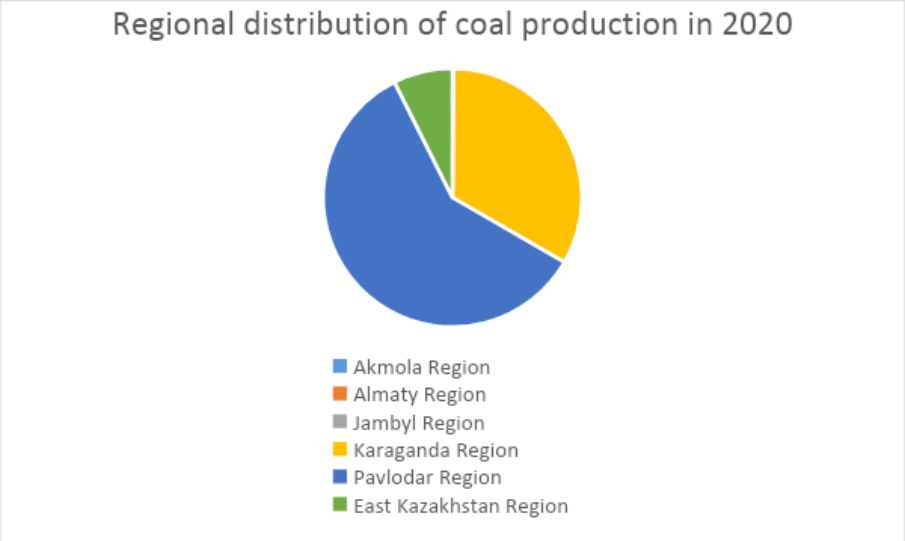

Figure 32. Regional distribution of coal production in 2020