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SOCIOLOGY 3

2026: FIRST TERM

ARTIFICIAL INTELLIGENCE, AGRICULTURE, AND MINING IN A WARMING WORLD

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INTRODUCTION

This module examines the relationship between artificial intelligence (AI), primary production systems (mining and farming), and the ecological and climate crises shaping the contemporary world. It begins from the premise that climate change, biodiversity loss, soil degradation, and widespread environmental contamination are not accidental by-products or external disruptions to food, energy, and resource systems. Rather, they are historically produced outcomes of dominant industrial models of agriculture, fossil fuel–based energy production, and large-scale mineral extraction that have prioritised efficiency, growth, and profit over ecological limits and social reproduction. These systems have been consolidated through colonial and postcolonial political economies, state and corporate power, and the uneven distribution of technological capacity and environmental risk across regions and populations.

By situating ecological crises within these longer histories of production and power, the module challenges narratives that frame environmental problems as recent or purely technical challenges awaiting technological solutions. Instead, it emphasises how hegemonic production systems shape what counts as a problem, whose knowledge is recognised, and which solutions are considered legitimate. Industrial agriculture, energy, and extraction are treated not simply as sectors, but as interconnected socio-ecological regimes that organise labour, land, resources, and data, while producing persistent patterns of inequality and environmental harm.

Within this context, AI is not approached as a neutral, autonomous, or purely technical innovation. Rather, the module treats AI as a socio-technical system that is embedded within existing relations of production, governance, and ecological transformation, and that both reflects and reinforces prevailing political-economic priorities. AI technologies are examined in terms of how they are designed, deployed, and governed, whose interests they serve, and how they redistribute power, risk, and responsibility across global value chains. Attention is paid to the material, energetic, and labour-intensive infrastructures that make AI possible, as well as to the ways AI reconfigures knowledge, decision-making, and control within primary production systems.

The central analytical question running throughout the module is whether AI can meaningfully contribute to ecological repair and social transformation, or whether it primarily functions as a technological fix that manages symptoms while leaving the underlying drivers of environmental degradation intact. In this light, students are encouraged to critically assess claims that AI enables sustainability, resilience, or climate adaptation, and to consider whether AI-backed systems represent genuine pathways toward transformation or strategies that stabilise and extend historically unsustainable systems of production, consumption, and extraction under conditions of accelerating ecological crisis.

Drawing on environmental studies, political ecology, science and technology studies, and critical data studies, the module moves beyond linear narratives of technological progress and innovation. Through lectures, empirical case studies, and practitioner-led discussions, students develop critical, evidence-based perspectives on the possibilities and limits of AI in addressing climate change, ecological degradation, and social inequality. The module encourages students to reflect on whose knowledge, labour, and environments are prioritised in AI-driven transitions, and what alternative pathways might be required for socially just and ecologically sustainable futures.

CONTENT

The module is organised into six interconnected weeks that move from conceptual framing to sectoral analysis and critical synthesis. Week 1*, AI, Climate Change, and Hegemonic Production Systems*, introduces key AI technologies and situates them within the historical development of the Anthropocene, highlighting industrial agriculture, fossil fuel dependence, and extractive economies. Week 2*, AI in Agriculture – Technological Fixes and Reformist Promises*, examines AI as a reformist intervention within industrial farming systems. Week 3*, Agroecology and Competing Models of Agricultural Sustainability*, explores agroecology as a contrasting paradigm grounded in ecological processes, social relations, and alternative knowledge systems. Week 4, *Coal Mining, Fossil Energy, and Climate Change*, examines coal mining and coal-based energy systems as central drivers of climate change, ecological degradation, and socio-economic inequality. Week 5, *AI, Critical Minerals, and the Material Foundations of Digital Infrastructures*, examines how the expansion of AI technologies and data centres is intensifying demand for critical minerals and extractive activity. Week 6*, Just Transitions, Governance, and the Socio-Ecological Limits of AI*, brings these themes together through a critical examination of governance frameworks, including Environmental, Social and Governance standards (ESGs), accountability, and power across AI-linked agricultural, energy, and extractive systems.

LEARNING OUTCOMES

By the end of this module, students will be able to address the following questions:

1. How is AI embedded within hegemonic systems of production that have contributed to climate change and ecological degradation?
2. To what extent does AI-enabled agriculture address, reproduce, or intensify the historical problems associated with industrial farming systems?
3. How do agroecological approaches challenge dominant technological models of agricultural sustainability, and where does AI fit within these competing paradigms?
4. How do coal mining and coal-based energy systems contribute to climate change, ecological degradation, and social inequality?
5. How does the expansion of AI technologies and data centres intensify demand for critical minerals, and what climatic, ecological, and social costs are associated with AI-driven extractive supply chains?
6. How do governance frameworks such as ESGs, and just transition policies shape accountability, and justice across AI-linked food, energy, and extractive systems?

FORMAT AND ASSESSMENTS

The module is six weeks long. There are four sessions a week: Tuesday 2nd period, Wednesday 3rd period, Thursday 4th period, and Friday 5th period (and possibly Friday 6th period as well in certain weeks). All sessions take place in Arts Major Lecture Theatre.

There is a 3-year exam written in June, which is worth 60% of the entire module's mark. The other 40% consists of in-term assignments. There will be two assignments: the assignments will take the form of tests and will take place at the end of the 3rd week and 5th week of term.

REFERENCING AND PLAGIARISM

Please consult the *Sociology Handbook* for an outline of the University's policy on plagiarism, guidelines on the formatting and writing of assignments, the departmental rules regarding citations and references, and the criteria for assessing written work. A copy of the *Assignment Cover Sheet*, which must accompany all assignments submitted to the Department, is also available in the Handbook. Assignments must be submitted via Turnitin on RUConnected).

WEEKLY THEMES AND READINGS

Week 1: Introduction – AI, Climate Change, and Hegemonic Production Systems

This week introduces the core concepts and analytical frameworks of the module. Students are introduced to key forms of AI, including machine learning, robotics, and predictive analytics, and to the expanding role of AI in contemporary debates about sustainability and climate adaptation. Climate change is discussed in relation to the contested concept of the Anthropocene, often used to describe human-induced planetary change. Rather than treating climate change as an external shock, the lectures situate it within the historical development of industrial agriculture, fossil fuel dependence, and extractive economies. AI is framed as a technology embedded within socio-ecological systems and power relations, highlighting that proponents often romanticise AI as a technological fix. Students are encouraged to consider how technological innovation both responds to and reproduces environmental and social crises.

Key Questions:

1. How are climate change and ecological degradation understood through the contested concept of the Anthropocene, and how are they linked to hegemonic systems of production?
2. How is AI positioned—often as a technological fix—as a response to climate and ecological crises, and with what assumptions?
3. What does it mean to analyse AI and other technologies as socially and ecologically embedded within relations of power?

Readings:

Block, K. (2022). The Anthropocene as a challenge for sociological thinking in planetary dimensions, *DIE ERDE – Journal of the Geographical Society of Berlin*, Vol. 153(3), pp. 188–197.

Copeland, B.J. (2016). Artificial intelligence, *Britannica*. Available at: https://www.britannica.com/technology/artificial-intelligence.

Dorn, F.M., Hafner, R. & Plank, C. (2022). Towards a climate change consensus: How mining and agriculture legitimise green extractivism in Argentina, *The Extractive Industries and Society*, Vol. 11, pp. 1–10.

Lidskog, R. & Waterton, C. (2016). Anthropocene – a cautious welcome from environmental sociology?, *Environmental Sociology*, Vol. 2(4), pp. 395–406.

Sommer, B. & von Querfurth, S. (2024). 'In the end, the story of climate change was one of hope and redemption': ChatGPT's narrative on global warming, *Ambio*, Vol. 53(7), pp. 951–959.
Whyte, K. (2017). Indigenous climate change studies: Indigenising futures, decolonising the Anthropocene, *English Language Notes*, Vol. 55(1), pp. 153–162.
Wickberg, A. & Gärdebo, J. (2023). Computation, data and AI in Anthropocene history, *History and Technology*, Vol. 39(3–4), pp. 328–346.

Week 2: AI in Agriculture – Technological Fixes and Reformist Promises

This week focuses on the application of AI within industrial agriculture. Students examine precision farming, smart irrigation, remote sensing, autonomous machinery, and algorithmic decision-support systems that are promoted as climate-smart solutions. These technologies are analysed as reformist interventions aimed at optimising existing agricultural systems rather than transforming their underlying structures. The lectures critically assess claims about efficiency, sustainability, and yield increases through engagement with empirical studies and political-economic critiques. Students explore how AI-driven agriculture can intensify capital concentration, increase farmer dependence on proprietary platforms, and marginalise local and experiential knowledge, while leaving intact the ecological drivers of soil degradation, biodiversity loss, and greenhouse gas emissions.

Key Questions:

1. What problems is AI in agriculture designed to solve, and whose problems are prioritised?
2. How does AI function as a technological fix within industrial farming systems?
3. What new vulnerabilities or dependencies does AI introduce into food systems?

Readings:

Alonso-Fradejas, A. (2020). 'Junk agroecology': The corporate capture of agroecology for a partial ecological transition without social justice. Amsterdam: ATI, TNI and Crocevia. Available at :https://www.tni.org/files/publication-downloads/38_foei_junk_agroecology_full_report_eng_lr_0.pdf
Baur, P. & Iles, A. (2023). Inserting machines, displacing people: How automation imaginaries for agriculture promise 'liberation' from the industrialised farm, *Agriculture and Human Values*, Vol. 40(3), pp. 815–833.
Carolan, M. (2018). 'Smart' farming techniques as political ontology: Access, sovereignty and the performance of neoliberal and not-so-neoliberal worlds', *Sociologia Ruralis*, Vol. 58(4), pp. 745–764.
Forney, J. & Epiney, L. (2022). Governing farmers through data? Digitisation and the question of autonomy in agri-environmental governance, *Journal of Rural Studies*, Vol. 95, pp. 173–182.
Hackfort, S. (2024). Democratisation through precision technologies? Unveiling power, participation, and property rights in the agricultural bioeconomy, *Frontiers in Political Science*, Vol. 6, pp. 1–6.
Montenegro de Wit, M. & Canfield, M. (2024). 'Feeding the world, byte by byte': Emergent imaginaries of data productivism, *The Journal of Peasant Studies*, Vol. 51(2), pp. 381–420.

Rotz, S., Duncan, E., Small, M., Botschner, J., Dara, R., Mosby, I., … et al. (2019). The politics of digital agricultural technologies: A preliminary review, *Sociologia Ruralis*, Vol. 59(2), pp. 203–229.

Thomas, J. (2024). *Black box biotech: Integration of artificial intelligence with synthetic biology*. Johannesburg: The African Centre for Biodiversity. Available at: https://acbio.org.za/gm-biosafety/black-box-biotechnology-integration-of-artificial-intelligence-with-synthetic-biology/

Thomas, J. & ETC Group (2024). *Trojan horses on the farm: Challenging the digitalisation of the agrifood chain*. Val David: ETC Group. Available at: https://www.etcgroup.org/content/trojan-horses-farm

Vogel, B. (2025). *When chatbots breed new plant varieties: Generative artificial intelligence and new genetic engineering techniques*. Berlin: Save Our Seeds (SOS). Available at: https://www.saveourseeds.org/publications/when-chatbots-breed-new-plant-varieties/

Week 3: Agroecology and Competing Models of Agricultural Sustainability

This week introduces agroecology and related approaches as alternatives to industrial, input-intensive agriculture. Students explore agroecological principles such as biodiversity, soil regeneration, ecological interactions, and circular resource use, alongside their social dimensions, including farmer autonomy, collective knowledge, and resilience. Through comparative case studies, the lectures examine tensions between agroecological systems and AI-intensive agriculture. Students critically assess whether AI tools can be meaningfully incorporated into agroecological practices or whether the epistemological and political logics of data-driven automation conflict with agroecology's emphasis on place-based, relational knowledge and low-input systems.

Key Questions:

1. How does agroecology challenge the ecological foundations of industrial agriculture?
2. Can AI support agroecological practices without undermining their core principles?
3. How do different agricultural models value knowledge, labour, and ecosystems?

Readings:

Bellon Maurel, V., Bonnet, P., Piot-Lepetit, I., Brossard, L., Labarthe, P., Maurel, P., … et al. (2022). *Digital technology and agroecology: Opportunities to explore, challenges to overcome*. INRIA, pp. 76–97.

Canfield, M., Juster, K., Maina, A., Maingi, D., Muya, G. & Ntambirweki, B. (2025). *Connecting communities or corporations? Digital agriculture, data harvests and food sovereignty in Kenya*. BIBA. Available at: https://scholarlypublications.universiteitleiden.nl/handle/1887/4273621

Hilbeck, A., McCarrick, H., Tisselli, E., Pohl, J. & Kleine, D. (2022). *Aligning digitalisation with agroecological principles to support a transformation agenda*. ECDF Working Paper. Available at:https://api-depositonce.tu-berlin.de/server/api/core/bitstreams/e941b9ee-031f-41c1-a11d-10f093800a6f/content

Kesselman, B. & Zukulu, S. (2025). Traditional foodways of the Amadiba: A struggle for indigenous food sovereignty in Mpondoland, South Africa, *Journal of Political Ecology*, Vol. 32(1), pp, 1-15.

Shilomboleni, H. & Schnurr, M.A. (2025). Are disruptive agricultural technologies compatible with agroecology?, *Sustainable Agriculture*, Vol. 3(1), p. 21.
Stone, G.D. (2022). Surveillance agriculture and peasant autonomy, *Journal of Agrarian Change*, Vol. 22(3), pp. 608–631.
Sullivan, S. (2023). Ag tech, agroecology, and the politics of alternative farming futures: The challenges of bringing together diverse agricultural epistemologies, *Agriculture and Human Values*, Vol. 40(3), pp. 913–928.
Van der Ploeg, J.D. (2021). The political economy of agroecology, *The Journal of Peasant Studies*, Vol. 48(2), pp. 274–297.
Wezel, A., Bellon, S., Doré, T., Francis, C., Vallod, D. & David, C. (2009). Agroecology as a science, a movement and a practice: A review', *Agronomy for Sustainable Development*, Vol. 29(4), pp. 503–515.
Wittman, H., James, D. & Mehrabi, Z. (2020). Advancing food sovereignty through farmer-driven digital agroecology, *International Journal of Agriculture and Natural Resources*, Vol. 47(3), pp. 235–248.

Week 4: Coal Mining, Fossil Energy, and Climate Change

This week examines coal mining and coal-based energy systems as central drivers of climate change and ecological degradation. Students explore the historical role of coal in industrial development and its continued importance within contemporary energy systems, particularly in the Global South. The lectures analyse the environmental impacts of coal extraction and combustion, including greenhouse gas emissions, air and water pollution, land degradation, and public health harms. Social and political dimensions are also examined, focusing on labour, mining-affected communities, state dependence on coal, and the political-economic forces that sustain coal despite climate commitments and decarbonisation goals.

Key Questions:

1. Why does coal remain central to many energy systems despite its role in climate change?
2. What ecological and social harms are associated with coal mining and coal-based energy?
3. How do political and economic interests shape the persistence of coal in a warming world?

Readings:

Cock, J. (2019). Resistance to coal inequalities and the possibilities of a just transition in South Africa, *Development Southern Africa*, Vol. 36(6), pp. 860-873.
Dikgwatlhe, P. & Mulenga, F. (2023). Perceptions of local communities regarding the impacts of mining on employment and economic activities in South Africa, *Resources Policy*, Vol. 80, pp. 103-138.
Gasparotto, J. & Martinello, K. (2020). Coal as an energy source and its impacts on human health, *Energy Geoscience*, Vol. 2, pp. 1-10.
Leonard, L.N. (2024). Socio-environmental impacts of mineral mining and conflicts in Southern and West Africa: navigating reflexive governance for environmental justice, *Environmental Research Letters*, Vol. 19. Available at: https://doi.org/10.1088/1748-9326/ad7047

Seloa, P.I. & Ngole, V. (2022). Community perceptions on environmental and social impacts of mining in Limpopo, South Africa and the implications on corporate social responsibility, *Journal of Integrative Environmental Sciences*, Vol. 19, pp. 189–207.
Shackleton, R.T. (2020). Loss of land and livelihoods from mining operations: A case in the Limpopo Province, South Africa, *Land Use Policy*, Vol. 99, pp. 1-11.
Widana, A. (2019). The impacts of mining industry: A review of socio-economic and political impacts. Available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3423562

Week 5: AI, Critical Minerals, and the Material Foundations of Digital Infrastructures

This week focuses on the material foundations of AI by examining how the expansion of AI technologies and data centres drives demand for critical minerals. Students analyse the mineral-intensive hardware and infrastructures required to sustain AI systems, including servers, chips, batteries, and cooling technologies. The lectures examine the climatic and ecological impacts of intensified mineral extraction, such as land degradation, water depletion, biodiversity loss, and rising energy use, alongside social consequences including labour exploitation and community displacement. Case studies highlight how AI-driven mineral demand is embedded in unequal global extractive economies and legitimised through digital and sustainability narratives.

Key Questions:

1. How does the expansion of AI technologies and data centres increase demand for critical minerals?
2. What climatic, ecological, and social impacts are associated with AI-driven mineral extraction?
3. How are extractive activities legitimised through narratives of digital and sustainable transitions?

Readings:

Atkins, E. (2020). Tracing the 'cloud': Emergent political geographies of global data centres, *Political Geography*, Vol. 86, pp. 1–3.
Boafo, J., Obodai, J., Stemn, E. & Nkrumah, P.N. (2024). The race for critical minerals in Africa: A blessing or another resource curse?, *Resources Policy*, Vol. 93, pp. 1–10.
Dauvergne, P. (2022). Is artificial intelligence greening global supply chains? Exposing the political economy of environmental costs, *Review of International Political Economy*, Vol. 29(3), pp. 696–718.
Deberdt, R. & Le Billon, P. (2025). 'Critical mineral (in)securities: Techno-legal fixes and the reproduction of socio-environmental abuses', *Environment and Security*, pp. 1–27. Available at: https://journals.sagepub.com/doi/pdf/10.1177/27538796251383998
Hlabisa, S. (2025). The ecology of artificial intelligence: Energy, water, materials, and land limits of digital systems, *Carbon Neutral Systems*, Vol. 1(1), pp. 1–20. Available at: https://doi.org/10.1007/s44438-025-00018-8
Kalantzakos, S. (2020). The race for critical minerals in an era of geopolitical realignments, *The International Spectator*, Vol. 55(3), pp. 1–16.
Regilme, S.S.F. (2024). Artificial intelligence colonialism: Environmental damage, labour exploitation, and human rights crises in the Global South, *SAIS Review of International Affairs*, Vol. 44(2), pp. 75–92.

Stacciarini, J.H.S. & Gonçalves, R.J.D.A.F. (2025). *Data centres, critical minerals, energy, and geopolitics: The foundations of artificial intelligence*. Centre for Open Science Working Paper No. 2zvkt_v1, pp. 1–22.

Vivoda, V. (2026). AI and digital governance for critical minerals in the Asia-Pacific, *Technologies for the Sustainable Use of Natural Resources*, pp. 1–10. Available at: https://www.researchgate.net/publication/399715404_AI_and_Digital_Governance_for_Critical_Minerals_in_the_Asia-Pacific

Week 6: Just Transitions, Governance, and the Socio-Ecological Limits of AI

The final week draws together the module's core themes through practitioner-led discussions from an individual working at the intersection of agriculture, mining, energy, governance, and community impacts. Drawing on first-hand experience from Southern Africa and other regions shaped by primary production, the discussions examine how sustainability, Environmental, Social and Governance standards (ESGs), Corporate Social Responsibility (CSR), and just transition frameworks operate in practice across AI-linked food, energy, and extractive systems. The discussions explore the resettlement of farming- and mining-affected communities, the loss of livelihoods, and the management of conflict and grievances under conditions of expanding extractive activity and technological change driven by global demand for AI-enabled systems. These empirical accounts are used to reflect more broadly on accountability, responsibility, and power within global AI value chains.

This culminating week also explicitly wraps up the module by integrating critiques of AI in agriculture, energy, and extraction with broader debates about governance, justice, and sustainability. Students are encouraged to synthesise insights from across the module and to reflect on what a genuinely just transition would require beyond existing policy and corporate frameworks.

Key Questions:

1. How do ESG, CSR, and just transition frameworks operate across AI-linked agricultural, energy, and extractive systems?
2. What gaps emerge between sustainability rhetoric and the lived experiences of communities affected by AI-enabled production systems?
3. What would a genuinely just transition require across food, energy, and mineral systems in a warming world?

Readings:

Amnesty International. (2016). *This is what we die for: Human rights abuses in cobalt supply chains in the DRC*. Available at: https://www.amnesty.org/en/documents/afr62/3183/2016/en/

Chaudary, M.S.A. (2025). Lithium dreams, local struggles: Navigating the geopolitics and socio-ecological costs of a low-carbon future, *Energy Research & Social Science*, Vol. 121(1), pp. 1–11.

Eweje, G. (2007). Multinational oil companies' CSR initiatives in Nigeria: the scepticism of stakeholders in host communities, *Managerial Law*, Vol. 49(5–6), pp. 218–235.

Human Rights Watch (2022). *The forever mines: Perpetual rights risks from unrehabilitated coal mines*. San Francisco: Human Rights Watch. Available at: https://www.hrw.org/sites/default/files/media_2022/07/southafrica0722_web.pdf

Vanclay, F. (2017). Project-induced displacement and resettlement: from impoverishment risks to social sustainability, *Development Studies Research*, Vol. 4(1), pp. 19–30.

Webster, D.G. (2022). Social licence and CSR in extractive industries: a failed approach to governance, *Global Studies*, Vol. 2, pp. 1–14.