K4DD Knowledge for Development and Diplomacy

How women's empowerment contributes to climate change and natural resource management outcomes

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What is the evidence that women's political, economic, and social empowerment has contributed to action and outcomes for climate change and natural resource management?

Contents

1. Summary

There is significant evidence in the literature that women's empowerment in the following domains has had positive outcomes for action on climate change and/or for sustainable natural resource management.

- **Political representation in parliaments and governments:** An increase in the proportion of women in parliaments and governments has been associated with stricter climate change policies, lower national CO_2 emissions, greater renewable energy consumption, greater protection of land areas, and reduced deforestation.
- **Political empowerment in society:** Women's political empowerment in society has been associated with positive environmental outcomes including reduced vulnerability to climate change, lower rates of deforestation, and lower CO_2 emissions per capita.
- **Gender equality:** Women's empowerment as measured by broad indexes of gender equality has been linked with reductions in CO_2 emissions, decoupling of economic growth and CO_2 emissions, and better scores on broader environmental performance indicators.
- **Education and resilience to natural hazards:** There is strong evidence that education helps reduce vulnerability and increase adaptive capacity before, during, and after natural disasters.
- **Social protection** programmes have good potential to support resilience to climate change risks and environmental shocks and can support broader environmental outcomes when benefits are conditional on adopting improved environmental practices (payments for ecosystem services).
- **Sexual and reproductive health and rights (SRHR)** supports resilience to climate change and environmental shocks and is particularly effective in supporting positive environmental outcomes within the context of integrated population, health, and environment (PHE) initiatives.
- **Corporate leadership:** Many studies have found links between women's presence on corporate boards of directors and in upper management, and positive environmental outcomes. Gender diversity at the corporate board level has been found to improve corporate governance and decision-making. Many studies have found that a 'critical mass' of at least two to three women, or 30% to 35% women within a group, is necessary for effects on corporate decision-making to become apparent.
- **Water resource management:** There is significant evidence that women's participation in water resource management increases project effectiveness, efficiency, performance, and the likelihood of sustainability.
- **Land tenure:** There is significant evidence that ensuring women's access to and control of land incentivises and supports sustainable land management practices, and increases resilience and capacity to cope with environmental shocks.
- **Resilience to natural hazards:** Women's empowerment, leadership, and participation, as well as girls' education, contribute strongly to emergency

preparedness, risk reduction and humanitarian response related to natural hazards induced by climate change. Nature-based solutions are often cost-effective approaches to increasing resilience.

There is also evidence about other pathways linking women's empowerment and environmental outcomes, but the evidence in these areas is more limited:

- **Education** is widely believed to have a role in addressing environmental challenges including climate change, and in supporting sustainable development, but the evidence base for how this is achieved is weak except in relation to resilience to natural hazards. Education may also be positively associated with concern for the environment and with environmental behaviour change, but evidence specifically related to low-income countries or to women and girls is limited.
- **Education** of girls and women is linked with slower population growth, which could potentially reduce future greenhouse gas emissions and natural resource use, although empirical evidence on this point is weak and some ethical challenges exist.
- **Education** could also lead to *increased* greenhouse gas emissions through faster economic growth, increased consumption, urbanisation, and an ageing population.
- **Social protection** programmes may be able to contribute to positive environmental outcomes in a broad sense, but evidence on this is limited.
- **Sexual and reproductive health and rights (SRHR)** may contribute to positive environmental outcomes by reducing population growth rates, but the evidence for this is weak and ethical challenges have been raised.
- **Gender-based violence** gender-based violence is a systemic barrier to women's empowerment across all of the domains discussed in this report, but evidence that demonstrates women's empowerment and reductions in gender-based violence with clear links to outcomes for climate action or natural resource management is limited.
- **Community forest management:** Women's inclusion in community forest management groups can improve sustainable management of forest resources, but the evidence is limited, especially outside South Asia.
- **Community fisheries management:** Increasing women's participation in small-scale fisheries management has led to positive outcomes when gender norms are overcome and enabling conditions are met, but the evidence linking empowerment and conservation outcomes is limited.
- **Climate-smart agriculture:** Women are receptive to adopting climate-smart agricultural practices, but there is limited evidence linking women's empowerment with environmental outcomes that derive from these practices. Most of the evidence related to these initiatives focuses on food production and is often gender blind.
- **Green employment and entrepreneurship:** Women have advantages compared with men in some green employment and entrepreneurship sectors, and have demonstrated success in building livelihoods, but there appears to be limited evidence available about environmental outcomes that may result.
- **Illegal wildlife trade:** Women participate in law enforcement work to a limited extent, and there are numerous community-based initiatives such as alternative livelihoods

programmes aimed at reducing illegal wildlife trade, but evidence of the conservation outcomes arising from these activities is limited.

There is significant evidence that broadly speaking, women tend to be more concerned than men about environmental problems, more knowledgeable about climate change, perceive greater risks from environmental problems, and have more positive attitudes towards taking action on climate change and on environmental issues. These differences in environmental attitudes between women and men are likely a consequence of prevailing social norms around gender.

This report is not a systematic review and cannot provide a complete assessment of the evidence available on each of the topics discussed. Within the time available, only a small selection of the available literature on each aspect of women's empowerment and environmental outcomes could be examined. Disability issues were very rarely addressed in the literature examined, and in the time available it was not possible to search specifically for information on disability.

2. Political empowerment

2.1. Representation in parliaments and governments

An increase in the proportion of women in parliaments and governments has been associated with stricter climate change policies, lower national CO_2 emissions, greater renewable energy consumption, greater protection of land areas, and reduced deforestation. Most of this evidence comes from statistical analysis of global datasets. Examples of observed outcomes include:

- A 10 percentage point increase in the proportion of women in parliament was associated with an increase of 10 percentage points in the strictness of climate change policies, as measured by the Climate Laws, Institutions and Measures Index (CLIMI), and with a decrease in CO_2 emissions of 0.24 metric tonnes per capita, in a statistical analysis that covered 91 countries between 2005-2016 (Mavisakalyan & Tarverdi, 2019).
- An increase in the proportion of women in parliament was associated with greater renewable energy consumption in higher- and middle-income countries (GDP per capita about $3000), although the association was negative in low-income countries (100 countries between 1997 and 2017) (Salamon, 2023).
- Countries with a higher proportion of women in parliament and/or women in ministerial government positions tend to designate more protected land area per capita (90 countries, 2001-2004) (Nugent & Shandra, 2009).
- A higher proportion of women in parliament contributes to increased forest cover (reduced deforestation) when the proportion of female legislators exceeds 38% (177 countries, 1990-2015) (Salahodjaev & Jarilkapova, 2020).

2.2. Political empowerment in society

Women's political empowerment in society has been associated with positive environmental outcomes including reduced vulnerability to climate change, lower rates of deforestation, and lower CO_2 emissions per capita. Examples include:

- Women's political empowerment (measured by the Varieties of Democracy (V-Dem) dataset, comprised of indicators of women's civil liberties, civil society participation, and political participation) was found to reduce vulnerability to climate change (a country's exposure, sensitivity and capacity to adapt to the negative effects of climate change, as measured by the Notre Dame Global Adaptation Initiative). The most important mechanisms through which women's political empowerment reduces vulnerability to climate change are education, public spending on education, and the effectiveness of governance. The effect is strongest in upper middle income countries, followed by low income countries, high income countries and lower middle income countries (169 countries, 1995-2017) (Asongu et al., 2021).
- Higher levels of women's NGOs (and environmental NGOs) per capita are associated with lower rates of deforestation (61 countries, 1990-2005) (Shandra et al., 2008).
- Countries with higher levels of women's political status, measured by the proportion of seats in parliament held by women, the number of years women have had the right to vote, and the proportion of women in ministerial positions in government, tend to have lower CO_2 emissions per capita (91 to 103 countries in 2001-2004) (Ergas & York, 2012, p. 974).

3. Social empowerment

3.1. Gender equality

Women's empowerment as measured by broad indexes of gender equality has been linked with reductions in CO_2 emissions, decoupling of economic growth and CO_2 emissions, and better scores on broader environmental performance indicators.

Examples include:

- Women's political empowerment as measured by an index combining political participation, civil liberties and civil society participation is associated with long-term reductions in CO_2 emissions in a cross-country statistical analysis of 72 countries spanning 1971-2012 (Lv & Deng, 2019).
- In countries with greater gender equality as measured by the United Nations Development Programme (UNDP) Gender Inequality Index, GII (which covers reproductive health, empowerment, and the labour market), the association between GDP per capita and CO_2 emissions per capita is much lower than in countries with more inequality – that is, growth and emissions become decoupled (140 countries, 1995-2014) (McGee et al., 2020).

- Greater gender equality as measured by both the Gender Inequality Index (GII) and the Global Gender Gap Index (GGGI) was associated with better scores on the Environmental Performance Index, including indicators on climate change and greenhouse gas emissions per capita. These correlations are strong for both measures of gender equality in high- and higher-middle income countries, significant for the GII but not the GGGI in lower-middle income countries, and not significant for low-income countries, although the latter category also suffers from a shortage of data. No decoupling of growth and emissions was observed (142 countries, 2010-2020) (Rainard et al., 2023).

3.2. Education

Education is widely believed to have a role in addressing environmental challenges, including climate change, and in supporting sustainable development (Bangay, 2022, p. 15; Pankhurst, 2022, p. 5). Education helps people understand environmental problems and their consequences and understand the actions required to address them (UNESCO, 2016, p. 24). However, 'the evidence base for how this is to be achieved is weak as yet… there is still some way to go in determining the causal chains by which education systems bring about the expected positive change' (Bangay, 2022, p. 15; see also Pankhurst, 2022, p. 7). Some authors warn against focusing too narrowly on outcomes that education might produce for climate change or other goals as a harmful 'instrumentalist' approach, arguing that education must be valued as a right and as an intrinsic good, and noting that its benefits will only be realised in conjunction with other social and economic changes such as gender equality and women's legal and economic empowerment (Pankhurst, 2022, pp. 34–38).

There is some evidence that education is positively associated with concern for the environment and with environmental behaviour change, but evidence specifically related to low-income countries or to women and girls is limited. It is widely asserted that education contributes to making people 'more inclined to change behaviour around environmental issues' (UNESCO, 2016, p. 24) and many studies find an association between higher education levels and concern for the environment (Meyer, 2015, p. 108). For example, a study using data from 29 countries (mostly middle- and higher-income) between 1993 and 2010 found that education levels were linked with levels of environmental concern and that this effect went beyond simply equipping individuals with knowledge of environmental issues; the effect was most consistent in European countries, and less likely to be found in countries outside Europe and in lower-income countries (Clery & Rhead, 2013, p. 23). Another study drawing on data from 14 European countries in 2007 and 2011 found 'a substantial causal effect' of educational attainment on pro-environmental behaviour and suggested that education may make individuals more aware of the external effects of their behaviour and more concerned with social welfare (Meyer, 2015, p. 116). However, this effect is not necessarily uniform: 'some studies find no evidence of an association or even that education is negatively associated with pro-environmental attitudes or behavior' (Meyer, 2015, p. 109). One comprehensive literature review on girls' education and climate change found only limited evidence of a relationship between education and environmental concern and behaviour (Pankhurst, 2022, p. 33).

There is strong evidence that education helps reduce vulnerability and increase adaptive capacity before, during, and after natural disasters. A recent systematic review found that girls' education has a clear and strong role in reducing vulnerability to disasters and improving resilience and adaptability (Pankhurst, 2022, p. 40). One statistical analysis spanning 125 countries from 1980 to 2010 found that 'education (and in particular female education) is the single most important social and economic factor associated with a reduction in vulnerability to natural disasters' (Striessnig et al., 2013, p. 5). Another analysis across 167 countries between 1970 and 2010 found that female education was strongly associated with a reduction in disaster fatalities, and was more significant than household income or GDP per capita (Lutz et al., 2014, pp. 1061–1062). A third analysis of data from 162 countries found a strong positive association between the average number of years of schooling that a girl receives and her country's score on the ND-GAIN index, a measure of resilience to climate-related disasters (Kwauk and Braga, 2017, cited in Price, 2020, p. 19). Education reduces vulnerability directly by improving cognitive skills, problem-solving skills, knowledge, and risk perception, and indirectly through poverty reduction, increasing access to information, and strengthening social capital (Muttarak & Lutz, 2014, p. 2). More educated households and populations tend to undertake more risk reduction and preparedness efforts, suffer less harm to people and property, and cope better with loss and psychological impacts (Lutz et al., 2014, p. 1062).

Education of girls and women is linked with slower population growth, which could potentially reduce future greenhouse gas emissions and natural resource use, although empirical evidence on this point is weak and some ethical challenges exist. Education, especially of girls and women, is the most effective means of slowing population growth (UNESCO, 2016, p. 24). It is widely argued that measures to slow population growth (including women's empowerment, girls' education, and family planning and reproductive health services) are likely to be beneficial in reducing the impacts of climate change, and that improving access to and quality of girls' education is one of the most cost-effective strategies for climate change adaptation and mitigation, alongside and complementary to family planning (Price, 2020, pp. 2, 12–13). However, empirical evidence about the impact of girls' education on reduced CO_2 emissions through reduced fertility is weak or mixed (Pankhurst, 2022, pp. 29–31). Some estimates suggest that achieving universal education for girls could reduce global population in 2050 by 1.5 billion compared with current trends, with attendant reductions in greenhouse gas emissions (Lutz, Butz, and Samir, 2014, cited in Pankhurst, 2022, p. 8). Project Drawdown, a US-based non-profit organisation, has suggested that a global programme to achieve universal education and access to family planning costing USD 409 billion per year could lead to an 8.4% decrease in future global population levels and a cumulative reduction of almost 70 gigatons of greenhouse gas emissions (Namasivayam et al., 2022, p. 5). Interventions targeting population growth also raise ethical and social justice issues – see section 3.4 on sexual and reproductive rights and health in this report.

Conversely, girls' education could lead to increased greenhouse gas emissions through faster economic growth, increased consumption, urbanisation, and an ageing population (Pankhurst, 2022, p. 31). Higher educational attainment is broadly associated with higher labour productivity, economic growth, and emissions (O'Neill et al., 2020). Increased girls' education is positively correlated with per capita CO_2 emissions, and high-

income countries with higher levels of female education emit more carbon than average, possibly because education can contribute to higher incomes, more consumption, and a larger industrial workforce (Devonald et al., 2021).

3.3. Social protection

Social protection programmes have good potential to support resilience to climate risks and environmental shocks. Social protection improves resilience to climate-related shocks, supports inclusive disaster preparedness, can reduce reliance on negative coping strategies, addresses chronic poverty, helps mitigate barriers to economic participation, and has positive long-term effects on household productivity and labour market participation (Costella et al., 2021, p. 5; Livingstone & Jenkins, 2021, p. 26). In cases of extreme weather events, disasters, and ecosystem degradation, cash transfers can support poor households' income, consumption, and financial resources (Bagolle et al., 2023, p. 3). Social protection systems are seen as a useful mechanism for supporting resilience in many countries because they are existing programmes for aid delivery that operate continuously at a large scale, engage with vulnerable segments of the population, and typically have broad political support (Agrawal et al., 2019, pp. 1–2, 6, 26). On the other hand, a contrasting study that examined social protection and climate resilience across 122 countries concluded that most existing programmes only help households cope with short-term climate-related stresses, and do not support disaster preparedness or build long-term adaptive capacity (Bharadwaj, 2022, p. 3). Although there is literature on links between social protection and women's empowerment, the evidence dealing with links between social protection and climate resilience generally does not appear to also integrate women's empowerment as an issue.

Social protection programmes may be able to contribute to positive environmental outcomes in a broad sense, but evidence on this is limited. One way that social protection programmes can lead to positive environmental outcomes is by supporting poor and vulnerable households so that they can reduce exploitation of natural resources. Studies in Indonesia and Colombia found cash transfers to be associated with reductions in deforestation because cash and market-bought goods substituted for the use of forest resources during crises (Ferraro and Simorangkir, 2020, and Malerba, 2020, cited in Bagolle et al., 2023, p. 19). However, a study in Mexico found the reverse: cash transfers were linked with increased consumption of goods that required intensive land use which could incentivise deforestation (Alix-Garcia et al., 2013, cited in Bagolle et al., 2023, p. 19).

A more direct way to support environmental conservation and restoration is to make social protection benefits conditional on protecting or restoring ecosystems (payments for ecosystem services) (Agrawal et al., 2019, p. 18; Bagolle et al., 2023, pp. 19–20). In Brazil, for example, the Bolsa Floresta program made monthly payments to households in protected areas in the Amazon if they commit to limit deforestation and follow additional sustainable land use practices; the programme reduced deforestation by 10% and forest degradation by 11% (Cisneros et al., 2022). Another Brazilian programme, Bolsa Verde, provided cash transfers conditional on sustainable management and ecosystem conservation requirements; this was found to prevent 80,000 hectares of deforestation and 35 megatons of CO_2 emissions, although the reduction in deforestation was only observed in settled areas in Amazonia, and not in settlements outside Amazonia (which had smaller

forested areas) or in protected areas (where deforestation rates were already low) (Costedoat et al., 2022). In Ethiopia, the Productive Safety Net Programme provides pays recipients for working on land and water conservation and reforestation projects; this was found to increase tree coverage by 3.8% from 2005 to 2019 and capture 5.7 tonnes of CO2 per hectare per year (Hirvonen et al., 2022, and Györi et al., 2021, cited in Bagolle et al., 2023, p. 20).

3.4. Sexual and reproductive health and rights (SRHR)

Access to sexual and reproductive health and rights (SRHR) may contribute to positive environmental outcomes by reducing population growth rates, but evidence on this is mixed. High quality empirical evidence on the effectiveness of family planning and reproductive health initiatives on climate change and environmental sustainability is limited, and although there is literature on the theorised benefits and connections, there is no clear consensus in the literature (Engelman et al., 2016, p. 1; Price, 2020, p. 2). Many authors argue that access to SRHR contributes to reducing population growth rates, which in turn leads to reductions in greenhouse gas emissions, environmental degradation, pressure on the resource base, and the number of people exposed to climate hazards, although these effects interact in complex ways with other factors (Engelman et al., 2016, p. 1; Namasivayam et al., 2022; Mogelgaard and Patterson, 2018, cited in Price, 2020, pp. 20–22). Although industrialised countries have historically contributed most to greenhouse gas emissions, low- and middle- income countries experiencing both economic and population growth could contribute much more to future emissions (Price, 2020, p. 14). Other authors, however, suggest that fertility policy is not likely to have a large effect on carbon emissions because population levels respond slowly to changes in fertility, and the regions of the world that currently have high population growth rates have very low emissions per capita (Budolfson and Spears, 2020, cited in Price, 2020, p. 13). Fertility policies also have limited influence alongside many other factors such as education levels, economic growth, urbanisation, child mortality, cultural factors, and social norms on family size (Dodson, 2020, cited in Price, 2020, p. 6).

Interventions targeting population growth raise ethical and social justice issues and have been seen by some as blaming people in low-income countries for climate change when they bear very little responsibility for global greenhouse gas emissions (Devonald et al., 2021; Pankhurst, 2022, pp. 8–9; Price, 2020, pp. 3–4, 29–30). In practice, direct discussion of population growth is ‘generally excluded from the UNFCCC discourse… [and] considered taboo by the UN and development community’ (Price, 2020, pp. 29–30).

Access to SRHR may contribute more effectively to positive environmental outcomes in the context of integrated population, health, and environment (PHE) initiatives, but empirical evidence on this is limited (Engelman et al., 2016, pp. 2, 14). PHE approaches explicitly link efforts to improve environment and climate change adaptation with rights-based voluntary family planning and women’s health (Wedeman & Petruney, 2019, p. 2). Such projects have demonstrated environmental impacts including: reducing deforestation; improving the health of fisheries, corals, and mangroves; protecting wildlife and reducing human-wildlife conflict; adoption of sustainable agricultural practices; and increasing

women's participation in natural resource management (Lopez-Carr & Ervin, 2017, pp. 101–102; Wedeman & Petruney, 2019, p. 2; Yavinsky et al., 2015, pp. 14–17).

Access to SRHR supports resilience to climate change and environmental shocks. Improving access to SRHR supports climate change adaptation and resilience by: improving the health of women, children, and entire communities; strengthening health systems generally; strengthening women's networks; increasing women's range of opportunities, such as taking up and remaining in education, employment, or other livelihoods; increasing women's ability to participate in community affairs and politics; increasing women's incomes; and reducing family size and limiting household demands on resources (Mogelgaard and Patterson, 2018, cited in Price, 2020, pp. 22–23; Women Deliver, 2021, pp. 19–21). In Bangladesh, for example, a disaster risk management project that integrated women's forums to discuss and address reproductive health and pregnancy issues attributed much of its success to the leadership and capacities of women to respond when the area was hit by a cyclone (Varma, 2017, cited in Women Deliver, 2021, p. 20). Some authors also note that improved access to SRHR may contribute to lower population growth, which in turn tends to lessen exposure to and harm arising from environmental change, and enhance resilience to climate change and other environmental shocks (Engelman et al., 2016, p. 14; Dodson, 2020, cited in Price, 2020, p. 18).

3.5. Gender-based violence

Gender-based violence is 'devastatingly pervasive' (WHO, 2021) **and a systemic barrier to women's empowerment across all of the domains discussed in this report.** Gender-based violence stops women from exercising their rights over and use of resources. It is used to maintain power imbalances between women and men in households and in workplaces; maintain control over land, property, and natural resources; make women who gather natural resources insecure; secure the positions of environmental criminals; and discourage women from protecting natural resources against exploitation (Castañeda Camey et al., 2021, pp. 6–17). There is considerable literature on the links between gender-based violence and climate change and natural resource management, but the majority of the literature found in the course of preparing this report appears to document the extent and impacts of gender-based violence, call for preventing it, and discuss how climate change and environmental shocks exacerbate it; case studies that demonstrate reductions in gender-based violence with clear links to outcomes for climate action or natural resource management are rare.

Examples of interventions to increase women's empowerment and reduce gender-based violence that have produced positive outcomes for climate change action and sustainable natural resource management include:

- In Nepal, the Hariyo Ban programme undertakes biodiversity conservation, climate change adaptation and resilience-building work. Gender-based violence is a problem in the region, and women were vulnerable when patrolling forests, participating in meetings, speaking out about local leaders and holding positions thought by perpetrators that were deemed to be inappropriate. Programme implementers sought to increase women's participation in forest management, community decision-making

and livelihood activities, but understood that transformation in gender norms would require involving men. The programme developed a cadre of men champions among leaders and decision-makers to fight discrimination and gender-based violence, raised awareness on gender-based violence, gender equality, and social inclusion, and worked to change national policies. According to programme implementers, women's empowerment and capacity building has resulted in better practices in many community forests and has contributed to better environmental and sustainable development results (Castañeda Camey et al., 2020, p. 11)

- In Ecuador, the shrimp industry caused mangrove losses and disproportionately affected women who collected shellfish and crabs in the mangroves. The Foundation of Ecological Defense (Fundación de Defensa Ecológica – FUNDECOL) worked with the women to ensure their access to mangroves and to conserve the mangrove ecosystems. Initially, participating women faced violence within their households, but they gradually became more empowered, gained more credibility and confidence, and asserted themselves as activists, organisers and leaders. Success in the conservation and protection of the mangroves led to a change in power relations within the communities. Women's knowledge and roles as mangrove managers and environmental defenders were more visible, and some adopted new roles within their own communities, including leadership positions. Supporting women's agency to represent, advocate for and defend their traditional income-generating activities and their livelihoods was proven essential, triggering positive change in attitudes surrounding gender-based violence and gender equality (Veuthey & Gerber, 2012, cited in Castañeda Camey et al., 2020, p. 57).

4. Economic empowerment

4.1. Corporate leadership

Many studies have found links between women's presence on corporate boards of directors and in upper management, and positive environmental outcomes. There is evidence that women may be more sensitive to, and may exercise more influence on, corporate social responsibility and environmental issues than men (Nielsen and Huse, 2010, and Boulouta, 2013, cited in Ben-Amar et al., 2017, pp. 370, 373). A large meta-analysis of women's business leadership and environmental, social, and governance performance found that firms with more women on their boards of directors tended to show better sustainability practices including reduced greenhouse gas emissions, higher rankings on environmental performance, increased environmental investments, fewer environmentally-related problems and community concerns, and improved quality and extent of sustainability reporting and disclosures of environmental practices (Di Miceli & Donaggio, 2018, p. 5). Several studies on ethical decision-making find that women tend to demonstrate higher ethical standards than men (for example, finding it more difficult to justify unethical practices or being more sensitive to ethical dilemmas), although some find no significant differences (Atif et al., 2021, p. 4; Ben-Amar et al., 2017, p. 373). Female managers and directors 'care more about society at large than their male counterparts', are more concerned about ethical practices and socially responsible behaviour, tend to follow business practices that match

corporate social responsibility principles, and are more inclined to take actions to reduce perceived risks (Atif et al., 2021, p. 4). Most of this evidence comes from statistical analyses focusing on large North American, European, and global firms. The reasons for differences in women's and men's attitudes towards wider social and environmental issues are believed to be related to socialisation into traditional gender roles, discussed in section 6 of this report.

Gender diversity at the corporate board level has been found to improve corporate governance and decision-making. Diverse groups tend to consider a greater range of perspectives and improve the quality of decision making (Atif et al., 2021, p. 3; Ben-Amar et al., 2017, p. 372). Female directors tend to enhance corporate governance by putting more emphasis on monitoring, as demonstrated by more frequent board meetings, better attendance by both males and females at board meetings, higher dividend payouts, and shorter-term debt than other firms, and they mitigate cognitive biases such as overconfidence among male executives (Atif et al., 2021, p. 3). Women 'are perceived to have a more participative, democratic, and communal leadership style' which may lead to improved board effectiveness as a result of better informed discussions, improved quality of board deliberations, and better supervision of the firm's disclosures (Ben-Amar et al., 2017, pp. 370, 373).

Examples of how gender diversity in corporate decision-making has produced positive environmental outcomes include:

- Both the percentage and number of women on corporate boards have a positive causal effect on renewable energy consumption. This effect is stronger for female independent directors than for female executive directors (this study examined 1491 firms in the USA between 2008-2016) (Atif et al., 2021).
- There is a positive correlation between the percentage of women on a company's board and its environmental performance (as measured by a set of indicators provided by the research firm Sustainalytics). Companies in the top quartile by percentage of women on their boards have environmental ratings 36% higher than the bottom quartile. Companies that increased gender diversity on boards between 2013 and 2018 were 60% more likely to reduce energy intensity, 39% more likely to reduce greenhouse gas emission intensity, and 46% more likely to reduce water use intensity (2,300 companies worldwide in 2017 and 2018) (FP Analytics, 2020).
- Companies with greater gender diversity on their boards perform better on a range of climate action indicators related to governance, risk management, and disclosure, they are 25% more likely to have developed medium- and long-term strategies for emissions reductions, twice as likely to have developed a decarbonisation strategy, and are significantly more likely to allocate capital to these targets (159 companies worldwide across 15 industrial sectors) (Subramanian & Wayth, 2021).
- Gender diversity at the corporate board level is correlated with lower CO_2 emissions and with increased disclosure of environmental data. Having more than 30% women on the board was also associated with lower growth rates of emissions (0.6%, compared to 3.5% for companies without any female board members), although this effect was limited in the oil and gas sector (11,700 companies across 102 countries, 2017-2019) (BloombergNEF & Sasakawa Peace Foundation, 2020).

- Gender diversity in management is associated with lower CO_2 emissions: a 1 percentage point increase in the proportion of female managers within a firm leads to a 0.5% decrease in CO_2 emissions. After the Paris Agreement, firms with greater gender diversity reduced their CO_2 emissions by about 5% more than other firms. Gender diversity at the managerial level has a stronger effect on mitigating climate change if females are also well-represented in political institutions and civil society (1951 firms in 24 countries, mostly European, 2009-2019) (Altunbas et al., 2022).
- Companies with more women on their boards have been widely reported to be more likely to participate in voluntary disclosures of information about greenhouse gas emissions and climate change strategies and risks. Examples include studies that encompassed:
    - between 69 and 89 companies in Canada between 2008-2014 (Ben-Amar et al., 2017);
    - multinational companies from 15 countries (Frias-Aceituno et al., 2013, cited in Ben-Amar et al., 2017, p. 373);
    - an uncertain number of South Korean companies covering 9,406 firm-years between 2014 and 2020 (Kim, 2022);
    - 329 UK companies in 2010 (Liao et al., 2015); and
    - 215 UK companies between 2011 and 2014 (Tingbani et al., 2020).

  However, a contradictory study, undertaken among a sample of 283 global companies in 2008, did not find any effect of gender diversity on greenhouse gas emission disclosures (Prado-Lorenzo and Garcia-Sanchez, 2010, cited in Ben-Amar et al., 2017, p. 371).
- Companies with three or more female directors on their boards achieve higher environmental, social, and governance performance on indicators measured by the Kinder, Lydenberg, Domini, Inc. KLD STATS database (78 companies in the USA in the electronics and chemical industries, 2006-2007) (Post et al., 2011).
- Companies with more women on their boards are more likely to invest in renewable energy, integrate climate change into actuarial models and risk management, measure and reduce carbon emissions, reduce the environmental impact of packaging, address environmental risks in financing decisions, manage and improve their energy efficiency, and minimise and mitigate impacts on biodiversity (1,500 companies) (McElhaney & Mobasseri, 2012, pp. 3–4).

Many studies have found that a 'critical mass' of at least two to three women, or 30% to 35% women within a group, is necessary for effects on corporate decision-making to become apparent. If there are too few women, 'their voices may be ignored, they may feel too intimidated to comment, or they may not be particularly representative of women in general, having been selected because their views were consistent with the men in the organization' (McKinsey and Company, 2007, and Buckingham, 2010, cited in Ergas & York, 2012, p. 968). Many studies suggest that two women (Atif et al., 2021, p. 5; Ben-Amar et al., 2017) or three women (Torchia et al. 2011, and Konrad et al. 2008, cited in Ben-Amar et al., 2017, p. 374; Post et al., 2011) are enough to produce an observable effect. Other studies suggest that the critical threshold is reached when 30% to 35% of the people in a group are women (Joecks et al. 2013, cited in Ben-Amar et al., 2017, p. 374; BloombergNEF &

Sasakawa Peace Foundation, 2020; Kanter, 1977, and Kanter et al., 2002, cited in Buckingham et al., 2005, p. 431).

4.2. Community forest management

Women's inclusion in community forest management groups can improve sustainable management of forest resources, but evidence for this is limited, especially outside South Asia. Much of the literature on women's empowerment in the context of forest management focuses on governance processes, social issues, and livelihoods issues rather than environmental outcomes. A systematic literature review in 2016 found 'strong and clear evidence of the importance of including women in forest management groups for better resource governance and conservation outcomes' in India and Nepal, but outside those two countries 'there are substantial gaps in the evidence base' (Leisher et al., 2016, pp. 1, 8). A more recent literature review by the international NGO Landesa finds 'moderate evidence' that women's inclusion in forest management groups in South Asia has contributed to productivity and reduced time burdens for women, and 'limited evidence' of enhanced carbon sequestration and improved forest conditions (Landesa, 2023, p. 4). There is also some contradictory evidence suggesting that women's participation in forest management may not always produce better environmental outcomes. For example, a study of forest user groups in Kenya, Uganda, Mexico, and Bolivia found that female-dominated groups were less likely to adopt new technologies and monitoring practices associated with sustainability, possibly due to gender biases in technology access, labour constraints, and limitations to women's sanctioning authority (Mwangi et al., 2011, Sun et al., 2011, cited in Doss et al., 2018, p. 72).

Women tend to have fewer opportunities than men to participate in decision making about community forests and forest resources (Larson et al., 2015, p. 45). Women's ability to participate in forest management varies depending on context, but is often constrained by social norms to exclude substantive decision-making, ownership, and benefits (Duguma et al., 2022). It has been observed that having a 'critical mass' of women involved in community forest management groups, possibly through gender quotas or mandates, can make a significant difference (Canpolat et al., 2022, p. 25; Larson et al., 2015, p. 45). A study of community forest groups in India and Nepal found that a threshold for enabling women to participate and hold office was reached when they comprised at least 25% to 33% of a group's executive committee (Agarwal, 2015); this is consistent with studies of women's participation in parliaments and corporate leadership described in sections 2.1 and 4.1 of this report.

Examples of community forest management projects that have produced positive environmental outcomes include:

- A study of 135 community forest management groups in India and Nepal found that committees with women, especially all-female committees, consistently made stricter rules about collecting firewood, collecting grass, and grazing animals, with the exception of some groups that included larger proportions of landless women who had greater need to access forest resources (Agarwal, 2009). Related studies in the same areas found that forest management groups that were all-female or had a

critical mass of women were better able to protect forest territories from outsiders, leading to fewer violations and more sustainable harvests (Agarwal, 2015, p. 12; Agarwal, 2010, cited in Leisher et al., 2016, app. 4).

- A study in India's West Bengal state found that women-only forest protection committees tend to have fewer rules violations, increased patrolling, greater transparency, and higher overall participation than mixed-gender groups (Das, 2011, cited in Leisher et al., 2016, app. 4).
- One of the components of the Yedeni forest management project in Ethiopia is an all-female group of forest protectors, members of a forestry management cooperative, who patrol and monitor the status of the forest. The programme achieved a 62% reduction in deforestation from 2012 to 2015, supported more efficient cooking stoves and reduced unsustainable harvesting of firewood, improved crop and livestock management practices, and supports small forest-friendly businesses and cooperatives that provide income for the local community and economic incentive to protect the forest (EcoAct, n.d.; Lawton, 2022).

4.3. Community fisheries management

Increasing women's participation in small-scale fisheries management has led to positive outcomes when gender norms are overcome and enabling conditions are met so that women can effectively participate in resource management and decision-making (Chambon et al., 2023, p. 15). However, the evidence linking women's empowerment to environmental outcomes is limited; many studies agree that there is a lack of gender-disaggregated data related to fisheries, especially in Africa and Asia, and much of the research on women's participation in fisheries focuses on social and livelihoods issues, leaving significant knowledge gaps about environmental outcomes (Chambon et al., 2023, pp. 13–14, 16; Kleiber et al., 2015, p. 547; Leisher et al., 2016, p. 1; Siles et al., 2019, p. 15; WWF, 2019, p. 5). Projects have often included alternative livelihoods elements to support women when customary seafood harvests are disrupted by conservation measures or otherwise increase support for the project (Dazé & Terton, 2021, p. 25; UNDP, 2013; USAID, 2017).

Women and men in the fishing industry often have distinct roles which are dictated by social and cultural norms. Offshore fishing is typically male-dominated, although women have significant (but often undervalued and undercompensated) roles in processing, sales, logistical support, and other informal and support roles; 80%-90% of seafood processing workers, for example, are women (Siles et al., 2019, pp. 15, 20; WWF, 2019, p. 4). In coastal, small-scale, and subsistence fisheries, on the other hand, women are often much more heavily involved in harvesting, although they are under-represented in management and decision-making (FAO, Duke University, and WorldFish, 2022, p. 5; Siles et al., 2019, pp. 16, 25).

Examples of community fisheries management projects that have produced positive environmental outcomes include:

- In Vanuatu, a coral gardening project sought to restore and expand coral beds which are adversely affected by climate change. GIZ and the Nguna-Pele Marine and Land Protection Area Network provided training and capacity development 'to encourage women to take on the role of resource champions' in local marine conservation committees. Women took on responsibilities for collecting coral fragments, using them to create new coral beds, and for guiding tourists (thus creating new sources of income). Coral fragments collected by women were found to have a 75% survival rate, while those handled by men had only a 55% survival rate. The new coral beds have provided new habitats for fish and enhanced coastline protection from waves and cyclones (Dazé & Terton, 2021, p. 25).

- In the Philippines, an all-woman community organisation serves as volunteer guards to protect Subic Beach, a former fishing ground that is now a marine protected area and eco-tourism destination. The USAID programme Ecosystems Improved for Sustainable Fisheries (ECOFISH) supported training for local fishers to manage the fishery sustainably and helped local women to develop alternative livelihoods around craft-making and eco-tourism. The women took responsibility for enforcing rules in the marine protected area, including checking the cargoes of incoming fishing boats. The protected area experienced a 24% increase in fish biomass by the end of the ECOFISH programme (USAID, 2017).

- In The Gambia, TRY Oyster Women's Association brings together 500 female oyster and cockle harvesters from 15 villages to diversify and improve members' livelihoods, add value to the products they harvest, and to develop and implement a comprehensive natural resources management plan which includes enforcing seasonal closings, setting minimum size limits for cockles, reducing damage to mangrove beds, and planting mangrove trees. Caught oysters have increased in size by 30% and the group planted 53,500 mangrove seedlings across 22 hectares between 2010 and 2012 (UNDP, 2013).

4.4. Climate-smart agriculture

There is limited evidence linking women's empowerment with environmental outcomes arising from climate-smart agricultural initiatives. Climate-smart agricultural practices aim to sustainably increase agricultural productivity and incomes, adapt and build resilience to climate change, and mitigate the impacts of agriculture on climate change (Van Wijk et al., 2020, pp. 1–3; World Bank, FAO, and IFAD, 2015, pp. 2–4). They encompass a wide range of techniques for land and water management (including agroforestry, constructing terraces and bunds, water harvesting and management systems, and crop residue mulching), soil fertility and crop management (including composting, cover cropping, efficient use of fertiliser, selecting appropriate crop varieties, and reduced tilling), livestock management (including feed management, manure management, adjusting numbers and types of livestock, and pasture management), and other practices (including processing, cookstoves, and aquaculture) (World Bank, FAO, and IFAD, 2015, pp. 2–4). However, much of the evidence about the outcomes from climate-smart agriculture programmes appears to focus on agricultural productivity, with limited data available regarding environmental outcomes. A review of 15 frameworks for assessing climate-smart agriculture initiatives, for

example, found that these assessment tools generally looked at agricultural production without assessing its sustainability, and found methodological weaknesses in how the tools assessed mitigation of greenhouse gas emissions and climate change adaptation (Van Wijk et al., 2020, pp. 4–8). Many studies are gender-blind, and consider climate-smart agricultural practices at the household level without considering gender dynamics within the household (Oyawole et al., 2021, p. 106).

Women are more likely to adopt climate-smart agricultural practices that support their practical needs and strategic interests and are feasible within their particular social contexts. Women's practical needs include access to labour-saving devices, climate information, and training on farming techniques, while strategic needs include policies that afford women secure access to land, as well as shifts in social norms to provide women with greater mobility, encourage men to contribute equally to domestic responsibilities, and facilitate decision-making and leadership opportunities for women (Chakraborty et al., 2023, p. 2). Climate-smart agriculture projects need to improve women's collectivisation at the local level, improve participation in leadership roles at macro levels, and promote women's decision-making across all levels to enhance gender-responsiveness (Chakraborty et al., 2023, p. 2). For example, a study in Tanzania found that women's control of farm resources was a major determining factor in the adoption of technologies to boost crop and livestock diversity, irrigation, application of chemical fertilizers, and agroforestry (Kurgat et al.,2020, cited in IFC, 2023, p. 9), and a study in India found that households with greater women's participation in decision-making were more likely to adopt climate-smart agricultural practices (Aryal et al., 2020).

Women are disadvantaged compared with men in their ability to manage agricultural land and adopt climate-smart agricultural practices. Women's ability to adopt climate-smart agricultural practices is hindered by gender-based discrimination which imposes restricted gender roles and limits access to land, financial capital and credit, markets, education, advice, information, networks, and other productive resources (Chakraborty et al., 2023, p. 7; Doss et al., 2018, p. 72; OECD, 2023, pp. 130–132; Oyawole et al., 2021, p. 106). Land tenure is a particularly significant constraint and is discussed in more detail in section 4.6 of this report.

Examples of climate-smart agriculture projects that have successfully built on women's empowerment include:

- In India, the international clothing manufacturer and retailer Primark partnered with Cotton Connect and the Self-Employed Women's Association (SEWA) to train female farmers in sustainable farming methods beginning in 2013. The programme addressed seed selection and sowing; soil, water, pesticide, and pest management; and harvesting, grading and storage. Farmers who completed the three-year training programme achieved improvements in both the quality of the cotton and the size of the yields, tripled their profits, and used 40% less fertiliser, 44% less pesticide, and 10% less water than farmers in a control group (Sustainable Brands, 2020).
- In Burkina Faso, Mali, and Senegal, the Agroecology Plus Six (AE+6) program in 2016 and 2017 sought to enable smallholder farmers to adapt to the impacts of climate change and reverse land degradation, with a strong emphasis on women's

empowerment. The project included a wide range of interventions aimed at women, including organising savings and credit groups, providing livestock, providing training in gardening practices and nutrition, increasing crop diversity, facilitating access to equipment for processing raw materials into finished products, and strengthening women's land tenure security. At the community level, the project established seed banks and supported construction of collective grain storage facilities. The project also sought to increase women's social empowerment by working with the whole community to shift attitudes and beliefs about women's roles in agricultural value chains, facilitating the creation of village agroecological committees, and fostering women's participation in local governance and encouraging to take up leadership roles. Tangible outcomes included changes in municipal plans and policies, particularly around improving women's land tenure, but the short duration of the project (18 months) meant that longer-term outcomes were not monitored (Chakraborty et al., 2023, pp. 10–11).

- A project in the Indian state of Andhra Pradesh trained members of women's collectives in climate-smart farming methods such as zero tillage, perennial green cover, and production and use of natural fertilisers for horticultural crops and kitchen gardening. Since women were mainly responsible for providing meals, they valued having access to nutritious, easy-to-cook, and cheaper food for household consumption. The project improved resilience, quality of produce, and mitigation measures by promoting soil carbon sequestration (Galab et al., 2020, and Gupta et al., 2020, cited in Chakraborty et al., 2023, p. 6).

4.5. Water resource management

It has long been recognised that women's participation in integrated water resources initiatives increases project effectiveness, efficiency, performance, and the likelihood of sustainability (GWA, 2006, p. 13). Many studies in the water sector that consider the relationship between women's empowerment and project outcomes do not clearly link inputs to results, and often describe results in qualitative terms (Jenniskens, 2022, p. 9). However, when women are involved in decision-making processes in the water sector and are provided with adequate support to actively participate, they can have a positive impact on policy-making and projects can be more effective and sustainable (GWP and UNEP-DHI, 2021, p. 14; Jalal, 2014; Jenniskens, 2022, p. 26). In the water utilities sector, increasing women's participation benefits women through access to more and better jobs; benefits communities through better representation in water management bodies; and benefits utilities companies' organisational performance (World Bank, 2019, p. xi). A review of 13 case studies around the world concluded that 'performance within and beyond the water sector improved with the increased involvement of women. Examples include: barriers for tariff setting have been resolved and the willingness to pay improved; better services to customers; increased access to clean water; improved maintenance; efficiency of irrigation projects has increased (less water usage); less pollution; safe sanitation; better health; more nutritious food; more women and girls empowered; better access to education and skills training; higher attention to climate change, environmental and social issues; change in the composition of staff (more women on board); safer workspaces; better economic opportunities (jobs, own businesses)' (Jenniskens, 2022, p. 9). Gender diversity improves

customer satisfaction, because involving women in the design, operation, and maintenance of water supply systems often results in improved user-friendly and female-friendly design (World Bank, 2019, p. xi).

In much of the world, women are hindered from participating in water resource management processes at all levels of government, at the local community level, and in water utilities. Women are 'rarely involved in decisions relating to water policies and strategies, water resource management, or tariff setting and technology choices' (Jenniskens, 2022, p. 23), and are marginalised in water governance (OECD, 2020, p. 6). Women are also severely under-represented in the water utility workforce, making up only 17% to 18% of workers (Jenniskens, 2022, p. 8; World Bank, 2019, p. x). Barriers to participation and leadership include gender norms (and in some cases legal barriers) that discourage or prevent women from obtaining relevant education and technical qualifications, taking up employment in the sector, working in roles that are incompatible with domestic responsibilities, or participating in consultation and decision-making processes on an equal basis with men (GWP and UNEP-DHI, 2021, p. 14; Jenniskens, 2022, p. 8). Water rights and involvement in water management decisions are often linked to land rights, and since women often lack formal land tenure they may be excluded from decision-making processes and water user associations (GWP and UNEP-DHI, 2021, p. 14; Jenniskens, 2022, p. 19; World Bank, 2019, p. xii). In some cases, gender policies or strategies including quotas have been used to strengthen women's representation, but 'evidence has revealed a clear gap between these policies and practice. Such strategies are not always accompanied by concrete action plans, nor are they adequately funded; measures and mechanisms are often not fully implemented; and data collection and monitoring and evaluation processes may not always be sophisticated and disaggregated enough' (GWP and UNEP-DHI, 2021, p. iv).

An example of water resource management cases that have produced positive environmental outcomes include:

- The Climate Change Adaptation Project in Oasis Zones (PACC-ZO) in Morocco built local capacity to cope with reduced rainfall, overexploitation of the water table, desertification, and flood risks associated with climate change. The project strengthened women's participation in women's associations, water user groups, and farming cooperatives, and involved women's groups and leaders of women's associations in planning. The primary focus of the project was to rebuild and enhance traditional irrigation systems fed by rainfall and groundwater and build groundwater replenishment structures. It also aimed to diversify income sources through farming cooperatives and women's associations; it provided training in weaving and cooking, water management, and farming techniques, and provided seed funding for businesses developing alternative livelihoods. Outcomes include increased agricultural production and marketing of organic products from the region, and development of businesses around weaving and tourism (Adaptation Fund, 2016, 2020, p. 15).

4.6. Land tenure

There is significant evidence that ensuring women's access to and control of land incentivises and supports sustainable land management practices, and increases resilience and capacity to cope with environmental shocks. Secure land tenure is widely recognised as being important for climate change mitigation and adaptation, soil conservation, managing land degradation and desertification, and improved management of forests (Livingstone & Jenkins, 2021, p. 25; Shukla et al., 2019, pp. 51–55, 70). When smallholder farmers have secure rights to land, they are more likely to preserve the soil, plant trees and protect forests, which are important measures for avoiding, reducing, and reversing land degradation, and countries with more secure land rights tend to have lower rates of deforestation (UNCCCD, 2019, p. 6). Land policy can affect environmental outcomes across cropping, rangeland, forest, freshwater ecosystems, and other ecosystems (Shukla et al., 2019, p. 70). Legal land rights can enable marginalised populations to access funding sources and opportunities that support efforts to reduce climate change, and can facilitate compensation when land is taken for conservation purposes or when climate-induced disasters destroy fields and homes (Wedeman & Petruney, 2019, p. 4). Evidence from multiple studies shows that strengthening security of land tenure for women contributes to increasing long-term productive and environmentally beneficial investments including sustainable land use practices that alleviate land degradation, soil and water conservation measures, tree planting, investments in adaptation infrastructure that promote carbon sequestration and adaptive capacity, integrated adaptation and mitigation measures, and livelihood diversification and other livelihood management strategies that build adaptive capacity (Hurlburt et al., 2019, p. 719; Landesa, 2023, pp. 3–4; Livingstone & Jenkins, 2021, p. 25; Shukla et al., 2019, p. 43). The link between women's land rights and climate change mitigation is particularly strong for indigenous and rural women because of their strength of traditional knowledge and particularly high dependence on local natural resources for livelihoods (Livingstone & Jenkins, 2021, p. 25). The UN Convention to Combat Desertification calls women's land rights 'essential for achieving the intertwined global goals on gender equality and land degradation neutrality' (UNCCCD, 2019, p. 1)

In many regions of the world, women have significant responsibilities for agriculture and collecting natural resources but lack control over land and resources. Women also have particular understanding of the impacts of environmental change, and have expertise in traditional and sustainable methods of natural resource management (UNCCCD, 2019, p. 2; Wedeman & Petruney, 2019, p. 5). However, women often have less secure rights and less access to and control over land and resources than men, either in law or due to social and cultural norms (Livingstone & Jenkins, 2021, p. 25; Shukla et al., 2019, p. 43; Wedeman & Petruney, 2019, pp. 4–5). Women may be at risk, for example, of losing land rights due to changes in marital status or family composition (Landesa, 2023, pp. 3–4). In addition, where communities access natural resources located on common lands, these are often governed by decision-making processes that exclude women (Wedeman & Petruney, 2019, p. 5).

Examples of how land tenure security has contributed to positive environmental outcomes include:

- In northern Uganda, a climate-smart agriculture programme encouraged mixed-gender farmer groups to enable women to access productive resources, set targets for equal numbers of women and men to partake in training, promoted climate-smart technologies, and urged farmer cooperatives to include women in leadership roles and treat them equally; as a result of the project, over 1,500 hectares of land have improved climate-smart agriculture and sustainable land management practices, 100,000 agroforestry trees were planted, and the average maize and bean crop yield has tripled in project sites (Muwaya, 2017, cited in UNCCCD, 2019, p. 10).
- An evaluation of a land registration programme in Rwanda that improved land access and inheritance rights for married women found that households whose land rights were regularised were 10 percentage points more likely to have initiated or maintained soil conservation measures as households in a control group, and this rose to 19 percentage points more likely among female-headed households whose land rights were regularised (Ali et al., 2014, pp. 262, 272).
- In Ethiopia, women managing agricultural plots who had more secure land tenure were more likely to plant trees and adopt climate-smart agricultural practices (Quisumbing and Kumar, 2014, cited in Doss et al., 2018, p. 72).

4.7. Green employment and entrepreneurship

Women have advantages compared with men in some green employment and entrepreneurship sectors, and have demonstrated success in building livelihoods, but there appears to be limited evidence available about environmental outcomes that may result. Women tend to be more impacted by climate change, and as a result may be well-placed to identify business opportunities related to climate change mitigation, adaptation, and community resilience; women also have an advantage in developing and delivering products and services that respond to women's needs, such as clean cookstoves and household fuels, public transportation, and some agricultural products (IFC, 2023, p. 8). In the household energy sector (e.g. solar powered devices and clean cookstoves), women are able to leverage social networks, enter homes and deal with female customers, understand household needs, and are more credible when discussing the products that they promote, compared with men (Dutta, 2018, p. 28). Evidence about links between women's economic empowerment and low-carbon transitions is also emerging in the agriculture, forestry, and agroforestry sectors, including increased uptake of climate-smart agriculture technologies and higher farming yields (Dupar & Tan, 2023, p. 4; IFC, 2023, p. 8) (see also section 4.4 on climate-smart agriculture in this report). However, there has been limited analysis of how to integrate women's economic empowerment in low-carbon transitions, discussion of gender issues and intersectional vulnerabilities (such as age, ethnicity, class, caste, disability) tends to be superficial, and there has been limited discussion about how workers in disadvantaged positions, including women, can progress into more secure, low-carbon employment (Dupar & Tan, 2023, pp. 3–4).

Women face significant barriers to accessing economic opportunities in the green/low-carbon economy. New jobs are likely to appear in renewable and low-carbon industries such as construction, energy, the circular economy, transport and conservation agriculture (ILO, 2017, cited in Livingstone & Jenkins, 2021, p. 22). However, much of the discussion about 'just transitions' focuses on compensating, training, and redeploying workers in fossil-fuel-related industries disrupted by the green economy, which tend to be male-dominated (Dupar & Tan, 2023, p. 3), and a large proportion of the employment in a 'just transition' scenario is likely to be in male-dominated industries such as renewable energy, manufacturing and construction (ILO, 2018, cited in Dupar & Tan, 2022, p. 6). In Latin America, for example, more than 80% of the new jobs created by the decarbonisation agenda are likely to be in sectors currently dominated by men, and women will not benefit from job creation unless this segregation is addressed (Aguilar, 2021, cited in Dupar & Tan, 2022, p. 6). Other barriers that women face in the green economy are similar to barriers that are well-known for economic participation more generally. Compared with men, women tend to own fewer assets of lower quality and value and are more vulnerable to loss of assets and rights due to changes in family circumstances; (Livingstone & Jenkins, 2021, p. 24; Oyawole et al., 2021, p. 106); they are legally barred from certain jobs or industries in many countries (World Bank, 2023, cited in IFC, 2023, p. 3; Livingstone & Jenkins, 2021, p. 21); they have less access to credit and face other forms of financial exclusion (IFC, 2023, p. 10; Livingstone & Jenkins, 2021, p. 26); they have less education and lack technical skills (Livingstone & Jenkins, 2021, p. 23); and they are restricted by social norms that limit their freedom to take up employment or education (IFC, 2023, p. 3; Livingstone & Jenkins, 2021, p. 21).

Examples of projects empowering women in green employment or entrepreneurship include:

- In Nigeria and Tanzania, Solar Sister recruits, trains, and supports a network of women entrepreneurs who sell solar-powered lights and clean cookstoves in rural communities. As of the end of 2023, Solar Sister reported that it had 10,000 women in its sales network, had delivered clean energy products to 4.3 million people, mitigated 1.4 million tonnes tons of CO2 emissions, and generated USD 300 million in economic benefits in off-grid communities (Solar Sister, 2024). Independent survey research in 2016 found that people who bought solar lanterns used them for reading, studying, leisure activities, indoor and outdoor economic activities, and household chores; respondents reported improvements in children's academic performance, reduced spending on kerosene, health improvements, and increased productivity in home-based businesses (Gray et al., 2017).
- A study of cookstove distribution in Kenya found that women entrepreneurs sold three times as many cookstoves as men, and that customers who purchased a cookstove from a woman were more likely to report correct and consistent use, and to say that it was better than their traditional stove, very safe, and easy to use, compared with customers who purchased a cookstove from a man (Shankar et al., 2015, pp. 3, 7).

5. Outcomes of particular interest

For the purposes of this report, resilience to natural hazards and combating illegal wildlife trade were identified as topics of particular interest. They are discussed here on their own, but interact with the forms of empowerment discussed earlier in this report.

5.1. Resilience to natural hazards

Women's empowerment, leadership, and participation, as well as girls' education, contribute to emergency preparedness, risk reduction and humanitarian response in connection to natural hazards induced by climate change (Barclay et al., 2016, p. 11; Deininger et al., 2023, p. 6; Pankhurst, 2022, p. 29; Striessnig et al., 2013, p. 5). Women have particular knowledge of their local environment and local risks, capacity to mobilise communities, strong social networks, experience of household management, and specific knowledge about community needs, especially the needs of women and of the most vulnerable people in the community (Barclay et al., 2016, pp. 24–27; Tanner et al., 2018, pp. 17–20; The Economist Intelligence Unit, 2014, pp. 13–14). It is considered best practice to systematically incorporate women's voices in the design and implementation of initiatives to manage risk and build resilience (Deininger et al., 2023, p. 13). Resilience programmes 'tend to perform better when women are involved, because they usually better identify women's and children's needs and, in some contexts, can reach other women more easily' (Erman et al., 2021, p. 54). Education, and particularly education for girls, has been shown to be the single most important social or economic factor associated with reducing vulnerability to natural disasters (Striessnig et al., 2013, p. 5) (see section 3.2 of this report).

Women are often significantly under-represented and lack influence in community decision-making structures dealing with resilience planning. They are constrained by patriarchal gender norms, burdens of unpaid work and family responsibilities, poverty, and low levels of education, literacy, leadership and other skills, and confidence (Barclay et al., 2016, pp. 16–23; Tanner et al., 2018, pp. 21–22). For the most part, discussions about disaster preparedness still focus more on women's participation than women's leadership (Tanner et al., 2018, p. 5). Measures to enable women's leadership in resilience planning may include gender-sensitive accommodations in working conditions, gender quotas, supporting women's networks, relevant and targeted training, creating roles targeted for women, ensuring collaboration as equals with male counterparts, using targeted communications to engage women, and establishing separate decision-making spaces for women (Tanner et al., 2018, pp. 23–26)

Nature-based solutions for climate resilience are often cost-effective approaches to increasing resilience. Nature-based solutions to climate change work by protecting ecosystems from loss or degradation, restoring ecosystems that have already been lost or degraded, or managing productive land more sustainably (Schmidt & Alam, 2023). Examples include reforestation or planting new forests (including mangroves in coastal areas), restoring or maintaining wetlands, using restorative agricultural practices, and protecting and restoring coral reefs. They aim to reduce the impacts of hazards such as storm surges, urban heat, droughts, and coastal erosion, while also providing social, economic, and environmental benefits (World Bank, 2023, p. 4). Nature-based solutions can be more cost-

effective than engineering solutions (for example, one study in the USA found that nature-based coastal defences could be two to five times cheaper than built infrastructure) and can often be implemented, operated, and maintained by local communities independently (Lucas, 2020, pp. 12–13; Narayan et al., 2016, p. 1).

Some examples of women-led nature-based solutions addressing climate resilience include:

- In Ecuador, the 'Guardians of the Hills' project implemented by GIZ aims to empower women to lead urban climate change adaptation measures in informal settlements in the city of Portoviejo which have been subject to deforestation and increased risk of flooding and landslides. The project engaged with women's groups and women leaders in the community, used participatory planning processes, strengthened women's roles as decision-makers, and provided training. Activities include installing orchards, terraced slopes, and eco-paths to stabilise slopes and increase rainwater infiltration, setting up neighbourhood signs and gardens, and raising awareness about gender-based violence to build social resilience in the community (Dazé & Terton, 2021, pp. 19–20).
- In Vietnam, the coastal province of Thua Thien Hue has repeatedly suffered from extreme weather and is expected to experience heavier rainfall and rising sea levels leading to increased flooding as a result of climate change. The Vietnam Women's Union is supporting women in the province to plant and restore mangroves as sea defences and to reduce soil erosion. Between 2018 and 2021, the Resil-Nam Coastal project planted more than 12,000 mangrove seedlings throughout the province, with an estimated return on investment of USD 2.30 for every dollar invested based on savings from reduced flood damage, enhanced fisheries, and increased eco-tourism (Schmidt & Alam, 2023).
- In Kenya, the project Mikoko Pamoja, founded in 2013, conserves 117 hectares of natural and plantation mangroves and is restoring an eroded section of shoreline. The programme contributes to improving local fisheries, wildlife habitats, and coastal protection, and sequesters approximately 3,000 metric tons of CO_2-equivalent per year. These carbon credits are sold on the Voluntary Carbon Market (VCM), earning at least USD 12,000 per year which is invested in community projects such as education and water supply. Mikoko Pamoja was the first community-based project in the world to sell carbon credits from mangrove conservation and restoration. The project is led by a committee of six women and seven men, and women have also been trained in mangrove forest management, integrated aquaculture, bookkeeping, and collecting data for monitoring, and verifying and reporting of carbon credits (UNDP, 2020).

Social protection programmes also make a strong contribution to resilience, as discussed in section 3.3 of this report.

5.2. Illegal wildlife trade

Women who participate in illegal wildlife trade often play small-scale and local roles, with poverty and dependence on local natural resources being significant motivating factors. The illegal wildlife trade is highly male-dominated; data from Africa and Norway

suggest that 90% to 96% of people involved in wildlife trafficking are men (Seager, 2021, p. 29), but women's involvement may be under-reported because of gender stereotypes that have led them to be less often targeted or suspected by authorities (Anagnostou et al., 2020, and Kruttschnitt 2013, cited in Kahler & Rinkus, 2021, p. 837). Women are typically involved in activities such as facilitating transit and smuggling, processing, marketing, setting traps, undertaking other enabling roles, and as consumers of wildlife products (Agu & Gore, 2020, pp. 1–3, 6; Kahler & Rinkus, 2021, p. 838; Seager, 2021, p. 27). Factors that incentivise women to participate in illegal wildlife trade include seeking resources, protection, belonging, and power; suffering from exploitation, financial difficulties, and a lack of opportunities in the legal economy; or following the 'path of least resistance' (Iori, 2020, cited in Seager, 2021, p. 20). Food provision and collection of basic household resources are often the responsibility of women, and food scarcity is often a significant incentive for subsistence poaching (Agu & Gore, 2020, p. 8). Women have been found to encourage bushmeat hunting and make up the majority of bushmeat traders in parts of Africa (Lowassa et al., 2012, and Edderai & Dame, 2006, cited in Kahler & Rinkus, 2021, p. 838).

Most efforts to inhibit illegal wildlife trade focus on law enforcement, often using military-style tactics and equipment (Roe & Booker, 2019, p. 2). One analysis showed that 46% of funding for tackling illegal wildlife trade goes towards protected area management (anti-poaching), 19% towards other law enforcement activities, and 15% to support sustainable use and alternative livelihoods (Wright et al., 2016, cited in Roe & Booker, 2019, p. 2).

Including women in anti-poaching enforcement activities may offer some advantages compared with male-only teams. Women are under-represented in front-line wildlife protection work, comprising between 3% and 11% of the ranger workforce worldwide (Graham, 2022, p. 37; Seager, 2021, p. 46). High-quality evidence on women in wildlife protection is very limited (Kahler & Rinkus, 2021, p. 838), but there are suggestions that women-only or mixed-gender teams may have some advantages over male-only teams, which are the norm in most countries.

- Women may be better than men at engaging positively with poachers, negotiating, de-escalating and resolving conflict, and producing enforcement outcomes with less force (Graham, 2022, p. 38; Seager, 2021, p. 50; Seager et al., 2021, p. 208).
- Women rangers are able to search and question female suspects, which might be inappropriate for male rangers in some circumstances (Seager, 2021, p. 50; Seager et al., 2021, p. 208).
- Women rangers are often more effective community liaisons, particularly in building relationships with women and youth in local communities to gain information and promote conservation (Graham, 2022, p. 37; Seager, 2021, pp. 50–51; Seager et al., 2021, p. 208).
- Women rangers are often perceived as more honest than their male counterparts, and women-only units have been reported to have experienced zero corruption (Graham, 2022, pp. 38, 40).

- Women, or mixed-sex enforcement teams, are less likely than male-dominated teams to resort to use of violence against community members and poachers (Seager, 2021, p. 48).
- Women and men often have life experiences from different ecosystems arising from their traditional gender roles, which can help them be more effective in different environments (Seager et al., 2021, p. 208).

A small number of women-only anti-poaching units in Africa stand out as notable examples of women's empowerment. Three groups are notably well-documented in the literature:

- The *Black Mambas* in South Africa were established in the Balule Nature Reserve in Limpopo Province to help engage impoverished communities in and around the reserve; they provide a visible deterrent to poachers, gather intelligence, and engage with communities, and although they have identified and demolished poachers' camps and equipment, they do not seek to directly confront poachers (Graham, 2022, p. 39; Hübschle & Shearing, 2018, pp. 28–29).
- *Team Lioness* in Kenya is a similar programme, with sixteen women recruited from two local Maasai communities including each of the eight sub-clans in the region; they operate in specialised units within a larger ranger organisation patrolling in and around Amboseli National Park, with roles that consist largely of working with communities and intelligence gathering (IFAW, 2023; Mahugu, 2023; Smith, 2020).
- *Akashinga*, with more than 500 personnel operating in Zimbabwe, Mozambique, and Botswana, takes a more aggressive approach to enforcement: members receive paramilitary-style training, are armed with rifles, and they directly confront and arrest poachers (Akashinga, 2023b; Graham, 2022, p. 38; Nuwer, 2018).

Both the Black Mambas and Akashinga specifically recruit women from particularly disadvantaged backgrounds, notably including seeking out victims of sexual assault or domestic violence, single mothers, sex workers, abandoned wives, widows, orphans, and wives of imprisoned poachers (Akashinga, 2023a; Hübschle & Shearing, 2018, pp. 29–30; Nuwer, 2018). All three of these organisations provide unique economic and social empowerment opportunities for women and have also been criticised for breaking gender stereotypes and placing women in non-traditional roles (Agu & Gore, 2020, p. 7; Akashinga, 2023a; Hübschle & Shearing, 2018, pp. 29–30; Mahugu, 2023; Nuwer, 2018; Smith, 2020). Other all-female ranger units have also been reported in Bangladesh, Nepal, India, Australia, and China, and significant efforts to increase recruitment of women into integrated ranger units have been reported in Kenya and Zambia (Graham, 2022, pp. 39–40; Roe & Booker, 2019, p. 3; Seager, 2021, p. 51; Sommerville et al., 2022).

There is limited evidence about the enforcement or conservation outcomes that these all-female units have achieved. Akashinga claims to have achieved an 80% reduction in poaching and a 400% increase in animal populations in areas where it operates (Akashinga, 2023a), and made 200 arrests between 2017 and 2022 (Graham, 2022, p. 38). The Black Mambas in South Africa are reported to have contributed to a 76% reduction in poaching and snaring in the areas that they patrol (Graham, 2022, p. 39). However, there does not yet

appear to be high-quality independent evidence of their conservation impacts (Hübschle & Shearing, 2018, p. 30; Mkono et al., 2023, p. 1101).

Increasing women's empowerment through community-based approaches to combat illegal wildlife trade could potentially have positive impacts, but empirical evidence on this is weak. Some experts argue that providing diversified alternative livelihoods for women to reduce their economic dependence on men and on poaching is critical for reducing illegal wildlife trade (Seager, 2021, pp. 13, 38). However, while there are many examples of community-based approaches to combating illegal wildlife trade, including alternative livelihoods projects, it has difficult to document their conservation outcomes through robust evidence: for example, one review of 50 case studies 'found no apparent link between the reported effectiveness of an initiative and the type or number of community engagement strategies employed' (Roe & Booker, 2019, p. 7), and a later review looking at 115 case studies stated 'there did not appear to be any connection between the type of community engagement strategy adopted and the effectiveness of the intervention' (Wilson-Holt & Roe, 2021, p. 3). A report published by UN Environment concludes that communities 'need realistic incentives to support and actively engage in conservation', but 'the evidence-base for the effectiveness of these initiatives is very limited' (Cooney et al., 2018, p. 10).

6. Gender differences in environmental attitudes

Women tend to be more concerned than men about environmental problems, more knowledgeable about climate change, perceive greater risks from environmental problems, and have more positive attitudes towards taking action on climate change and on environmental issues generally (Asongu et al., 2021, p. 6; Ergas & York, 2012, pp. 965–966; Lv & Deng, 2019, p. 605; Mavisakalyan & Tarverdi, 2019, p. 151; Ramstetter & Habersack, 2020, pp. 1063–1065, 1077; Salahodjaev & Jarilkapova, 2020, p. 1; Salamon, 2023, pp. 3–4; Seager, 2021, p. 35; Seager et al., 2021, p. 207; Wedeman & Petruney, 2019, p. 3). When considering efforts to mitigate climate change, men tend to place greater weight on their perceptions of personal and social costs associated with mitigation, while women are more likely to perceive the benefits (Bush and Clayton, 2021, cited in Salamon, 2023, p. 4). Much of this evidence is from Europe and North America, but it is also supported by some studies in Latin America, Africa, and Asia. However, this effect should not be overstated and women should not be stereotyped as 'natural environmentalists' (Pankhurst, 2022, p. 8; Seager, 2021, p. 32). Some studies do show the opposite effect and point out that women's attitudes are also influenced by educational attainment, ethnicity, and other cultural factors (Ergas & York, 2012, p. 966; Ramstetter & Habersack, 2020, pp. 1064, 1067; Seager, 2021, p. 32; Seager et al., 2021, p. 207).

Differences in environmental attitudes between women and men are likely a consequence of prevailing social norms around gender. Gender socialisation theory suggests that broadly speaking, women are socialised to be compassionate, cooperative, caring, more focused on interpersonal skills, and more focused on the long term, while masculine behavioural norms call for being competitive, independent, self-interested, and to focus on short-term actions; this may lead women to be more likely to hold altruistic and empathetic views towards the environment, place more value on the safety of the family and community, and allocate resources for the benefit of the household, community, or society

as a whole than for personal gain (Atif et al., 2021, p. 4; Ben-Amar et al., 2017, p. 373; Lv & Deng, 2019, p. 605; Mavisakalyan & Tarverdi, 2019, p. 152; Ramstetter & Habersack, 2020, pp. 1065–1066). A 'social roles' argument arrives at a similar conclusion based on the idea that the stereotypical roles that women and men perform in society (in production, employment, homemaking, and parenthood) inform individuals' perceptions and behaviours (Mavisakalyan & Tarverdi, 2019, p. 152; Ramstetter & Habersack, 2020, p. 1066). Gendered division of labour often positions women as homemakers, caregivers, subsistence food producers and labourers, and gatherers of water and fuelwood; it may be that in these roles they are more keenly attuned to environmental change than men are, because they are more dependent on natural resources and more vulnerable (because of other social disadvantages) to environmental shocks (Ergas & York, 2012, pp. 965–966; Mavisakalyan & Tarverdi, 2019, p. 152). In a similar vein, women's and men's traditional economic and social roles often mean that they work in, experience, and understand different parts of the natural world, and thus may have different understandings of environmental problems (Seager, 2021, p. 34).

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