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Peer Review

Review of: "Adverse Environmental and Public Health Effects of Artificial Intelligence: A Narrative Review"

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Critique of the Paper and Critical Evaluation

1. New and Significant Pieces of Information

In fact, the paper offers a thorough review of the harmful impact of artificial intelligence (AI) across its complete lifecycle, from the extraction of resources to the disposal of e-waste, both in environmental degradation and in public health ramifications. This is a new and seminal contribution to the field, linking AI's environmental footprint with public health impacts through an environmental justice lens. This suggests an under-researched frontier in the literature, exposing the disproportionate burden of AI's impacts from these data points on marginalized communities and the Global South. Including quantitative estimates (such as energy consumption, water use, e-waste generation) and specific cases (such as training GPT-3, algorithmic bias in healthcare) adds weight to the analysis. The paper also suggests concrete mitigation approaches, including renewable energy mandates, circular hardware economies, or bias audits, which are all instrumental in addressing the new challenges posed by AI. But in more detail, the feasibility and implementation challenges associated with proposed mitigation strategies could have been detailed. Although calling for a radical transition of AI governance, the paper lacks the specific roadmap for achieving such change that would make it a more practical approach.

Relationship to Literature

The paper displays good knowledge of the literature in the discipline and references a broad scope of contributors from environmental science, public health, computer science, and social sciences. Reference is made to core research (Obermeyer et al. (2019) on healthcare system algorithmic bias and the analysis of International Energy Agency: data center electricity demand projections). The review adds richness

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and strengthens its arguments by incorporating interdisciplinary sources. So, there are a couple of limitations in relation to the literature:

• Geographic Gaps: The paper notes that most studies are focused on the USA, Europe, and China, with critical understudies focusing on impacts in the Global South. This is a big void because the paper highlights the disproportionate load on these areas.

• Very Fast Advancement of Technology: AI development is moving too fast, and so studies can end up outdated by publication, the paper points out. This has implications for how studies will stay current.

• Dependence on Grey Literature: Though using preprints and grey literature during the article's description, this dependence could weaken the conclusions of some of the findings. Peer-reviewed studies should be prioritized to ensure accuracy and reliability.

3. Ignored Significant Work

The paper does not seem to ignore any major works because it cites many studies and reviews written by peer-reviewed journals and organizations. The paper identifies the dominant techno-optimistic storyline rather than the scientific and empirical facts that support the positive contributions of AI and offer a more balanced view of science and technology.

Conclusion

With new and significant points making its mark, it was deserving of publication because its topic of intersection of AI, environmental degradation, public health, and environmental justice is quite insightful. It shows a sufficient comprehension of the applicable literature and references a wide variety of outlets. However, it may fill more research gaps by region, limit grey literature usage, and balance out the pros and cons of AI. On the whole, the work is informative, and it identifies important directions for investigation and policymaking.

Critique and Critical Assessment of the Paper

1. Methodology

The method that is used and applied in this paper is a systematic scientific literature review, which is appropriate for synthesizing evidence in other areas. The inclusion of databases like PubMed, Web of Science, Scopus, and Google Scholar allows for a wide and diverse source. By drawing upon interdisciplinary research from environmental sciences, computer sciences, and social sciences, it consolidates the paper's theoretical base further. However, a few shortcomings with the methodology exist:

• Absence of Formal Framework: The paper does not utilize a formal systematic review framework like PRISMA, which would have further strengthened the rigorous nature of the review. Although the narrative synthesis approach is valid, it may lack the structured methodological approach for replicability and breadth of coverage.

• Research Selection: The review excludes studies that look only at AI application for good, which can introduce biases. A more rational analysis would consider the potential benefits and some drawbacks of AI and provide more rounded data.

• Geographical Bias: The paper points out that the number of studies mentioned is almost exclusively from the USA, Europe, and China, and its impact on the Global South is underexplored. This restricts the generalizability of the findings and compromises the environmental justice underlining the paper.

Results

Results are clearly stated with quantitative projections and elaborate examples to bolster the paper's claims. The tables of environmental and public health impacts (e.g., energy, water use, e-waste, algorithmic bias) are comprehensible and present useful data. Figure 1 also provides an excellent framework visually illustrating the AI lifecycle and associated ramifications and also shows the disproportionate impact on marginalized communities. However, there are some shortcomings:

• Depth of Analysis: Although the results are comprehensive, analysis of feasibility, cost factors, and possible barriers to implementation is lacking in certain sections (e.g., mitigation strategies). While the recommendation to transition data centres to on-site renewable energy sources is compelling, technical and economic impediments to the impact of renewable energy are still not fully examined. • Conclusions and Results Integration: We draw conclusions that integrate the paper's elements and make clear that a paradigm shift must take place in the governance of AI. However, there is a lack of integration between the results and the proposed solutions. Quantitative estimates of environmental impacts, for example, can be used to model the potential benefits of specific mitigation strategies and can provide a more definitive basis for the conclusions. Conclusion

There is a theoretical basis for the paper′s methodology and a systematic approach to literature review that is generally appropriate. However, a few studies on AI's benefits have been omitted, and the paper fails to provide a formal framework for this, which can introduce bias. The findings are displayed in a clear manner and are accompanied by quantitative data; however, further depth of analysis is warranted, especially with respect to the possible solutions. The findings summarised by the conclusions were very

strong but might be better linked to the mitigation strategies. Overall, however, the paper is well-organized and offers useful information; it would benefit from filling in these methodological and analytical gaps. Assessment and Critical Evaluation of the Paper

1. Implications for Research

This paper highlights that there are areas of research worth looking into, such as the following:

• Environmental Impacts in the Global South: This paper argues for greater inquiry into the environmental and social impacts of AI in marginalized geographic regions, including the Global South, where resource utilization and the disposal of e-waste are disproportionately harmful. • Standardized Reporting: It encourages that AI systems be reported through standardized life-cycle assessment (LCA) methods to enhance transparency and comparability of impacts on both the environment and public health. • Algorithmic Bias: This has serious consequences for equity in the healthcare field as well as other public domains requiring high-stakes audits such as fairness audits. However useful these implications are, specific suggestions might be given in the paper for methodologies, such as longitudinal studies or case studies (where possible), experimental designs, etc., which aim to address the identified gaps. The paper might also discuss ways that collaboration between environmental scientists, public health experts, and AI researchers would help advance the field.

2. Implications for Practice

The paper provides action-focused, actionable recommendations for practice such as:

• Sustainable AI Development: Helping technology manufacturers use renewable sources of energy, increase energy efficiency, and adopt circular economies for AI hardware developers. • Bias Audits: Imposing fairness audits and the use of diverse datasets when developing existing AI systems, e.g., in health-related and hiring applications. • Public Health Impact Assessments: To push for health impact assessments to be mandated for large infrastructure projects powered by AI to produce equitable impacts. Although these suggestions are useful and timely, they are all good ideas; the paper may further cover the economic and commercial dimensions of these efforts in some form. For instance, it might tackle the cost and opportunity analysis of moving toward renewable energy or circular hardware economies and the significance of government subsidies in helping to achieve these benefits.

3. Implications for Teaching

The paper contains some relevant theoretical content for the teaching and learning of courses, including environmental science, public health, and AI ethics. The diagram (Figure 1) and tables describing the

impacts and implications of each approach would seem very useful teaching tools. As a case study, the paper could also be a place in which to discuss the intersection of technology, sustainability, and social justice.

4. Implications for Public Policy

It argues a strong case for the role played by regulation in confronting the environmental and public health consequences of AI. It also cites the European Union's AI Act as an example of extensive regulation and advocates for similar frameworks elsewhere. The paper also highlights the importance of coordinated international efforts aimed at combatting global disparities in sectors like resource extraction and e-waste disposal in the AI process. The paper delineates major policy implications, but a broader analysis could add to policymakers' recommendations. For example, it might detail how to implement transparency guarantees, encourage renewable energy consumption, or mitigate algorithmic prejudice. The paper might also investigate how public-private partnerships might be used to effectively put those policies in place.

5. Impact on Society

There is great potential for the paper to shape public opinion and the quality of life by drawing attention to the environmental and public health impacts of AI. In emphasizing the disproportionate pressure on marginalized communities, the paper adds to the discussion on environmental justice and social equity. It also underlines that AI development must be ethical, giving priority to human and planetary well-being. But that paper does not take the opportunity to better articulate how its findings can turn into actionable steps for individuals, communities, and organizations. It might, for example, recommend ways consumers could champion sustainable AI use, and educators could incorporate these issues into curricula to encourage a more informed and engaged citizenry.

Conclusion

Keywords on research, practice, societal issues, environmental sustainability, public health, social equity. It fills the distance between theory and practice by showing practical strategies for mitigation and stressing that regulatory intervention is essential. However, some finer suggestions, particularly regarding research methods, implementation in practice, and engagement with the public, are suggested in the paper, which has much to do with solidifying the research results. At the end of the day, the paper can play a major role in adding to the literature, advising on public policy, and shaping public opinion in favour of the ethical and sustainable development of AI systems and innovation.

Critique and Assessment

1. Consistency between Implications, Findings, and Conclusions

The conclusions in the paper are, to a large extent, consistent with the implications provided in the paper. The article relates the ecological and public health impacts of AI to sustainable systems, regulation, and wider societal consciousness. For example:

• The results regarding energy use, water use, and the generation of e-waste resonate with the paper's call for moving to renewable energy, a circular economy, and transparent tracking.

• Discussion of algorithmic bias and health inequities is also consistent with advocacy and recommendations for fairness audits and diverse datasets in AI development.

• The focus on environmental justice and the overburdening of marginalized communities corroborates the demand for equitable governance of AI and community health impact assessments put forth in the paper.

But there are some gaps:

• Economic and Commercial Implications: The paper mentions the environmental and social costs of AI, but it fails to give sufficient attention to its economic and commercial effects if the same should be carried out. For example — shifting over to renewable energy or embracing AI hardware in a circular economy would come at great expense; however, these are not detailed.

• Practical Implementation: It offers high-level recommendations but does not identify concrete steps stakeholders (government & civil society, corporates, etc.) could take to operationalize them.

2. Quality of Communication

The paper is clearly written and shows good command of technical language that is appropriate to the area. The language is clean and careful, making it accessible to readers with a background in environmental science, public health, or AI. The use of tables and figures, like the conceptual framework shown in Figure 1, adds some clarity and provides readers with a way to visualize the concepts. But the quality of communication can also be further enhanced:

• Use of Tech and Acronyms: The paper employs technical terms and acronyms related to the world (LLMs, GHG, REEs), but it doesn't give enough explanation for readers who may not have knowledge of these terms. For instance, the acronym called "LLMs" is defined only once, and words such as "digital phenotyping" are included without explanation.

• Sentence Structure: Some sentences with an element of "too complex" and/or "too dense" might be an impediment to readability. For example, the sentence where it mentions the carbon emissions of training GPT-3 could be simplified for better comprehension.

• Balance of Contents: The article is sometimes more focused on technical details rather than on accessibility. This is suitable for the target audience, but it may not reach a relevant audience such as policymakers or educators.

Conclusion

The implications are mostly in line with its findings and conclusions, but some aspects could be added to more extensively engage with economic and practical considerations. The communication quality is good, the expression is clear, and the technical terms used are effective. However, the paper needs to be simplified, as detailed definitions would be of more value if complex sentences were more easily understood, jargon reduced, and less familiar terms explained. This would improve the reading experience and extend the impact of the paper to a wide range of readers.

Recommendation: Major Revision

Although it provides important insights into the environmental and public health implications of AI and has significant impact on research, practice, and society, the paper can still benefit immensely by improving its clarity, depth, and practical applicability. Below are reasons for recommending a major revision of the text.

Strengths

1. Broad Focus: The paper provides a thorough review covering energy consumption, water depletion, e-waste, algorithmic biases, and social equity. The integration of environmental science, public health, and environmental justice perspectives is commendable and adds depth to the analysis. These measures include the adoption of renewable energy, bias audits, and public health impact assessments, which are both timely and applicable.

Areas for Improvement

1. Economic and Practical Implications:

o The paper lacks a detailed discussion of the economic and commercial impacts of its recommendations. For example, transitioning to renewable energy or adopting circular economies for AI hardware may involve significant costs and logistical challenges. These should be addressed to make the recommendations more actionable.

o The proposed strategies should be better articulated within the context in which they could be adopted (e.g., by governments, corporations, educators).

2. Clarity of Communication:

o Rewrite excessively complex sentences into simpler ones for clarity.

o Reduce jargon and acronyms or provide clear definitions of less familiar terms (e.g., LLMs, digital phenotyping).

o Balance technical details with accessibility so that the paper is more meaningful to a broader audience, including policymakers and educators.

3. Evidence and Methodology:

o Review the limitations of the evidence base more in depth, for example by addressing reliance on projections and so-called "grey literature."

o Provide rigorous research suggestions for future studies, inclusive of interdisciplinary approaches.

4. Public Engagement and Societal Impact:

o Discuss how the results can be used to develop tangible, actionable recommendations for individuals, communities, and organizations.

o Explain how the paper's findings can affect public opinion, enhance quality of life, and foster a more informed, socially engaged citizenry.

The paper represents the potential to contribute significantly to the knowledge base, public policy efforts, and public perspectives in supporting sustainable and ethical AI development. However, the paper still needs major revisions to address gaps in economic, practical, and clarity aspects, and to provide more detailed recommendations for research and implementation. Addressing these issues should make the paper poised to make a substantial contribution to the field.

Declarations

Potential competing interests: No potential competing interests to declare.