

Managing Innovation and Collaboration towards Sustainable Post-Mining Land Reclamation: Systematic Literature Review

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Abstract: *Post-mining land reclamation is getting more attention from many parties since it is perceived as a solution to creating more sustainable mining lands in Indonesia. Reclaiming mining land can reduce negative impacts and create more productive land to generate more economic benefits. Collaboration and innovation from various parties, such as the government, communities, private companies, and other stakeholders, are needed to achieve this goal. This study explores data and information related to post-mining land reclamation alternatives by applying the concepts of collaboration (co-creation) and innovation among stakeholders. The method used in this research is systematic literature review. This method aims to review the relevant literature through a systematic process. There are 11 articles used as a source of literature review, which are grouped based on concepts and discussions following the topics raised in this study. The results of this study are a post-mining land reclamation idea and the concept of collaboration between the stakeholders to realize sustainable post-mining land reclamation in Indonesia.*

Keywords: *post-mining land; collaboration; innovation; sustainability*

Introduction

The mining sector in Indonesia has been growing since 1998, in line with Indonesian government policies on mineral resources. The policy was associated with the regional autonomy given by the central government to the regional government to manage the local mineral resources. That policy has impacted the increasing number of mineral demands in Indonesia. The Indonesian government then attempts to maximize the benefits of the mining sectors in terms of revenue and economic development (PwC, 2012).

The mining industry has become one sector with a high contribution to Indonesia's GDP. In 2020, this sector will account for approximately 7.2 percent of total Indonesian GDP (Estefania et al., 2021). Several provinces have the highest mining contributions in Indonesia: West Papua, East Kalimantan, East Belitung, and West Nusa Tenggara. Because Indonesia has a wealth of mineral resources, it is able to import them into global markets. Like the mining industry, the minerals sector attracts many investors from many countries, like China, India, Russia, and South Korea, who have more intention of

investing in the Indonesian mining sector (PwC, 2012).

Besides its potential to generate more economic benefits, it cannot be denied that mining activities in Indonesia may negatively impact the surrounding environment. Environmental damage is a negative impact that can be seen physically and felt in a non-physical way (Anura, 2019). Mining activity makes the post-mining land unproductive. More than 8,700 ha of post-mining land in Indonesia are still not used (Wachid, 2020) and have enormous potential to impact the environment and society negatively. So, in response to this risk, society around the mining areas requires the mining company to act more transparently and with more respect towards society, especially when it comes to the environmental issues caused by mining activity. Therefore, land rehabilitation should be done so that land can be utilized again. Rehabilitation is one of the land recovery solutions to make the lands more valuable without having to be restored to their original form (Yasri and Sudarma, 2017).

Due to that phenomenon, many researchers have given more intention to the mining sectors in Indonesia in recent years. It may be due to the positive and negative impacts caused by mining activity, even more so its impact on environmental sustainability. In their study, Soelarno (2007) and Haeruman (2014) explain the importance of post-mining land transformation to supporting sustainable development in Indonesia. Other researchers also spoke about several alternatives to post-mining land transformation. Several studies indicate that post-mining-lands can be transformed

into more productive lands. For example, in South Africa, post-mining lands are transformed into agriculture and tourism (Mthenjane, 2019). Meanwhile, in Queensland and New South Wales, agriculture and biodiversity are the most proposed post-mining land uses (Fogarty et al., 2019). Then, in Indonesia itself, post-mining lands are suitable for being transformed into agricultural (Dariah et al., 2007), forestry (hirfan, 2016), agroecotourism areas (Kodir et al. 2017), etc. To support the transformation of post-mining lands, in 2017, Setyowati and Munir proposed three stages of post-mining land transformation: land preparation, planting, and maintenance.

Although there is so much research about the transformation of post-mining lands, unfortunately, there is limited research that discusses the importance of collaboration and innovation in the transformation of post-mining lands. Whereas, to overcome the issue related to post-mining lands, collaboration from all stakeholders in the mining industry is needed to generate more innovative solutions to make the post-mining lands more productive and generate more income. So, through this research, the authors are trying to do a systematic literature review related to the collaboration model for post-mining transformation while discussing more innovative ideas related to alternatives to transforming post-mining lands in Indonesia.

Methods

To achieve the objective of this research, the method that supports this research is a Systematic Literature Review.

The primary purpose of this method is to help researchers find solutions to issues raised in their research transparently and reproducibly (Linnenluecke et al., 2019). Using this method, the researchers try to collect, identify, review, and synthesize published evidence (literature) in line with the research topic (Lame, 2019). This

method is appropriate to help researchers synthesize different studies (Siswanto, 2010).

According to Perry and Hammond (2002), there are eight stages to conducting a systematic literature review. Those steps are explained in the table below.

Table 1. Systematic Literature Review Stages

No	Stages	Description
1.	Research Questions Identification	Identifying issues or questions to be answered
2.	Develop Systematic review research guidance	Create systematic steps in conducting the research
3.	Determine research area	Make a limitation about the research area covered in the research
4	Selection of relevant literature results	Collecting relevant results from the literature studied
5	Choose quality research results	Choose good quality literature to be included in the study
6	Extraction of data from individual studies	Extract data from each study to obtain significant findings
7	Synthesis of results by meta-analysis or narrative method	Synthesize results using meta-analysis (quantitative) or narrative techniques (qualitative)
8	Presentation of results	Writing research results in a systematic review report document

Source: Perry and Hammond, 2002

In doing a systematic literature review, reviewers can use two methods: meta-analysis and meta-synthesis. Siswanto (2010) employs meta-analysis to combine quantitative and qualitative research findings. Since researchers are trying to do a qualitative systematic literature review, the method used in this research is Meta-Synthesis using the Meta-Aggregation Approach. Using this approach, the researchers will collect several relevant studies to be analyzed and synthesized as "aggregates" (Siswanto, 2010). This approach follows several steps (Francis & Baldesari, 2006).

1. Formulate the research questions or issues
2. Searching for relevant qualitative literature or articles

3. Screening and selecting appropriate qualitative research articles
4. Analyze and synthesize the selected literature with good quality
5. Writing a systematic report

In this research, the issues raised are related to the transformation of post-mining lands in Indonesia and building collaboration among stakeholders to realize land reclamation successfully. After searching for qualitative articles, more than a hundred articles discuss the issue. But, in total, 15 articles are used in this research as appropriate sources for conducting a Systematic Literature Review using the Meta-Aggregation Approach. Those 15 articles will then be analyzed and synthesized to get the pertinent findings

discussed in the Results and Discussion section.

Results And Discussion

The meta-aggregative approach used in this research is fascinating to implement in social science research since so many well-established conceptual and theoretical frameworks have been published in this field. Several steps are conducted to get better results and understand the topic discussed. Those steps are formulating the research issues, searching and selecting the appropriate qualitative literature, and then analyzing and synthesizing the findings.

Formulating the Research Topic or Issue

Reclamation of post-mining land is carried out to restore land according to its initial color so that later it can be transformed into agricultural land or other things. Therefore, the mining industry should consider and pay close attention to efforts to save nature and the environment from the beginning, even from the planning period, long before mining is carried out. In carrying out reclamation, it is not only necessary to restore the former mining conditions as much as possible as before. It is also necessary to think about how the benefits can be maximized for the

community and can be managed sustainably. Thus, even though mining operations are no longer, they can still benefit the community and the country.

Considering the benefits, not all ex-mining land must be returned exactly as before by revegetation (planting trees again). So, reclamation can be done with various adjustments according to the needs and benefits; one example is tourist attractions. In addition to enjoying the natural beauty, tourist sites of ex-mining holes can be used as educational tours to provide mining insights for visitors who travel (Muntaha, 2019).

By using the Meta-Aggregation approach, the researchers are trying to discuss two main issues related to post-mining land reclamation: innovative transformation ideas and stakeholders' collaboration.

Searching and Selecting Appropriate Qualitative Literature

In searching and selecting appropriate literature, several articles related to post-mining land reclamation published in Indonesia and other countries are reviewed to get better insights and systematic literature review findings. Below is the flowchart outlining the review procedure of the included studies.

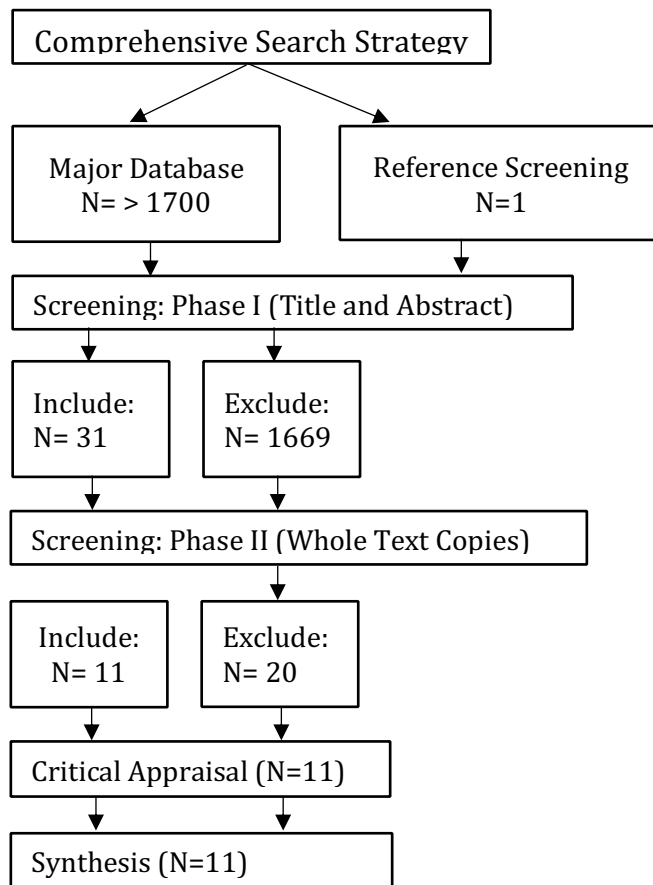


Figure 1. Flowchart Outlining the Review Procedure of The Included Studies.

Source: Flowchart was adapted from Hannes et al. (2019) and then was modified by the authors

We retrieved more than 1700 studies from the 15 electronic databases. From those 1700 studies, after we were doing the first screening process, only 31 studies were relevant to our topic, and we decided to exclude 1669 studies based on title and abstract. Then, we enter the second screening process by considering the full text of the selected studies. We chose only 11 studies, with many considerations. It should be noted that the idea of post-mining reclamation should be

discussed by several countries, including Indonesia, the stakeholders in the mining area, and the collaboration for post-mining reclamation.

Synthesis of Findings

Table 2. describes the 11 kinds of literature used in this study. We categorized the findings into four main synthesized statements for our studies: land transformation ideas, stakeholders, and collaboration.

Table 2. Literature Review Process

References	Title	Country	Research Methods	Findings
Category #1: Types of innovative post-mining lands transformation				
(Limpitlaw and Briel, 2014)	Post-mining land-use opportunities in developing countries—a review	Africa	Literature Review	Types of post-mining lands reclamation: tourism facilities and

References	Title	Country	Research Methods	Findings
				conservation
(Kodir et al., 2017)	The integrated post-mining landscape for sustainable land use: A case study in South Sumatera, Indonesia	Indonesia	Geographical Information System (GIS), a land suitability evaluation, and a feasibility study	Four alternatives for post-mining lands reclamation: plantation forests, cultivation of cajuput crops, aquaculture, and cattle farming
(Herdiansyah et al., 2018)	Sustainability of post-mining land use and ecotourism	Indonesia	Analytical Hierarchy Process (AHP)	Three alternatives for post-mining lands reclamation: water treatment, agriculture & ecotourism, and flora & fauna conservation
(Hattingh et al., 2019)	Applying a regional land use approach to mine closure: opportunities for restoring and regenerating mine-disturbed regional landscapes', in AB Fourie & M Tibbett (eds)	Australia	Literature Review	Types of Land Use: 1. In Australia: Conservation area and cattle grazing. In Canada and the USA: cattle and other farming 3. In Europe: Museums, tourism destinations, restaurants, sporting facilities, and concert areas. The lands are also used for scrapyards, sawmills, chemical processing facilities, and waste treatment plants. In developed countries: museums and industrial-related heritage resources 5. In South Africa: recreation/sport (such as fishing) or aquaculture in remaining voids, biodiversity in pre-mining ecological areas (Binns & Nel 2003); farming in pre-mining farming areas (Limpitlaw & Briel 2013); and cultural tourism
(Singh and Uppgupta, 2021)	Post-mining land use determination based on land suitability analysis: a case study in Bokaro district of	India	Quantitative analysis using Ground Survey	Four alternatives for post-mining lands reclamation: forest, agriculture, plantation activities, and recreation point

References	Title	Country	Research Methods	Findings
		India		
(Marot and Harfst, 2020)	Post-mining landscapes and their endogenous development potential for small- and medium-sized towns: Examples from Central Europe	Central Europe	Good practice analysis	Three alternatives for post-mining lands reclamation: New green areas, renewable energy production facilities, and new tourism products
(Beer et al., 2021)	Post-mining land uses – a literature review	Australia	Literature Review	Types of lands transformation: 1. Active tourism, including mine sites as places for physical activity and adventure tourism 2. Recreation uses and hotel accommodation Office accommodation The processing of waste and other materials in bioreactors 5. Science precincts Energy generation; and, Environmental assets, including wetlands.

Category #2: Collaboration

(Kretschmann, 2017)	From Mining to Post-Mining: The Sustainable Development Strategy of the German Hard Coal Mining Industry	German	Qualitative Methods	Types of collaboration for post-mining lands reclamation: 1. Collaboration between the mining company and mining experts 2. Collaboration between universities and companies 3. Collaborations between governmental institutions 4. Collaborations of governments
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References	Title	Country	Research Methods	Findings
(Foran and Yuen, 2021)	Defining success for CRC-TiME: A collaborative governance approach to impact and evaluation	Australia	Qualitative method using Participatory Workshop	There are three types of collaboration for post-mining lands transformation: 1. Collaborative governance (collaboration system and policy to engage stakeholders to reach public purposes). 2. Collaborative Governance Regim (related to interaction among stakeholders to reach shared goal). 3. Collaboration dynamics (consist of moral engagement, shared motivation, and collective capacity).

Category #3: Stakeholders

(Anonim, 2015)	Stakeholder Analysis of the Mining Sector in Armenia	USA	Mixed method using questionnaire and interview	Types of mining stakeholders: national, regional, and local governmental bodies, scientific institutions, local NGOs, mining companies and international organizations
Foran and Yuen, 2021)	Defining success for CRC-TiME: A collaborative governance approach to impact and evaluation	Australia	Qualitative method using Participatory Workshop	Types of Stakeholders: 1. Public like experts (Role: co-design studies, analyze and deliberate, co-produce findings). 2. Experts (Role: Co-produce findings, analyze, and deliberate). 3. Government (Role: Take decisions) 4. Association (Role: network)

Source: Processed data (2021)

Each piece of literature gave impressive results since the geographic area, and the scope of each research are also different from one another. After getting the literature result, the next step in the Meta-Aggregation approach is to categorize the result using the categories

analyzed before entering the synthesis process.

Category #1 (Innovative Post-Mining Lands Transformation)

The types of post-mining lands are categorized in Table 3.

Table 3. Synthesis #1

Types of reclaimed pos	Count
Agriculture	5 findings
Forest/Conservation	4 findings
Cattle farming	3 findings
Tourism	6 findings
Museum and cultural recreation	2 findings

Source: Processed data (2021)

Several countries use many alternatives, from developed to developing countries, to reclaim their post-mining lands to create a more sustainable environment and economy for society. The transformation of post-mining lands is influenced by several factors, like the size of post-mining lands, the location, the type of mining, the soil types, etc. So, there are so many alternatives that can be chosen to transform the lands into more productive lands. Most of the country's post-mining lands are transformed into tourism facilities and agricultural.

Category #2 (Collaboration)

Collaboration in the post-mining lands reclamation process is categorized in Table 4.

Table 4. Synthesis #2

Types of reclmaed pos	Count
Collaboration types	3 findings
Collaboration system	2 findings

Source: Processed data (2021)

In reclaiming post-mining lands, stakeholders need collaboration to make sure many parties support the reclamation process in terms of ideas, financial, human resources, other resources, policies, etc.

Category #3 (Stakeholders)

Types of stakeholders in the post-mining lands reclamation process are categorized in Table 5.

Table 5. Synthesis #3

Types of reclmaed pos	Count
Mining Company	2 findings
Government	3 findings
NGO	1 finding
Experts	1 finding
Academia	2 findings
Public	2 findings
Association	1 finding
International Organization	1 finding

Source: Processed data (2021)

There are many stakeholders involved in reclaiming post-mining lands, from the mining company itself, the government, academia, the public, and other stakeholders. Each stakeholder has their own role. For example, the mining company has a role in producing productive post-mining lands. Then, the government's role is as a policymaker. Then, to do good planning for the reclamation, the mining company can collaborate with academia or research institutions.

Discussion

The history of mining activity in Indonesia started in 1846, which has reached the exploration stage. Today, mining is one of the industries with the highest GDP contribution in Indonesia. However, mining activities impact the environment if not managed properly. The impact can last forever, not only on the environment but also on society (Kapyła, 2020). Therefore, the management of post-mining land is essential to being a significant concern in mining governance activities (Pushep. 2020). The management of post-mining land is called the reclamation process. Reclamation will be carried out when mining activities have been stopped. This activity is considered

essential to be carried out by every mining company in Indonesia and throughout the world.

Reclamation is initiated to reduce the negative impacts of mining activities on the environment. Reclamation activities are also expected to change non-productive lands into more productive ones and bring more social and economic benefits to the environment. Reclamation can be called a reused activity where people are trying to reuse the post-mining lands to become new, safe and productive lands (Hirfan, 2016).

Many post-mining lands have been transformed into different productive lands, which include the farming area (Limpitlaw and Briel, 2014), tourism activity (Beer et al., 2021), cattle farming like in the USA and Australia, and other productive lands that bring environmental and economic benefits for society. Considering the benefits, not all post-mining land must be returned exactly as before by revegetation (planting trees again). So, reclamation can be done with various adjustments according to the needs and benefits. One example is tourist attractions. In addition to enjoying the natural beauty, the former mining pits can be used as educational tours to provide mining insights for visitors who travel. The post-mining pit, used as a tourist spot, can be an attractive option. That post-mining pit that has been transformed into a tourist spot can be used as a fishpond that accommodates various types of fish. Another example is as an area for water sports. But, as mentioned previously, the water in the ex-mining pit should be treated first to remove heavy metals and other dangerous materials (Muntaha, 2019).

Before starting the reclamation, it is essential to ensure that the post-mining lands are ready to be transformed into new productive lands. So, all stakeholders need collaboration to achieve good reclamation results, starting from the pre-reclamation process, like choosing the best land transformation alternatives, and developing, monitoring, and evaluating the reclamation process.

Collaboration Practice for the Success of Reclamation Process

Many researchers around the world have discussed the concept of collaboration. In this research, the researchers will be focused on the importance of collaboration for post-mining land reclamation. In general, collaboration is a relationship between organizations that participate and mutually agree to achieve goals jointly, share information, share resources, share benefits, and be responsible for joint decision-making to solve various problems (Lai, 2011). Collaboration involves several parties, starting from the individual, workgroup, and organizational levels (Whitford, 2010). In line with this research topic, collaboration refers to the cooperation carried out by the stakeholders (mining company, government, researchers, society, etc.) to achieve the reclamation goal by sharing ideas, information, resources, and benefits.

According to the results of the systematic literature review, Foran and Yuen (2021) suggested a collaborative governance concept to be implemented in the mining sector. Emerson, Nabatchi, & Balogh (2012) define collaborative governance as processes and structures

used to engage various people from different levels of the organization to achieve a shared vision or goals. In this case, collaborative governance is aimed at getting stakeholders' engagement to reach the reclamation goal. To achieve collaboration among stakeholders in the post-mining land reclamation process, stakeholders need to understand and trust each other (principled engagement), develop shared ownership (shared motivation), and share their available assets (capacity for joint action). Collaboration dynamics are those three aspects (Emerson and Nabatchi, 2015a, 2015b).

Conclusion

In general, the reclamation carried out by mining companies today is through the transformation process of post-mining land into more productive lands, such as agricultural land, tourist sites, livestock, forests, conservation areas, and others. This reclamation process needs support and commitment from all involved parties (stakeholders), like mining companies, the government, academia, associations, and even society around the mining lands. Collaboration governance then becomes a critical plan today and in the future. Good collaboration governance can make each stakeholder work together to achieve the goal of post-mining reclamation. By applying collaboration, the non-productive post-mining lands in Indonesia can be transformed into more productive lands, which is expected to bring more benefits for society and increase the regional GDP in general.

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References

- Beer, A., Haslam-McKenzie, F., Weller, S., Davies, A., Cote, C., Ziemski, M., Holmes, K., & Keenan, J. (2021). *Post-mining land uses - a literature review*. CRC TiME Limited., Perth, Australia.
- Binns, J.A. & Nel, E. (2003). The village in a game park: local response to the demise of coal mining in Kwa-Zulu Natal, South Africa. *Economic Geography*, 79, 41.
- Dariah, A., Abdurachman, A., & Subardja, D. (2010). Reclamation of Ex-Mining Land for Agricultural Extensification. *Jurnal Sumberdaya Lahan*, 4(1).
- Emerson, K., & Nabatchi, T. (2015a). *Collaborative governance regimes*. Washington, DC: Georgetown University Press.
- Emerson, K., & Nabatchi, T. (2015b). Evaluating the Productivity of Collaborative Governance Regimes: A Performance Matrix. *Public Performance & Management Review*, 38(4), 717-747. DOI:10.1080/15309576.2015.1031016
- Emerson, K., Nabatchi, T., & Balogh, S. (2012). An Integrative Framework for Collaborative Governance. *Journal of Public Administration Research and Theory*, 22(1), 1-29. doi:10.1093/jopart/mur011
- Estefania, Sativa, E., & Noorliana, E. (2021). Analisis Pertumbuhan PDB Indonesia Melalui Pengembangan Sektor Pertambangan. *Jurnal Indonesia Sosial Sains*, 2(5), 756-765.

- medium-sized towns: Examples from Central Europe. *The Extractive Industries and Society*. <https://doi.org/10.1016/j.exis.2020.07.002>
- Mthenjane, M.I. (2019). Post-mining use of rehabilitated land - an opportunity for the South African mining industry for sustainable development. *Journal of the Southern African Institute of Mining and Metallurgy*, 119(9), 693-696. <https://dx.doi.org/10.17159/2411-9717/2019/v119n9a1>
- Perry, A. & Hammond, N. (2002). Systematic Review: The Experience of a Ph.D. Student. *Psychology Learning and Teaching*, 2(1), 32-35.
- Pushep. (2020). *Sejarah Pengaturan Pertambangan Minerba dan Perjanjian Karya Pengusahaan Pertambangan Batubara (PKP2B)*. Pushep.or.id
- PwC. (2012). Mining in Indonesia: Investment and Taxation Guide. *The report, PWC, Indonesia*.
- Setyowati, R.D.N., & Munir, M. (2017). Kajian Reklamasi Lahan Pasca Tambang. *Klorofil*, 1(1), 11-16.
- Singh, P.K., & Upguta, S. (2021). Post-Mining Land Use Determination Based on Land Suitability Analysis: A Case Study in Bokaro District of India. *Ecology, Environment and Conservation Paper*, 27, 226-230.
- Siswanto. (2010). Systematic Review Sebagai Metode Penelitian untuk Mensintesis Hasil-Hasil Penelitian (Sebuah Pengantar). *Buletin Penelitian Sistem Kesehatan*, 13(4), 326-333.
- Soelarno, S.W. (2007). Planning of Post Mining Development for Supporting Sustainable Development: Case Study on Coal Mining PT Kaltim Prima Coal in East Kutai Regency, East Kalimantan. In: *Ph.D. Dissertation Report, Univ. of Indonesia, Depok*.
- Wachid, W. (2020). Ada 87.000 Hektar Lahan Bekas Tambang Terancam Terbengkalai. Gatra.com. <https://www.gatra.com/news-479025-ekonomi-ada-87000-hektar-lahan-bekas-tambang-terancam-terbengkalai.html>
- Widana, Anura. (2019). Environmental Impacts of the Mining Industry: A Literature Review.
- Whitford, Andrew B. dkk. 2010. Collaborative Behavior and The Performance of Government Agencies, *International Public Management Journal*. Yasri, GR & Sudarma, E. (2017). Pemanfaatan Lahan Pasca Penambangan Grasberg, Papua, Indonesia. *Jurnal Sains dan Seni Pomits*, 6: 2337-3520.