

Gender Equality and the Environment in Digital Economies

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Abstract

At the intersection of gender equality, AI systems and climate management lie critical questions on gendered dynamics that have important implications on the future of human security and the Women, Peace and Security Agenda. This paper presents a novel approach to the society-technology-environment nexus, achieved through an inclusive and civil society-led dialogue, grounded in critical theory and highlighting historical power structures that have led to inequalities. The authors provide eleven recommendations that aim to help decision makers address these issues from a multidisciplinary viewpoint and inform gender-sensitive modules in national and international AI and digital economy policies.

While the climate crisis and the surge of digitization have important socioeconomic effects on women, so does Artificial Intelligence (AI). At its intersection with gender equality and climate management lie critical questions on gendered dynamics that have important implications for the Women, Peace, and Security (WPS) Agenda. This is particularly true when it comes to deployment of AI systems in natural resource management (NRM) sectors such as fishing, agriculture, energy and mining.

AI in the agriculture market alone is expected to be worth \$4.7 billion in 2028¹ which presents a number of important opportunities for women² in Agricultural

AI such as robot harvesting, automated forecasting, etc. In many cultures, women are powerful knowledge keepers in charge of managing the natural resources needed by their communities.³ Meanwhile, historically, those who controlled the technology and resources had the power⁴ and, in a digital economy, Natural Resource Data (NRD) is a highly valuable commodity in its own right. If NRD is held by a limited number of individuals, it risks perpetuating economic inequity and power imbalances.⁵

Furthermore, the absence of women from consequential decision-making (data set preparation,

¹ *Artificial Intelligence in Agriculture Market worth \$4.7 billion in 2028*, Exclusive Report by Markets and Markets, March 2023, <https://www.prnewswire.com/news-releases/artificial-intelligence-in-agriculture-market-worth-4-7-billion-in-2028---exclusive-report-by-marketsandmarkets-301759328.html>

² Please read "women" as womxn or more specifically as defined by intersectional feminism (overlapping concurring forms of oppression) as well as including LGBTQ2IA or trans persons who identify as non-binary, Two-Spirited and as women.

³ Joseph, L., & N. J. Turner (2020). *"The Old Foods Are the New Foods!": Erosion and Revitalization of Indigenous Food Systems in Northwestern North America*. *Frontiers in Sustainable Food Systems* 4 : 596237.

⁴ Nye Jr, J. S. (2011). *The future of power*. Public Affairs.

⁵ References pertaining to data monopolies and data ownership: *Who Owns Personal Data?* (2021) World Bank Development Report 2021. <https://wdr2021.worldbank.org/spotlights/who-owns->

[personal-data/; Economic Properties of Data and the Monopolistic Tendencies of Data Economy: Policies to Limit an Orwellian Possibility. https://www.un.org/en/desa/economic-properties-data-and-monopolistic-tendencies-data-economy-policies-limit](https://www.un.org/en/desa/economic-properties-data-and-monopolistic-tendencies-data-economy-policies-limit); *Cross-border Data Flows and Development: For Whom the Data Flow*, UN Digital Economy Report (2021). https://unctad.org/system/files/official-document/der2021_en.pdf; References pertaining to land, natural resources ownership: Nelson F., (Ed.) (2010). *Community Rights, Conservation and Contested Land: The Politics of Natural Resource Governance in Africa*, Earthscan, New York; UN Women, 2020, *Realizing women's rights to land and other productive resources*. 2nd Edition; Agarwal, B., Anthwal, P., & Mahesh, M. (2021) *How Many and Which Women Own Land in India? Inter-gender and Intra-gender Gaps*, *The Journal of Development Studies*, 57:11, 1807-1829, DOI: 10.1080/00220388.2021.1887478c; Gaede, F., Ana-Maurine, L., Reyes-Santos, A., Thornhill, K. (2022) *Afro-Indigenous Women Healers in the Caribbean and Its Diasporas: A Decolonial Digital Humanities Project*, *Digital Humanities Quarterly*, 16, 3.

algorithmic design, Human Computer Interaction (HCI), governance, etc.) in the sociotechnical pipeline of AI systems.⁶ This significantly impacts the intended uses of AI-augmented technologies and leads to biased outputs. While proposed AI regulations⁷ plan for risk mitigation, they leave a number of critical questions open (defining harm and high impact AI systems, protecting collective rights, etc.). In parallel, some countries have made steps in discussing gender-sensitive AI policy, however, these initiatives are still nascent globally⁸.

This policy brief is the result of the AI on a Social Mission Workshop focused on intersectional, Indigenous, regional and gender perspectives on AI for NRM⁹ with the goal is to ensure fairness in AI systems and digital economies, and contribute to macroeconomic Gender Strategies.¹⁰ The proposed recommendations aim to seize the opportunities presented by AI while mitigating risks and contribute to shaping Sustainable Development Goals (SDG) oriented AI solutions and partnerships.

The authors propose three areas of action¹¹:

1. Solution-Design-Responsibility Loop

AI value-chains are “*the organizational process through which an individual AI system is developed and then put into use*”¹² which include the necessary innovation ecosystems as well as the sociotechnical factors. To prevent new forms of exclusion and inequity, it is important to investigate gendered disparities and limitations to decisional powers in the AI value chain. These constraints may arise from factors such as colonial-era property rights, legal frameworks,

regulatory innovation mechanisms, cultural norms, funding policies and so on.

In Africa, 60% to 80% of women produce food, yet only 10% - 20% own the agricultural land on which they produce crops. They make up 70% of the agricultural workforce that manages 90% of household water and fuel needs, undertaking 60% of marketing and produce sales. Only 43% of the agricultural labour force in developing countries are composed of women. This number could increase by 20-30% if given the same resources as men.¹³ On the other hand, while energy is perceived as a key element of security for any country and critical to improve livelihoods, most of the interlocutors in the energy transmission and transit points are men. Research indicates that the linkage between energy supplies and gender roles is prominent in countries where there is a high dependency on biomass fuels for cooking, heating, and lighting.¹⁴

An example of design choice having considerable impact is the distance between tools and home. In many rural communities, women need to travel long distances to use agricultural tools in general. Design choices are pivotal in Agricultural AI to avoid creating additional barriers and limit the effectiveness of these tools.

Changing preconceived notions of how certain fields or disciplines are defined will also have consequential impact on a number of AI projects’ capacity to be supported. For example, who is traditionally defined as a farmer? If a survey collects data per household, defining men as farmers but not women, AI funding and investment models will be planned for men’s needs, instead of deconstructing the roles of food producers in agriculture, and foreseeing who could become a farmer

⁶ Roopaei, M., Horst, J., Klaas, E., Foster, G., Salmon-Stephens, T. J., & Grunow, J. (2021, May). *Women in AI: Barriers and solutions*. In 2021 IEEE World AI IoT Congress (AIIoT) (pp. 0497-0503). IEEE.

⁷ <https://artificialintelligenceact.eu>; Bill C-27, House of Commons Canada, <https://www.parl.ca/DocumentViewer/en/44-1/bill/C-27/first-reading>; *Blueprint for an AI Bill of Rights*, The White House, <https://www.whitehouse.gov/ostp/ai-bill-of-rights/>

⁸ *Developing Inclusive AI Policy in Southeast Asia*, <https://cs.unu.edu/news/news/blog-developing-inclusive-ai-policy-in-southeast-asia.html>

⁹ AI on a Social Mission (2022), *The Gender Equality and the Environment in Digital Economies Workshop*. November 16th, 2022: <https://www.aionasocialmission.com/speakers>

¹⁰ International Monetary Fund, *Gender Strategy* (2022): <https://www.imf.org/en/Topics/Gender>

¹¹ See Annexe 1. List of Summarized Recommendations

¹² Engler, A. C. & Renda, A. (2022). Reconciling the AI value chain with the EU’s Artificial Intelligence Act. Centre for European Policy Studies: <https://www.ceps.eu/ceps-publications/reconciling-the-ai-value-chain-with-the-eus-artificial-intelligence-act/>

¹³ *Women in Agriculture Closing the gender gap for development, 2010-2011*, The Food and Agriculture Organization (FAO), <https://www.fao.org/publications/sofa/2010-11/en/>

¹⁴ *United Nations Commission for Africa report in 2009 on Gender and Climate change Women Matter*, <https://repository.uneca.org/handle/10855/15345>

with the help of precision technologies. This slows down innovation and poses a threat to food security.¹⁵

Adopting a multidisciplinary approach to AI will break down siloed learning systems. Computer science, software engineering and other traditional academic AI training options are male dominated,¹⁶ creating a sense of exclusion for women and LGBTQ2IA+ individuals. Accessible learning opportunities (micro-credentialing, reskilling, STEAM and project-based learning) facilitate a sense of community, key to preventing social barriers. A continuous assessment of the impact of inclusivity in learning and engagement initiatives in AI is recommended.

Emerging regulations are providing incentives to use AI and data for social good, which remains to be defined with a broad number of stakeholders and citizens.¹⁷ We must better understand the barriers to taking part in the AI narrative to avoid washing out valid concerns of equity-deserving communities, often underrepresented in this field. The arts can be a tool for engagement, yet without best practices¹⁸ in place, they can entrench gender inequality in AI.¹⁹ Investing in civic engagement

is fundamental in democratically constructed social licenses in responsible AI value chains.

Indigenous AI and data protocols should be woven into value chains including team composition, research and development of data sets, algorithmic design, and impact assessments of AI systems, etc. Protocols require local knowledge before expanding to a global context. Each Indigenous group will have their own approach and concerns regarding AI systems.²⁰ An example of an Indigenous matriarchal approach to governance protocols includes truthfulness, respect for life and all generations, reciprocity and cultivating enduring relationships. Protocols also include mutual accountability, shared benefits, avoiding extractivist data collection and use, and promoting data sovereignty.

¹⁵ Denly et al., *Do Natural Resources Really Cause Civil Conflict? Evidence from the New Global Resources Dataset*, Sage Publications, (2021), <https://journals.sagepub.com/doi/epub/10.1177/00220027211043157>; Kate Lin, *New Trends in Agricultural Development--Sarabetsu, Hokkaido*: <https://akmp.cpc.org.tw/en/post/contents/319>

¹⁶ Artificial Intelligence Index Report (2021). Stanford Institute for Human-Centered AI, 2021. <https://aiindex.stanford.edu/wp-content/uploads/2021/11/2021-AI-Index-Report-Master.pdf>; <https://pursuit.unimelb.edu.au/articles/the-women-putting-intelligence-in-artificial-intelligence>

¹⁷ *Learning Together for Responsible AI*, Report of the Public Awareness Working Group (2023): <https://ised-isde.canada.ca/site/advisory-council-artificial-intelligence/en/public-awareness-working-group/learning-together-responsible-artificial-intelligence>

¹⁸ Goddard, V (2023). *Emerging Scientific Orientations in Multidisciplinary AI Design*: <https://valentinegoddard.medium.com/art-shaped-ai-value-creation-in-the-digital-era-94694f1cea8b>

¹⁹ *Cinema has helped 'entrench' gender inequality in AI*, (2023). Cambridge University: <https://phys.org/news/2023-02-cinema-entrench-gender-inequality-ai.html>

²⁰ References on the importance of Indigenous Data sovereignty (ownership and equity), intersectionality and nation-to-nation approaches therein: *CARE Principles for Indigenous Data Governance* (2019); Research Data Alliance International Indigenous Data Sovereignty Interest Group, September 2019. The Global Indigenous Data Alliance. www.gida-global.org; *The disaggregated Demographic Data Collection in British Columbia (BC): A Grandmother Perspective* (2020). BC's Office of the Human Rights Commissioner: <https://bchumanrights.ca/wp-content/uploads/BCOHR Sept2020 Disaggregated-Data-Report FINAL.pdf>; A First Nations Data Governance Strategy (2020-21): <https://fnps.ca/bcfndgs-engagement-sessions/>, <https://fnigc.ca/wp-content/uploads/2020/09/FNIGC FNDGS report EN FINAL.pdf>, <https://www.afn.ca/wp-content/uploads/2021/10/Jonathan-Dewar-Presentation.pdf>; Walter, Maggie, et al. (2020). *Indigenous Data Sovereignty in the era of Big Data and Open Data*, Australian Journal of Social Issues 4:141, 2020. <https://doi.org/10.1002/ajs4.141>; Lewis, Jason Edward et al. (2020). *Indigenous Protocol and Artificial Intelligence Position Paper*, Honolulu, Hawai'i: The Initiative for Indigenous Futures and the Canadian Institute for Advanced Research (CIFAR): <https://spectrum.library.concordia.ca/id/eprint/986506/7/Indigenous Protocol and AI 2020.pdf>

2. Resource Ownership and SDG-Oriented Governance

Sustainable co-governance of NRD in the AI value chain can be achieved by allowing time, space, and continued funding for local communities to assess new data collection or annotation processes, apps, or devices to be used. Although they refer to broader notions of equity and ethics, neither the FAIR,²¹ nor the CARE²² principles explicitly consider gender as a factor. Policies must protect and promote the role of women in AI and data governance for natural resources and set clear goals regarding their integration as data collectors, owners, and AI system designers. Ex: keep track of which crop productions use Agricultural AI to understand who controls the produce and NRD.

Data collaboratives, such as social purpose data trusts for fishing data²³ can unite stakeholders with opposing interests by having a common goal with clear conditions to access the data. NRM data trusts require new SDG-oriented business models.

Applying a gender-lens to public funding would call attention to a gendered support in AI research and development. This is currently not the norm. In Canada, for example, the federal government supports a largely male-dominated private tech sector, while allocating no funding to civil society organizations²⁴ (CSOs), a largely female-occupied sector. Increased support for CSOs are important in providing locally based and socially relevant guidance. A sectoral strategy, with new funding and investment models, are pivotal to accelerate the access of women to AI and data resources and representation in AI value chains.

²¹ FAIR Principles: <https://www.go-fair.org/fair-principles/>

²² CARE Principles for Indigenous Data governance, <https://www.gida-global.org/care>

²³ Goddard, V. (2022). *Feasibility Study of a Data Trust for the Saint-Lawrence River*, a socio-legal study on fisheries data and recommendations for a mission-oriented data trust (French only): <https://static1.squarespace.com/static/62daf89f5631980e25a12d54/t/640ba2228026bf46ab4b4440/1678484006046/Fiducie+pour+le+Saint-Laurent-Étude+stratégique+2.pdf>

²⁴ Brandusescu, A. (2021). *Artificial intelligence policy and funding in Canada: Public investments, private interests.*

3. Foreign Policy and Climate Security

AI's underlying geopolitical implications are disrupting the old order of territorial integrity. The nexus of gender, climate and digital economy should inform feminist foreign policy and climate security agendas. These must find meaning in a community of states, otherwise, it will result in limited trade opportunities and shared resources. Worldwide, women are more vulnerable to the impact of climate change, yet, during COP26 multilateral negotiations on climate action, a UN Women's analysis raised the lack of a gender perspective.²⁵ Such gender-blind AI strategies in natural resources and extractive industries will lead to a deepening of global socioeconomic gaps and polarization, posing national security risks to all nations.

There is a link between gender imbalances in natural resource ownership, and in AI ownership, leading to increased security risks for women. Meanwhile, increasing women's ownership of AI tools has led to initiatives protecting women's safety, rather than harming them.²⁶

Governments and organizations must put in place interministerial, multidisciplinary workgroups that are enabled to monitor these by gathering data, assessing the impact of AI on women, and of women on AI, and setting concrete targets to drive gender balance in decisional powers.

Centre for Interdisciplinary Research of Montreal, McGill University. March 2021:

https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4089932

²⁵ Emandi, R., Encarnacion, J., Seck, P. (2022). *Big data analysis finds little mention of gender in climate speeches*: <https://data.unwomen.org/features/big-data-analysis-finds-little-mention-gender-climate-speeches>

²⁶ See Fournier-Tombs, E. (2023) Panel talk at CSW67: Women, Peace, and Cybersecurity. UN Women.

Conclusion

Inequalities prevalent in AI development and climate technologies are linked to systemic and historical marginalisation of different groups, including women, trans and non-binary persons, and Indigenous communities. However, these inequalities are still not addressed enough from a holistic perspective, where our societies and our environment are integral to the way in which technologies are developed. As we move forward, conscious, and deliberate efforts must be made to ensure that the global restructuring of economic systems and partnerships do not replicate nor augment existing gendered and regional inequities. Natural resource data is more than a critical commodity. Upon this data rests our collective capacity to safeguard the future of our planet and humanity. Therefore, AI policies must consider the protection and promotion of decisional power across AI value chains with gender equity, intersectionality, and Reconciliation with Indigenous Peoples as a priority. In doing so, emerging AI governance structures, cyber-diplomacy models, and digital economy partnerships will be better equipped to leave a safe place to live for the generations to come.

Summarized List of Recommendations

1. Address preconceived notions and definitions in NRM;
2. Adopt a multidisciplinary approach to AI design and deployment;
3. Weave Indigenous AI and Data Protocols into the value chain for AI systems while promoting traditional matriarchal models of knowledge and environmental protection;
4. Identify, monitor and report on gender disparities in the AI value chain and including limitations on decisional power and resource ownership;
5. Put in place interministerial, multidisciplinary workgroups that are enabled to gather data, assess the impact of AI on women, and of women on AI, and setting concrete targets to drive gender balance in NRM;
6. Create accessible learning opportunities, creative outreach engagement and conduct continuous assessment of their impact;
7. Facilitate multifaceted investment strategies for informed and independent civic engagement and

AI literacy fundamental to social license in responsible AI value chains;

8. Research and facilitate the creation of social innovation spaces to explore new business models for NRM data collaboratives (social purpose trusts) and incentivize SDG-oriented governance models;
9. Increase access to data collection technologies and facilitate ownership of NRD for women;
10. Adopt a holistic flow to the assessment, analysis and evaluation processes of the ESG of AI;
11. Increase support and access to AI and data resources for CSOs (NGOs, non-profits, social entrepreneurs).

Note: The recommendations are interrelated. They are not placed in order of priority.

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Global Gender Gap Report 2022: [Global Gender Gap Report 2022 | World Economic Forum](#)

[People less outraged by gender discrimination caused by algorithms](#)

[The Gender Digital Divide Is a Reflection of the Overall Discrimination Faced by Women and Girls, High Commissioner for Human Rights Tells Human Rights Council | OHCHR](#)