



Risk perception among the most interested parts in case of a fertilizers production company closure in the actual context of the energy crisis with focus on socio-economic aspects

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Abstract. The purpose of this research was to discuss on specific information regarding risk perception of different stakeholders in the context of the closure of a fertilizers production company considering the actual context of the energy crisis based on the geopolitical conflicts in Eastern Europe. In the first part, there were considered some of the most important aspects referring to risk concept and more specific to risk perception. Then, the actual geopolitical context was discussed, based on the Russian invasion of Ukraine and its impact on the gas and energy market. In this regard, we have conducted a survey with the most interested and potential affected parties. The results indicated that depending on the group they belong, different socio-economic aspects may affect different stakeholders in the given context. We have also proposed some future directions for this article, considering all the technological progress made in recent years, for the use of alternative and renewable energies in the fertilizers production industry.

Key Words: energy crisis, fertilizers, gas prices, risk perception, stakeholders, sustainable production processes.

Introduction. One of the most accepted approaches of people perspectives on risk is to have represented quantitative risk estimations for hazards, most of them expressed in numbers: such as numbers of death or losses, risks per hour of exposure, annual probability for death reduction etc. (Slovic 1987).

SEVESO III Directive defines "risk" as: "the probability that a specific effect will occur in a certain period or under certain circumstances" (Directive 2012/18/EU).

No matter if we are talking about natural conditions from the environment, human or industrial activities, they can all generate hazards, which means that they can all generate risks (Kirchsteiger 1999).

Risk, in the chemical industry, is defined in the form of probable annual production losses or human accidents as a result of unforeseen technical events (Crowe et al 1967). It also represents a combination of uncertainties and damages or the ratio of hazard to safety (Ozunu et al 2008). One of the most used definitions for "risk" in risk analysis is the one considering risk is depending on these 3 terms: events, probability and consequences (Renn & Rohrman 2000).

On the other hand, risk is usually associated with actions or decisions needed to be taken so that to avoid negative impact and to prevent unwanted consequences (Hokstad & Steiro 2006). Considering risk perception, if we take a look at some random events, we will notice that people will always stand up for threats they can avoid or think they can manage because the risk is expected and that is why they are prepared for it and, even if those threats may never or extremely rare happen (Sandman 1994).

There is no doubt that personal experience is important, which means that the expectancy or recognition of a risk happening, but this should not be the only guarantee

(Martin et al 2009). Most of the time, the actions taken in order to prevent or mitigate a risk are reflected in our decisions by the way we perceive that risk (Powell 2007).

There will always be different perceptions in different persons and contexts (Slovic et al 1980). And all these because risks cannot be and happen without affecting or influencing people. Risk perception should be considered, expressed and evaluated not only for accidents or hazardous technologies, but for all kinds of activities with possible negative outcomes. Considering this, a growing number of risk assessment studies are describing more and more often the closed relationship between trust and cooperation in risk perception, especially because of risk's multidimensional characteristics (Earle et al 2012).

The actual context for the fertilizers production in Europe. In the last decade, there have been many interrelated geopolitical crises that have affected the economy worldwide. Undoubtedly, some of them have destabilized food security and nutrition (IEA 2022).

Agriculture is one of the most significant energy consumer sectors. The energy is used directly through natural gas and electricity and indirectly in the form of pesticides, lubricants and fertilizers, it is very important that the adequate energy input to be provided (Stout 1990; Rokicki et al 2021; Paris et al 2022).

Russia has been Europe's largest supplier of natural gas for so many years so far (Ahrend & Tompson 2005; Spanjer 2007). Unfortunately, the actual political context that has led to the energy crisis nowadays, involving continuous increasing in the gas price, more and more European fertilizers production companies have temporarily stopped their activity, because of fertilizers' prices becoming uncompetitive compared to the same products from Russia and the United States (Fertilizers Europe 2022).

The fertilizers production industry uses gas as raw material for the energy supply assurance in the synthesis process. Of course, that high production needs high gas use. In this context, to continue to be profitable, it means that any fertilizers production company has to increase fertilizers prices so that to be profitable.

Because of historically high prices for natural gas on the European market, the cost of production has been directly affected. For example, in Poland, the price quotation increased from 72 euros for 1 MWh on 22 February to 276 euros on 22 August 2022 (European Commission 2022).

One of the most intensive energy consuming sectors, the fertilizer one, is among the first heavy industries in Europe to reduce their production considering the existing energy crisis. The fertilizer industry is among the largest gas consumers in the EU, therefore also the most exposed. Up to 70% of the cost of fertilizers is gas, so without gas there is no fertilizer, and without fertilizer there is no intensive agriculture.

Because of the record gas prices, the European industry has been significantly impacted, especially on aspects like food security, fertilizers production and even sustainability (www.fertilizerseurope.com).

Above all, 2022 has been one of the driest years, affecting many regions of Europe, impacting the harvest and production of fertilizers. In the summer of 2022, there might have been registered the most severe drought Europe has experienced in the last 500 years, with record-breaking temperatures and unusual lack of rain (Toreti et al 2022).

Because fertilizers play a significant role for food security, a global crisis of mineral fertilizers and energy is currently affecting food security and food prices worldwide. Considering the aspects discussed above, we have identified the most important categories of stakeholders that may be affected at some point in this whole context.

At this moment, a lot of fertilizers companies from Europe have suspended their production activities and that is why we want to underline the most significant risks and effects felt at the level of the most important interest groups from this sector and moreover, what is their perception regarding the current situation.

According to the European Parliament official and public communications, in August 2022, when there was a significant peak for gas prices in Europe, more than 70% of the ammonia production industry closed its production as it had become unprofitable

(COM 2022). This fall in the ammonia production, definitely tips the scales to higher imports, which generates a trade deficit to non-EU countries, for example, while there was a 9% drop in the exports of nitrogen intermediates and fertilizers have dropped, while imports have increased with 19% in the first semester of 2022.

The scope of this article, was to analyze and observe the risk perception of different categories of stakeholders in case of the closure of a fertilizers production company, considering both social and economic aspects.

The main objective would be to conduct a survey with relevant questions, for different people belonging to one or more groups of interested parties, in order to underline different perceptions on the same risk. Based on their answers, there have been discussed some important aspects regarding the present situation for the energy crisis in Europe and the future direction we should consider.

Material and Method. First of all, we have constructed a simple four quadrant stakeholder matrix for the most interested parties in this whole process of closing the factory located in the north central part of Romania, considering their interest and influence on this topic. Of course, influence is usually a subjective criterion to take into consideration, but for the prioritization of the stakeholders, is a necessary one.

Generally speaking, stakeholders have power and this aspect helped us to have construct the map below (Figure 1), in order to identify and include all the interested parties with concerns on this topic (Polonsky 1996).

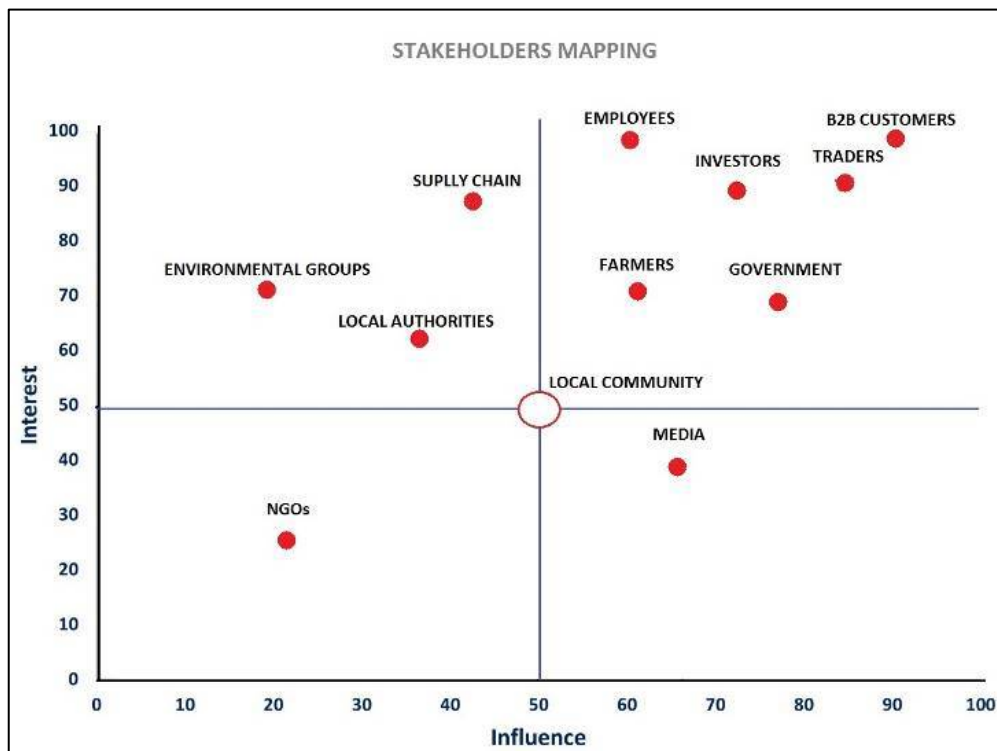


Figure 1. Map representing the position of different stakeholders depending on their interest and influence.

After stakeholder identification, we have performed a questionnaire for the ones considered the key ones. Its validation was based on evaluating risk perception, risk factors, direct or indirect interests, behaviors and preventive knowledge. There were no inclusion or exclusion criteria established. The responders chose to keep their identity anonymous, so that to avoid any eventual consequences. Intentional sampling selection was used. We have considered a sample containing 30 individuals, parts of 5 different stakeholder groups.

Experimental design. The questionnaire was created by a team of 4 experts in risk analysis and assessments, risk perception and fertilizers production process, based on perceived risk related factors, preventive and mitigative knowledge against the risk of closure of a fertilizers production company from Romania, in the actual context of the energy crisis with focus on socio-economic aspects. The survey has been completed and validated under the title: „Questionnaire on the influence of closure of a fertilizers production company in the actual context of the energy crisis”.

There was a total of 6 questions established and a 1 – to – 5 – point Likert type response scale, with a maximum score of 30 (100%). The responders distributed the results they have attributed to each question, to the scale referring to their perception on the risk of closure the company (Figure 2). While 1 was meant to express the lowest level of perception on the risk of closing which means – none, 5 went to the maximum risk ranking, meaning that 0% led to zero risk and 100% led to the highest risk.

The maximum score of 100% points out that the responder considers the event of closure of the fertilizers production factory with a high level of risk, with a very negative impact, especially from the economic and social point of view, this involving losses of jobs for the employees, losses of funding sponsorships for local events and even losses in the local economy. The only positive aspect identified through the survey directly linked to this topic, would be the improvement in both the quality of the environment and health and safety of the local community.

STAKEHOLDERS CHECKLIST TO DETERMINE THE RISK PERCEPTION IN THE CASE OF CLOSING THE ONLY FERTILIZERS FACTORY FROM ROMANIA CONSIDERING THE ACTUAL ENERGY CRISIS						
Crt. no.	Questions	Range				
		1	2	3	4	5
		Very low	Low	Medium	High	Very high
1.	Closing the factory is considered as a threat for the local economic development					
2.	Closing the factory generates an impact in the national economic development					
3.	Closing the factory will affect your activity					
4.	Closing the factory puts in danger the national food security					
5.	Closing the factory generates an improvement in the quality of the environment					
6.	Closing the factory generates an improvement in the health and safety of the population ensuring					

Figure 2. The questionnaire used to identify stakeholders’ perception on the risk.

Results and Discussion. We have presented the questionnaire in person for some of the responders or we have sent it through the e-mail, for those who chose this option. One important aspect to be mentioned here is that we have centralized only the answers of the key stakeholders.

For the supply chain, there was calculated a percent of 76, this meaning that their perceived risk involves a significant level of preoccupation on this topic. Because Russia was the main actor in the natural gas supply chain for the European Community with a high level of dependency and EU has established a lot of sanctions against it, this clearly affected the commercial relationship between Russia and EU.

When talking about fertilizers in the context of the supply chain stakeholders' group, another important aspect to be mentioned is that Russia is the biggest actor not only on natural gas supply, but also on other critical raw materials for the fertilizers industry, such as phosphate and potash or potassium chloride (two of the three main chemical nutrients used in commercial fertilizers, besides nitrogen).

For the local authorities, the total score was 25 points out of 30 and a 83.33% percentage calculated, which means that the risk perceived was a very significant one. What has been pointed out by the local authorities during the survey, was the fact that in the case of closure of the fertilizers production company, not only the quality of the environmental factors such as air, water, soil, waste management, will be significantly improved, but also the health and safety of the locals is going to be assured, considering all the hazards and risks associated to the production process.

The local community scored the percentage of 86.66%, with similar answers with the local authorities' group, indicating a high level of risk perception.

The farmers, scored a total of 19 points, with a medium risk ranking from the financial point of view. They underlined the fact that from their point of view, there will be consequences for both local and national economic development. Another important aspect to be mentioned here is that the farmers' main concern would be that the closing of the only national fertilizers production factory will directly affect their activity.

For the employees, which are undoubtedly one of the most interested parts in this process, there was a percentage of 80% calculated. For this category of stakeholders, the risk perception was distributed on 2 directions. First of all, they have associated a medium risk for the improvement of the environment's quality and the health and safety of the population. But with a more significant risk, in their perception, would be the national food security and economic development. What they consider at the highest level of risk, with a score of 5 points, was the threat on the local economy and their activity, their jobs.

The results of the survey suggest that, the responder's perception on the risk of closure of a fertilizers production company, suggests a rapidly increase at the beginning of it and after a period of time, when people seem to get used to the idea, begins to decrease. Negative feelings such as worry and anxiety about the actual geopolitical crisis, were noticed. Moreover, the results show that different groups may experience different risk perception feelings, depending on a combination of several factors such as work experience, personal economic issues, perception on the environment protection, political interests etc (Burns et al 2012).

Russia being one of the most important actors on the gas supply market, building a new value chain with other gas suppliers for EU, others than Russia, is going to be a really challenging gradual process, which cannot happen from one day to the next without economic consequences.

Another important aspect to be discussed, is that there is no coincidence that right in the middle of the stakeholders' map, stays the local community, considering their level of influence and interest. They are by far the most interested and affected parties in the given context if we consider all the economic and social aspects involved. Their influence is not negligible, but it is well known that they are not powerful enough to stop this kind of crisis. The interest they have in stopping this process, is clearly a notable one, considering that the majority of the employees that are working there, are coming from the local community, which means that a lot of them will lose their jobs.

In the interpretation of the local community answers to the questionnaire based on their risk perception, we need to consider that local businesses pay local taxes, which means that a lot of money goes into the local community, in different kind of improvements, like infrastructure, education and culture etc. All the aspects mentioned above, should be considered not only for the local community's risk perception, but also

for the local authorities one. Their major preoccupation on this topic is the financial one, which reflects a negative perception on the risk, while in contrast they have attributed high scores to the environmental and health and safety aspects, which, in their opinion will be significantly improved with the closing of the fertilizers production activity.

Considering all the aspects discussed, one of the future research directions, may be to assess the risk of closure of a fertilizers production company, with specific qualitative methods, specifically PHA (Preliminary Hazard Analysis). Practically, we consider that people's perception on the risk of closure of a fertilizers production company would depend on both the probability of the hazard to happen and the consequences it will lead to (Liu et al 2021).

People involvement, no matter what stakeholders' group is part of, is very important in mitigating risks, because individual's perception on risk will always influence the way they choose to act against the risk or to remain indifferent (Ren 2004; Martin et al 2009). This means that there is always a significant possibility that some of the measures taken in order to reduce risks, may not be enough.

Conclusions. Considering all the aspects discussed, one of the future research directions, may be to assess the risk of closure of a fertilizers production company, with specific qualitative methods, specifically preliminary hazard analysis.

One of the most important conclusions would be that risk perception may be different depending on the stakeholders who take part in its assessment, based on their convictions, past experiences and knowledge. This means that, for example, the same people belonging to two different interested parties groups, may have different risk perceptions, because of their group's interests and influence on that risk.

Most of the time the perception vis-a-vis "risk" is different depending on the stakeholders who take part in its assessment, like specialists or experts, regulatory bodies / public authorities, industry, economic operators and last but not least, media – which is not only a source of information and knowledge, but it also contributes to the formation of an opinion and the shaping of a fundamental attitude referring to various relevant risk topics.

Another thing that needs to be noted is that the fertilizers industry will face a lot of challenges in the near future. First of all, considering the actual context of Russia's aggression against Ukraine, it's important for Europe to become independent of Russian gas and energy, which means that there should be find alternatives for energy procurement. Besides this, the technological progress made towards sustainable production processes, should be considered, not only regarding the fossil free fertilizers, but also for different types of fuels as energy sources.

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