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THE EDUCATION OF WOMEN AND ITS IMPACT ON CLIMATE CHANGE

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Introduction

The suggestions of climate change education actors have concentrated on drawing in youth from the early stages and furnishing all children with the necessary skills important to change their practices and adapt to new and obscure realities. These endeavours may appear as interdisciplinary methodologies that mesh environmental topics into existing educational curricula, or programming that connects with children as community members and potential pioneers (Hill and King, 1995). However, just as gender actors have missed the significance of youth, childhood, and adolescent education in their endeavours to improve the status of women in climate conversations, education actors have missed the importance of gender in their efforts to more readily prepare children and youth to confront the immediate and future challenges of climate change. However, girls' education actors might have the ability to connect the missing link. Research on girls' education has reliably exhibited an abundance of positive outcomes from investing in girls' access to and finishing of quality education (Kwauk and Braga, 2017).

Studies have additionally demonstrated that increased education and empowerment for girls can mean the “difference between life and death in the face of climate-related crises”. In reality, when girls and women are better educated and when they are involved in decision-making processes at all levels, their families and communities are more durable and more versatile to economic and ecological shocks, and they are more readily able to anticipate, adapt to, and bounce back from climate-related calamities (Anderson, 2010). For instance, an investigation of climatic disasters in developing countries evaluated that if countries had invested more in girls' education somewhere between 1960 and 2003, 465 million individuals could have been spared from injury, 667 million from drought, and the loss of life from floods could have been diminished by 60,000. Another study anticipated that if at any rate 70% of women between ages 20 and 39 accomplished at least a lower-secondary education, disaster-related deaths in 130 countries could be decreased by 60% by 2050 (Kwauk *et al.*, 2019). However, regardless of the advantages of investing in girls' education, climate action and financing have given little consideration to girls' education as a cost-effective methodology for handling long-term carbon reduction and for building community resilience and adaptive capacity.

Climate change is likely to highlight the gaps between the world's rich and poor. It is generally acknowledged that women in developing countries establish one of the least fortunate and most disadvantaged sections in society. Various human practices are more likely to intensify the present situation of environmental and ecological degradation and increment the development of greenhouse gas emissions in the environment. Among these are deforestation, energy intensity, burning of vegetation, population growth, and, eventually, financial development. Women's contribution and cooperation can, in turn, help and be beneficial in all the above situations (Heyward, 2012). It has been well recorded that rural women, in specific, assume a crucial role in environmental and natural resource management. Women's dynamic association in farming, and their reliance on biomass energy, makes them critical stakeholders in effective environmental management. Therefore, women and their livelihood activities

are especially vulnerable to the risks and dangers presented by environmental depletion. The need to differentiate energy resources and introduce alternative fuels for household use comprises a fundamental part of adaptation strategies (Denton, 2002).

Research also shows that climate change intensifies existing gender inequalities by affecting the most vulnerable individuals, to a great extent, women and girls, most severely. For instance, girls are at a higher risk of early marriage in times of climate-related emergencies, since their settlements can help facilitate the burden of scarce household resources. Additionally, girls are often the first to be withdrawn from schools or attend school less frequently during times of drought so that they can finish household obligations like bringing water. Despite this, considerable research has begun to acknowledge the influential role that investments in girls' education can play in climate change adaptation and mitigation. Research suggests, that for every additional year in which a girl has the opportunity of receiving schooling, her country's resilience to climatic disasters could expectedly improve by 3.2 points as measured by the ND-GAIN Index ¹(Sorensen *et al.*, 2018).

Research suggests that simple and potentially more effective ways of tackling the climate emergency, get less attention. Arguably, one powerful catalyst for rapid change within this sector is the education of girls. Access to education is a fundamental human right. Yet, across the world, girls continue to face multiple barriers based on their gender and its intersections with other factors such as age, ethnicity, poverty and disability. However, there is evidence that for each intake of students, educating girls has multiple benefits that go far beyond the individual and any society. It can also result in a rapid and transformative change that affects the planet itself. This occasional paper, therefore, presents evidence where educating women and girls is and can be one of the most effective, but often overlooked, ways in which we can achieve climate change mitigation and consequently better public health outcomes. Accomplishing gender equality and the Sustainable Development Goals requires multi-sectoral activity. However, climate change techniques pursued by gender, education, and climate actors have remained to a great extent bound to the areas from which they stem. This occasional paper attempts to address this knowledge gap. It focuses on three explicit stages on which actors in these areas can work together and bolster women and girls as operators and agents of change in the quest for sustainable development and equitable climate action. The three stages through which climate actors can be a part of this pursuit relate to promoting girls' reproductive rights, investing in girls' education to encourage climate participation and leadership and the connection between women's well-being and sanitation.

This occasional paper has also explored case studies of experiments that may serve as models to be replicated and scaled. In the most impoverished villages around the world, people are looking for solutions to pollution, poverty, access to clean water and gender inequality. Primarily, there has been one predominating solution that seems to have been disregarded within the climate change agenda, and that is of empowering women to be social agents and change-makers. A woman's voice that has been silenced for generations, often by her community is now being used to inspire and transform people and their communities. Here, a woman's lack of formal education isn't a limitation but is, in fact, a tool that has been used to empower women in low-income rural communities to be able to learn-by-doing and essentially become proficient in the fields of sustainability, without having a specific degree from a university. Rural women have the gift of traditional knowledge and conventional wisdom as well as the courage to help us create a more sustainable world from the ground up. Realising a woman's potential begins with a journey, such as those at Barefoot College in Rajasthan, India, where women are given the opportunity to delve into a world with new challenges and possibilities. Within the case studies discussed in this occasional paper, women are seen learning new technologies the practical way, gaining the skills they need to become empowered social agents, pioneering change. Every day, girls face barriers to education caused by poverty, cultural norms and practices, poor infrastructure, violence and fragility.

¹ This index is instrumental in calculating the vulnerability of a country to climate change in relation to its resilience.

Women and girls' education, however, is a strategic development priority which can be extremely beneficial in climate change mitigation strategies. Within this paper, are several examples of case studies like Barefoot College, Project Safidy and Bhungroo Irrigation Technology, that have been elaborated upon to provide a more in-depth understanding to the kind of initiatives that have been developed over time that give us evidence of ways in which women can be empowered to make significant changes within their communities, as well as globally.

Ensuring Equitable Climate Action by Promoting Girl's Reproductive Rights

There is a clear link between more significant levels of female education and lower rates of fertility. A woman who has completed secondary education is more likely to have fewer children over a lifetime than a woman who has only completed her primary education. For example, Van der Land and Hummel (2013) show evidence that women in Mali with secondary education or higher, have an average of three children. In contrast, those with no education at all have an average of seven children. However, efforts related exclusively on reducing fertility rates and stabilising population growth are woven with moral issues. Instead, the global community must approach women's reproductive wellbeing from gender justice, and rights-based perspective conveyed through quality girls' education.

This perspective can be explained through factors such as decreased infant and child mortality rates, increased age at the time of birth, increased spacing between births as well as increased access to employment opportunities in the formal sector. It has been discussed, that if the universal standard of education for girls was to be achieved soon, the population in 2050 could be reduced by 1.5 billion people whereas if girls' access to education remained as it is, then by 2100 that number could amount to 5.7 billion fewer people (Kwauk and Braga, 2017). For example, some studies estimate that the amount of carbon emissions that can be reduced by lowering the U.S. population, by a single person, is 20 times more than the reductions that could be seen if a single person in the U.S. was more conscious of their carbon footprint and moved towards more sustainable forms of living. Therefore, it is no doubt that action to control population growth has been one of the leaders in conversations regarding women's incorporation in climate mitigation.

Actors concentrated on addressing the connection between population growth and climate change have come fundamentally from the population-health-environment (PHE) community. Associations like Pathfinder International and Blue Ventures, along with their development and conservation work, have been helping women gain access to family planning in specific areas like coastal communities in Madagascar and Tanzania's Great Rift Valley and the Lake Victoria Basin. Here, an increase in population pressures has prompted the unsustainable utilisation of natural resources and an increased vulnerability to climate-related shocks. Studies in PHE have demonstrated that increasing access to family planning and an exhaustive reproductive health care system, explicitly, engaging women with the data, administrations, services, and decision-making opportunities to control their reproductive lives and the number and spacing of their children, generates strength and resilience and improves the adaptive capacity of people and families (Kwauk *et al.*, 2019).

Additionally, environmental economists and other researchers have demonstrated that family planning is a more cost-effective investment in reducing harmful greenhouse gases than other more technical strategies, including adopting wind power technology, shifting to solar power, or driving hybrid vehicles. Significantly, family planning interventions work best in communities with higher levels of female education. Quality education for girls would result in positive impacts on other outcomes as well, including factors like the health status of individuals. Well educated individuals are consequently better producers of health, wherein they are healthier in comparison to those who may have received less education. Additionally, an expanded education of a specific generation would also have a positive impact on the educational attainment of the upcoming generation. Furthermore, an increase in the mother's education would result in raising the level of education among their children (Mocan *et al.*, 2012).

Essentially, investing in women also means investing in families where 90% of the income of Indian women, for example, is invested in their families itself. The research proposes that when funds are rare, investments would be progressively beneficial in terms of reductions in carbon emissions whenever separated between girls' education and family planning as opposed to if they were assigned to one activity over the other (Kwauk and Braga, 2017). Given this, significant efforts ought to be made early on to ensure that girls have easy access to and are in the process of completing a quality education, including aspects related to gender, puberty as well as reproductive health education with critical attention towards issues of gender and power within both formal and informal methods of learning and their environments.

It is evident how studies continue to suggest that girls who stay in schools for a more extended period are more likely to use contraception and other family planning resources that are available to them. Despite this knowledge and evidence, few actors focus on promoting the education of girls' along with their reproductive rights, as smart and cost-effective investments that could have positive contributions for population dependent mitigation agendas (Andrews, 2018). If, however, we approach women's reproductive health from a gender justice and rights-based point of view that can be delivered through investing in quality education for girls', then population-centred agendas can be avoided from being misappropriated by coercive state policies that increasingly violate reproductive rights of marginalised women in the Global South. This revised perspective can create more equitable climate action because women's empowerment and gender equality, in turn, becomes the goal of fertility and population-based mitigation efforts (Kwauk and Braga, 2017).

Investing in Girls' Education to Promote Climate Participation and Leadership

As previously discussed, investing in education for women also means investing in women leaders and consequently in entire communities. One study found that women leaders' part of village councils, invest more in commitments towards infrastructure such as water, fuel and roads. Women are more likely to participate in policy-making if the woman becomes a leader of the council. Studies show that female leaders are increasingly compelling in preservation and protection efforts and are bound to seek after more sustainable practices for the future of their communities. However, as of 2015, women made up just 24% of the 173 delegates to the U.N. Forum on Forests, 12% of the heads of 881 national environmental sector ministries, and 4% of 92 national member committee chairs to the World Energy Council. Endeavours to expand women's cooperation, participation and leadership miss a critical foundational approach that focuses on early learning and building the idea of empowerment among girls from a previous stage (Mocan *et al.*, 2012).

Essentially, quality education for girls' results in higher female participation at various levels. An analysis of 130 countries demonstrated that women were more likely to validate international environmental treaties, and another review of 90 countries showed that those with higher female participation at the parliamentary level tended to protect land areas at higher rates. While this evidence puts forth the defence for expanding the number of women in environmental change initiatives, the rates at which calamities impact especially poor women and girls are additional proof that there are fundamental variables affecting everything concerning female vulnerability to climate change that goes unaddressed when women are absent from the climate decision-making processes. Heads of family units, who in several societies are men, are the central points of aid projects and are therefore given an increase in access to resources and assets, including food. However, if women don't make up the framework that advises planning and responses to climate-related difficulties, alleged gender-neutral conventions will continue to be inconsistent in terms of gender equality. What is critically missing is a crucial systemic approach that focuses on early learning and building a pipeline of girls to women's leadership for widespread, long-term change.

To challenge these discrepancies, one approach dominating climate change action and gender has focussed on increasing women's leadership and participation in crucial climate decision-making bodies and governance institutions. To fulfil this approach, quality education for girls from a young age is of primary importance. This approach is centred on strengthening a woman's voice and her agency while ensuring inclusion, decision-making opportunities and equal participation within her community. For women, this would also include expanding access to economic opportunities, enforcing land rights, increasing access to the use of clean energy as well as increasing women's access to family planning and healthcare services, all of which play a crucial role in involving women in climate mitigation processes. What is most significant in this approach, is the attempt to increase women's participation in disaster response, disaster risk reduction and adaption to ensure that their economic, social and health vulnerabilities and rights are taken into consideration as well as to ensure that their local environmental knowledge is included in decision-making processes (Kwauk, and Braga, 2017).

Such approaches that endeavour to increase women's participation in climate action, mainly aim to develop women's sector-specific technical knowledge about things like sustainable agriculture, warning signs of weather-related disasters, existing mitigation and adaptation processes and their rights in general and how to claim them. Despite current climate change and gender efforts in acknowledging low levels of education among adult women, such approaches often disregard the skills and education levels that are required for girls to attain higher levels of engagement as women. Therefore, while women-specific efforts

are crucial in the short term, the pattern of low female investment and low degrees of female initiatives in climate action will proceed if the global community doesn't connect with and bolster young women today for long term objectives. However, while the associations between poverty, gender-based social discrimination, and climate change take steps to intensify gender-based health disparities, women's social jobs and potential for agency afford opportunities for promoting solutions to sustainability, disaster risk reduction, and solutions to health risks. Guaranteeing that policies move past conventional separations of wellbeing, gender, and the environment and grasp proactive and gender-based arrangements is of prime importance in ensuring women's wellbeing and preparing their vast social potential to mitigate, adapt to, and react to climatic dangers.

Knowles *et al.* (2002) observe that schooling of women and girls' increases the labour productivity across countries. Schultz (2002) suggests that countries with reduced inequalities of educational attainment between men and women have grown faster. Furthermore, he argues that developing countries should reallocate public education resources in favour of women on the ground of efficiency because social returns to education are higher for females than it is for males (Mocan *et al.*, 2012). Drawing on Mocan *et al.*, (2012), a Sierra Leone Demographic and Health Survey was administered in 2008, to investigate the extent to which exposure to enhanced educational resources had an impact on acquired schooling. The effect of schooling on women's preferences regarding their health and well-being was estimated using instrumental variables. It was found that an external increase in education, activates an empowering change in attitudes for women. One avenue through which education can modify an individual's behaviour is through access to information. For example, when a woman becomes literate, she can read and learn about the health risks of unprotected sex. However, while increased degrees of education lead to more noteworthy concerns about the environment, a rapidly thorough investigation is expected to exhibit the effect of female authority on outcomes. This would regard not just women and girls in climate-related catastrophes and sustained climate change, but also overall efforts at climate mitigation, adaptation and sustainable development.

Perceiving women's roles as teachers, parental figures, holders of information, and powerful agents of social change appropriates women to successfully structure and implement socially acceptable interventions where they are required most. Women ought to be empowered as crucial partners at the start of any venture with the understanding that joining scientific data and community knowledge will yield better outcomes. Education about the gender-specific health threats of climate change is required within general wellbeing, public health, policy, medication, and general education. In addition to this, an investment in abilities and capacity building among women will encourage leadership and fortify strength.

The Connection between Women's Well-being and Sanitation

Research suggests that there is a significant interrelation between women's well-being and sanitation facilities, water supply and hygiene practices. If women's interests relating to water and sanitation provision are a vital focus of planning and implementation of programmes, then it would have a direct impact on a woman's life experience, her potential, her opportunities as well as the difficulties she may face. Furthermore, there are increasing benefits for women when they are involved in the planning, administration and implementation of water supply, sanitation and hygiene programmes (Figueiredo and Perkins, 2013). Women who become engaged with the planning, structure, design and implementation of water, sanitation and cleanliness intercessions, are often left feeling empowered. Both the women concerned, and the more extensive female community are currently observed as having certain skills, abilities and potential. This general improvement in their status within the community generates numerous opportunities for women, including various methods for the generation of income as well as the chance of proceeding to possess other public and persuasive roles (Fisher, 2008).

The United Nations Sustainable Development Goals were intended to combat hunger, poverty, illiteracy, environmental degradation and discrimination against women as well as a few other concerns. The fifth SDG is concerned with 'promoting gender equality' and is measured against the targets of achieving gender parity in education and levels of female literacy and representation in government. SDG 6 is 'to ensure clean water and sanitation', with a target 'to halve the proportion of people without access to safe drinking water and sanitation by 2030'. Indicators for this are the proportions of rural and urban populations with sustainable access to improved water and sanitation. However, there is still a long way to go in terms of successfully reaching these targets. Within this period, less than 35% of developing countries have improved access to sanitation and the previous targets set within the Millennium Development Goals of 2000 exceeded its deadline with the target for improved sanitation being missed for over 600 million people. There is a strong interconnection between the SDGs, how they can be accomplished, and the advantages they will result in. An example of this is if a woman can get enough safe water for her family from a close-by pump, she has additional time and opportunities to improve her life and her family's lives through education, paid work and better health. Besides, if women are allowed to take responsibility about where that pump should be put and what requirements it needs to ensure it is well utilised, the advantages are considerably more prominent (Fisher, 2008).

A few research investigations have perceived that the rural poor who depend on groundwater for water supply and rainfall for food production, are especially vulnerable against climate change. It has been noticed that fruitful climate actions to improve food security need to incorporate focused interventions to address gender since women represent 75% of the work in the agricultural sector. Many impoverished women are farmers who endure the effects of environmental change more than men due to the absence of contribution in decision making, constrained access to land as well as restricted access to livestock (Andrews, 2018).

Therefore, if women's interests, perspectives and needs are set at the focal point of decisions about water supply, hygiene and sanitation development activities and programmes, there will be proof of constructive outcomes extending into numerous parts of women's lives. These incorporate the opportunity for personal dignity and individual privacy, better all-round wellbeing (including during pregnancy and childbirth), an increase in educational opportunities, better personal safety and more opportunities for acquiring income (Basij-Rasikh, 2018).

The Need for Education and Wider Relevance

There is a critical need to understand further the elements that determine women's ability to adapt to and adjust to unfavourable climate conditions. The international community and especially those within the climate change field have disregarded the role of education in realising behavioural change for mitigation. Educators have long conventions of education for social change and can utilise their ability on skills, knowledge, and attitude and behaviour change to help decrease greenhouse gas emissions. Quality education is, therefore, a critical element of adaptive capacity, in addition to health, assets and governance. How women are educated and the content of that education, produces the skills and knowledge that are needed to make informed decisions about how women's livelihoods, as well as social, ecological or economic systems, can adapt to the changing environment.

For example, women in Kenya invest more time than men in dealing with family and illnesses. They are conventional water collectors and regular food producers. Extreme climatic conditions like droughts and floods influence the accessibility of food, firewood and clean water and therefore heightens the strain on women in terms of workload. Consequently, women have less time for education, income generation or participation in decision-making processes within their communities (Puzyreva *et al.*, 2018). During times of hardship, women often also seek unhealthy coping strategies and lifestyles to sustain their families. These may include factors like commercial sex work and being exposed to the risk of contracting STD's or even being forced to marry early and obtain dowry to meet her family's needs. Women in traditional communities are often subject to cultural beliefs and are more likely to experience poverty while also having significantly less socio-economic powers than men. In such cases, it becomes increasingly critical to educate and empower women in low economic and agricultural communities. Empowering traditional women would lead to benefits such as securing land rights, ensuring access to financial and productive inputs as well as an increase in the adoption of sustainable practices such as agroforestry, thereby becoming a crucial part of climate change mitigation (Puzyreva *et al.*, 2018).

Recent studies from the World Bank and the Centre for Global Development express that educating women and girls is probably one of the ideal methods of guaranteeing that communities are better ready to adjust and therefore be less vulnerable to extreme weather-related risks and climate change. In light of existing information exhibiting that educating women could potentially reduce their and their families' vulnerability to death and injury during catastrophic events, researchers have found that a large number of climate-related disasters could have been prevented if more developing countries had concentrated on "progressive but feasible female education policies" (Anderson, 2010). In the Global South, neutralising the impacts of climate change soon would require educating a large proportion of women which in turn could enhance their countries' future resilience. Furthermore, the education of women and girls is a highly cost-effective option that has been affirmed by World Bank Research (Chigwanda, 2016).

Studies further suggest that in relation to an individual's capacity to adapt, quality education would play a more crucial role for women rather than men. Improving access to and quality of formal education would be an effective way to increase individual's adaptive capacity concerning the adverse effects of disasters on people's level of education, which in turn reduces their adaptive capacity, thereby resulting in a vicious circle of increasing risk (Wamsler, 2011). In India, for example, there is a persistent gap of 10% between the secondary enrolment rates of boys and girls. In places like Rajasthan, this gap goes up to 30%. Research also shows a relevant drop in 12-13-year-old girls' attendance at schools. Girls and students with exceptional talent are given very few opportunities through traditional centres of excellence, such as in the IITs and IIMs where the share of women ranges from 10% to 12%. The participation of working women in India is seen to be as 40% lower than in Vietnam and China. In India, there are several public and private efforts for primary programmes; however, secondary education has not seen much activity even though adolescence is recognised as a critical transition in the life of a girl. In India, pregnancy during

adolescence leads to a \$100 bn loss in potential income over a lifetime. However, as discussed, an increase in secondary education for girls would eventually lead to a lower maternal and child mortality, a reduction in population growth and an improved education for children (Andrews, 2018).

Globally, 47,700 girls who are about 17 years old and under are married each day. In countries with high rates of child marriage, research shows that keeping girls in school beyond the primary level is probably the ideal approach to avoid early marriage. In Bangladesh, for instance, each extra year of secondary school reduces a girl's danger of marrying before the age of 18 by 4% and decreases her risk of having her first child before the age of 18 by 6%. Higher levels of education are inextricably linked with more robust measures of agency where an individual is more able to make decisions about their lives and is allowed to act on decisions to achieve desired outcomes, without any fears. For example, fewer than 20% of women with a higher level of education lack sexual autonomy as compared to 60-80% of women with no education at all. Effectively, the average impact of investing in girls' education focuses on greater benefits made in the social, monetary, and political conditions essential for achieving gender equality (Kwauk *et al.*, 2019).

The one-woman-focused mitigation strategy that has enthralled climate specialists and demographers for several decades is that of fertility. As indicated by the United Nations Population Fund (UNFPA), there are 1.8 billion youth between the ages of 10 and 24, out of which 600 million are adolescent girls, which presents both, challenges and opportunities for climate change. If countries invest their resources into youth-friendly policies that expect to reduce mortality and fertility rates, they can effectively explore a demographic dividend for financial development due to a larger workforce with fewer dependents. However, if current fertility rates continue, estimates propose that most of the total population growth in the following 40 years will occur in the Global South, where gender differences in educational attainment are most prominent, where women have minimal command over their reproductive lives, where vulnerability to climatic dangers is the highest, and where carbon emissions are anticipated to increase the most in the following few decades (Atkinson and Bruce, 2015).

The competition for resources increases along with population growth and thereby debilitates our capacity to manage climate change. By handling birth rates through investment in girls' education, we can accomplish the most significant beneficial impact of both, improving lives while additionally making those populations, and the world, more resource secure. According to World Bank statistics, the difference in family sizes for women with no schooling as compared to women with 12 years of schooling, is about 4 to 5 children per woman. Therefore, a quality education that includes knowledge and information about family planning guidance and female reproductive health can, in turn, generate more personal opportunities and an increase in financial independence for young women. Croffoot-Suede and Good (2010) analyse that educated girls in secondary school, earn up to 25% more per year, reinvest about 90% back into their families, and are three times less likely to be HIV positive. Instead, they marry at a later stage, have smaller and healthier families and invest in their children's education.

The quality education of girls, therefore, results in assisting populations to become more resilient. It not only helps in decreasing pressures of resources but also increases the opportunities of lasting developmental success with the help of an increase in resource security, specifically in rural communities where much of the population depends on agriculture for survival. As previously discussed, women are the most vulnerable to the impacts of resource scarcity as well as the adverse effects of floods and droughts. Educated women, however, can gain access to and share the knowledge and skills required to mitigate the impact of resource constraints and climate change. With this perspective, the education of women and girls is a significant starting point for social change, where educating a mother would be beneficial to future generations of girls as well.

Consequently, the global population outlook greatly relies upon further progress in education, especially of young women and girls. The United Nations currently proposes that the total population will increase from 7.3 billion today to 9.7 billion by 2050, with a large portion of that development being in the Global South. However, recent research shows that if the education of young women continues to increase, that number would add up to 2 billion fewer individuals by 2045. A better-quality education for girls is also essential for the wellbeing, economic development, democracy, as well as the human progress of communities (Van der Land and Hummel, 2013).

On the political level, as previously discussed, women experience inconsistent access to resources and decision-making processes, making them less ready to influence strategies, programmes and decisions that have an impact on their lives. Universally, just 17% of cabinet and 19% of parliament individuals are women. A recent report from 2009 discovered increasing support for the possibility that expanding women's political status, specifically through representations in national governments, positively affects a state's environmental protection efforts (IUCN, 2015). However, despite the global community's increasing affirmation of the various experiences and abilities that women and men bring to environmental sustainability and development efforts, women still have less financial, political and legitimate power. They are subsequently less ready to adapt to and are relatively more exposed to the adverse impacts of climate change.

Case Studies

Case Study 1 - Barefoot College, Rajasthan

The Barefoot College, situated in Tilonia, Rajasthan, is a not-for-profit social enterprise and a community-based model which is owned, managed and run by the poor. It empowers women and children in vocational skills by working towards financial sustainability, primarily through its community based solar programmes and artisan industries. The Barefoot College, set up in 1972 by Sanjit Bunker Roy, is essentially an Indian based, grassroots organisation, having its values rooted in the life and approach of Mahatma Gandhi's philosophies. For the past 40 years, The Barefoot College has been instrumental in designing new ways to support and nurture a woman's journey towards empowerment, one village at a time, while imparting training to the rural community in vocational skills. The college demonstrates and decentralises technology and puts new tools in the hands of the rural poor, with a primary objective of spreading sustainability and self-sufficiency. The six-month training programme is conducted at the Tilonia campus where women are given hands-on training in assembling electronic circuits, making lamps and learning how to repair solar units. The founding principles of the Barefoot College adhere to the belief of the endless potential among the rural poor that can be taught skills with which they could transform their village, regardless of gender, ethnicity, caste, schooling or age. With this, Barefoot College offers a woman-centred global network that is dedicated solely to sustainable development among all communities in which poverty exists (Roy and Hartigan, 2008).

The work undertaken by Barefoot College has a substantial impact on the development of a strong, informed and inclusive civil society where long-term and community-led initiatives form the root of their solutions. From the very beginning, Barefoot College has tapped into the undervalued and underutilised knowledge that exists within rural communities, along with which they have catalysed a system of grassroots innovation that empowers women and other individuals to be changemakers. The Barefoot College has a geographic focus on the least developed countries and trains women globally, to be solar engineers, educators and innovators who can return to their villages and introduce light and learning within their communities. Barefoot emphasises on the practical, hands-on and learning-by-doing approach while focusing on poor communities to combat social injustices. One of Barefoot's most revolutionary programmes is the Barefoot Solar Engineering Programme that trains mothers and grandmothers in solar electrification. So far, the college claims to have trained over 15,000 women in skills including health care, water testing and solar engineering. Barefoot graduates or Barefoot solar engineers, return to their communities with light to illuminate homes, with the capabilities of developing clean drinking water systems, and with the skills and knowledge that can be imparted to teach others to do the same.

Barefoot College has a firm belief in its vision of working towards building a sustainable world through the transfer of life-changing technologies, access to information and the ability for communities in the developing world to work together. The college works towards nurturing a global community in which women have the confidence and competence to fully participate in the development of their communities and countries, regardless of the barriers of formal education. Their sole mission is to disseminate the Barefoot Approach, further explained within this study, throughout rural communities across the globe, including approaches for strong environmental impacts, sustainable value change for communities and overall community empowerment. The Barefoot College believes that the skills and knowledge found in rural communities should be heard, respected and nurtured and that the concept of education for rural communities should be redefined. Stemming from the belief that women are the most underdeveloped resource in the developing world, the Barefoot College reiterates that all communities that aspire to emerge from poverty will have women as an essential part of their solutions (Bhowmick, 2011). Given this, the Barefoot programme is designed to improve life in villages from several different perspectives.

In contrast, some of the Barefoot solutions include education, access to water, solar electrification, communication, women empowerment and livelihood, all of which are further explained within this case study.

The Barefoot Approach

Essentially, the programmes that the Barefoot College is putting into practice is not an entirely new approach. It has in fact, previously been followed by Mahatma Gandhi's non-violent approach of equality, austerity and sustainability that has been institutionalised and incorporated into the work and life of the Barefoot College. However, while adopting Gandhian ideologies into its work ethics, the college remains distinct in terms of prioritising the same principles and holding it universally relevant even in the 21st century. The College strongly opposes the 'top-down' development approach, but instead, aims to identify and apply existing traditional skills and knowledge, while giving practical skills greater importance than theoretical knowledge, from the bottom-up (Roy and Hartigan, 2008). The Barefoot College believes that illiteracy is not a defining factor in determining whether an individual can be a solar engineer, an architect, a designer or a communicator, or even one that can construct rainwater harvesting tanks. It emphasises that there are several powerful methods of learning apart from the written word itself. The most significant eligibility criteria for an individual to join Barefoot College is to be illiterate, semi-literate, perhaps physically challenged, from the rural community and one without any qualifications. In this way, the college challenges the formal education system by training women with very little or no educational experiences (Goel, 2018). The individuals that attain places at the college mainly come for the many challenges and the desire to influence fundamental and lasting changes within their communities. They come to try new ideas and for the possibilities of making mistakes and learning from experiences. Through advocating capacity building within the rural poor communities, the Barefoot graduates, eventually become Barefoot teachers, doctors, solar and water engineers, health workers, architects and designers, to name a few.

The Barefoot Approach also emphasises respect for five "non-negotiable" values which include equality, collective decision-making, decentralisation, self-reliance and austerity. The Barefoot approach is primarily rooted in a partnership model between individuals and their communities and comprises a decentralised, low-cost and community-driven framework that 'capitalises on resources that are already present within villages' (Bhowmick, 2011). The college employs only those technologies that can be controlled and understood by rural communities to improve their quality of life. Being a multi-cultural organisation, it is committed to inclusive development principles, including learning from the communities it serves. The approach adopted to inform the Barefoot Solutions, includes essential elements such as access to energy and education, better health and sustainable livelihoods, that directly impact women. The approach also focuses on the least developed countries targeted by the United Nations, high-risk communities, as well as developing countries that are facing the urgent challenges of climate change.

The Barefoot Model

The Barefoot College is a safe space where things like equality, inclusion and social justice, are a way of life. Mostly villages that are remote, inaccessible and non-electrified are considered for the solar power programme. The college has inspired a vision of grafting together formal urban learning with rural knowledge, enabling the voices of the rural poor to be integral to creating their solutions. Keeping the Gandhian belief as the foundation of the college, the mindset of social justice and inclusion continues to inspire, impact and educate people today. Being exclusively for the poor, this rural college has worked with marginalised, impoverished and exploited rural communities who live on less than \$1 a day. The

programme helps these communities to emerge out of the poverty line with independence, dignity and self-respect. The college employs a public, private and people's partnership model that impacts lasting policy change for the inclusion of decentralised and self-sufficient community models for the delivery of renewable energy (Roy and Hartigan, 2008).

Recruited women from rural communities are brought to Tilonia, Rajasthan, and are trained holistically within cross-cultural cohorts while being empowered to return to their villages with beneficial skills and knowledge. Despite vast cultural differences, women are trained together to become solar engineers and much more. At the Barefoot College, illiterate women learn through listening and memorising with the help of colour-coded charts and panels that enable them to remember the combination and permutation of the wires, without needing to read or write. Knowledge is also imparted with the help of sign language and practical demonstrations along with learning words in the women's local languages. The college applies traditional rural knowledge to meet diverse objectives while also spreading socioeconomic messages at the grassroots level (Goel, 2018).

Barefoot College believes that an individual customer model is not instrumental in carrying an entire community forward, but that a partnership model is the only solution that can enable large-scale impacts. The private sector, the government and civil society, along with communities, is more capable of achieving a stronger and more effective impact in terms of shifting values and challenging social norms. Through its unique and bottom-up model for sustainable economic growth, The Barefoot College Model is also being replicated in Africa, South Asia and Latin America. The initial batch of solar engineers from Uganda, Tanzania, Malawi, Ethiopia, Sierra Leone and Bhutan, completed their six-month residential training programme in Tilonia in 2009, and have set up solar power in their respective villages since then (Bhowmick, 2011).

The Barefoot Strategic Plan and Solutions

The Barefoot Approach has spread across more than 80 countries within the past five years and offers a range of impact strategies that do a lot more than alleviate poverty. The college has developed and operates multiple programme units, with specific models, theories of change and impacts. These models or 'The Barefoot Solutions' include solar energy, education, clean water, livelihoods, professions, and advocacy and empowerment, all to help communities take control of their well-being.

Through Barefoot Solutions, solar energy is not only seen as that which provides electricity and reduces carbon emissions but also as a catalyst to boost income, create employment and provide self-reliant solutions for village communities. Barefoot College trains women and grandmothers to become solar engineers and to learn the skills of solar electrification, water heating, parabolic solar cookers and filtering water through solar-powered desalination. Once trained and graduated as solar engineers, the so-called "Solar Mamas" return to their villages with the necessary skills and equipment to electrify over 50 homes within their communities, each (Bhowmick, 2011).

In terms of education, Barefoot College transforms the conventional education framework by making 'learning' available and accessible to all. They focus on rural networks and tackle social norms around the value of education and gender biases. The college develops the value of conventional occupations such as traditional housewives, weavers and bonesetters, all deeply embedded within formal education lessons. This distinct approach is intended to value conventional wisdom, educate gender-sensitive communities and enable children and women to partake in their communities. The Barefoot Education Programme is designed for cultivating youth improvement in rural areas and accentuates hands-on, learning-by-doing procedures of gaining skills and knowledge. For the 60-70% of children limited from schooling due to

household errands, education during 'night school' programmes offers an elective approach to learning and development. The Education Programme is issue-based, place-based and scholarly where they integrate things like child marriage and domestic abuse, providing contexts that are genuine to the students. The education programme has included over 3,000 children annually and has taught them the significance of collective decision-making, participation, transparency and ethics. This also led to the development of the 'Barefoot Enriche Curriculum' that helps women transform themselves and their communities and provides them with the essential skills and knowledge required to develop their sense of agency. The curriculum trains women to lead in several departments including digital IT skills, women's reproductive health, livelihood skills, legal rights and civil society, environmental stewardship and self-awareness. The college engages over 20 NGOs to work towards the Enriche co-curriculum with the vision of generating grassroots change-makers and entrepreneurs among women and rural communities. With the help of the Enriche curriculum, women are equipped with the requisite skills, information, technology and agency that is needed to transform and empower rural communities (Roy and Hartigan, 2008).

Barefoot College believes that every community has the right to equal access to clean water. Rural communities across India often suffer from water scarcity, droughts and a lack of clean water sources for sanitation and consumption. Given this, the Barefoot programme has implemented a few water solutions to address the range of water challenges faced within rural communities, which include rainwater harvesting tanks, solar-powered reverse osmosis, dams, water desalination plants and wells for groundwater recharge. Access to clean water is one of the world's most imminent climate challenges, and most often it is the women and girls who face the harmful effects of trying to retrieve water from distant and inaccessible sources. Therefore, Barefoot believes that access to clean water is a critical component in their agenda and have developed several solutions regarding the same. Through the Global Rain Water Harvesting Collective (GRWHC), Barefoot connected the roofs to 50,000 litres underground waterproof tanks, and for six months of the year, children would not have to walk to collect drinking water during school hours.

Driven by the ethos of social justice, Barefoot believes that every individual is valued for the role they play in the development of their communities. With the help of the Barefoot Programmes, any individual from the rural community, irrespective of caste, gender, ethnicity, age and schooling, can be instrumental in providing essential services and sustainable solutions for the development of their communities. Through the integration of traditional knowledge and demystified technologies, Barefoot has been instrumental in developing an entirely sustainable artisan industry that offers over 500 professionals the opportunity of availing a viable livelihood. The livelihood programme also provides opportunities for others to become dentists, community health workers and midwives, jobs that are communicated through a radio station that reaches over 50,000 people a day. The college trains many men and women as Barefoot professionals across a variety of careers that in turn help to sustain their communities. For instance, the Barefoot College health care programme offers basic health care services to over 150 villages with the help of a team of over 250 Barefoot health workers and doctors, all of whom have been experientially and practically trained to treat patients. Other Barefoot professions include mechanics, teachers, architects, designers, artisans, carpenters, masons, accountants and computer instructors in addition to other opportunities in areas of solar and water.

Another significant element of the Barefoot College programmes is that of indigenous NGO's and government capacity building. The essence of empowering the rural communities necessitates the development of lasting partnerships, an increase in capacity building as well as advocating for the needs of the rural poor. Barefoot College is associated with several durable partners across various levels of advocating for the incorporation of decentralised community-owned renewable energy models. The extensive network includes sponsors, donors and volunteers across the globe who act as mediators of positive change, advocating against caste discrimination, social inequities, gender bias and illiteracy. The crucial importance of non-traditional and vocational education approaches includes the voices of

marginalised communities and women. The Barefoot solutions, therefore, enable women to return to their communities and not only advocate during decision-making processes, but also increase their opportunities for income generation by imparting and implementing their knowledge and skills developed at Barefoot (Goel, 2018).

The Barefoot College healthcare programme provides basic healthcare services to many villages with the help of a team of Barefoot doctors and health care workers. Through a grassroots network of Barefoot health leaders, the college has cultivated health awareness among rural women, men and children, specifically on issues such as food and nutrition, hygiene, reproductive health, family planning, immunisation and HIV/AIDS. Through these Barefoot solutions, the college aims at providing a holistic approach to long-term stability and sustainability.

The Barefoot Success

Since 1972, The Barefoot College has electrified over 1,896 villages across 93 countries and over 10,00,000 people with light, with 2,546 solar women meeting 14 out of the 17 UN Sustainable Development Goals in the Global South, all through the process of training semi-literate and illiterate women to be solar engineers and entrepreneurs. These include 14 Pacific islands, 39 African countries, 19 LAC&SA countries and 18 Asian countries, where the barefoot graduates fabricate, install, repair, maintain and sell solar home lighting systems within their communities. Today, there are illiterate women solar engineers in Gambia, Mauritania, Cameroon, Mali, Sierra Leone and Ethiopia who have solar electrified their villages. Several illiterate grandmothers who were trained from Tanzania, Rwanda, Uganda, Malawi, and Benin have also solar electrified their communities (Remedios *et al.*, 2013). Since the solar course was initiated in 2005, over 300 Barefoot engineers have brought power to more than 13,000 homes across India. Using the Barefoot Model, a further 6,000 households in over 120 villages in 24 countries, from Uganda to Afghanistan have been powered similarly. According to the coordinator of the college's solar division, the Barefoot engineers have already saved at least 1.5m litres of kerosene a year in India, which would have otherwise been used to power stoves and lamps (Bhowmick, 2011).

After bringing people to Tilonia for several years and training them, the college shifted into a new phase of expansion with the vision of building new training centres based on the Tilonia model, in places "wherever poverty exists" (Roy and Hartigan, 2008). In 2006, The Barefoot College began its expansion with Timbuktu in Mali for the first time. It launched an experiment to provide solar power to specific rural villages that had no potential of being connected to a conventional grid. In 2013, the Barefoot founder, Bunker Roy, was honoured with the Clinton Global Service award, in response to which the Indian government authorised \$2.5 million for Barefoot to launch five regional training centres in Sub-Saharan Africa. Here, Barefoot College International was initiated and, in 2014, Barefoot continued with its international expansion to Zanzibar, Africa, with the inauguration of the first five regional training centres that were based on the model, approach and solutions of The Barefoot College in Tilonia. Any woman from a remote, inaccessible and non-electrified area is eligible to enrol for the International course. Additionally, Barefoot also initiated some expansion plans in Guatemala, for the first regional centre in Latin America. Finally, in 2016, Barefoot launched the first Pacific Solar Initiative, a programme that affected over 15,000 lives across 14 Pacific island countries, aimed at creating solar engineers to install and maintain solar systems within their communities. With this, Barefoot College began its expansion of international programmes and tripled the number of beneficiaries associated with The Barefoot College by 2018. The Tilonia campus has now been replicated in Zanzibar and South Sudan, with the pre-construction process in Liberia, Senegal and Burkina Faso being underway. The map below represents

the countries that have been impacted by Barefoot in places like Africa and Asia, and the number shows the number of Barefoot Solar Engineers.

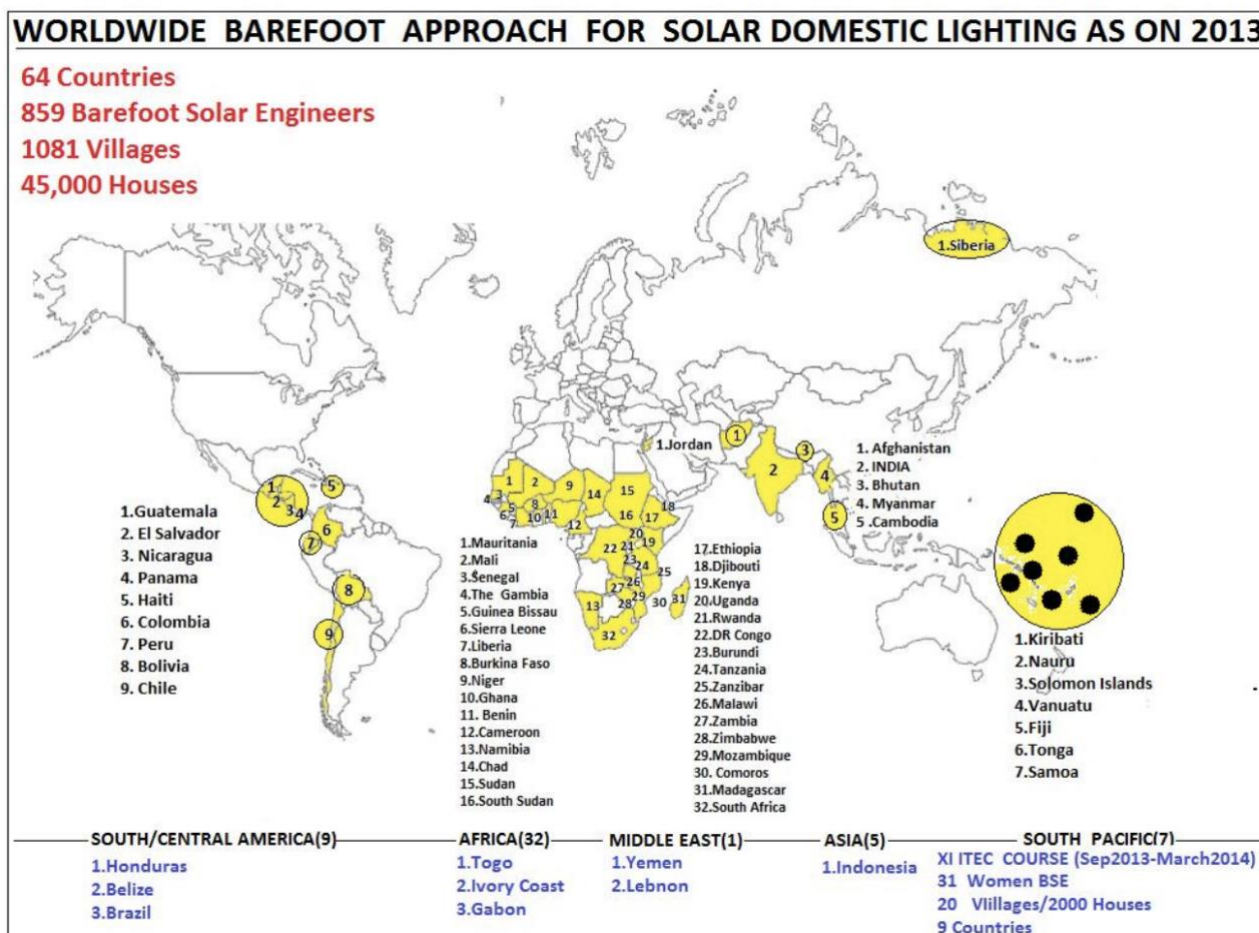


Figure 1: Worldwide Barefoot Approach (Remedios *et al.*, 2013)

Barefoot College has played a significant role in terms of capacity building. It has inspired governments across the Global South in positive and transformative attitudes towards rural communities with a reconsideration of the value that women represent in the developing world. The Barefoot College works along with partners such as WWF, Conservation International, The Amazon Conservation Team and Blue Ventures to help develop communities towards best practices for sustainability.

Challenges

The Barefoot Solar Engineering Initiative for women has faced many challenges with regard to overcoming existing notions about access to education, as rural women have often been convinced that they are unable to learn due to low literacy, gender biases and lack of schooling. Here, the biggest challenge is that of convincing and changing the rural mindset of how educating and empowering women can have lasting impacts. Furthermore, the funding pools and the broader development community is also often challenged due to the lack of conviction in a grassroots community-based model, that has the possibility of having large scale impacts.

Furthermore, in an interview, the founder expressed that every development input in any poor community may have a political impact. The opening of a night school, the installation of a hand pump, the solar electrification of a village by illiterate women, can all be political acts because it leads to the changing of attitudes, the asking of questions and the motivation to act. This implication is one that can be challenged but may face several barriers in the hope to achieve women empowerment.

Conclusion

Through this case study, it is apparent that Barefoot College's inclusive strategy has made an impact on vital issues of social progress. As the global agenda shifts its focus towards poverty alleviation and climate change, the success of The Barefoot College's holistic approach that is founded on empowering women from around the world offers a clear and evident strategy for large-scale impact. Today, over 1,500 villages are solar electrified across many countries, thereby bringing new life to over 500,000 people, one woman at a time, one village at a time and one country at a time. Through its framework, solutions and impacts, The Barefoot College is firm in its belief that an empowered woman is the future and the solution to the global climate crisis. Built on its foundation and its unique approach, The Barefoot College aspires to continue producing demonstrable results through its comprehensive solutions, thereby expanding its potential and making its way into the outer reaches of the world with a message of social justice, economic hope and prosperity. After training the Barefoot Solar Engineers, these women can provide electricity to their communities, which not only gives them recognition and respect but also empowers them and gives them a source of income to support their families and educate their children. The college works because of the simple idea of learning, unlearning and relearning, and the actors seeking change in the scope of poverty and climate change must also imbibe the process of unlearning and relearning themselves. New paradigms are required to envision the resources, skills and talents of those who have been marginalised for so long. The idea of human potential and human relationships needs to supersede the top-down approach in terms of imparting knowledge, where an increasing number of people need to learn to unlearn those things that they thought they once knew, and relearn a new idea of the things that can be possible (Goel, 2018).

The impacts of The Barefoot College exceed generalised social changes and have large-scale impacts within the climate change agenda as well. The villages that are now powered with solar electricity have positive environmental effects and have considerably reduced air pollution, fire and health hazards that often occur due to the burning of firewood. Furthermore, these communities that previously relied on firewood, now see significant reductions in deforestation and land degradation. It also reduces the workload on women who often walk miles in search of wood and increases their economic advantage by improving community-wide economic activities such as handicrafts, which women can now conduct even after sunset. Extended daylight hours enable more flexible schedules for completing domestic tasks, working and studying. In Ghana, solar energy has now been providing lighting for some food processing plants where women produce butter during the night time (Remedios *et al.*, 2013). In Rwanda, women have increased their time in craft-making, in Niger, women have increased their engagement with honey production, and in Ethiopia, women have increased their production of handicrafts, all due to solar electrified areas. Furthermore, one of the most significant and direct impacts of The Barefoot Programme is the drastic change that has been brought about in the social status of women. These women not only feel more empowered as Barefoot Solar Engineers but also gain the confidence to participate in decision-making processes within their communities. This confidence further helps women in obtaining leadership roles to train more women within their communities and spread their knowledge vastly.

Further Potential

Finally, the Barefoot Model of sustainability is and can be easily replicable. Its traditional values, simplicity and unique approach towards rethinking education are effective lessons that can inspire several similar initiatives. There are fourteen grassroots rural organisations in fourteen different states in India that use Barefoot Solutions in tackling community issues and in overall rural development. These organisations take inspiration from the experiences and the successes of the many different Barefoot projects including solar, water, education and livelihood solutions. These organisations are independent of Barefoot College but collaborate as a network, such as SAMPDA, that innovate and develop low-cost methods of empowering rural communities. SUTRA, for example, is an organisation in Himachal Pradesh that also follows the Barefoot solution of night schools for children that live in slums and work during the day. Agramee in Orissa also uses the Barefoot philosophy of training semi-literate women to create ‘ecopreneurs’ that can sustain their households. The Himalaya Vikas Samiti Mission in Uttarakhand is another initiative that replicates the Barefoot model of rainwater harvesting and solar electrification in many communities within the state (Remedios *et al.*, 2013).

The Barefoot model and its approach has enabled the expansion of its programmes and has inspired communities to make positive social changes in culturally and ecologically diverse settings. The best practices and lessons learnt from the Barefoot approach can easily be replicated and generalised due to the reason that these initiatives and philosophies are sustainable, participatory, self-reliant and simple. In such ways, the dissemination of Barefoot’s knowledge, content and solutions can be scaled across the Global South, while also expanding the reach of the Barefoot Education programme. Through imparting the wisdom, knowledge and power of rural communities and transforming them, rural women of the developing world foster the ability to impact social customs, influence values and support sustainable practices through unprecedented capacities.

Case Study 2 - Project Safidy, Madagascar

The interconnection between lack of family planning facilities, population growth and the increasing strain on natural resources led to the development of The Safidy Community Health Programme and the first Andavadoaka Clinic in Madagascar, a family planning clinic that was funded and established by a British Charity, Blue Ventures Conservation (BVC). The concern expressed by the communities in the Velondriake region led to the development of the first “pop-up” family planning clinic in the village of Andavadoaka in Southwest Madagascar, that was established in 2007 with the vision of working towards conservation through educating and empowering women. This initiative is, in fact, part of a wider Population, Health and Environment (PHE) Programme, called Safidy, that has served over 45,000 people and has now been running for over a decade. This initiative primarily focuses on specific economic and participation opportunities for women, including educating women and girls towards more sustainable livelihoods. Within this initiative, the Andavadoaka clinic is essentially a weekly family planning clinic that offers counselling and provides access to injectable and ingestible birth control options and other contraceptive measures (Mohan and Shellard, 2014).

A general lack of awareness about contraception and a significant unmet need for family planning and contraceptive services enabled BVC to expand its work and facilitate the provision of reproductive health education services. With the approval of government health bodies and community leaders, a BVC health

care professional initiated the role of the clinic, which helped in empowering local women and couples to choose the number and spacing of their births freely. Due to this reason, the project came to be known as ‘Safidy’ which essentially means ‘the freedom to choose’ in Malagasy. The project attained widespread acclaim from the day it opened where 20% of all reproductive women in Andavadoaka visited the clinic with the hope of receiving contraceptive services. In addition to community-based family planning services, The Safidy Programme also overlooks maternal and child health and malaria prevention and hygiene promotion initiatives.

The Safidy services and the education it provides is primarily delivered by local women in Madagascar who have mainly been trained to serve as community health workers. These women were trained and supported to offer contraceptive options to couples within their communities and were provided with contraceptive methods at cost price to sell at affordable retail prices. This also enabled these women to generate income from this voluntary work. Through a lasting partnership with the Madagascar Ministry of Public Health, this programme can provide long-lasting contraception services and safe birthing facilities to the local women. Apart from initiating the development of a family planning clinic, Project Safidy aims to provide government-endorsed and rights-based comprehensive sexual education to communities across Madagascar. This community health education programme is essentially designed to support the inculcation of healthier behaviours and to empower couples to make their own reproductive choices as well as to influence attitudes (Mohan and Shellard, 2014). Through this project and its education, young people can be empowered to take control of their sexual and reproductive health and can learn how to avoid negative health outcomes and unintended pregnancies. The educational programme is an integration of international best practices for behaviour change communication with certain principles to develop meaningful interventions. With the help of education and the development of communication skills, young women and girls are more able and empowered to assert their rights within relationships and in larger decision-making processes.

The Project Safidy Approach

Madagascar is home to a staggering array of unique plants and animals, making it one of the world’s most important biodiversity hotspots. Madagascar’s waters support one of the largest coral reef systems in the world and rich diversity of marine life. Semi-nomadic communities in the coastal region have strong cultural ties to the ocean and depend entirely on the marine environment for their food and income. However, due to their extreme isolation, they lack access to even the most basic of health services. Women would often have to travel 40-50 kilometres on foot to visit any clinic, and for that reason, many women who wanted to use contraceptive measures were unable to do so. State-run health clinics within this region suffered supply and staff shortages, and most of the clinics in the Velondriake region were staffed solely by male workers, a significant access barrier for women. Driven mainly by this unmet need for family planning services, the population of these coastal communities in Madagascar was increasing rapidly. Women had an average of seven children each, maternal and infant mortality was extremely high, and the population was predicted to double every 10-15 years (Robson *et al.*, 2017). The population began to increase with a simultaneous decrease in their resources, due to which people also began to use destructive fishing methods. Overfishing, along with other climate change threats began to degrade the marine environment upon which traditional livelihoods depended, and the situation had been compounded due to the lack of livelihood alternatives in the region. BVC began supporting these communities to respond to these interconnected challenges in an integrated way. This approach reflects the inextricable links between people, their health and their environment. In direct response to the unmet family planning needs expressed by these communities, BVC started to offer voluntary planning services, that came to be known as Safidy, the freedom to choose (Robson *et al.*, 2017).

The name ‘Safidy’ is linked with the idea of giving individuals the freedom to choose, where availing services is entirely voluntary for people who desire them. This allows people to make the correct choices

in terms of their reproductive health. Project Safidy also offers many different methods so that people can choose what type of contraception suits them. In addition to outreach clinics run by the midwives, local women have also been trained to offer family planning advice and services in their villages. In remote areas where access is limited and trained health professionals are few, this provides a valuable way of reaching communities with healthcare.

Each component of this integrated PHE approach is supported through educational activities. Several different methods are employed to induce behaviour change and adapt communication strategies depending on the people. Education and specialised support are given across these communities where the advantage of combining conservation and health topics is that people become more aware of such issues. More than 80% of people in these communities now recognise the links between reproductive health, family size and food security. Education of family planning results in a woman's ability to space her births so that she can afford to send her children to school and engage in other economic activities. Women are being empowered to take more responsibility for resource management and conservation and become more resilient to climate change externalities. Integrating health, conservation, education and livelihoods, enables organisations like BVC to engage with communities through a variety of entry points, sharing resources and saving costs across programmes.

With this perspective, Project Safidy essentially employs a rights-based approach towards educating young people on their sexual and reproductive health. This approach is situated within the internationally known concept of Sexual and Reproductive Health and Rights (SRHR), the methods of which have been adopted and endorsed by the World Health Organisation and the United Nations, among others. The SRHR approach not only provides technical health information but instead goes beyond such services to primarily promote personal choices and enforce overall well-being among individuals (Robson *et al.*, 2017).

In the first six years since the programme began, the proportion of women in Velondriake using contraceptives increased more than five-fold while the general fertility rate fell considerably. The connection between family planning and marine reserves is that family planning lets couples choose how many children to have while marine reserves help to increase fish catches. If the population isn't growing too rapidly, and the fish catches are increasing, then the communities can have a better balance between fish stocks and the population. This primarily means that people and the environment can live together and benefit from each other, reinforcing the approach with which Project Safidy was founded.

The Project Safidy Model

The Project Safidy Model is primarily based on the PHE approach, which is essentially an interdisciplinary model of programme design that responds to the interrelated challenges faced by ecosystems and the communities that depend on them. These challenges range from unmet family planning needs to environmental degradation and poor health. This approach reflects how challenges affecting people relate to their environments, often resulting in a vicious cycle with unsustainable resource use, environmental degradation and an increase in poverty (Mohan and Shellard, 2014).

Almost half of the population in Madagascar is under the age of 15, and their reproductive health outcomes drastically influence the future and sustainability of the nation. In 2007, 56% of girls aged between 15-19 from the Velondriake region, were pregnant or already had children, placing them at the highest risk of maternal and infant mortality. There is enough evidence that represents how reproductive health outcomes influence a family's health and economic well-being more than other factors. For example, a girl who experiences an unintended pregnancy is less likely to finish school, thereby decreasing

her opportunities to find employment (Robson *et al.*, 2017). The ways in which comprehensive sexual health programmes have provided evidence in reducing unwanted pregnancies and other sexually transmitted diseases (STDs) such as HIV, emphasises on how educating women and young girls can increase the likelihood of finishing school, gaining employment and contributing socially and economically towards their communities. The local Safidy health education officer oversees the Safidy Educational Programme. It incorporates inputs from all Safidy and BVC staff members, community-based health workers and other community members (Mohan and Shellard, 2014).

Project Safidy is rooted in its belief that young people have ‘a human right to choose’ in terms of the right to choose when to engage in sexual activities and with whom, to decide when to safeguard their health through access to services and the right to choose when to use contraception. In Madagascar, however, the ability to have this right or this agency is, unfortunately, a privilege that is not available to a large proportion of the youth. Driven by a lack of sexual health education and under-resourced healthcare services, young people are prevented from exercising their rights to sexual and reproductive health. Project Safidy has therefore been addressing such gaps through the SRHR process of education in schools across Madagascar.

The project Safidy model has been developed through strong partnerships like Population Services International, which provides initial training for community health workers and helps set up the supply chain for health products. Their collaboration with Marie Stopes Madagascar ensures access to long-acting reversible contraceptives. The integration of education and health services along with an increase in economic activities, holistically completes the PHE model of livelihood diversification, biodiversity conservation, health and education. This approach may not entirely address all the needs and threats of the ecosystem upon which these communities depend but represent an attempt to act and think more holistically as compared to traditional single-sector approaches.

The Project Safidy Success

During the first six years of the Safidy programme, 9,730 months of oral contraceptives, 293 implant implants, 3,101 Depo-Provera injections and 60 intra-uterine devices were provided to more than 3,000 women of reproductive age (Mohan and Shellard, 2014). The first Andavadoaka clinic was instrumental in increasing the village’s contraceptive prevalence rate (CPR) from 9.4% to 36.3% within its first two years. In 2009, BVC also began running fortnightly satellite clinics in other villages in Madagascar, to reach out to more people in the wider Velondriake area. BVC developed a partnership with Marie Stopes Madagascar to offer additional long-acting contraceptive options, including intrauterine devices and implants. However, despite the expansion of their outreach, there were still a large number of people who lacked access to family planning services across Velondriake. So BVC began collaborating with Population Services International in 2010, primarily to educate and train local women as community-based distributors of short-acting contraceptive options. Now, these community health workers not only provide family planning services but have also been trained to manage common childhood illnesses and respiratory infections, to offer reproductive health information to pregnant women, to facilitate small group discussions to support the inclusion of health-promoting practices, sell water-purifying solutions and are also instrumental in encouraging community engagement in marine resource management (Kirkby, 2020).

In 2013, The Safidy programme received an Excellence in Leadership for Family Planning (EXCELL) award and the St. Andrews Prize for its inspirational work in the national health-environment network and for promoting population-health-environment partnerships. With the help of the Ministry of Education, Project Safidy has been instrumental in implementing an integrated SRHR curriculum in 214 schools, across 22 regions, reaching over 30,000 students. Through delivering topics such as menstrual

hygiene management, early pregnancy and gender-based violence, students become comprehensively equipped to exercise their SRHR learnings beyond the classroom. Beginning with the clinic in the village of Andavadoaka, the Safidy programme now serves over 45,000 people across four regions in Madagascar including Velondriake, the Barren Isles, Belo sur Mer and the Ambanja and Ambaro Bays, all through community health promotion efforts. The number of women of reproductive age in the Velondriake area using contraception services has increased more than five times since the programme was initiated, with an increase from less than 10% to over 50% as of 2016. Across three of the regions, over 15,600 couples have been protected from unintended pregnancies, and over 4,500 unwanted pregnancies have been averted across 25,000 people (Robson *et al.*, 2017).

Since Safidy was established, the Safidy teams have fostered strong links with other BVC programmes ranging from fisheries to aquaculture and have witnessed encouraging developments in gender equality and local marine resource management. Women now constitute 38% of the general assembly that governs the locally managed marine area in Velondriake. Safidy has come a long way since their first ‘pop-up’ clinic in Andavadoaka in 2007 and is now working on their ambitious commitment of increasing the access to family planning services for 600,000 people living in geographically hard-to-reach coastal communities.

Challenges

Integrating environmental programmes with health interventions often generates challenges in terms of the difficulties that conservationists face in sustaining long-term community engagement in conservation efforts. Ensuring that community-based health workers and distributors remain motivated to impart knowledge and services for such a low income can prove to be challenging. Up till now, this has been dealt with by ensuring regular training and follow-ups for the community workers, for which they are paid to attend by the Safidy team.

One of the most significant challenges faced by Safidy and BVC health workers is the lack of adequate state-provided healthcare. Resource limitations and weak transportation links across the 40 villages has resulted in a lack of provision of services and intrapartum care in many areas by the Safidy midwife herself. Due to this reason, a large part of unmet health needs continues to exist for a lot of women in the region, thereby limiting improvements in overall health outcomes. This factor also leads to the intermittent appearance of travelling ‘medicine sellers’ who are people with no pharmacological or medical training, selling a range of medications without any form of clinical supervision. Without providing any appropriate advice or medical prescriptions, these individuals sell oral and injectable contraceptives in remote areas and were eventually discovered by the Safidy team (Robson *et al.*, 2017).

Cultural taboos regarding talking openly about sex and contraception, also present barriers to engaging youth in vital conversations and education programmes. However, the Safidy family planning initiatives are empowering women and couples to be more open and take immediate action and control over their fertility, thereby providing long term benefits to families and communities. This approach of integrating family planning services, also offers conservationists more opportunities and entry points to engage with communities and in turn, help to reduce resource pressures.

Conclusion

In adopting a population, health, environment approach, Safidy, along with BVC, has generated synergies that enable more effective developments and achievements of health and conservation outcomes. Through the community health programme, Project Safidy has enlightened students, young women and girls with the importance of beginning SRHR education at a young age to prevent negative reproductive consequences such as unwanted pregnancies and STDs. Through Project Safidy, young women and girls are educated and equipped with the knowledge that is needed to prioritise and protect their reproductive health while also encouraging them to think about their futures.

Along with building and increasing the work done around family planning, there is a hope that if communities become healthier, they can also become more resilient to climate change. Essentially, a broad human-rights based approach is crucial for removing barriers to community engagement in conservation practices. PHE programmes are instrumental in combining family planning and other health services with community-based natural resource management and livelihood diversification initiatives. These programmes are vital in generating important benefits for communities while also advancing conservation. Through this PHE network, the Safidy programme is instrumental in standing up for the human rights of all individuals to choose freely during times of childbirth through informed contraceptive choices. Furthermore, this integrated and multi-pronged approach also enables effective progress towards a more sustainable future.

This case study represents how BVC and Project Safidy has used the PHE programme design for providing family planning services in a remote coastal region in Madagascar. The PHE framework responds holistically to the challenges faced by communities and their ecosystems, and within the context of Madagascar, the PHE programme has integrated family planning services into a pre-existing, community-based conservation effort. Apart from the strong conceptual rationale of combating interrelated challenges of health and the environment, this case study has provided evidence of the increasing benefits of employing an integrated approach. Integrating health services and family planning into conservation projects has the potential to provide immediate, practical and long-lasting benefits towards gender equality, poverty reduction, health, food security, biodiversity as well as resilience towards climate change. Initiatives like Project Safidy also provides the international family planning community and respective governments with a mechanism for contributing and delivering services to inaccessible and remote areas of high biodiversity. When women can manage their fertility, they develop a greater sense of self-efficacy and have more opportunities to engage in economic, educational and natural resource management activities. Healthier and more engaged communities are also more likely to adopt more sustainable and effective methods of sustaining their ecosystems and natural resources upon which their livelihoods depend. Essentially, the use of family planning enables the reduction in population growth rates, and lower growth rates result in a decrease in pressures on natural resources. This, in turn, leads to healthier ecosystems which results in more available natural resources, leading to healthier families. The recognition of this inextricable link between communities, their health, and the environments in which they live, is the approach that has driven the Safidy Project to its significant, effective and impactful success.

An analysis of the Safidy and BVC Programme reflects that voluntary family planning services offered by a marine conservation organisation among villages in Madagascar have resulted in a significant increase in the uptake of modern contraceptive use and a decline in fertility rates. It also shows that environmental conservation organisations can partner with health agencies to address unmet daily planning needs and enforce reproductive rights effectively. Lastly, this study of the Safidy Project depicts how changes in fertility due to increased access to family planning services, may unburden the pressures on natural resources and thereby generate local environmental management efforts.

Further Potential

Over the coming years, the Safidy Project aims to work towards increasing the autonomy of the community health workers at their sites, while integrating with and strengthening the public health system as appropriate. The Safidy project hopes to collaborate with new partners to address unmet water and sanitation needs while exploring ways in which they can support better nutrition through their integrated programming.

There is immense potential for replicating this approach. Essentially, Madagascar is not the only place experiencing these interrelated challenges of unmet healthcare needs and unsustainable reliance on natural resources and environmental degradation. These challenges are faced in many biodiversity hotspots in the developing world. With the success of the many programmes like Safidy that have been developed by BVC, the benefits of working in an integrated way have been made apparent. Other conservation and health organisations can also collaborate and replicate this approach. By addressing community needs and the threat to the environments upon which livelihoods depend, organisations can aim to strengthen local conservation efforts in a holistic way while reaching the hard-to-reach populations with vital health services. To ensure universal access to reproductive health, unique and innovative projects such as Project Safidy, based on a PHE model, can be considered.

Case Study 3 - Bhungroo Irrigation Technology

Finding feasible solutions to climate change issues has been a lasting process for researchers and professionals. Across the world, climate change adaptation activities have developed on ground levels to help tackle challenges such as food insecurity, floods and dry spells due to increments in extreme climatic conditions. A significant number of these local activities have increased universal media recognition for their advancement and proficiency, including acknowledgement and support from the United Nations Framework Convention on Climate Change (UNFCCC) and associations with other worldwide organisations, like the International Union for Conservation of Nature and Natural Resources (IUCN). This dynamic is a key part of "transnational advocacy networks" (TANs), which are systems that include those actors working on international issues and are bound together by values, common agendas and a strong exchange of information and services and people-to-people interactions at various levels from local communities to international NGOs (Christoff and Sommer, 2018). Recently, a few local projects addressing climate change adaptation as well as increasing the status of women have received widespread acclaim for promoting the importance of both gender and climate issues. Given this, this case study focuses on one such project, The Bhungroo Irrigation Technology, that addresses both climate change adaptation as well as gender equality (Preetha, 2018).

Drought has been a significant challenge and issue faced by communities in the Western Indian state of Gujarat, India, particularly by underprivileged women farmers whose livelihoods depend on the monsoons. Poor terrains, as a result of climate change, has made it increasingly challenging for farmers to cultivate their lands during the dry season. The Bhungroo Irrigation Technology was developed in Gujarat, to empower rural women to prepare for disasters, improve food security and provide an opportunity for generating income through water technology usage. This project was primarily developed in response to the 2001 earthquake that resulted in large-scale water scarcity within the rural communities. Due to the earthquake, temperatures rose drastically, resulting in acute water scarcity, and was followed

by heavy monsoons and immense water logging in the fields. This situation resulted in several challenges across various months of the year, but also provided the founders of Bhungroo to recognise the potential of using these challenges as solutions. For example, the challenges of excess water above the ground could be an advantage if stored underground for later months. These factors led to the development of the Bhungroo project, a water harvesting technique that uses an injection module to store excess rainwater underground, allowing farmers to utilise the stored resources for irrigation across all seasons (Samuel, 2016).

Over the years, the Bhungroo Irrigation Technology has been improved and developed to be a more sustainable solution to steady farming, harvesting and storing water for irrigation, in both, dry and wet seasons. This sustainable initiative has proven to be a long-lasting solution that is integrated with the need to improve the livelihoods of the poor and semi-illiterate rural women. Naireeta Services, the organisation under which the Bhungroo project was developed, trains women to use this technology and impart their knowledge within their communities and educate other women to do the same, thereby widening their skillsets and giving them a sense of agency. Here, women have been given the responsibility for managing the irrigation technology, thus helping them improve their social power in places like Gujarat, where the majority of women do not have adequate land rights (Christoff and Sommer, 2018).

Essentially, Bhungroo Technology is beneficial in fighting both dry spells and waterlogging issues with a unique rainwater harvesting technology. Providing rural women with the rights to Bhungroo Technology has proven to be a significant action in terms of giving women control over their natural and social environments. Despite not having land rights, women now have the rights to the technology and the tools that farmers require to increase the productivity of their land. Farmers, specifically men, are now able to make their lands more useful and usable by giving women the agency and allowing them to take control of the technology.

The Bhungroo Approach

Large-scale flash floods in the region have been a long-lasting problem in the state of Gujarat, resulting in water-logging, water scarcity, reduction in soil fertility and increase in soil salinity, thereby affecting agricultural produce and farmers' income levels. Traditional irrigation systems divert water from rivers to cities, leading to a reduction in farming and an increase in urban migration, adversely affecting women the most. However, with the development of this simple irrigation technology, the Bhungroo Project has managed to improve farmers' harvests and increase their income generation capacities. Furthermore, this new technology is owned and run exclusively by women (Samuel, 2016).

The Bhungroo Technology focuses on tackling environmental, economic and social barriers that are faced mainly within rural communities. In India, over 6.72 million hectares of land is affected by seasonal waterlogging and salinity, threatening the food security of over 5 million marginal farmers. Marginal farmers in India have less than 2 hectares of land and depend on rain-fed cultivation as their primary source of income. However, recurring floods and droughts heighten farmers' debts and food insecurity, often resulting in farmer suicides. The existing systems and services to address these challenges are often costly and not easily accessible or locally available. Furthermore, poor rural women with no land rights are the most vulnerable in these situations due to their low social statuses.

Naireeta Services is a social enterprise that was established in 2011 in Ahmedabad, Gujarat, specifically working towards the eradication of poverty in India through projects like Bhungroo. This organisation works with underprivileged women with the aim of 'Antyodaya,' a Gandhian ideology that means to serve all individuals in the best possible way, specifically the smaller landholders in rural India that do not have

any access to water services for their crops. Women play a significant role in the agricultural sector in India, in terms of labour and having the capacity of indigenous knowledge. However, this factor is often disregarded within communities as women lack the power and agency in decision-making processes. Women without land rights have particularly insecure livelihoods in these conditions and face the majority of the challenges in terms of farming and food security. However, with the help of Naireeta Services and the initiative of the Bhungroo project, women are now trained to run and monitor the technology as well as impart their knowledge to others. Furthermore, they are made responsible for overseeing the Bhungroo Technology, thereby enabling them to play an active role in land cultivation, agriculture and uplifting their social powers (Preetha, 2018).

The Bhungroo Model

Bhungroo Technology is essentially a water management system that injects and stores excess rainwater underground and lifts it out during dry spells. The underground reservoir is massive and can store as much as 40 million litres of rainwater, harvesting water for about ten days per year and supplying water for as long as seven months. Adding rainwater to underground water reservoirs and artificially recharging aquifers, enables rural communities to continue their farming processes for the majority of the year. The technology ensures that floodwater seeps through a straw (Bhungroo) into a pipe that carries it to an underground well. The water then mixes with the fresh groundwater, but the density of rainwater being lower than that of the water already present in the aquifer enables the harvested water to stay above. Additionally, the salinity of the land is reduced, and the salt is carried below and sinks, leaving freshwater available for usage during cropping seasons. Essentially, by decreasing desertification, this technology helps to develop resilience to climate change and is beneficial in rejuvenating local biodiversity. This not only helps the overall climate agenda but also benefits the local community as it enables the growth of local and healthier foods (Samuel, 2016).

Naireeta Services embodies a hybrid business model, where wealthy and mid-income farmers pay direct and subsidised costs. In contrast, subsidies from federal and state agricultural departments, NGOs and Corporate Social Responsibility programmes fulfil the costs for poorer farmers. Each Bhungroo unit improves the land fertility for five families and ensures cropping for two seasons over 30 years. The costs of installing the Bhungroo Technology has been subsidised under the National Rural Livelihoods Mission (NRLM) where underprivileged farmers and those affected by droughts, are not required to pay any money for the installation. Other farmers with larger landholdings are required to pay a subsidised fee of around Rs. 5000 (Samuel, 2016).

While not all community members are supportive of combating climate change through empowering women, the Bhungroo system particularly identifies the poorest of women who can benefit from this technology. The model works on the basic criteria of providing services to those women with lowest incomes, lacking food security, land with unsuitable soil conditions and having no other income options. Naireeta Services, trains, and empowers rural women to run and monitor Bhungroo technology. These smallholder women farmers constitute Women Climate Leaders (WCLs) who provide fee-based agricultural advice within their communities. Groups of five women, comprising extremely underprivileged and poor rural women farmers collaborate and jointly own the Bhungroo technology systems within their communities. This provides them with an increase in income from their crops and helps women build resilience to climate change by curtailing desertification and enabling more sustainable livelihoods. Women are given necessary tools to use, distribute and manage the technology, where their role is to help their communities adapt to challenging land and weather conditions as well as to give them the power to decide the access to and provision of the water. Women are also then able to use this agency as leverage among their families and communities (Dutta, 2013).

Along with a network of social entrepreneurs across the globe, the organisation has adopted a partnership model where various NGOs, corporations, institutions and CSR wings of organisations have partnered with Naireeta Services to become carriers of the technology. Drawing on the Transnational Advocacy Networks, the Bhungroo project fits into a more extensive external and existing network of climate change and gender equity. Within this broader context, the Bhungroo initiative received immense international support for the programme to expand on the ground. For example, the Bhungroo Technology received the Buckminster Fuller Global Challenge Award in 2017 and continues to receive other support and recognition for its work internationally, which would not have been possible if global ideologies relating to gendered solutions to climate change adaptation had not existed (Christoff and Sommer, 2018). Both international and domestic NGOs have been significant in the success of the Bhungroo project that has been gaining many new partners along the way.

The Bhungroo Impacts

The implementation of Bhungroo technology has resulted in large scale socio-economic and environmental impacts. The introduction of 132 units of the Bhungroo Technology, emancipated over 6,100 poor farmers, resulting in reverse migration and the regaining of land. It has also led to an increase in food security and sustainable livelihoods for over 20,000 marginal farmers and has increased income generation capacities among the rural community, with a 500% increment in yearly family incomes (Christoff *et al.*, 2017). Food security has been guaranteed to a total of 6,550 members who are below the poverty line, enabling these farmers to afford at least two milch animals and one cow, thereby leading to an increase in incomes through allied sector developments as well as an increase in local economic opportunities. Farmers and community members have been able to transform their livelihoods from agricultural labourers to cultivators and have also learnt the benefits of intercropping and other sustainable methods of farming. Furthermore, due to an increase in family income, there has also been a reduction in school dropout rates, specifically for girls resulting in the adoption of further educational opportunities (Dutta, 2013).

As previously discussed, climate change-induced events result in flash floods and waterlogging, reducing soil fertility and affecting the overall agricultural produce and farmer incomes. However, these disasters have now been converted into livelihood opportunities by marginal women farmers with the help of Bhungroo technology. Once implemented, each unit of Bhungroo has a life span of 30 years and frees about 5-10 acres of land from water logging during the monsoons, providing water for at least 20 acres of land during the winters. Therefore, each Bhungroo unit saves the land of five farming families from fertility loss and ensures cropping for at least two seasons for 30 years, thereby ensuring lifelong food security to at least 25 low-income family members. The Bhungroo system, therefore, not only ensures lifelong food security but also guarantees the doubling of income for marginal farmers. In India itself, water-logging drastically impacts about 12 states, including about 7% of the total national landmass, resulting in about 6.7 million ha of land being uncultivable during crucial cropping periods. A minimum of 1.9 million marginal farmers with smaller landholdings, along with their family members, are deprived of food security and sustainable livelihoods. A yearly crop loss volume of at least \$1,580 million can be avoided by the implementation and adoption of Bhungroo Technology (Preetha, 2018).

Bhungroo Technology has also empowered women to employ political positions to improve their livelihoods and villages. These women aspire to participate in micro-planning processes by contesting the elections and standing up for their rights in local Panchayats. The representation of women in local governments also may eventually benefit other issues surrounding gender relations. Furthermore, the programme is also linked to broader concepts of gender equity and climate change adaptation where this technology has helped to evade women's lack of land rights to overcome gender inequality, by providing them with the technology that has made the land more useful. Furthermore, by involving women in

Bhungroo projects, women use their agency to negotiate with the local government to fund more relevant programmes that concern them and their issues (Christoff and Sommer, 2018).

The Bhungroo Success

Since its inception, Naireeta Services has worked with over 14,000 farmers and has been instrumental in transforming 40,000 acres of disaster-affected and barren farms. Along with the help of its partners, Naireeta has managed to install the Bhungroo Technology in many farms across Gujarat, Jharkhand, Bundelkhand, Karnataka, Uttar Pradesh, Andhra Pradesh and Bihar. The initiative has also expanded globally to Bangladesh, Togo, Ghana, Zimbabwe and Madagascar. Naireeta Services has also received support and funding from growing foundations such as The Deshpande Foundation, The Rockefeller Foundation and other NGOs that work on large-scale projects. About 3,000 marginal farmers and agricultural women labourers have been engaged with and received technical education through the Bhungroo project so far. With a gender-centred approach, about 21 Women Climate Leaders have been brought together and have learnt how to utilise and promote Bhungroo technology, thereby delivering fee-based agricultural advice and increasing their income generation capacities. These WCLs have learnt and expanded the irrigation process across their communities and other disaster-affected regions. The Bhungroo system has received widespread recognition and support from the World Bank, Indian and state governments as well as other climate change and development agencies across the globe, for its work on increasing gender equality, climate change adaptation and resilience to natural calamities (Samuel, 2016).

The Bhungroo Project has been beneficial in freeing women from debt, giving them land ownership and enabling them to participate in local governance with the help of their expertise and influence in the agricultural sector. The project has provided food security and sustainable livelihoods to over 18,000 marginal farmers in India, who have over 96,000 dependent family members. The project is rooted in being a women-led initiative, including a fully women-driven process from selecting farmers, implementing the technology as well as operating and maintaining the irrigation system (Christoff *et al.*, 2017).

The Bhungroo technology comes in 17 designs for various agro-climatic zones in India. Through the implementation of Bhungroo Technology, there has been an increase in the accessibility of land for farming, thereby enabling farmers to grow crops throughout the year. This has not only resulted in enhanced management of natural resources but has also improved food security and ensured higher income generation from agricultural activities. Moreover, this initiative has uplifted the role of women in their families and communities, enabling them to participate in local decision-making processes.

The Bhungroo technology and its services have also received several awards including the national DBS-NUS Social Venture Challenge Asia Award, the DST Lockheed Martin India Innovation Growth Programme Innovation Award, the Cartier Women's Initiative Award as well as an international acknowledgement from UNFCCC momentum for Change's 'Women for Results' Award, among many others. The effective use of Transnational Advocacy Networks has increased the possibilities of large-scale sustainable social change.

Challenges

One of the most significant challenges faced by the Bhungroo project is that alternative irrigation systems like tube wells, check dams and canals already exist in the market. However, all these alternative systems present drastic challenges for marginal farmers in terms of costs, access and maintenance. Secondly, it is uncertain whether the Bhungroo Project can be managed in a way that a 'new normal' in terms of an increase in women's social status and political participation can be established. For example, there may be varying cultural dynamics between farmers and labourers in different countries across Asia and Africa, and there may also be different practices in terms of sustainable roles of women globally. Furthermore, since this programme is relatively new, it is not apparent whether future generations of Gujarati women will also assume leadership roles in similar ways (Samuel, 2016).

Conclusion

Effective policies, programmes and projects for gender equality must be developed at the national and sub-national level, to ensure equal space and resources for women to participate in climate change decision-making. There is an imminent need to integrate gender-related concerns within climate change action policies to develop the capabilities, perspectives and unique knowledge of women, to not only build their resilience towards the negative impacts of the climate but also to enable them to be active agents of climate change mitigation.

Through the Bhungroo project, farmers can recover about 70% of the harvested water, thereby benefitting them in terms of using the collected water in times of need to avoid crop loss. If a group of farmers with adjoining lands come together and implement this system, they will reap collective benefits and decrease costs in the longer term. Majority of the Bhungroo systems have been installed free of charge so far, using the money gained through awards received for the innovation of such an impactful technology.

The women-centred Bhungroo Irrigation programme has effectively reduced the impacts of climate change in the Gujarat region and has promoted a cross-cutting environmentally sustainable innovative initiative internationally. Involving local women in NGO-centred climate change adaptation projects appears to increase their agency within their respective communities through varying channels that may be affected by gender awareness, media outreach of NGOs involving women as well as women's political participation in local governance. However, there is a greater emphasis needed in terms of understanding whether local women can benefit from such programmes in the longer term and how these benefits can be extended across all local women. Integrative strategies may enable women to overcome challenging restrictions and may have the potential to place more women within local governments, thereby eventually increasing women's rights as well as transforming educational systems at the local levels. Having observed the challenges faced by rural women, their resilience and their aspirations to adopt new technologies, The Bhungroo system has developed to be a solely women-centric model. The most significant impact of the Bhungroo project has been the change in perception of women by others as well as the change within their self-esteem.

Further Potential

An analysis of the Bhungroo Project provides a framework for the potential evaluation of other projects relating to gender and climate change adaptation. The Bhungroo technology is primarily open-source and is therefore replicable and scalable in other regions. However, one of the founding principles of the technology is that underprivileged and poor communities should use it. Through the support of the Indian Government's Department of Science and Technology, Bhungroo is now being implemented in various African and Asian countries. The Gujarat Ecology Commission has replicated Bhungroo in other regions of the state while the state education board has also incorporated this model and innovation into the school curriculums. A Boston based organisation, Change Agent, has also helped spread the Bhungroo model to parts of Africa. Naireeta Services also plans to increasingly develop the local communities' knowledge to co-create more Bhungroo models in the future. However, being an open-source technology, The Bhungroo Project presents one condition of being used by and for the marginalised.

Findings from the Case Studies

- It is evident that women play a significant role in the agricultural sector in India, in terms of labour and having the capacity of indigenous knowledge. However, this factor is often disregarded within communities as women lack the power and agency in decision-making processes.
- It is apparent that the basis upon which all the case studies depend, is on social change and community transformation and ideally challenging formal education systems and empowering people beyond the idea of schooling.
- All the case studies focus on tackling environmental, economic and social barriers that are faced mainly within rural communities. In all 3 cases, we can see how women are not only educated about things that are relevant to them but how they are empowered to use that knowledge and information and give back to society, spread the knowledge and inform more stable communities.
- It is apparent that women and girls are the most affected in terms of climate change impacts - they are the last to eat or be rescued; they face greater health and safety risks as water and sanitation systems become compromised; they take on increased domestic and care work as resources decrease. Women need to be empowered to use their agency to negotiate with local governments to fund more relevant programmes that concern their issues.
- Through the case studies, we can see that the link between educating women and girls and climate change is indeed a strong one. In all 3 cases, we can analyse how women have been instrumental in making large scale social and environmental impacts either through renewable energy, family planning or innovative water technologies.
- Essentially, giving women that sense of agency can help in terms of the livelihoods of their communities and climate change in general. For example, if women have a say in decision-making processes, then they can make changes accordingly, and if they are given a voice, then they can speak up in terms of their reproductive rights as well.
- Given women's position of being on the front line of the impacts of climate change, women can be uniquely situated to be agents of change - to help find ways to mitigate the causes of global warming and to adapt to its impacts on the ground-level.
- It appears that women-centred projects that are developed "on-the-ground" (i.e., within the geographical region of intervention) generally are viewed more favourably because they consider local factors such as customs and laws to create sustainable solutions.

- In the case of Barefoot College, it is apparent that empowering and educating illiterate women to be solar engineers and spread knowledge is beneficial in terms of providing them with opportunities to develop a sense of agency, to increase their income-generating capacities, to voice their opinions and participate in local decision-making processes as well as develop their self-esteem and respectability.
- In the case of Project Safidy, we can see how family planning and population control is managed along with environmental management through an integrated approach that collaboratively works towards large-scale sustainable development.
- In the case of The Bhungroo Technology, it is apparent that the implementation of this new system has worked towards empowering rural women, preparing rural communities for disasters, improving food security and providing an opportunity for generating income through water technology usage.
- Ideally, there must be investments in multi-stakeholder, multi-sectoral and participatory Climate Change Gender Action Plans to integrate gender-related concerns and build on the capabilities, unique knowledge and perspectives of women, to not only build their climate resilience but also to make them active agents of mitigation.
- As seen in the case of The Barefoot College, one of the most potent tools for increasing the effectiveness of women in climate change mitigation is renewable energy, which can help transform the lives of women by improving their health, increasing their relevance in society, providing them with better livelihood prospects, improving their education opportunities and more. It offers women many entrepreneurial avenues for further deployment of renewable energy, which in turn mitigates carbon emissions.
- Empowering women and challenging gender biases can have a stimulated impact on the achievement of good governance, human development, sustained peace and harmonious dynamics between the environment and human populations.
- New paradigms are required to envision the resources, skills and talents of the women and their rural communities that have been marginalised for so long. The idea of human potential and human relationships needs to supersede the top-down approach in terms of imparting knowledge.
- In the case of Project Safidy, its educational programme is an integration of international best practices for behaviour change communication, and with the help of education and the development of communication skills, young women and girls can be more empowered to take control of their sexual and reproductive health, assert their rights within relationships and in larger decision-making processes and learn how to avoid negative health outcomes and unintended pregnancies.
- Essentially, there is an inextricable link between people, their health and their environments, and therefore communities need to respond to these interconnected challenges in an integrated way.
- Integrating health services and family planning into conservation projects has the potential to raise awareness and provide immediate, practical and long-lasting benefits towards gender equality, poverty reduction, health, food security, biodiversity as well as resilience towards climate change.
- Bhungroo Technology has been instrumental in freeing women from debt, giving them land ownership and enabling them to participate in local governance with the help of their expertise and influence in the agricultural sector.
- Essentially, through these case studies, it is apparent how educating women, and young girls can increase the likelihood of finishing school, gaining employment and contributing socially and economically towards their communities, thereby impacting the climate change agenda both directly and indirectly.
- Ideally, a broad human-rights based approach is crucial for removing barriers to community engagement in conservation practices as well as for empowering women to become social agents of change.

Potential Scalability and Replicability

- There is a lot of scope and potential for work to be done in the rural sector in geographically hard-to-reach communities. Here, women are often unaware of the skills and wisdom they innately possess because of underlying challenges with self-esteem and because a lot of them haven't been allowed to tap into their potentials.
- Both cases of Barefoot and Safidy can be replicated and scaled, and they work on specific models that can influence other projects and form the basis of new initiatives - for example, educating women about family planning and then empowering them to return to their communities and spread that information to others who may not have got the opportunity of receiving that education.
- Ideally, the PHE framework is one that has large-scale impacts because it not only helps in educating and empowering women but represents an attempt to act and think more holistically and is integrated in a way through which the environment and the health of populations can also be impacted through one single initiative.
- One of the best ways forward is that of integrating the community in decision-making processes and integrating various factors like population, health, environment in terms of holistically combating climate change impacts and adopting methods of mitigation - ideally using approaches from the bottom-up and using the potential that exists within rural communities to achieve the large-scale effects.
- There are a lot of biodiversity hotspots in the developing world, facing interrelated challenges of unmet healthcare needs, large scale unsustainable use of resources and overpopulation - these are areas where work can be done to reduce population growth and in turn, help the environment and ecosystems.
- A hotspot or a region with potential for change can be identified, somewhere in the Global South, and some of these models could be integrated into existing educational systems. With a developed approach and a potential vision, one can have several projects within that framework that can develop and operate multiple programme units, with specific models, theories of change and impacts.
- Such initiatives could be developed and advanced to another level where one would not only educate and empower women but provide them with opportunities to put that knowledge to use and give back to their communities, thereby widening their skillsets and giving them a sense of agency.
- The Barefoot College Model has spread across more than 80 countries within the past five years and offers a range of impact strategies that do a lot more than alleviate poverty. The model is also being replicated in Africa, South Asia and Latin America, and the Tilonia campus has now been replicated in Zanzibar and South Sudan, thereby showing its viability for scalability.
- The traditional values, simplicity and unique approach of The Barefoot College, directed towards rethinking education are effective lessons that can inspire several similar initiatives. The Barefoot model can be used to raise awareness of its approach and its power to create impact at scale. Its open-source adoption of curriculum and methods can lead to an international expansion of such an approach.
- Furthermore, initiatives need to be developed that tackle issues of low literacy, gender biases and lack of schooling where the biggest challenge would be that of convincing and changing the rural mindset of how educating and empowering women can have lasting impacts.
- There are fourteen grassroots rural organisations in fourteen different states in India that use Barefoot Solutions in tackling community issues and in overall rural development. These organisations replicate the Barefoot model of rainwater harvesting and solar electrification in many communities and use the Barefoot philosophy of training semi-literate women to create

‘ecopreneurs’ that can sustain their households. These are ways in which the Barefoot model has been previously scaled and shows the potential for further development in a broader context.

- Essentially, generating innovative initiatives and developing low-cost methods of empowering rural communities is the most impactful approach that can be taken towards climate change adaptation and mitigation.
- The Barefoot solution of night schools for children that live in slums and work during the day is also an extremely viable solution for rural education that could be implemented elsewhere. Best practices and lessons learnt from the Barefoot approach can easily be replicated, and generalised due to the reason that these initiatives and philosophies are sustainable, participatory, self-reliant and simple and in such ways, the dissemination of Barefoot’s knowledge, content and solutions can be scaled across the Global South.
- The Safidy Programme now serves over 45,000 people across several regions in Madagascar and therefore represents its potential for scalability through other community health promotion efforts.
- In the case of Project Safidy, integrating health, conservation, education and livelihoods, can enable other organisations like BVC to engage with communities through a variety of entry points, sharing resources and saving costs across programmes. The approach of integrating family planning services also offers conservationists more opportunities to engage with communities and help reduce resource pressures.
- When women can manage their fertility, they develop a greater sense of self-efficacy and have more opportunities to engage in economic, educational and natural resource management activities. Healthier and more engaged communities are also more likely to adopt more sustainable and effective methods of sustaining their ecosystems and natural resources upon which their livelihoods depend.
- The interdisciplinary PHE approach can prove to be extremely valuable in terms of responding to the interrelated challenges faced by ecosystems and the communities that depend on them. Using this approach in potential initiatives can be beneficial in terms of a holistic approach to sustainable development. Furthermore, a broad human rights-based approach is crucial for removing barriers to community engagement in conservation efforts.
- Integrating things like the SRHR curriculum within schools by teaching topics such as menstrual hygiene management, early pregnancy and gender-based violence, can be beneficial in helping students become comprehensively equipped to exercise their learnings beyond the classroom. To ensure universal access to reproductive health, unique and innovative projects such as Project Safidy, based on a PHE model, can be considered.
- In the case of Bhungroo, Naireeta has managed to install the Bhungroo Technology in many farms across Gujarat, Jharkhand, Bundelkhand, Karnataka, Uttar Pradesh, Andhra Pradesh and Bihar. The initiative has also expanded globally to Bangladesh, Togo, Ghana, Zimbabwe and Madagascar, thereby depicting a method of increasing gender equality, climate change adaptation and resilience to natural calamities that can potentially be replicated in other underprivileged and poor communities.
- Furthermore, all 3 cases and their models can also be incorporated within school curriculums, through topics relating to sexual and reproductive health, family planning, renewable energy, alternative technologies, sustainable farming practices etc. from a young age.
- Through imparting the wisdom, knowledge and power of rural communities and transforming them, rural women of the developing world foster the ability to impact social customs, influence values and support sustainable practices through unprecedented capacities.
- There is an imminent need to integrate gender-related concerns within climate change action policies to develop the capabilities, perspectives and unique knowledge of women, to not only build their resilience towards the negative impacts of the climate but also to enable them to be active agents of climate change mitigation.

Conclusion

There is a large amount of evidence of the constructive outcomes emerging from situating women and their inclinations at the core of planning and implementation of improvements to things like water supply and sanitation. The examples in this occasional paper originate from a wide scope of sources and areas around the world, but the fundamental concept consistently remains the same, where the intercession is increasingly successful and feasible, bringing about numerous enhancements to the personal satisfaction and quality of life of women that are affected and the community in general. The outcomes of such interventions can be seen primarily because women have considerable knowledge of local water and sanitation practices that can be incorporated into implementation programmes, thereby resulting in improved health and quality of life for women and their communities. It is therefore critically important that these effects are acknowledged in terms of planning, design and construction of future water supply and sanitation services.

In terms of climate change, the impacts on the lives of women as individuals, are largely varied, but should essentially include more active roles for women regarding community decision-making processes. These include factors such as increasing opportunities for women to gain financial independence, increasing female attendance in schools, reductions in maternal morbidity and child mortality as well as an improvement in health for women and girls (Fisher, 2008). Although this field is convoluted by other social elements, it is currently certain that getting more girls into school, and giving them quality education, has a progression of significant impacts. These include decreased frequency of illnesses, higher life expectancies, an increase in economic prosperity, lesser forced marriages and fewer children. Greater educational access and accomplishment not just equips women with the aptitudes to manage the impacts of climate change, but also gives them influence over how their communities may take precautionary measures.

Empowering women as caretakers, educators and holders of knowledge can entitle them to be agents of social change that can help improve adaptation and mitigation strategies and policy interventions. Demographic researchers analysing the connection between population and climate change have seen education, as a critical factor in deciding how well societies will adapt to climate change in terms of mortality, fertility and migration. It will take more than equipping women with the abilities to adjust to the impacts of climate change but will instead require a 'holistic societal approach' to transform the processes, structures, and systems that have held women back. A 'holistic life approach' including ways in which improving women's status through quality education and opportunities as girls, will similarly assist with guaranteeing that the future generation of women will have the vital information, knowledge, skills and attitudes to partake in climate action and sustainable development.

As discussed within this occasional paper, quality education for girls' will not only be instrumental in enhancing women's reproductive health but will also be beneficial in terms of climate mitigation through approaches that are crucial to ensuring equitable climate action. Educating women and girls can be beneficial in promoting women empowerment and gender equality, key factors in reducing women's disproportionate vulnerability to climate-related disasters. Researchers at the Brookings Institution have also shown that a girl with a good quality education would be able to gain greater economic prosperity, out of which a significant amount of her income could be directed back into her family. In the global context of climate change, an educated girl or woman is well equipped with the skills and abilities to withstand and overcome the negative impacts of extreme climatic conditions and changing weather cycles.

In this occasional paper, the analysis of educating women helps in understanding how this change could transform women's preferences regarding the issues that are directly related to women's well-being and

their communities. Primarily, the transformative power of good quality education for women empowers women and girls to use their knowledge and leadership in ways that would make them more intolerant of practices that conflict with their lifestyles and well-being. An increase in education for women helps in mitigating population growth, keeping checks on sexually transmitted diseases, increases opportunities for leadership and thereby affects the climate change dilemma. Furthermore, educating women would help populations become more resilient, reduce resource pressures and increase resource security, specifically in lower-income rural communities, thereby ensure stability in a changing world.

While there are still gaps in the evidence that needs to be filled and questions that need to be explored, achieving gender equality and women's empowerment through girls' education, is a key factor to tackling climate change. Investing in girls' quality education is one of the most cost-effective and high-impact solutions and is the foundation that must be achieved first to address the growing pressures of climate change. Essentially, educating women brings a range of benefits to society and is a critical factor in improving efforts to fight the climate emergency.

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