TECHNOLOGICAL INNOVATIONS TACKLING BIODIVERSITY LOSS: SOLUTIONS OR MISDIRECTION?

Using original data derived from the thematic analysis of three international agreements and the 2016 COP/MOP Decisions, this article examines the incorporation of technology and technological innovation in the biological diversity regime. It finds that that the biodiversity regime incorporates discourses of ecological modernisation and prioritises technological innovation for biodiversity loss, particularly in the COP/MOP Decisions adopted in 2016.

The empirical analysis indicates that themes around progress, 'improving' the environment, and the role of technology in mediating economic growth and development are embedded in references to technology and technological innovation. Drawing on an ecofeminist perspective, this article examines how these themes highlight the prioritisation of technological innovation to prevent biodiversity loss. The author concludes that this prioritisation inhibits opportunities to fully engage with developing alternative approaches towards resolving environmental problems as these approaches require a re-evaluation of the societal institutions and practices that exploit and destroy the nonhuman environment.

Keywords: Ecological modernisation theory, ecofeminism, biodiversity, technology, technological innovation, international law, feminist theory

Abbreviations: Ecological modernisation (EM); ecological modernisation theory (EMT); Conference of the Parties (COP); Meeting of the Parties (MOP)

Introduction

Earlier technological advances, such as CFCs, leaded petrol, and the insecticide DDT are now known to cause significant harm to the environment. Increasingly, scientists are beginning to understand the full extent of harm caused by plastic – the wonder material that is in everything from clothes to mobile phones. At the same time, scientists, engineers, and other epistemic communities continue to portray technological innovation as a self-evident good. State and international actors maintain that innovation can ensure continued economic growth and development without putting additional pressure on the environment.[1] Thus, technology is framed as the solution to environmental problems that earlier manifestations of technology may have helped create, while supporting continued economic growth.

[1] HM Government, *Industrial Strategy*; UNCTAD, *Technology and Innovation Report 2018*.

This perspective of technology is embedded in environmental discourses such as sustainable development (SD) and ecological modernisation (EM). Supporters of these concepts claim that 'environmental goals' can be won without necessitating a radical transformation of current economic and social arrangements.[2] They claim that technological development that underpins industrialisation is the solution to ecological risks.[3]

SD also views technology as an inherent good. Commonly defined as 'development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs'[4] it recognises the 'ultimate limits'[5] imposed by available technologies on the ability of the environment to meet the needs of future generations. Therefore, it embeds ideas around equity, justice, institutional and governance change. Recent iterations of sustainable development identify technology as fundamental to achieving these changes.[6]

However, critics argue that these discourses prioritise technical, market-based and technological solutions for environmental degradation. This enables the continuation of structural, institutional and conceptual values that devalue the environment and legitimise a political economy predicated on exploitative value dualisms.[7]

This is not a conscious process, but one that is embedded in the foundational concepts of Western, rationalist thought that recasts human/nature relationships as one of a series of intersecting dualisms forming these conceptual frameworks. These frameworks shape Western thought, inform political theories, science, and other key structures of human society. This means they shape the way in which we understand the world around us, and the concepts,

[2] Curran, "Is Renewable Energy Still Green," 3.
[3] Curran, "Ecological Modernisation," 203.
[4] WCED, *Our Common Future*, 43.
[5] WCED, *Our Common Future*, 8.
[6] UN General Assembly, Res 70/1 (2015), Goal 9; Anadon et al., "Making Technological Innovation."
[7] Plumwood, *Environmental Culture*.

norms and values that inform this understanding. Therefore, should discourses of EM be embedded within the biodiversity regime, this can highlight the continued affirmation of exploitative values, assumptions, and beliefs that have shaped the international community's response to environmental problems.

Using the biodiversity regime as a focus, this article examines the discourse of EM and its privileging of technology and technological innovation as the solution to environmental problems. Article 1 of the 1992 Convention on Biological Diversity (CBD) confers a central role to technology in order to achieve the objectives of the conservation and sustainable use of biodiversity. This prominent role has been reaffirmed in subsequent protocols and decisions by the Conference of the Parties (COP). Because of the prominence of technology within the documents, the biodiversity regime offers an original forum to explore how technology is portrayed within an international environmental institution and what this may say about the discourses that inform and shape international responses to environmental problems.

Definitions of technology

'Technology' is traditionally associated with military weapons and industrial machinery, and more generally the tools of war and work.[8] This overlooks other technologies which 'affect most aspects of everyday life', such as those which reduce the burden of domestic labour, for example, cooking stoves, fridges, and water heaters.[9] A simple web-search reveals that definitions and descriptions of technology are cast in terms of traditionally male activities of work: war and science.[10]

[8] Wajcman, "Feminist Theories," 2.
[9] Wajcman, "Feminist Theories," 2.
[10] Wajcman, "Feminist Theories," 2; for example, 'technology … is the collection of techniques, skills, methods, and processes used in the production of goods or services or in the accomplishment of objectives, such as scientific investigation.' "Technology."

This view of technology is incorporated in the multitude of definitions of technology in EMT. Theorists such as Ashford[11] Mol[12] and Cohen[13] speak of 'science', 'science and technology', and 'technological innovation' in their work on EMT.[14] Similarly, the CBD regime speaks of 'technology' in very broad terms.[15] Böhm and Collen propose that technology under the CBD regime can be understood as 'involving both hard and soft technologies that are relevant to the conservation and sustainable use of biodiversity or make use of genetic resources and do not cause significant damage to the environment'.[16] Following from these scholars, technology is understood to include both 'hard' (such as the hardware needed to accomplish a task) and 'soft' (such as the knowledge needed to use the hardware appropriately) technologies.

This article defines technology as the application of technological knowledge for practical purposes and includes the products resulting from such application.[17] Adopting a materialist ecofeminist perspective, this article examines how technology is framed within the documents by analysing the language of the regime's treaty, protocols, and COP/MOP Decisions. Conducting a thematic analysis of the documents, the author identifies dominant themes that are consistent with the discourse of EM which align technology with cooperation, progress, innovation and 'improving' the environment. These themes are then interrogated to examine how technology is portrayed in relation to biodiversity conservation and the role of technology to solve existing and future environmental problems.

This article begins by setting out the key provisions of the biodiversity regime that relate to technology and recent developments concerning technological innovation. EM theory is then

[11] Ashford, "Government and Environmental Innovation."
[12] Mol and Sonnenfeld, "Ecological Modernisation around The World."
[13] Cohen, "Ecological Modernisation, Environmental Knowledge."
[14] Howes et al., "Adapting Ecological Modernisation."
[15] See definitions: *Convention on Biological Diversity (1992),* art 2(3), art 2(7).
[16] Böhm and Collen, "Toward Equality," 6.
[17] This is based on the definition of technology in Oxford English Dictionary Oxford English Dictionary, "Technology, n".

introduced, before explaining the value of adopting a materialist ecofeminist perspective in the analysis of technology. Section five sets out the methodology and findings from the analysis. The remainder of the article discusses themes found from this close reading of the texts, first considering how they relate to discourses of EM and then evaluating the implications of this from an ecofeminist perspective.

The biodiversity regime

The CBD provides the 'most comprehensive framework to address biodiversity loss'.[18] Negotiated under the auspices of the United Nations Environment Programme (UNEP), this framework convention aims to ensure the conservation and sustainable use of biodiversity. To achieve this, the CBD has three objectives: the conservation of biodiversity, the sustainable use of biodiversity components and the 'fair and equitable sharing of the benefits arising out of the utilisation of genetic resources, including by appropriate access to genetic resources and by appropriate transfer of relevant technologies…'[19] The objective relating biotechnology and benefit sharing proved to be highly controversial because of its close relationship to other to other international legal regimes, such as intellectual property rights and international trade.

Technical and scientific cooperation and technology transfer are identified as cross-cutting issues within the CBD regime.[20] Articles 15 – 18 of the CBD address technology transfer and improving scientific and technical cooperation. Elements of these provisions have been incorporated in the 2000 Cartagena Protocol on Biosafety (Cartagena Protocol) and the 2010 Nagoya Protocol on Access and Benefit Sharing (Nagoya Protocol). Both identify the development of technological capabilities and the transfer of technology are as important

[18] Sands et al., *Principles* 4th ed, 387.
[19] *Convention on Biological Diversity (1992),* art 1.
[20] CBD Secretariat, "Technology Transfer."; CBD Secretariat, "Technical and Scientific Cooperation."

mechanisms for access and benefit sharing and to ensure the safe use of living modified organisms.

Therefore, the biodiversity regime explicitly connects the role of technology with achieving its objectives. Each legal agreement emphasises the importance of technology in attaining their respective objectives, and they all support the transfer of technology to promote cooperation between parties to the regime. This indicates that technology is seen as a mechanism to overcome environmental problems without having to divert from the path of modernisation.[21] Because of this, these international agreements and their subsequent COP/MOP decisions offer a useful starting point to explore discourses of EM in environmental agreements.

Ecological modernisation: theory and discourse

According to Hajer, EM is the 'discourse that recognises the structural character of the environmental problematique but none the less assumes that existing political, economic, and social institutions can internalise the care for the environment'.[22] It can be understood as a 'meta-discourse'[23] because it underpins policy practice and academic debates around environmental governance and international environmental law (IEL). This means that it can be used at two levels: first, as a theoretical concept to analyse changes in central institutions considered necessary to solve the ecological crisis; and second, as a pragmatic political programme to direct environmental policymaking.[24]

[21] Hannigan, *Environmental Sociology*, 183..
[22] Hajer, *The Politics of Environmental Discourse*, 25; see also Howes et al., "Adapting Ecological Modernisation," 6; Milanez and Bührs, "Marrying Strands," 565.
[23] Bäckstrand and Lövbrand, "Planting Trees," 52.
[24] Gibbs, "Ecological Modernisation, Regional Economic Development," 12.

EM is explicitly a theory of modernisation where technology plays a pivotal role in this process.[25] EM starts by identifying the distinctions between 'primitive, traditional and modern societies'[26] using criteria such as industrialisation, technological advancement and liberal forms of government and governance. This means that 'development' understood as 'modernisation' is driven by technological innovation. Technical expertise is considered as 'the key to environmental progress'[27] and enables humanity to progress towards modernity.

Like other discourses, there are different versions of EM which can be differentiated by the attention paid to five core strands of EM: technological, economic, social, policy (political and institutional change), and discursive change.[28] These versions can be placed along a continuum from the original 'weak' version of EM to the more recent 'strong' EM. Table 1 below presents characteristics of 'weak' and 'strong' EM.

TABLE 1: 'WEAK' AND 'STRONG' ECOLOGICAL MODERNISATION

Weak	Strong
Economistic	Ecological
Technological	Institutional/systemic
Instrumental	Communicative
Technocratic/neo-corporatist	Deliberative democratic/open
National	International
Unitary	Diversifying

Source: Christoff, "Ecological Modernisation."

[25] Bäckstrand, "Scientisation vs. Civic Expertise," 697; Huber, "Pioneer Countries."
[26] Huber, "Ecological Modernisation," 43.
[27] Bäckstrand, "Scientisation vs. Civic Expertise," 697.
[28] Milanez and Bührs, "Marrying Strands."; Howes et al., "Adapting Ecological Modernisation."; see also Pepper, "Ecological Modernisation."; Horlings and Marsden, "Towards the Real Green Revolution?."; Christoff, "Ecological Modernisation."; Dryzek, *Politics of the Earth* 3rd ed; Hajer, *The Politics of Environmental Discourse*; Berger et al., "Ecological Modernization."

Differences between 'strong' and 'weak' EMT

One of the main distinctions between 'strong' and 'weak' EM is that 'strong' versions allow for 'multiple EM possibilities'.[29] This version is presented as a 'reflexive' approach which encourages a strategic political transition to an ecological democracy thus adopting a 'critical self-awareness' which involves democratic control and public scrutiny.[30] As part of this process, it addresses political and justice implications raised by environmental risks and envisions a broader participation through societal development, encapsulating the notion of 'ecological democracy'.[31]

Unlike weaker versions of EM, 'strong' EM views technology as part of the solution, but goes beyond a 'technological re-tooling of industry'.[32] It recognises that long-term changes require significant economic and political transformation. Therefore, it includes a substantial role for the state, including intervention, restructuring and reform to economic systems and institutions of modernity.[33]

It also adopts a critical perspective of modern institutions and dominant policy paradigms to address environmental threats.[34] Most importantly, it incorporates discursive change and elevates notions of equity, 'futurity' and ecological imperatives in comparison to narrow economic goals. This means it contemplates the possible limits to modernisation. In this way it recognises the deeper changes in morality and beliefs, as well as a need to re-embed society in communities, regions, and ecosystems. [35]

[29] Glynn, Cadman, and Maraseni, *Ecological Modernization*, 29.
[30] Curran, "Ecological Modernisation," 204; Gibbs, "Ecological Modernisation, Regional Economic Development."; Dryzek, *Politics of the Earth* 3rd ed; Howes et al., "Adapting Ecological Modernisation."
[31] Bäckstrand and Lövbrand, "Planting Trees," 54.
[32] Curran, "Ecological Modernisation," 204.
[33] Christoff, "Ecological Modernisation," 490; Howes et al., "Adapting Ecological Modernisation."; Dryzek, *Politics of the Earth* 3rd ed.
[34] Toke, "Ecological Modernisation," 768; York and Rosa, "Key Challenges."
[35] Christoff, "Ecological Modernisation," 490.

By contrast, ‘weak’ EM takes a narrower approach and focuses on reconfiguring capitalist political economy in order to enable economic development and environmental protection to proceed simultaneously and reinforce one another.[36] Weaker versions of EM hold an instrumental view of nature as provider of resources/services and propose rudimentary changes to the current political ecology arrangements while adopting sustainability and modernisation language. [37] Therefore, it provides reassurances about continuing modernisation and growth and the continued existence of capitalist political economy, and does little to reconceive the broader social, political and economic order in light of the ecological crisis.[38]

Weak EM proposes creating partnerships between governments, business, and scientists, who are tasked to manage the transition to an 'environmentally sensitive economic system’.[39] These have been successful in Western Europe where government and business relations have moved towards more ‘collaborative relationships with industry’.[40] States incorporating EM thus adopt corporatist frameworks which promote a more coordinated approach to environmental problems.[41] Therefore, this version of EM signals a ‘receptiveness growing community demands for responsive environmental governance’,[42] but avoids upsetting structural interests by moving slowly on sectoral reform.[43]

By maintaining the current political economy arrangements of dominant institutions, ‘weak’ EM indicates that there is no need to make difficult decisions between environmental protection

[36] Dryzek, *Politics of the Earth* 3rd ed, 173.
[37] Christoff, "Ecological Modernisation."; Fisher and Freudenburg, "Ecological Modernization and Its Critics."; Bäckstrand, "Scientisation vs. Civic Expertise."; Grunwald, "Diverging Pathways."; Dryzek, *Politics of the Earth* 3rd ed.
[38] Pepper, "Sustainable Development."
[39] Dryzek, *Politics of the Earth* 3rd ed, 175; Curran, "Ecological Modernisation," 204.
[40] Buttel, "Environmental Sociology," 324; Spaargaren and Mol, "Sociology, Environment."; Gouldson and Bebbington, "Corporations."; Bailey, Gouldson, and Newell, "Ecological Modernisation and the Governance of Carbon."; Williamson and Lynch-Wood, "Ecological Modernisation."
[41] Dryzek, *Paradigms and Discourses*, 166-67; Barry and Paterson, "Globalisation."
[42] Dryzek, *Politics of the Earth* 3rd ed, 175.
[43] Curran, "Ecological Modernisation," 203.

and economic growth, or balance the needs of the present against the long-term future.[44] This strategy of 'weak' EM is central to its popularity because the connection between economic growth and environmental protection opens up the possibility of environmental protection as a potential source of growth.[45]

Because weak EM views environmental risks as a management problem, solutions are technical in orientation and focus on three main areas: technological innovation, creating new markets for environmental goods and services and increasing the efficiency in the use of materials and energy.[46] This version points to the considerable efficiency gains in the way in which materials and energy is used in transport, industrial and domestic sectors. It highlights that efficiencies can be achieved using existing technologies but is also dependent on the continued high levels of technological innovation.[47]

This aspect of 'weak' EM is central to its popularity. It ensures that there is money in it for business, by selling green goods and services, and to sell pollution prevention and abatement products.[48] Therefore, it reflects 'techno-bureaucratic state-led and -initiated 'greening' of certain key sectors of the economy'.[49] Because it does little to restrict the political economy, it has greater political attractiveness and is therefore more common.[50]

[44] Dryzek, *Politics of the Earth* 3rd ed, 175.
[45] Langhelle, "Ecological Modernization," 306.
[46] Curran, "Ecological Modernisation," 204; Barry and Paterson, "Globalisation."; Mol and Sonnenfeld, "Ecological Modernisation around The World."
[47] Barry and Paterson, "Globalisation."; see e.g. *Natural Capitalism*; Asafu-Adjaye et al., *An Ecomodernist Manifesto*.
[48] Langhelle, "Ecological Modernization."; Dryzek, *Politics of the Earth* 3rd ed.
[49] Barry and Paterson, "Globalisation," 768; Mol, "Ecological Modernisation and Institutional Reflexivity."
[50] Curran, "Ecological Modernisation," 203.

Relationship between EMT and sustainable development

Scholars such as Hajer, Pepper and Langhelle suggest that sustainable development (SD) and EM are closely interrelated. Some argue that EM is an approach to SD, while others argue that SD is 'one of the paradigm statements of ecological modernisation'.[51] This indicates that there is more than a family resemblance between weak versions of EM and weak and reformist approaches to SD.[52]

Both 'weak' SD and EM are inherently anthropocentric and eschew earlier/radical environmentalist approaches.[53] They challenge the assumption that there is a trade-off between economic and environmental protection and pay little attention to the limits to growth, albeit to a greater degree in EM.[54] Therefore, they maintain the language of 'neoclassical economic rationality'[55] with its underlying assumptions concerning economic growth.

They envisage a process of progressive modernisation of social institutions rather than destruction or dismantlement.[56] Both give a prominent role to science and technology in order to innovate, and diffuse new and efficient technologies into the global market, and both view technology and social organisations as variables which can be manipulated to make economic growth possible within the limits set by nature.[57] However, for EM, social problems can be solved with 'with technological means and the hegemonic forms of the production of scientific knowledge'[58] therefore indicating that technology plays a more central role for EM.

[51] Hajer, *The Politics of Environmental Discourse*, 26; see alsoPepper, "Ecological Modernisation," 4; Smith and Connelly, *Politics & the Environment*, 155; Connelly, Smith, and Saunders, *Politics and the Environment* 3rd ed.
[52] Pepper, "Ecological Modernisation," 4.
[53] Langhelle, "Ecological Modernization."; Hajer, *The Politics of Environmental Discourse*.
[54] Pepper, "Ecological Modernisation," 2; WCED, *Our Common Future*, 45; Dryzek, *Politics of the Earth* 3rd ed; Langhelle, "Ecological Modernization."
[55] Pepper, "Ecological Modernisation," 4.
[56] Gibbs, "Ecological Modernisation", 4.
[57] Huber, "Ecological Modernisation."; Mol and Jänicke, "Origins."; Langhelle, "Ecological Modernization."
[58] Brand, "Sustainable Development," 145.This is manifest through the use of objective limits which can hide 'societal dimensions like power relations or symbolic-discursive dimensions'.

Critics point to the underlying assumptions that inform the benign view of market-driven technological innovation and argue that EM looks for the solution to the environmental crises within the paradigm of classical modernity.[59] This means that it rejects the argument that human societies must 'harmonize with nature to avoid economic and ecological collapse'.[60] Instead, this theory depicts an ideal human society as one which is 'largely emancipated from the natural world and organises itself independent of natural resources'.[61] Therefore it decouples human society from nature and argues that humanity should withdraw from nature into 'a synthetic high-tech society'[62] disembedded from the material world.

Therefore, many are critical of weak versions EM with its prioritisation of technical, market-based and technological solutions for environmental problems. From an ecofeminist perspective, 'progress' in weak EM discourses seeks to disembed human society from nature and create an entirely synthesised world that is separate and distinct from the nonhuman nature. Should such discourses be embedded within IEL, and the subsequent governance surrounding specific environmental regimes, it may highlight the continued affirmation of an exploitative and disembedded worldview that continues to shape the international community's response to environmental problems.

Ecofeminism: criticisms of technology, ecopolitics and international law and critiques of technological optimism

Ecofeminism is one of many different feminist perspectives that explore the gendered interconnections between humanity and technoscience. These different perspectives can be

[59] Grunwald, "Diverging Pathways," 1856.
[60] Asafu-Adjaye et al., *An Ecomodernist Manifesto*, 6.
[61] Grunwald, "Diverging Pathways," 1856.
[62] Grunwald, "Diverging Pathways," 1856.

arranged on a continuum from those that express profound ambivalence to technology to those that show a respect and enthusiasm for technology.[63]

At the critical end of the continuum, feminists argue that many of the epistemological ideals informing technoscience have 'androcentric origins' which are in need of reconstruction.[64] They argue that the sciences embody 'deep and systematic gender bias by which women, and any interests, perspectives, or insights associated with them, are disvalued and marginalized'.[65] At the other end, feminists celebrate the emancipatory potential of technologies to address gender inequalities in society.[66] This paper will give a brief overview of the different feminist perspectives on technoscience in order to identify why ecofeminism is a more nuanced perspective to use.

Feminist perspectives on technoscience

Early feminist engagements with technoscience focused on the impact of technological change on gender relations and women's lives and much of the scholarship explored the role of technology in the home and emerging reproductive technologies.[67] They noted the paradox that the mechanisation of the home had not decreased the time women spent on household chores.[68] Some presented technology as an 'extension inevitable extension of a male desire to control, and potentially eliminate, women's biological role in reproduction'.[69] However, this

[63] Crasnow et al., "Feminist Perspectives on Science."
[64] Whelan, "Politics by Other Means," 540; Code, *What Can She Know*, 314; Crasnow et al., "Feminist Perspectives on Science." ; Merchant, *Death of Nature*. ; Fox Keller, *Secrets of Life*.
[65] Crasnow et al., "Feminist Perspectives on Science."
[66] Faulkner, "The Technology Question."
[67] Wajcman, "Reflections on Gender."; Oldenziel, "Of Old and New Cyborgs."
[68] Wajcman, "Reflections on Gender."; Faulkner, "The Technology Question."; Ravetz, "Modern Technology."; Corea, "The Reproductive Brothel."
[69] Faulkner, "The Technology Question," 80; Corea, "The Reproductive Brothel," 39; Biehl, *Rethinking Ecofeminist Politics*; Biehl, "Problems in Ecofeminism."; Leach, "Earth Mother Myths."; Agarwal, "Gender and Environment Debate."

early scholarship has been criticised for adopting naïve determinism, which treated women as 'passive victims' and dismissed technological developments as patriarchal.[70]

More recent feminist research problematises the gendered nature of the development and diffusion of technologies.[71] Research into different technologies reveals that gendering processes 'affect every stage in the life of a technology'.[72] These investigations highlight how the construction of gender and technology are relational processes that are shaped by social interaction.[73] This scholarship argues that the relationship between technological innovation and gender power interests is much more subtle and complex than previously understood, a conclusion shared by ecofeminists in their work on women/environment connections.

Other scholarship investigates how 'technology as culture is implicated in the construction of subjective gender identities.'[74] Adopting a more positive view of technology, scholars such as Donna Haraway argue that society should embrace the potential of technoscience and the potential for it to create new meanings and entities and to make new worlds.[75] Some argue that it has the potential to fundamentally affect the basic categories of 'self' and 'gender' by enabling the body to be transformed into objects that can be altered, made and remade through technoscience.[76] Others argue that technoscience challenges established notions of the 'human' and consequential ethical norms by building on the 'conceptual disruptions produced by contemporary technoscientific practices such as cloning'.[77] These examples concentrate on the emancipatory potential of scientific inquiry to understand and change sex/gender inequities.

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[70] Wajcman, "Reflections on Gender," 450; for similar criticisms in early ecofeminist research, see: Braidotti et al., *Women, the Environment*; Jackson, "Women/Nature."; Gaard, "Ecofeminism Revisited."
[71] Cockburn and Ormrod, *Gender and Technology*; Casper and Clarke, "Making the Pap Smear."; Ferrando, "Is The Post-Human."; Davis, "Reading the Strange Case."
[72] Wajcman, "Reflections on Gender," 455.
[73] Daniels, "Rethinking Cyberfeminism(s)."; Shepherd, "Cyberfeminists Pt 2."; Sikka, *Climate Technology*.
[74] Wajcman, "Reflections on Gender," 457.
[75] Wajcman, "Reflections on Gender."
[76] Wajcman, "Reflections on Gender."; Haraway, *Simians, Cyborgs*.
[77] Roberts, "Relating Simply?."; Braidotti, *Transpositions*.

Building on the work above, some argue that an outright rejection of technology is not an option and that critical engagement with technoscience can provide 'opportunities to transform, invent, and make decisions about technology'.[78] One line of inquiry is the role of information technologies and their emancipatory potential.[79] Some posit that technoscience could bridge the widening gap between humanity and nature through developing different communication strategies.[80] These examples highlight how contemporary feminists are approaching technoscience as a 'reservoir' for concepts, models and discourses that could be of use to feminism and feminist thinking.

However, these critiques pay little attention to the way in which nature is valued in technoscience and how the treatment of nonhuman nature and women are conceptually related. As will be demonstrated below, ecofeminism understands the subordination of women and the environment as a 'framework of domination involving dualisms that represent a cultural 'institutionalisation of power relations' and depict these as a 'logic of colonization'.[81] Therefore it can develop a more nuanced understanding of the social relations of technoscience and what it means for both women and the environment in a globalised world.[82]

Ecofeminist theory

Ecofeminism is a multifaceted theory that can be summarised as 'a movement and current of analysis that attempts to link feminist struggles with ecological struggles.'[83] This broad definition 'encapsulates the idea of a gendered discourse on environmental issues'[84] central to

[78] Whelan, "Politics by Other Means," 540.
[79] Wajcman, "Reflections on Gender."; Roberts, "Relating Simply?," 76 fn 50; Carter Olson, "#BringBackOurGirls."; Martin and Valenti, *#FemFuture*; McKeown, Parry, and Penny Light, "'My iPhone Changed My Life'.", who explores the role of technology in challenging societal constructions of women's sexuality; Pierce, "Singing at the Digital Well.", who explores the potential of social media to strengthen women's activism.
[80] Roberts, "Relating Simply?," 76; Haraway, *Primate Visions*.
[81] Plumwood, "Politics of Reason," 443.
[82] Åsberg and Lykke, "Feminist Technoscience," 300.
[83] Sandilands, *Good-Natured Feminist*, xvi.
[84] Morrow, "Not So Much a Meeting of Minds," 187.

the theory. It adopts a more holistic approach to the construction of women and nature than other feminist theories because it 'features human exploitation of the environment in "its list of interwoven forms of oppression such as sexism, heterosexism, racism and ethnocentrism"'.[85]

Ecofeminism gains strength from the fact it draws from different theoretical foundations, including socialism, materialism, and post-colonialism, and combines the local and global in its perspective.[86] It is inherently interdisciplinary and adopts an intersectional approach.[87] This means it offers a polycentric and porous perspective through which to analyse the role of technology in mediating the relationship between humanity and the environment, and the gendered implications of such mediations.[88]

Therefore, it is more appropriate to refer to 'ecofeminisms'[89] falling 'along a continuum ranging from essentialist to socialist ecofeminism'.[90] The main strength of ecofeminist theory is that it can critique the exploitation of women and nature from the underlying conceptual frameworks informing Western thought through to the impact of technology for women, environment and sustainable development policies. The following paragraphs briefly highlight these different layers of ecofeminist critique and how they relate to technology.

[85] Wilkinson, "Payment for Ecosystem Services," 172.
[86] Wilkinson Cross, "The Environment as Commodity."
[87] Morrow, "Ecofeminism."; Kings, "Intersectionality."
[88] Braidotti et al., *Women, the Environment*, 161; Kao, "The Universal Versus the Particular."; Sturgeon, *Ecofeminist Natures*.
[89] Plumwood, *Feminism and Mastery*, 36.
[90] Morrow, "Ecofeminism," 371. Mainstream scholarship generally portrays ecofeminism as 'essentialist, biologist, lacking political efficacy, intellectually regressive, and inconsistent'. It presents ecofeminism as a monolithic theory which is wholly located at one end of the spectrum and ignores scholarship incorporating 'materialist and posthumanist analysis of gender and the environment prior to these being popular within mainstream Western academia.' It also silences the internal dialogue amongst ecofeminists who have engaged with these criticisms. many ecofeminists have responded to these criticisms, see e.g. King, "Caring about Nature."; Lahar, "Ecofeminist Theory."; Morrow, "Ecofeminism."; Plumwood, *Feminism and Mastery*; Wilkinson Cross, "The Environment as Commodity."; Cuomo, "Still Fooling."; Davion, "Is Ecofeminism Feminist."; Gaard, "Ecofeminism Revisited."; Moore, "Eco/Feminism."; Plumwood, "Politics of Reason."; Sturgeon, *Ecofeminist Natures*; Sturgeon, "Ecofeminist Appropriations."; Thompson, "Back to Nature.".

Ecofeminist critiques of technoscience

The first layer of ecofeminist critique reveals the 'exploitative and gendered conceptual frameworks that underpin the dominant and rational discourses in western society'.[91] These conceptual frameworks are formed by a 'set of values, attitudes, beliefs, and assumptions that shape and mirror how an entity views itself and the world around it'.[92] Ecofeminists deconstruct the rationalist foundation of Western thought and its dualist logic structures and reveal how these structures intersect to legitimise the exploitation of women and nature by casting both as 'other'.[93] These 'rationalist-dualist' constructs are embedded in many binaries such as subject/object, male/female, reason/emotion, production/reproduction.[94] They form systems of interlocking structures which serve to 'valorise "masculine", abstract, disembedded and dispassionate characteristics while simultaneously devaluing and embedding 'feminine' or subordinate characteristics within the body and the natural world'.[95]

These binary concepts have acquired cultural dominance and are evident in science and the 'economic systems that govern the global economy and economic development'.[96] This is because they are based on the concept of dualism which privileges certain forms of knowledge and thinking that valorise rationalist faculties as superior to other characteristics of the human condition. These dualisms are part of logical structures that institutionalise and normalise power.[97]

Ecofeminists focus on different dualist constructs as sites of oppression. Materialist ecofeminism reframes earlier socialist and radical positions within an ecological

[91] Wilkinson Cross, "The Environment as Commodity," 93; Warren, *Ecofeminist Philosophy*, 46; Plumwood, "Feminism and Ecofeminism."; Plumwood, *Feminism and Mastery*; Plumwood, "Politics of Reason."; Plumwood, *Environmental Culture*; Warren, "Empirical Data."; Wilkinson Cross, "Transformative Potentials."
[92] Wilkinson Cross, "The Environment as Commodity," 93.
[93] Plumwood, *Feminism and Mastery*; Plumwood, "Politics of Reason."; Plumwood, *Environmental Culture*.
[94] Plumwood, *Feminism and Mastery*, 43; Wilkinson, "Payment for Ecosystem Services," 168.
[95] Wilkinson, "Payment for Ecosystem Services," 168.
[96] Wilkinson, "Payment for Ecosystem Services," 168.
[97] Plumwood, *Feminism and Mastery*, 42.

problematique.[98] Like socialist perspectives, this perspective explores the dialectical relationship between production and reproduction and starts from the position that all humans are embodied beings and rooted in nature.[99] This form of politics is an 'existentially grounded analysis, recognising that a "woman's first environment is her body"'.[100] It 'refuses the globalising capitalist patriarchal megamachine'[101] and considers the 'materiality of ecopolitical questions'.[102] Therefore, it is concerned with the role of technology in regulating bodies and nonhuman nature, and changing the relationships between our bodies, minds and cultures, as well as the impact of national and economic development, the growth of privatisation, outsourcing and 'flexible' labour, all of which disproportionately affect women and degrade the environment.[103]

Materialist ecofeminists argue that Western society has sought to separate itself from the environment through productive systems, in which 'women have been materially associated with human embodiment largely through unpaid or underpaid work'[104] whereas men have disembedded and transcended the material (nature) sphere. As a result they dominate the sphere of monetised production which transforms nature through processes that are inherently destructive.[105] This analysis goes beyond mainstream feminisms and contests the 'traditional Eurocentric nature/culture dualism … rather than a 're-invention' of nature blended with man-made machine' which is articulated in postmodern feminist literature.[106] Therefore, it enables

[98] Salleh, "Dystopia," 202; D'Eaubonne, "Feminism or Death."
[99] Mellor, "Women, Nature," 180; Mellor, "Feminism and Environmental Ethics," 111; Merchant, "Scientific Revolution," 515.
[100] Salleh, "Dystopia," 202; Mellor, *Feminism & Ecology*; Mellor, "Feminism and Environmental Ethics."
[101] Salleh, "Dystopia," 202.
[102] Salleh, "Dystopia," 202.
[103] Wilkinson Cross, "Ecofeminist Potentials," 205.
[104] Wilkinson Cross, "Ecofeminist Potentials," 205; Mellor, "Feminism and Environmental Ethics," 110; Mellor, *Feminism & Ecology*, 154; Mellor, "Women, Nature."; Mellor, "The Politics of Women."
[105] Wilkinson Cross, "Ecofeminist Potentials," 205; King, "Healing the Wounds."; Mellor, *Feminism & Ecology*; Mellor, "Women, Nature."; Mellor, "Feminism and Environmental Ethics."; Wilkinson Cross, "Transformative Potentials.".
[106] Salleh, "Dystopia," 202; Haraway, *Simians, Cyborgs*, 173.

a multifaceted critique of the underlying philosophy and concepts that inform discourses of technology and their relationship with women and nature.

Ecofeminists argue that technology plays a central role in transforming nature, and because women are seen to embody nature, they are also ripe for alteration. Carolyn Merchant has argued that the narrative of the scientific method from the scientific revolution onwards has advocated 'extracting nature's secrets from "her" bosom through science'.[107] By recasting nature as female, stripped of activity and rendered passive, it can be 'dominated by science, technology and capitalist production'[108] and means that nature, humans and society consist of interchangeable parts which can be externally repaired or replaced through technological advances. [109] This worldview allows humanity to exist outside of nature as 'intellectual beings who calculate the maximum satisfaction or utility of nature'.[110]

In light of this, ecofeminists have explored the impact of technology on women and nature in the context of globalisation and sustainable development at the local and global levels. Writing in the 1980s, ecofeminists such as Vandana Shiva and Maria Mies highlighted the inverse relationship between technological developments in agriculture, the feminisation of poverty, and less diversity of food crops. They highlighted how neoliberal development and its commitment to modernisation through technology, free trade and commodification reinforces the insecurity and vulnerability of small farmers by disrupting informal and local practices of seed storage and co-cropping in favour of monocultures, patent-protected seeds and other socially and ecologically destructive practices.[111] Others have highlighted the relationship

[107] Merchant, "Scientific Revolution," 515.
[108] Merchant, "Scientific Revolution," 514.
[109] Wilkinson Cross, "Transformative Potentials," 38.
[110] Wilkinson Cross, "Transformative Potentials," 38.
[111] Shiva, *Staying Alive*; Shiva, "Development."; Mies and Bennholdt-Thomsen, *The Subsistence Perspective*; Shiva, "Biopatents."; Mies, Shiva, and Salleh, *Ecofeminism*. Mainstream literature supports this analysis and points to the role of technology in maintaining or reinforcing inequalities: Naudé and Nagler, "Technological Innovation."; Rotman, "Technology and Inequality."; UNDP, *Humanity Divided*, 236; Mirza et al., "Technology Driven Inequality."

between technological innovation, the femininization of poverty and the north/south divide.[112] Therefore, technology can be used to control and oppress women and nature, particularly when connected to other discourses of power and control, such as free trade and neoliberal development.

To conclude, ecofeminism is highly critical of the role of technology within the advancement of human society and the way in which it maps onto and reinforces the devaluation of women and non-human nature. Unlike other feminist critiques, ecofeminism places the connections between the unjustified domination of women and nature central in its analysis.[113] In contrast to other environmental perspectives,[114] ecofeminism argues that the 'gendered nature of the logic of domination in western thought should be central in any environmental philosophy'.[115] By drawing on these two perspectives ecofeminists develop a nuanced critique of *how* technology is used to mediate the material and social realms, reinforce the anthropocentric and androcentric worldview of the nonhuman world and legitimise the continued exploitation of women and nonhuman nature. By doing so, they have adopted a multifaceted and intersectional critique of the ways in which technology interacts with other structural inequalities which can reaffirm the exploitation of women and the commodification of nature.

Methodology and initial results

This article examines the provisions for technology in the CBD, Nagoya Protocol, and Cartagena Protocol, and the subsequent Decisions adopted by Parties to the CBD and its two Protocols. Specifically, it examines the Decisions adopted by the 13th Conference of the Parties

[112] Kailo, "Cyber/Ecofeminism", 5.
[113] Sessions, "Deep Ecology," 97-98.
[114] For a critique of other environmental perspectives, such as social ecology and deep ecology, see Plumwood, *Environmental Culture*; Plumwood, "Ecopolitics Debate."; Plumwood, "Politics of Reason."; Plumwood, "Ecofeminism."; Wilkinson Cross, "The Environment as Commodity."
[115] Wilkinson Cross, "The Environment as Commodity," 84; Kelly, "Women and Power," 115,.

to the CBD (COP Decisions), the 8th Meeting of the Parties to the Cartagena Protocol (CP-MOP Decisions), and the 2nd Meeting of the Parties to the Nagoya Protocol (NP-MOP Decisions), all held in 2016. In total, the research examined sixty-nine documents, comprising of three international agreements and sixty-six COP/MOP decisions. The analysis focused on how these documents portray technology and its role in achieving the objectives of the biodiversity regime.

There are important variables that affect references to technology in the documents. These include *type* of document, the *age* of the document, and *where* the reference is included in the document. This is because international agreements intend to create obligations under international law, while COP/MOP Decisions have a different level of obligations.[116] The COP/MOP Decisions are 'more concrete prescriptions on how to implement the Convention'[117] and can be considered as 'expressions of the regime, as they provide explicit principles, norms, and decision-making procedures'.[118] Therefore references to technology may differ between these two types of documents. References to technology may also differ depending on the age of the document because of developments in other international regimes, such as intellectual property and trade rights. The location of the provision may also affect the language used. This is because preamble paragraphs assist in treaty interpretation whereas operative provisions are legally binding.[119] These variables are taken into account during the discussion below.

The initial analysis was conducted using the text query function in NVivo. This function searched for the word 'technology' and its specialisations, such as 'technical', 'scientific', or 'mechanism' in all 69 documents. This initial search coded 1,118 references relating to

[116] *Convention on Biological Diversity (1992),* art 23(4)(i); *Vienna Convention on the Law of Treaties (1969),* art 2(1)(a); Sands et al., *Principles* 4th ed.
[117] Henne and Fakir, "Regime Building," 319.
[118] Henne and Fakir, "Regime Building," 320.
[119] *Vienna Convention on the Law of Treaties (1969),* art 31(2); Aust, *Modern Treaty Law* 3rd ed, 210-12.

technology in the international agreements and the combined COP/MOP decisions for the CBD, Nagoya Protocol and the Cartagena Protocol.

Documents containing less than 15 hits for ‘technology’ and its specialisations were removed at this stage. This ensured that the documents had sufficient content relating to technology for thematic analysis to take place. A total of 39 documents were excluded after the initial sift.

After the initial sift, the results were grouped into themes which were refined after subsequent reading of the texts. These themes were derived from an iterative reading and grouping of the texts. The text was initially grouped according to broad categories such as ‘technology and development’, ‘technology and economy’, and ‘technology and anthropocentric language’. These broad groups were then refined through an iterative process which identified more specific themes. For example, initial themes of ‘technology as a way to obtain value’, technology making a difference’, and ‘technology and productivity’ emerged from references relating to economic issues in the original group ‘technology and economy’.

These initial themes were subsequently refined after iterative readings of the documents and synthesised into the final themes used in this research. From reviewing the original broad groups and initial themes the researcher identified four dominant categories of technology/environment connections. These became the four categories of themes and sub-themes set out in Table 2.

The four main themes viewed technology as a tool or mechanism (to improve the environment; to mediate economic growth, development and nature; to facilitate cooperation), and engaged with issues around the relationship between technology, science and environmental problems (recognition of limitations, discourses of scientific validity). However, most of the themes focus on the role of technology as a tool for use in the biodiversity

regime, rather than engaging with more nuanced questions surrounding knowledge, validity and the potential limitations of Western epistemology and science.

Themes	Documents	References
Relationship between science and technology	**7**	**18**
Discourse of scientific validity	2	3
Limitations of current or furture scientific knolwedge	4	12
Limitations of technology or science	2	3
Technology and improving the environment	**9**	**21**
Anthropocentric framing	6	14
Technology way to obtain value	5	7
Technology as mechanism for cooperation	**12**	**33**
Relationship with other agreements	2	3
Technology makes a difference	10	20
Technology tool for cooperation	4	10
Technology used to mediate economic growth, development and nature	**12**	**38**
Connection between technology, trade and economic development	10	19
Technology contributes to sustainable development	2	2
Technology enables continued growth	2	3
Technology mediate between environ and humanity	4	5
Technology mediation between IPLCs and commoditisation of knowledge	6	9

TABLE 2

The analysis found that most themes are present in both the international agreements and COP/MOP Decisions. Themes emphasising technology as a mechanism for cooperation, making a difference and productivity are found in all three environmental agreements and some COP/MOP decisions. Themes emphasising the connection between biodiversity, the market and economic growth are found in all the documents. Generally, all documents contained themes framing technology and its specialisations in a positive light and as a vehicle for progress. However, there were some themes that acknowledged the negative role of technology, particularly in light of the limitations of current and future scientific knowledge. These were contained in both types of documents.

The analysis also found that the language incorporating these themes differs depending on where the theme is found in the document. For example, the excerpts below highlights how the language associating technology as mechanism for cooperation differs depending if it is found in a preamble or operational section of the document:

> The Contracting Parties *shall promote international technical and scientific cooperation* in the field of conservation and sustainable use of biological diversity, *where necessary*, through the appropriate international and national institutions (CBD, Article 18(1))
>
> *Technical and scientific cooperation to develop capacities in classical biological control, including scientific understanding*, the regulatory process, and the training of skilled staff, *is crucial for the success of biological control* programmes. (COP Decision XIII/12, paragraph 13)
>
> Recognizing the need for a *more integrated and coherent approach to capacity-building and technical and scientific cooperation in supporting the implementation of the Convention and its Protocols* as well as other biodiversity-related multilateral environmental agreements, (COP Decision XIII/23, Preamble para 2)

These excerpts indicate that the language used in preambles is generally 'soft' and uses passive phrases including '*is crucial for*' and '*recognising the need for*'. This language is different from the active and precise language used in the operative provisions. These provisions include verbs such as '*shall*' and '*shall promote*'. This difference indicates that these sections of the agreements intend to create obligations for states.[120] This pattern is repeated in other themes framing technology in a positive light and as a vehicle for progress.

However, there were some themes that acknowledge the negative role of technology, particularly in light of the limitations of current and future scientific knowledge. This theme was found predominately in preamble preambular text across both types of documents. For example, consider the following preamble paragraphs:

> Noting also that *where there is a threat of significant reduction or loss of biological diversity, lack of full scientific certainty should not be used as a reason for postponing measures* to avoid or minimize such a threat (CBD, Preamble para 9)
>
> Also notes that *it is not clear, given the current state of knowledge*, whether or not some organisms of synthetic biology, which are currently in the early stages of research and development, would fall under the definition of living modified organisms under the Cartagena Protocol, and further notes that *there are cases in which there may be no consensus on whether the result of a synthetic biology application is "living" or not* (COP Decision XIII/17, Preamble para 7)
>
> *Lack of scientific certainty due to insufficient relevant scientific information and knowledge* regarding the extent of the potential adverse effects of a living modified organism on the conservation and sustainable use of biological diversity in the Party of import, taking also into account risks to human health, *shall not prevent that Party from taking a decision*, as appropriate, with regard to the import of the living modified organism in question as referred to in paragraph 3 above, *in order to avoid or minimize such potential adverse effects* (Cartagena Protocol, art 10(6))

The preamble extracts set out above also use softer language in their recognition of the potential limitations of scientific knowledge and the management of risk. The CBD preamble

[120] Costelloe and Fitzmaurice, "Interpretation of Secondary Instruments."

uses ‘should’ rather than ‘shall’ in the above paragraph. ‘Should’ is generally understood to imply non-mandatory action, whereas ‘shall’ has mandatory character.[121] This, in addition to the passive language within the paragraph, indicates that the drafters sought to ensure that this provision is as broad as possible.[122] The difference between operative and preamble language and the use of mandatory and non-mandatory language is a common occurrence across all of the texts and will be considered in more detail below.

The discussion below explores three themes that emerged from this analysis. The themes are assessed to the extent they incorporate weak EM, before critiquing the presence of such discourses on the way in which technology is viewed within the biodiversity regime.

Technology used to mediate economic growth, development and environment

The use of technology to mediate economic growth, development and the environment is a common theme across all the documents. This concept is central to weak EMT which argues that states can continue grow their economy by encouraging greater economic efficiencies in the use of natural resources and through market corrections.[123] References to technology in the international agreements and COP Decisions reflect the assumption that technology is a marker of modernisation and progress, particularly in the context of technology transfer. Similarly, the COP Decisions reflect the continued reliance on traditional growth models within EMT by incorporating environmental accounting methods in order to encourage eco-efficiencies and as a solution to solving environmental problems. Like EM, the biodiversity regime adopts the

[121] D'Acquisto and D'Avanzo, "The Role of SHALL."; Bodansky, "Legally Binding."; Williams, *Tradition and Change*.
[122] Williams, *Tradition and Change*.
[123] Asafu-Adjaye et al., *An Ecomodernist Manifesto*; Barry, "Bio-fuelling the Hummer?."

solution that more growth and economic development through technological innovation is the solution to environmental problems.

A key strategy to ensuring continued economic growth through resource and material efficiencies is through creating an environment for technology transfer. Under Article 16 of the CBD, participation in the biodiversity regime by developing countries is contingent on access to financial support and technology transfer:

> Access to and transfer of technology … to developing countries *shall be provided and/or facilitated under fair and most favourable terms*, including on concessional and preferential terms where mutually agreed, and, where necessary, in accordance with the financial mechanism established by Articles 20 and 21. (Article 16(2))

Article 15(2) establishes that developing countries in particular should have access to technologies under fair and most favourable terms:

> Each Contracting Party shall endeavour to create conditions to facilitate access to genetic resources for environmentally sound uses by other Contracting Parties and not to impose restrictions that run counter to the objectives of this Convention.

By linking technology transfer, the needs of developing countries, and the need to facilitate access to technology, these operative provisions emphasise the importance of technology for the success of the regime. This indicates that weak EMT strategies of economic efficiencies has informed the development of the biodiversity regime.

The Nagoya Protocol similarly affirms the role of technology transfer as a way to enable the economic development of developing countries through the sustainable use of genetic resources while also ensuring biodiversity conservation. Like the CBD, Article 1 of the Protocol identifies the appropriate transfer of relevant technologies in benefit-sharing as a component of the main objective of the Agreement.[124] Further, the Protocol explicitly connects biotechnology and technology that uses genetic resources as key methods to ensure the sustainable conservation of genetic resources while also enabling Parties to conserve

[124] *Nagoya Protocol (2010),* art 1.

biodiversity.[125] This is demonstrated by including the transfer of knowledge and technology under 'fair and most favourable terms' as a form of non-monetary benefit in the context of access and equitable sharing of benefits:

> 2. Non-monetary benefits may include, but not be limited to:
>
> …
>
> (f) Transfer to the provider of the genetic resources of knowledge and technology under fair and most favourable terms, including on concessional and preferential terms where agreed, *in particular, knowledge and technology that make use of genetic resources, including biotechnology, or that are relevant to the conservation and sustainable utilization of biological diversity*; (Nagoya Protocol, Annex I para 2(f))

'Non-monetary benefits' are benefits that are negotiated as part the process to gain access to genetic resources based on mutually agreed terms negotiated between the provider granting access to the genetic resources and the entity that seeks to use those resources.[126] Therefore, these provisions use technology as a tool to mediate between economic growth and environmental sustainability by enabling Parties to have access to technologies that mitigate their contribution to environmental degradation.

These examples indicate that strategies of EM have been incorporated in the biodiversity regime. The Nagoya Protocol uses technology to mediate economic growth through the sustainable use of genetic resources and to conserve such resources. The Protocol incorporates a dominant assumption within weak EMT that continued economic growth through technological innovation or transfer enables an environment for the conservation and sustainable use of genetic resources. The use of technology transfer to facilitate and incentivise biodiversity conservation incorporates this assumption.

Technology is also proposed as a way to enable development through modernisation. As Vandana Shiva argues, 'development … is taken as synonymous with the introduction of

[125] *Nagoya Protocol (2010),* art 1.
[126] *Nagoya Protocol (2010),* art 5, art 23.

Western science and technology in non-Western contexts.'[127] This understanding shapes how EM and SD discourses approach environmental risks in the context of development. As noted earlier, EM views environmental risks as a management problem and proposes technical solutions through technological innovation, market diversification and efficiency gains in the use of materials and energy. Therefore, economic development and environmental protection are interrelated and can occur in the existing capitalist political economy. [128] This feature of EM is criticised because it maintains the assumption that continued economic growth is possible by using economic measures to correct the environmentally damaging actions of industries and states.[129]

The inclusion of economic measures such as ecosystem assessments, the use of environmental economic accounting and cost-benefit exercises indicate a commitment to technical and management-oriented strategies to alleviate environmental risk. For example, Decision XIII/3 'invites Parties and other Governments … To introduce or scale up the use of environmental economic accounting and natural capital accounting'.[130] Decision XIII/5 incorporates cost-benefit exercise of ecosystem restoration as part of the short-term action plan and makes the connection between restoring ecosystems and supporting the ecological and economic sustainability of other production activities. It gives examples of actions that could be taken in the context of broad-based ecosystem assessments and restoration activities:

> Assess the potential costs and multiple benefits of ecosystem restoration at relevant scales. *Benefits may include those linked to biodiversity and ecosystem services, and socioeconomic benefits, such as water and food security, carbon capture and sequestration, jobs and livelihoods, health benefits, and disaster risk reduction* (e.g. fire and erosion control, and coastal protection). *Identify opportunities for maximizing co-benefits and for reducing or eliminating conflicts among co-benefits* … (Annex para 13(4))
>
> Consider *how ecosystem restoration activities can support the ecological and economic sustainability of agriculture and other production activities*, as well as climate change mitigation and adaptation, and disaster risk reduction, and enhance ecosystem services, including for urban

[127] Shiva, "Biotechnological Development," 194.
[128] Dryzek, *Politics of the Earth* 3rd ed, 173.
[129] Nelson, "Economists."; Ruder and Sanniti, "Transcending." For examples of this assumption, see: Spaargaren, "Ecological Modernization Theory."; Buttel, "Ecological Modernization."
[130] CBD, Decision XIII/3 2016, para 18(b).

> areas… The *expected effects of restoration activities on the ecological function* of adjacent lands and waters should be considered, for example through environmental impact assessments and strategic environmental assessments. (Annex para 15(2))

Both weak SD and EM discourses propose using economic measures to internalise environmental externalities into the economy. These excerpts highlight how economic measures and their underlying assumptions have been incorporated into the biodiversity regime. Such practices and the models they inform are criticised by ecofeminists and feminist economists alike. They argue that the economic models they inform are assumed to be objective and neutral and do not reflect the reality of lived experience. At the same time, the agents and markets modelled in these models are assumed to be perfectly competitive, autonomous, rational, and self-interested, seeking to maximise utility or profit.[131] Not only do these models discount the gendered experiences of women in the context of development and the environment, they distance and divorce humanity from nature and frame ecological restoration and nonhuman nature as an 'economic good' which can be managed and manipulated to maximise 'co-benefits' by incorporating 'eco-efficiencies'. Therefore, they reinforce the status quo by discounting women's experiences and reinforce the view of nature as an economic good.

These excerpts reflect what Fox Keller refers to as 'objectivism', which is the belief in 'connection-free knowledge from an outside-of-nature, perspective-free viewpoint'.[132] The language used in the documents also reflect this 'objectivism' and highlights how economic and ethical choices are smuggled into environmental agreements under the guise of 'neutrality', with little attention of how such choices maintain the status quo of power relations.[133] This hides the way in which these documents represent a gendered economy that is removed from social and ecological frameworks, and thus disembodied and disembedded from ecosystems.[134]

[131] Nelson, "Rethinking Development."
[132] Nelson, "Economists," 443.
[133] Lee, "Ecofeminist Perspectives."
[134] Mellor, "Ecofeminist Political Economy," 254; Nelson, "Economists."; Ruder and Sanniti, "Transcending."

Technology as mechanism for cooperation

The second dominant theme in the documents relates to how technology is used to facilitate cooperation between the different actors involved in the biodiversity regime. In particular, the documents emphasise the role of technology in making a difference – both in terms of achieving objectives of the biodiversity regime and to enable capacity building for Parties to the agreements.

One of the main strategies of EM is to improve efficiencies of production through technological innovation, improved governance and policy instruments, and better institutions to provide managerial oversight.[135] These strategies focus on increasing cooperation between different actors across policy, industry and other sectors of the economy and other societal institutions, and use technology as a mechanism to facilitate greater cooperation. They are based on the assumption that cooperation enables more efficient governance, management and policy coherence and thus contributes to more efficient use of natural resources and a better space for technological and market innovation. However, this cooperation is often along the lines of dominant power relationships and can reinforce existing precarities between actors.

Each of the international agreements include provisions that promote international technical and scientific cooperation to implement the objectives of the agreements. The Cartagena Protocol clarifies that for the purpose of cooperation,

> the needs of developing country Parties, in particular the least developed and small island developing States among them, *for financial resources and access to and transfer of technology and know-how in accordance with the relevant provisions of the Convention, shall be taken fully into account for capacity-building* in biosafety. Cooperation in capacity-building shall … *include scientific and technical training in the proper and safe management of biotechnology*, …, and the *enhancement of technological and institutional capacities in biosafety* (Article 22(2))

[135] Bäckstrand and Lövbrand, "Planting Trees."; Baker, "Sustainable Development."

Similarly, both the Nagoya Protocol and the CBD associate collaboration, cooperation and capacity-building with technology transfer, development, and scientific research as a means to attain or strengthen the objectives of the Convention and the Protocol.[136] This suggests that the Parties view technology as a mechanism for international cooperation.

The operative provisions in the international agreements and COP Decisions reinforce the narrative that technology enhances cooperation between states and non-state actors. The CBD identifies information exchange between developed and developing country Parties as a pathway to cooperation and calls for contracting Parties to 'promote technical and scientific cooperation with other Contracting Parties, in particular developing countries, in implementing this Convention'.[137] The Nagoya Protocol also calls for Parties to 'collaborate and cooperate in technical and scientific research and development programmes, including biotechnological research activities, as a means to achieve the objective of this Protocol'.[138] These provisions identify technical and scientific cooperation as a key strategy to achieve the objectives of the biodiversity regime.

The COP/MOP Decisions similarly identify technological innovation as a pathway to international cooperation. COP Decision XIII/24 explicitly recognises the need for greater cooperation between States, governments and non-state actors. It encourages Parties

> To provide common training and other learning opportunities to the national focal points of the biodiversity-related conventions and other relevant staff to build capacity and mutual understanding of:
>
> …
>
> (iii) Communication methods to *raise awareness on the value of biodiversity and ecosystem services with their respective high-level policy decision-makers*;
>
> (iv) *Technical knowledge on synergy and coordination*. (Annex I para 25(b)(iii -iv))

[136] *Convention on Biological Diversity (1992),* art 18(1); *Nagoya Protocol (2010).*
[137] *Convention on Biological Diversity (1992),* art 18(2).
[138] *Nagoya Protocol (2010),* art 23.

It also encourages parties to provide training for technical knowledge on synergies and coordination between biodiversity-related Conventions, and to enhance the work of the secretariat in the use of internet technology.[139] These activities identify technology as a mechanism to help cement the cooperation between different actors involved in biodiversity conservation.

While states approach technology as a conduit for cooperation and communication, such cooperation can also be a conduit for unsustainable and inequitable practices, and the exploitation of gendered resources.[140] For example, these documents include limited recognition of the role of technology in appropriating traditional and gendered knowledge and how technology is being pitted against traditional practices across the globe.[141] Furthermore, the full cost of new manufacturing technologies is rarely considered because the 'material costs are often rendered invisible by externalisation on to other classes, races, genders, or species'.[142] This assumes that human culture, lifestyles and demands on nature are unchangeable rather than engaging with a comprehensive restructuring of Western culture.[143] As science and technology are socially constructed, the narratives around the role of technology and technological innovation are informed by dominant discourses, such as SD and EM. This can perpetuate the status quo and embedded power relations under the guise of progress and cooperation.

The participation by states and non-state actors in technological innovation is another key feature of EM found in the biodiversity regime. Parties are encouraged to develop transnational networks and institutions of technological innovation for the purposes of cooperation. This

[139] CBD, Decision XIII/24 2016, Annex II para 6; see also: CBD, Decision XIII/12 2016, Annex II para 1.4.
[140] Salleh, "Climate Strategy," 126.
[141] Shiva, "Biopatents."; Isla, "Biopiracy."
[142] Salleh, "Climate Strategy," 129.
[143] Plumwood, *Environmental Culture*, 8.

strategy reflects what Barry and Paterson identify as the 'techno-bureaucratic state-led and initiated 'greening' of certain key sectors of the economy'.[144] In this approach, state policy 'elites' act as 'brokers and prime movers in encouraging interest groups, trades unions, industry, consumer groups and sections of the environmental movement'[145] to accept the agenda of EM.

In line with this, both types of documents include references supporting greater participation and cooperation between actors involved in technological innovation. Article 18(1) of the CBD states:

> The Contracting Parties shall promote international technical and scientific cooperation in the field of conservation and sustainable use of biological diversity, where necessary, through the appropriate international and national institutions (CBD, Article 18(1))

The two Protocols include similar provisions relating to developing human resources and institutional capacity in developing countries through existing public institutions and increasing the participation by the private sector and civil society.[146]

The COP Decisions also emphasise the importance of 'cross-sectoral' partnerships and the need to support greater cooperation between states to develop technologies. For example, COP Decision XIII/11 states:

> Emerging technologies and sensor development increase the efficiency of this evolving network. There is a need for greater cross-sectoral partnership among government, industry and academia to facilitate the establishment of globally integrated monitoring systems (Annex I para 14)

The international agreements and COP Decisions also include provisions to support the participation by women and indigenous communities in the context of capacity-building, innovation and technology transfer, in addition to supporting the participation between state and non-state actors.[147] Where they are found in the operational text, they are often qualified

[144] Barry and Paterson, "Globalisation," 768.
[145] Barry and Paterson, "Globalisation," 769.
[146] *Nagoya Protocol (2010),* art 23; *Cartagena Protocol (2000),* art 22(1).
[147] *Cartagena Protocol (2000),* art 26; *Nagoya Protocol (2010),* preamble para 11, art 22(1), art 22(3); *Convention on Biological Diversity (1992),* preamble para 13, art 17(2).

by phrases such as 'subject to its national legislation'[148] and 'shall, in accordance with national legislation and policies'.[149] This leaves how to operationalise such participation to the discretion of state Parties.

Nevertheless, some include more positive statements concerning the participation by indigenous peoples. For example, Decision XIII/3 and Decision XIII/12:

> *Recognizes* the *central role of indigenous peoples and local communities in the conservation and sustainable use of biodiversity, and the need to strengthen their knowledge, technologies*, practices and innovations to continue supporting the biodiversity of the world (para 97)
>
> *Enhancing the use of the traditional, scientific, technical and technological knowledge of indigenous peoples and local communities*
>
> Given the unique challenges associated with the use of traditional knowledge, *more work should be done to identify effective ways of including that information* … Training activities could be organized prior to workshops at the relevant scale, *targeting both representatives and experts from indigenous peoples and local communities as well as from scientific institutions*. (Annex II para 1.5)

However, ecofeminists argue that as the institution and practices of science, technology and economics are distinctly gendered, this can exclude 'non-expert', embodied and lived experiences from having the same recognition and authority as 'professional experts'.[150] One of the key features in these documents is the way in which they assign environmental problems to 'professional experts' who maintain 'technical authority' when 'negotiating environmental risks'.[151] While there are references to the value of women and indigenous knowledge and technologies in the documents, it may not have the same weight as Western scientific findings. Therefore, encouraging cooperation between these elite actors and more marginalised communities may in fact reinforce dominant discourse that environmental problems are purely technical in content, and silence alternative understandings.

This analysis indicates that states have been transformed into brokers who encourage cooperation through different modes, including state-led regulation, developing different

[148] *Convention on Biological Diversity (1992),* art 8(j).
[149] *Convention on Biological Diversity (1992),* art 18(4).
[150] Code, *Ecological Thinking*; Curtain, "Women's Knowledge."; Lee, "Ecofeminist Perspectives."; Morrow, "Ecofeminism."; Faulkner, "The Technology Question."
[151] Mason, *Environmental Democracy*, 25.

market mechanisms, facilitating market shifts, and incentivising technological innovation. However, this focus on the use of technology to support cooperation and increase the benefits for development must also consider the way in which technology can 'embody specific forms of power and authority'.[152] Technology can act as a conduit for re-colonisation practices because it is positioned as the engine for modernisation and development.[153] This is because it has been an 'intimate and inextricable part of the colonial machinery' and 'colonial ontologies have been "rephrased" within the technoscientific frameworks of globalisation'.[154] Therefore, colonial histories and their contemporary legacies should be taken into account in negotiations relating to technology transfer and the potential for reaffirming hierarchies of power and knowledge.[155]

There are multiple ways in which the biodiversity regime has referred to technology to facilitate greater cooperation between states and non-state actors. This approach incorporates EM strategies which view technology and technological innovation as the solution to environmental problems. Greater cooperation and collaboration between States not only enables greater innovation but also ensures that developing countries will benefit from such cooperation and by extension, benefit from their participation in the biodiversity regime itself.

Technology and 'making a difference'

The connection between technology and 'making a difference' is another feature of the underlying commitment to progress and modernisation in EMT. 'Making a difference' is constructed in two ways in the documents: making a difference to ecosystems through

[152] Winner, "Do Artifacts Have Politics?," 121.
[153] Harding, "Postcolonial and Feminist Philosophies," 412.
[154] Pollock and Subramaniam, "Resisting Power," 957.
[155] Harding, "Postcolonial and Feminist Philosophies."; Harding, *Is Science Multicultural*; Lee, "Ecofeminist Perspectives."; Pollock and Subramaniam, "Resisting Power."; Foster, "Decolonizing Patent Law."; Seth, "Putting Knowledge in its Place."

restoration and conservation; and making a difference to human well-being by adding value to, or receiving other benefits from genetic resources, ecosystem functions, and ecosystem services.

These two approaches associate technological innovation with making a positive difference to ecological systems and humanity. The CBD preamble acknowledges that

> '[T]he provision of new and additional financial resources and appropriate access to relevant technologies *can be expected to make a substantial difference in the world's ability to address the loss of biological diversity* (CBD, preamble para 15)

This 'substantial difference' is used to support the transfer and provision of new and existing technologies to developing countries. Similarly, the Nagoya Protocol recognises how technology transfer can add value to genetic resources in developing countries.[156] The positive association between 'difference' and monetary or human-centred benefit through technological innovation is a feature of EM discourses. The presence of these provisions highlights the way in which the regime uncritically embeds the assumption that technology is a self-evident good which adds value to inert materials, such as genetic resources. Not only does this reaffirm that 'benefit' is primarily understood in term of monetary value, it also maintains the dominant view that nature (and its associated 'others') is inert and in need of transformation.

The connection between technological innovation and difference is also embedded in provisions concerning the role of technology in facilitating developing in developing countries. This is seen in the Nagoya Protocol which appears to conflate SD and EM where it explicitly adopts a strategy of building research and innovation capacities to add value to genetic resources. The preamble recognises

> [T]he important contribution to sustainable development made by technology transfer and cooperation to build research and innovation capacities for *adding value to genetic resources in developing countries*, in accordance with Articles 16 and 19 of the Convention, (para 5)

[156] *Nagoya Protocol (2010),* preamble para 5.

This paragraph merges technology transfer and innovation with adding value to nature-derived resources, thus revealing the deep-seated view of the environment as a resource which is deeply embedded within Western philosophical traditions and is central to weak EM discourses. This view of nature is also contained in operational provisions of the Protocol, particularly in terms of technology transfer, collaboration and co-operation.[157] The presence of this theme in the documents suggests that the biodiversity regime has incorporated EM discourses of technology.

This uncritically positive view of technology is reaffirmed in the COP Decisions. Decisions concerning cold-water ecosystems and synthetic biology portray technological innovation as a self-evident good which can solve existing barriers in attaining the objectives of the biodiversity regime.[158] Therefore, they promote the role of technology as having a key part in making a positive difference to biodiversity loss, conservation and the sustainable use of biological resources.

Obtaining benefit through increasing biological productivity

The biodiversity regime promotes the role of technology in restoring damaged ecosystems and to improve ecosystem productivity for human well-being. This is evident in the international agreements and COP/MOP Decisions which include statements supporting the role of technology to restore ecosystems and, more importantly, their productivity:

> *Encourages* Parties and *invites* other Governments to promote and support ...sustainable agricultural production, that may include increases in productivity based on the sustainable management of ecosystem services and functions, diversification of agriculture, agro-ecological approaches … (CBD COP Decision XIII/3, para 30)
>
> *Recognizing* the importance of genetic resources to food security, public health, biodiversity conservation, and the mitigation of and adaptation to climate change, (Nagoya Protocol, preamble para 14)

[157] *Nagoya Protocol (2010),* art 23.
[158] CBD, Decision XIII/5 2016, Annex para 14.10; see also CBD, Decision XIII/23 2016; CBD, Decision XIII/11 2016; CBD, Decision XIII/17 2016.

> *Recognizing* the special nature of agricultural biodiversity, its distinctive features and problems needing distinctive solutions (Nagoya Protocol, preamble para 15)
>
> In support of the implementation of this Protocol, capacity-building and development may address, *inter alia*, the following key areas:
>
> …
>
> (d) Capacity of countries to develop their endogenous research capabilities to add value to their own genetic resources (Nagoya Protocol, Article 22(4)(d)).

These excerpts reveal an expectation that technology makes a positive difference to human well-being by shaping and improving the nonhuman environment. In these excerpts, technology is used in two ways: first to derive value from genetic resources for human benefit, and second to increase the productivity of ecosystem functions and services to improve agricultural output.

Such practices are known to destabilise and undermine the lives of women by transforming traditional practices, products and processes into commodities.[159] As a result they can threaten the resources of indigenous peoples and vulnerable groups, and cause conflicts within communities.[160] Where development agendas are informed by the potential of technology to increase ecological production, technology can also lead to 'maldevelopment' or 'de-development', thus increasing the vulnerability of already marginalised communities.[161] Therefore, not only do these provisions highlight an anthropocentric understanding of the role of technology to improve productivity, they also incorporate a gendered and exploitative understanding as well.

Adopting an anthropocentric perspective of 'benefit'

The provisions relating to technology in the biodiversity regime reflect characteristics of dualism that systematically and pervasively construct the 'other' – in this case, the nonhuman environment – as inferior. These characteristics are incorporated in the provisions relating to role of the environment as a provider of genetic resources and services. By reframing the

[159] Braidotti et al., *Women, the Environment*.
[160] Foster, "Decolonizing Patent Law."
[161] Braidotti et al., *Women, the Environment*; Harding, "Postcolonial and Feminist Philosophies."; Shiva, "Bioprospecting."

nonhuman environment as an object or entity that technology can 'improve', these documents define the needs of the environment in terms of the needs of humanity. They radically exclude and instrumentalise the non-human environment therefore legitimising the exploitation and manipulation of the environment for human benefit. In this way, the environment is objectified and 'its ends are defined in terms of the master's ends'.[162] This demonstrates the anthropocentric foundation of the biodiversity regime and that the provisions relating to technology approach 'making a difference' from a purely human-centric perspective.

This human-centric perspective is contained in both the international agreements and COP Decisions. Both types of documents incorporate the narrative that technology is necessary to improve ecological productivity to ensure human well-being. This narrative is embedded in the preamble of the Cartagena Protocol, the operational parts of the Nagoya Protocol, and in subsequent COP Decisions:

> Recognizing that modern biotechnology has great potential for human well-being if developed and used with adequate safety measures for the environment and human health (Cartagena Protocol 2000, preamble para 6)
>
> In support of the implementation of this Protocol, capacity-building and development may address, *inter alia*, the following key areas:
>
> …
>
> > Capacity of countries to develop their endogenous research capabilities to add value to their own genetic resources. (Nagoya Protocol, Article 22(4)(d))
>
> Building the capacity of Parties to develop their *endogenous research capabilities to add value to their own genetic resources* and traditional knowledge associated with genetic resources through, inter alia, technology transfer; bioprospecting and associated research and taxonomic studies; and the development and use of valuation methods (COP Decision XIII/21, para 23(d))

In these documents, technology is promoted as a solution for existing or future damage to the environment. Implicit in this promotion is a worldview where human and nature are separate and different. Humanity is cast as superior which legitimises framing the environment

[162] Plumwood, *Feminism and Mastery*, 53.

in a server or provider role, as well as its manipulation through technology for the benefit of humanity.

These examples reflect an anthropocentric perspective of benefit. They identify technological innovation as the solution to the drivers of environmental degradation and security as it enables humanity to maximise environmental resources for their benefit. They justify environmental protection in terms of likely human benefit by increasing productivity and security.[163] Therefore, they incorporate the dualist characteristic of radical exclusion which occurs where the centre – in this case humanity – 'tries to magnify, to emphasise and to maximise the number and importance of differences and to eliminate or treat as inessential shared equalities'.[164] They demonstrate this by positively connecting technological innovation with making a difference to human lives.

In addition, these documents also obfuscate the gendered nature of such technologies. Biotechnology, for example, is woven into development projects and, as a result, has had profound consequences on the lives of rural women and communities.[165] This is because they can produce and preproduce unequal gender relations amongst communities into which they are imported.[166] The uncritical narrative within these documents not only views nonhuman nature as inert and in need of transformation, they also risk viewing women as 'productive engines to society and … profitable clients to any public or private sector developer.'[167] Therefore, they continue to perpetuate dominant understanding of the relationship between technology, gender, development and the environment within the biodiversity regime.

[163] Lacy, *Security and Climate Change*, 86.
[164] Plumwood, *Feminism and Mastery*, 49.
[165] see e.g. Aistara, "Seeds of Kin."; Gonda, "Climate Change, "Technology" and Gender."; Ezezika, Deadman, and Daar, "She Came, She Saw."; Gonda, "Revealing the Patriarchal Sides."
[166] Gonda, "Climate Change, "Technology" and Gender," 151.
[167] Falck-Zepeda, Zambrano, and Biermayr-Jenzano, *Gender Impacts*, 5.

This section has examined the two interrelated themes that associate technology with making a difference and as a mechanism for cooperation. The analysis found that technology is used as a mechanism to facilitate greater cooperation and participation from multiple state and non-state actors, by developing the closer relationships and partnerships needed to support innovation. This is a known strategy of EM as it encourages cooperation between different state and non-state actors in different societal institutions, such as the global market, private sector and industry. As such, it reflects the continued commitment to progress and modernisation embedded within EM.

Implicit in this strategy for cooperation is the belief that technology makes a difference by improving the ecological foundation of human society and for human well-being more directly. The analysis has found that technology is portrayed as one of the main vehicles through which to achieve progress in the biodiversity regime. This was demonstrated by the affirmation of technological innovation as one main vehicle to achieve progress by enabling ecosystem restoration, modification or conservation for human benefit. This approach towards understanding 'difference' highlights the close relationship between technology, making progress, and anthropocentrism in EM. This, in turn, has been incorporated within the biodiversity regime. It indicates that that 'difference' within the biodiversity regime is directly connected to two underlying concepts of EM: the optimistic view of technology as a problem solver, and as a mechanism to mitigate environmental damage from economic growth. Underlying both these concepts is the separation and desembedding of humanity from the ecological planet.

Increasing the productivity and value of the environment

The language contained in the COP Decisions incorporates a connection between technology, improving ecosystems and obtaining value from nonhuman nature. This indicates

that the documents associate technology with improving and adding value to the nonhuman environment by increasing its productivity.

Decision XIII/3 and Decision XIII/5 both seek to promote the productivity of land and enhance ecosystem services and functions. Decision XIII/3 encourages Parties to develop policy frameworks that

> …promote sustainable increases in the productivity and diversification of production of existing agricultural land and rangeland while enhancing ecosystem services and functions, including those services and functions that contribute to agricultural production (such as pollination, pest control, water provision and erosion control) (para 28)

Decision XIII/5 invites States to consider the following actions and undertake them if appropriate.[168] Decision XIII/22 states that messages should 'clearly show the linkages between diversity and other sustainable development issues',[169] particularly that 'biodiversity, environmental functions and ecosystem services contribute directly to human well-being and development priorities'.[170] The language used in these decisions frames the environment as a separate and distinct entity which can be improved to become more productive through technological innovation. While these terms are not explicitly incorporated within the decisions, they manifest themselves in the language of 'sustainable intensification'[171] of agriculture contained in the Decision.

Sustainable intensification refers to increasing the productivity of agriculture in a sustainable manner by employing technological innovations and technical efficiencies to ensure that agriculture yields can increase with less impact on the natural environment.[172] Strategies include the use of biotechnology, the development of 'smarter' pesticides and fertilizers, and the development of technology to enable more intensive and efficient agriculture

[168] CBD, Decision XIII/5 2016, Annex para 15(2).
[169] CBD, Decision XIII/22 2016, para 28.
[170] CBD, Decision XIII/22 2016, para 28(b).
[171] Mahon et al., "Sustainable Intensification," 74.
[172] Cook, Silici, and Adolph, *Sustainable Intensification,* 1.

in smaller land areas.[173] These approaches create technology-led solutions for food security and causes the negative impact of agricultural practices on the environment. This approach adopts EM strategies to respond to these concerns by focusing on improving efficiencies through technological innovation.

Inherent in this approach is the belief that technology can derive 'value' from the environment. This reinforces the view of the environment as valueless until manipulated for human benefit. This view is embedded in the international agreements and the COP Decisions:

> Aware that conservation and sustainable use of biological diversity is of critical importance for meeting the food, health and other needs of the growing world population, for which purpose access to and sharing of both genetic resources and technologies are essential (CBD, preamble para 20)
>
> Recognizing that modern biotechnology has great potential for human well-being if developed and used with adequate safety measures for the environment and human health (Cartagena Protocol, preamble para 6)
>
> Recognizing the importance of genetic resources to food security, public health, biodiversity conservation, and the mitigation of and adaptation to climate change (Nagoya Protocol, preamble para 14)
>
> *[Recognising] the role of forest biodiversity for the maintenance of ecosystem services and functions that contribute to sustainable development, poverty eradication and human well-being*, including through the provision of food, feed, water, wood, fibre, fuel, medicine, recreation, as well as the mitigation of and adaptation to climate change (COP Decision XIII/3, para 42)

These excerpts demonstrate a relational understanding of 'value' between humanity and nonhuman nature, wherein nature is defined in relation to human needs. In the CBD, genetic resources and related technologies are deemed 'essential' to meet the needs of humanity and the Protocols similarly recognise the role of nonhuman nature and technology for human security.

This relational understanding of nonhuman nature is reinforced by the definitions of biodiversity in the agreements. The CBD defines 'biological resources' as 'genetic resources, organisms … ecosystems with actual or potential use or value for humanity' and genetic resources are defined as 'genetic material of actual or potential value'[174] These definitions

[173] Diamond Collins and Chandrasekaran, *A Wolf In Sheep's Clothing*.
[174] *Convention on Biological Diversity (1992),* art 2(2), art 2(10).

indicate that ‘value’ is determined in relation to humanity, thus reinforcing the anthropocentric nature of the biodiversity regime.

The Nagoya Protocol also recognises the ‘important contribution’ made by technology transfer ‘for adding value to genetic resources’[175] and that the ‘economic value of ecosystems and biodiversity’ are ‘key incentives for the conservation of biological diversity and the sustainable use of its components’.[176] This presents technology as a mechanism to optimise or improve efficiencies in using the environment. Therefore, the value of the environment is defined in relation to human benefit.

The assumption that technology confers value to the nonhuman environment is deeply embedded in weak EMT. This theory takes a purely instrumental view of ‘value’ based upon an understanding of the environment as the resource base for ‘free market capitalism’.[177] Therefore, this discourse disassociates and disembeds humanity from the environment thus legitimising its exploitation and manipulation.

EM strategies that emphasise the need to increase the productivity of the environment to derive value for human benefit embed value dualisms that reinforce the separation between the human and nonhuman environment. By defining value in terms of human benefit, these references incorporate an objectified view of the environment as they approach the conservation of the environment as a means to an end, and they regard technological innovation as the mechanism to achieve it. The emphasis on increasing the productivity and efficiency of the environment epitomises this objectified view of the environment because it considers that the needs of the environment are defined in terms of human needs.

[175] *Nagoya Protocol (2010),* preamble para 5.
[176] *Nagoya Protocol (2010),* preamble para 6.
[177] Mol and Spaargaren, "Ecological Modernisation Theory," 22.

The references to the environment reduce 'complex ecological systems into discrete components that can be commoditised and utilised for the purpose of economic growth and social development'.[178] Technology is identified as the tool to derive that value, by manipulating or changing the environment into something that can be used, consumed or sold. In this way, the biodiversity regime incorporates the value dualism of relational definition which reinforces the separation of humanity from the nonhuman environment.

Materialist ecofeminists argue that this is indicative of how humanity has attempted to separate itself from nature through productive systems which legitimises the transformation of nature into profit through technological processes that erode and pollute it.[179] This encapsulates EMT's connection between technology and the environment, whereby technology improves the productivity of the nonhuman environment by improving the efficiency by which natural resources, and ecosystem services and functions can be used for human benefit.

Conclusion

This article analysed the references to technology contained in the CBD, Nagoya Protocol, and Cartagena Protocol, and the 2016 COP/MP Decisions. The analysis found that weak EM commitments to technological innovation are embedded in objectives of the biodiversity regime. This has implications for the future evolution of the biodiversity regime because this form of EM uses technological innovation to maintain the status quo. This means it does not question the underlying conceptual framework that legitimises 'efficient' harm to the environment. Instead, it remains committed to modernisation and progress based on the production and consumption of natural resources.

[178] Wilkinson Cross, "The Environment as Commodity," 239.
[179] Merchant, "Ecofeminism," 103; Mellor, *Feminism & Ecology*, 62; Wilkinson Cross, "The Environment as Commodity," 189; Wilkinson, "Is this the Future We Want."

This is demonstrated by the continued commitment to the overarching project of modernisation through efficient industrialisation and technological innovation in the biodiversity regime. While the documents support the pursuit of sustainable development, the strategies introduce weak EMT therefore suggesting that EM has pervasively influenced the understanding of 'sustainable' and 'development' in the context of the biodiversity regime.

Ecofeminists criticise interpretations of 'progress' and 'modernisation' in weak EM that disembeds humanity from nonhuman nature. They argue that it maintains a mechanistic worldview which reduces non-human nature into constituent elements to be reshaped and modified into something of economic value. Instead, society and human institutions should recognise the immanence of humanity and take account of natural limits, conditions and uncertainties. Disembedding and transcending ecological systems in the name of progress marginalises women's embodied work and enables 'dominant groups to live as if they were not embodied and embedded within a limited nature'.[180]

The inclusion of weak EM in the provisions relating to technology and technological innovation indicates that the biodiversity regime has adopted a strategy of maintaining the status quo. This may not have been a conscious decision. EM strategies adopt an explicitly optimistic worldview and have been effective in highly industrialised and developed countries to mitigate and counteract environmental problems by continuing to do what we do, but better and with more efficiencies. As such, they are highly persuasive and mobilise many states in support.

Nevertheless, such technocentric solutions do not create a space where truly alternative approaches to biodiversity loss may occur. Ecofeminists and other critical scholars point to flawed assumptions that inform EM which reinforce dualisms between humanity and

[180] Mellor, "Ecofeminist Economics," 125.

nonhuman nature, legitimising the exploitation and subordination of the environment. Mapped onto these dualisms are societal institutions that reinforce the separation between humanity and nonhuman nature by disembedding humanity from its material existence through the mode of production. These actions are visible in the biodiversity regime because it casts technological innovation as central pillar in the regime and its strategy to fulfil its obligations.

Therefore, the unwillingness to start conversations about structural inequalities between advanced and developing countries, or the fundamental values that inform the biodiversity regime, may not be a conscious decision. However, until we acknowledge that such strategies are informed by techno-optimistic visions of the future, and are shaped by a fundamentally unequal and exploitative conceptual framework, it may not be possible to consider any more revisions to the societal institutions that shape, inform and have an impact on the success of international environmental regimes.

International agreements and COP Decisions

Cartagena Protocol on Biosafety, 29 January 2000, 226 UNTS 208.

Decision XIII/3, Strategic actions to enhance the implementation of the Strategic Plan for Biodiversity 2011-2020 and the achievement of the Aichi Biodiversity Targets, including with respect to mainstreaming and the integration of biodiversity within and across sectors. 12 December 2016, CBD/COP/DEC/XIII/3. https://www.cbd.int/decisions/cop/13/3.

Decision XIII/5, Ecosystem Restoration: Short-Term Action Plan. 10 December 2016, CBD/COP/DEC/XIII/5. https://www.cbd.int/decisions/cop/13/5.

Decision XIII/11, Voluntary Specific Workplan on Biodiversity in Cold-Water Areas within the Jurisdictional Scope of the Convention. 10 December 2010, CBD/COP/DEC/XIII/11. https://www.cbd.int/decisions/cop/13/11.

Decision XIII/12, Marine and Coastal Biodiversity: Ecologically or Biologically Significant Marine Areas. 17 December 2016, CBD/COP/DEC/XIII/12. https://www.cbd.int/decisions/cop/13/12.

Decision XIII/17, Synthetic Biology. 16 December 2016, CBD/COP/DEC/XIII/17. https://www.cbd.int/decisions/cop/13/17.

Decision XIII/22, Framework for a Communication Strategy. 13 December 2016, CBD/COP/DEC/XIII/22. https://www.cbd.int/decisions/cop/13/22.

Decision XIII/23, Capacity-Building, Technical and Scientific Cooperation, Technology Transfer and the Clearing-House Mechanism. 16 December 2016, CBD/COP/DEC/XIII/23. https://www.cbd.int/decisions/cop/13/23.
Decision XIII/24, Cooperation With Other Conventions And International Organizations. 16 December 2016, CBD/COP/DEC/XIII/24. https://www.cbd.int/decisions/cop/13/24.
Convention on Biological Diversity, 5 June 1992, 1760 UNTS 79.
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UN General Assembly. Resolution 70/1. A/RES/70/1, (25 September 2015), http://undocs.org/en/a/res/70/1.
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