

Equity in Socio-technical Transitions

Comparing the Green Revolution to Low Carbon Transitions in India

A thesis submitted by

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in partial fulfillment of the requirements for the degree of

Master of Science

in

Environmental Policy and Planning

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August 2021

Abstract

Global greenhouse gas emissions must decline to net-zero by the middle of the century in order to avoid some of the worst impacts of climate change. This will require a large scale, multi-level shift in the energy systems of all countries. How can this transition be achieved in a manner than does not adversely impact the development of the poorest, most marginalized citizens of the world? This thesis looks at what is required for a more equitable low-carbon transition in the Indian context. It compares the ongoing low-carbon transition in India to a previous large scale socio-technical transition - the Green Revolution. It discusses the role that intra and international power diversities played in shaping the Green Revolution. It then looks at how similar power diversities are playing a role in the case of the low carbon transition. It then draws insights from the long term inequitable impacts of these power diversities in the case of the Green Revolution to argue that - in the absence of significant power shifting - the low carbon transition in India is likely to have similar inequitable impacts. In order to avoid this long term scenario the thesis argues for the need to shift power - at all stages of the transition - in both the global and national environmental governance regime.

Acknowledgements

This thesis would not have been possible without the support of many people and dogs. First, my advisor Dr Kristin Skrabut, for her guidance during this process. She helped me organize my scattered thoughts, gave me excellent feedback and pointed me to extremely valuable resources. She was also a strong advocate for my mental health throughout this process and supported me through many panic attacks.

To my reader, Dr Eric Kemp-Benedict, who is the best mentor a person could ask for and who introduced me to so much of the literature around which I built my thesis.

This thesis is an extension of work I began at the Stockholm Environment Institute (SEI) under the guidance of and in collaboration with Dr Sivan Kartha. Many of the ideas in this thesis were developed with him and I owe much of this thesis to his brilliance.

To Emily Ghosh and Zoha Shawoo, my inspiring colleagues at SEI. Our animated discussions on equity and work on shifting power influenced and informed my analyses in this work.

To Dr Janaki Srinivasan, my first mentor who sparked my interest in equity and taught me how to do research.

To my friends and family around the world, especially my mother, for believing I could do this and cheering me up when I was down.

To Pippo and Sums, who are experts at making me laugh and excellent listeners, even when thousands of miles away.

And finally and most importantly, to Yashvanth - my copy editor and partner. Without his unwavering support and unshakeable confidence in me I would get very little done in general and would definitely not have finished this thesis.

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Acronyms

CBDR Common But Differentiated Responsibilities. 41, 43, 44, 48, 54

COP Conference of Parties. 40–44, 48–50

HYV High Yielding Variety. 28, 30–33, 35–37

IPCC Intergovernmental Panel on Climate Change. 7, 9, 43, 56

MEA Ministry of External Affairs. 49

MLP Multi-level Perspective. 13, 17–22, 24, 25

MoEFCC Ministry of Environment, Forests and Climate Change. 49

NAM Non-aligned movement. 47

NAPCC National Action Plan on Climate Change. 44

UNEP United Nations Environment Programme. 39, 42

UNFCCC United Nations Framework Convention on Climate Change. 7, 40

WECD World Commission on Environment and Development. 39

Chapter 1

Introduction

At the 21st Conference of the Parties of the United Nations Framework Convention on Climate Change (UNFCCC) on December 12th 2015, 196 states agreed on a goal to keep global warming below 2 °C and preferably below 1.5 °C above pre-industrial era temperatures¹. To achieve this goal, global greenhouse gas emissions must decline to net-zero by the middle of this century. This will require a large-scale, multi-level shift in the energy systems of all countries. There is a concern from scholars, the Intergovernmental Panel on Climate Change (IPCC), and environmental justice movements as to whether this shift could come at the cost of the socio-economic progress that developing countries need to achieve in order to improve the quality of life for the world's poorest citizens (George, 2020).

In light of these concerns there has been an increasing focus among academics and policy makers around studying the distributional impacts² of environmental policies, and on developing frameworks around environmental justice and just transitions. The idea behind achieving just transitions is to understand what kinds of social interventions would be required to ensure that the transition to low-carbon energy sources also achieves a re-distribution of power within society – giving more power to marginalized voices and oppressed communities.

¹The Paris Agreement

²Unequal distribution of the costs and benefits of environmental policies, environmental destruction, and climate change

The results of a just transition would be a society rooted not just in ecological well-being but also social well-being. There is however a need to understand what a just transition might look like in different developing countries given their unique social, geographic and political constraints.

However, this is not the first time that developing countries have faced major socio-technical transitions – transformative changes to large socio-technical systems like the agricultural or transportation systems. These transitions - whether motivated by necessity, internal policy changes or international market dynamics have not consistently supported long-term development for these countries. The outcomes of these transitions are often mixed and often they have further exacerbated existing social and economic inequities both within the country and on a global scale. My research aims to learn from one such past transition – the Green Revolution – to offer insights into how a more equitable low carbon transition might unfold in the Indian context. The Green Revolution refers to a period when the agricultural systems of many developing countries (including India) shifted from native methods of farming to practices involving imported high-yielding seed varieties, chemical pesticides and fertilizers, heavy farm machinery, and large-scale irrigation systems.

In order to do this I trace how the unique geographical and social environments in India impacted how the Green Revolution unfolded. I pay particular attention to the equity implications of this transition and the role of intra- and international power disparities. I selected the Green Revolution because much like the climate crisis, the need to feed the world’s population prompted a call for international cooperation and technology transfer. I trace the global and national political contexts within which the Green Revolution emerged and played out in India. I then compare this context to the global and national political contexts in which India is currently undertaking a low carbon transition. The long term inequitable outcomes of the Green Revolution are well documented and analysed. Looking at the local and global contexts of the Green Revolution and low carbon transitions in India

together will allow me to study how these contexts are similar. By comparing contexts I will then analyze how emerging equity issues in the case of the low carbon transitions might play out given the long-term equity impacts of the Green Revolution. This is useful in understanding steps that can be taken to mitigate some potential inequitable impacts of a low carbon transition in India.

1.1 The Climate Crisis: Why 1.5 °C?

The need for global greenhouse emissions to decline to net-zero by 2050 is prompted by a need to keep global temperatures from rising more than 1.5 °C above pre-industrial temperatures. To understand why this is essential we must turn to the IPCC's special report on the impacts of global warming of 1.5 °C above pre-industrial levels (IPCC, 2018). This report was prepared by 91 climate change experts from 40 countries. At a high level the report says that keeping global warming below 1.5 °C rather than 2 °C would save hundreds of millions of people from being exposed to climate related risks and poverty. The report also warns that poorer and marginalized communities are at greater risk of being severely impacted by climate change. Countries in the tropics and the Southern Hemisphere would have their economic growth severely impacted by increased global warming. Chapter 3 of the report lays out the specific details of why it is imperative to try and keep global warming within the 1.5 °C limit rather than 2 °C:

1. Around 420 million fewer people will be exposed to heatwaves. 65 million fewer people will be exposed to exceptional heatwaves.
2. Risks of droughts, flooding, extreme fluctuations in precipitation are all substantially lower at 1.5 °C than 2 °C.
3. A much higher range and amount of ecosystem services will be preserved at 1.5 °C than 2 °C. This will benefit food systems (crop yields, aquaculture etc), tourism, transportation and other industries that rely on ecosystem services.

4. At 1.5 °C 6% of insects, 8% of plants and 4% of vertebrates will lose their climatically determined geographic range as opposed to 18% of insects, 16% of plants, 8% of vertebrates at 2 °C.
5. 50% fewer people would be exposed to water stress at 1.5 °C compared to 2 °C.
6. The report also says with medium to high confidence that the damage to infrastructure, land area and economic growth are all substantially lower at 1.5 °C than 2 °C.

As the above evidence suggests keeping global temperatures from rising more than 1.5 °C above pre-industrial levels will have substantial benefits for the world's economy, food and transportation systems and will save millions of lives and is therefore a goal worth pursuing.

1.2 Low Carbon Transitions, Inequity, Power, and Geography – The Need for a Just Transition

The literature around low-carbon transitions in the developed and developing world has expanded beyond a treatment narrowly focused on the engineering elements of low-carbon technological alternatives, their techno-economic characteristics, and energy policies designed to facilitate their deployment. Increasingly, as the public discourse has expanded to accommodate issues of energy justice and the inequitable impacts that the transition from fossil fuels towards low-carbon technology can have in certain geographies and societies, so too has the literature. Wilhite et al. (1996) studied the policy implications of the difference in cultural attitudes towards energy efficiency in Japan and Norway. Sovacool (2009) studied how deeply held ideas of trust and consumption in American society impacted successful transitions to renewable energy technology. Owen and Barrett (2020) show that in the UK, low carbon policy costs are disproportionately borne by low income households.

There is a growing recognition that successful future transitions will require more than just energy efficiency and ‘technological leapfrogging’³ (Baptista, 2018). Baptista (2018) stresses the importance of understanding the historical and spatial dimensions of past transitions in order to make sense of future energy transitions in the context of Sub-Saharan Africa. Broto et al. (2018) stresses that energy justice in the Global South will require unique transition pathways from energy justice in the Global North. Taking the case of Mozambique, they make the case that Western notions of energy justice will not work in post-colonial economies like Mozambique. They point out that policies for energy justice developed in the Global North often require specific conditions for success that are absent in the postcolonial context. In Mozambique for instance, injustices in energy access can be linked to infrastructure developments in colonial times. The current push for renewable energy and environmentally sound technology without a correction of these historical injustices is resulting in fragmented energy access and is ultimately affecting how successful the low-carbon transitions will be.

There are a number of examples of the inequitable impacts of low carbon transitions in India. Yenneti and Day (2015) show through a case study of the Charanaka Solar Park in Gujarat, how the implementation of solar energy policies is resulting in the further marginalization of rural communities and those at the lowest strata of Gujarat society. Acharya and Sadath (2019) showed that energy poverty is not necessarily tied to income poverty in all parts of the world and therefore freedom from income poverty will not always translate into freedom from energy poverty. They showed that in India, for instance, energy poverty is often tied to the caste system.

The literature laid out in this section points to a need to consider the cultural context and potential equity impacts when looking at a low carbon transition. In the absence of these considerations a low carbon transition could result in lower energy access for already energy poor communities. Universal access to affordable, reliable and modern energy services is

³Skipping through stages of technology development rapidly

the first target of SDG 7 (affordable and clean energy) and a low carbon transition without equity considerations will make this target much harder to achieve.

1.3 Research Questions

While there is now a wealth of information about the need to study how the historical, social and political landscape in which the low carbon transitions are embedded shape how equitable the outcomes of the transition are, there is a relative dearth of academic information about how a more equitable low carbon transition can be achieved. To help fill this gap in the Indian context, I propose looking at a past socio-technical transition (the Green Revolution) that bears important similarities to a low-carbon transition along several important dimensions - necessity, international involvement, and calls for technology transfer and financial aid. My specific research questions are:

1. How were the benefits and disadvantages of the Green Revolution differentially distributed across the Indian population?
2. How did the geographic, political, and socioeconomic environment into which the Green Revolution technology was deployed shape these outcomes?
3. In what ways are the intra- and international power disparities for low carbon transitions similar or different to those that ultimately led to the Green Revolution in India?
4. What high-level lessons can we learn from the Green Revolution which can be applied to low-carbon transitions in India with an aim to mitigate some of the inequitable impacts of this transition?

1.4 Methodology & Scope

In order to study the Green Revolution in India and its inequitable impacts I will first present a history of the transition (drawing on available peer-reviewed literature) and then review the transitions through the lens of a socio-technical regime shift using the Multi-level Perspective (MLP). Throughout, I will analyze how intra- and international power disparities have played a role in shaping the path that the transition took in India, paying specific attention to the long-term equity impacts (this information will also be based on a review of the available literature on the subject).

In order to compare the Green Revolution to the low-carbon transition in India I will use the same analytical framework (MLP + critical theory) to examine both transitions. I will review the history of global environmental negotiations within which the current discourse on the need for low carbon transitions has emerged. I will then look at how India's role in these negotiations has shifted over the years paying particular attention to the role that intra- and international power disparities have played in shaping these shifts. This analysis will be based on existing literature on global environmental governance as well as documents that inform on how low-carbon transitions are unfolding in India – national policies, international climate change agreements, UN policy documents, etc. The long term equity implications of the Green Revolution are well documented in secondary literature. There also exists emerging literature on the equity implications of specific low carbon projects in India. My analysis will therefore go on to compare the historical and political contexts within which both of these transitions emerged, and the role that similar intra- and international diversities of power have played in shaping them. It will then show how the emerging literature on the inequitable impacts of low carbon transitions in India supports my hypothesis that in the absence of serious attempts to shift power, the low carbon transitions will also have similar long-term equity implications. I will then draw lessons from the Green Revolution that may provide guidance for a successful and equitable low carbon transition in India.

A case study approach is indicated in this case as it allows for an in-depth study of the interactions between historical international policy decisions and geographical and social constraints in developing countries, and the equity impacts of these interactions. A limitation of a case study approach is that the findings from one case study are not directly generalizable to other developing countries or socio-technical transitions. However this study is not meant to generalize to similar case studies but is merely intended to make the argument that the unique hierarchies of power within developing countries and between countries globally have a strong impact on how socio-technical transitions unfold in these countries, and that it is worthwhile for future transitions to study these aspects. These constraints may well differ from country to country, or even within countries.

1.5 Chapter Overviews

This introductory chapter made the case for the need for a low-carbon transition in India as well as the need to consider the equity impacts of this transition. The rest of the thesis is organized as follows. Chapter 2 makes the case for the use of a hybrid analytical framework in this thesis, combining insights from the socio-technical transitions literature and critical development thinking. Chapter 3 discusses the Green Revolution in India and analyses the equity impacts of this large-scale transition using the framework outlined in Chapter 2. Chapter 4 leads with a history of global environmental negotiations in order to establish the historical contexts and power disparities within which the current discourse on low carbon transitions has emerged. It goes on to discuss and analyse the role India has played in global environmental governance leading up to its NDC (nationally determined contribution at the Paris Agreement) and analyses India's position through the lens of the framework outlined in Chapter 2. Finally Chapter 5 concludes by comparing the power dynamics and pathways in the Green Revolution to conversations around low-carbon transitions in India. This chapter also discusses the long-term equity impacts of these dynamics by drawing on

the previous discussion of the long-term equity impacts of the Green Revolution (in Chapter 3). Specifically it draws the conclusion that similar intra- and international power disparities have impacted/are impacting these transitions in similar ways. Therefore in order for the low carbon transition in India to avoid the long term equity implications of the Green Revolution there needs to be much more focus on bridging power gaps globally (between developed and developing nations) and nationally (between lower caste, low income and upper caste, high income communities) along with lowering atmospheric carbon levels.

Chapter 2

The Analytical Framework

As mentioned in the introduction to this thesis, meeting the goals of the Paris Agreement is critical and in order to meet these goals a large-scale overhaul of the world's energy systems is indicated. Similarly to solve world hunger, a large-scale overhaul of the world's agricultural systems was pushed forward. As Geels (2019) points out, looking at these problems at a systemic level is important as the impacts of the system as a whole are too large to ignore. Energy systems (as an example) account for 70-80% of the emissions and environmental impacts in developed countries Geels (2019). Therefore if long-term large-scale changes in impacts are what is needed, systemic level solutions are essential. In this thesis I therefore draw on the literature around systems transitions – specifically the literature on socio-technical transitions. Agricultural and energy systems both have social (markets, political systems, land-ownership patterns, public education, etc.) and technical components (energy technology, fertilizers, irrigation technology, etc.) and therefore fit the definition of a socio-technical system.

In socio-technical transition literature, a socio-technical system is “a cluster of elements, including technology, regulations, user practices and markets, cultural meanings, infrastructure, maintenance networks, and supply networks” (Geels, 2004). A socio-technical system (for instance an agricultural system or an energy system) is organized by, and both affects

and is affected by, the action of multiple actors and institutions at different levels both within and outside the system. Transitions occur when there is a disruption in the reproduction process of a system that results in a new system structure. Transitions can take place through varying pathways that differ based on a multitude of complex factors such as the time taken to complete the transition, the nature of the actors and technology involved, and external pressures on the system (Geels and Schot, 2007). The MLP on socio-technical transitions focuses on capturing the complexity of radical transformations in socio-technical systems particularly focusing on transitions towards sustainability and resilience. It has become the dominant framework used in academic literature to study sustainability transitions (Sorrell, 2018).

2.1 The Multi-level Perspective on Socio-technical Transitions

Socio-technical systems develop over many decades and involve multiple actors, interactions and technologies. Stability within a socio-technical system is a result of a shared set of rules and norms that guide the interactions, practices, and behaviours of all actors within the system (Geels, 2002). A socio-technical transition therefore involves a change to these underlying rules and norms. A stable socio-technical system obstructs radical change and encourages incremental change. This is because the co-dependency and co-evolution of various sub-systems locks in certain behaviours and technologies. This is often seen in the real world where an inferior technology achieves widespread adoption if they require less radical changes to the supporting infrastructure of the socio-technical system (a famous case being that of the QWERTY keyboard vs the DVORAK keyboard). The MLP on socio-technical transitions aims to understand how socio-technical systems achieve radical change. MLP draws upon previous literature from evolutionary economics (path dependence and lock-in) and science and technology studies (actor-network theory, social construction of technology).

To model the complex and dynamic nature of a socio-technical system transition, MLP situates the actors, institutions, roles, time scales, and activities within a multi-level framework (Geels, 2002). The three levels of the framework are the niche, the regime, and the landscape (see Fig 2.1). The highest level – the socio-technical landscape – is the broader set of long-term economic prospects and cultural values within which the socio-technical system is situated. The level below the landscape level is the socio-technical regime. This level consists of stakeholders who operate based on a set of explicitly codified or internally accepted rules and practices that guide the day to day reproduction of the socio-technical system (Geels, 2002). The regime is therefore responsible for the stability of the system. Innovation within a stable regime is incremental as the different sub-regimes (scientific, political, industrial, cultural) co-evolve and depend on one another. The alignment within the sub-regimes strengthens the stability within the regime as a whole but tensions can occur between these sub-regimes as a result of landscape pressures (Geels, 2002). At the lowest level of the framework are niche innovations. These are less regulated spaces where actors (think-tanks, researchers, policy-makers, firms) are constantly innovating and learning to produce new technologies or approaches for the socio-technical regime in the hopes that their technology will one day break into the regime. Activities at the niche level have a dialectical relationship with the activities at the regime level but are distinct because of the smaller scale and experimental nature of the activities. Niche innovations that are backed by powerful actors at the regime or landscape level and have achieved some level of adoption at the regime level are said to be ‘fully-developed’ (Geels, 2002). Case studies of socio-technical transitions view the different pathways that socio-technical transitions take as a combination of interactions between pressures from the landscape, internal tensions within the regime, and momentum at the niche level (see Fig 2.1) (Geels, 2002).

Geels and Schot (2007) differentiate between the pathways taken by socio-technical transitions on the basis of the nature of the landscape developments, the timing at which the

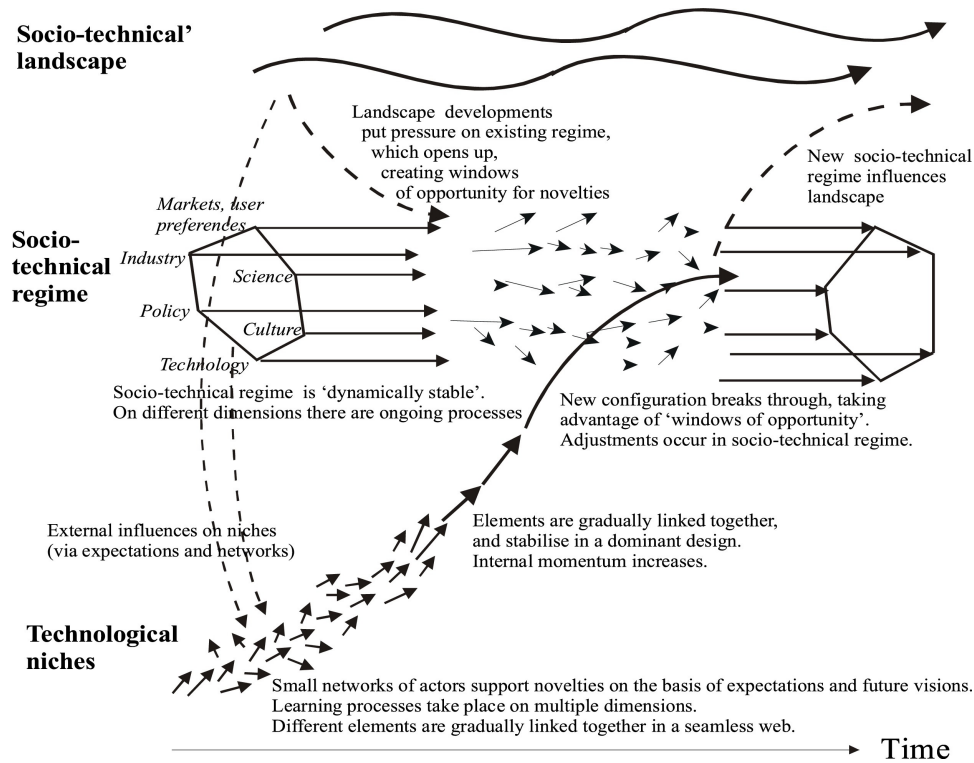


Figure 2.1: Multilevel perspective on socio-technical transitions (Geels, 2002)

landscape exerts pressure on the regime relative to the degree of development of niche innovations, and whether or not the niche innovations aim to replace or reinforce existing regime rules and practices. The transition pathway that the regime undergoes also depends on whether landscape developments are exerted at a time when the niche innovations available are fully-developed (the learning processes are complete, powerful actors are backing it and it has been adopted and tested to some degree by regime actors) or not yet developed (Geels and Schot, 2007).

The MLP is extremely useful in understanding the different kinds of processes, actors, and interactions involved in a transition. It allows for an analysis of the lock-in mechanisms and path dependences that make it difficult to dislodge existing technology from systems. It is also useful for understanding how the nature and timing of interactions between actors at different levels affect the transition pathway. Using this perspective therefore allows one to analyze a transition pathway from one stable regime to another – tracking the different inter-

actions and timings that affected the pathway. For future transitions it allows one to study factors creating path dependence and inertia within the system, and the struggles that niche innovations are facing to break into the system. It is precisely because of these advantages that the MLP is the state-of-the-art framework for analysing socio-technical transitions and is often used to analyze sustainability transitions. As an example, (Geels et al., 2017) use the MLP framework to analyze the low-carbon transition in Germany between 1990 and 2016. They point out that while other frameworks to analyze market transitions focus on policy-makers, producers, and consumers, the MLP framework broadens the scope of actors to include civil society actors, the media etc. The MLP framework also links the interactions of these actors to the broader cultural discourses of the society in which they exist. By using the MLP framework as opposed to a techno-economic framework (concentrating on the role of business strategy and technology) or an integrated assessment modelling framework (which concentrates on environmental science and policy) they were able to capture how exogenous landscape pressures (the oil crisis, nuclear disasters, the reunification of Germany) created windows of opportunity for a low carbon transition and destabilized the existed fossil fuel regime. They were also able to analyze how niche innovations were impacted by regime level politics – public oppositions, industry resistance, and advocacy. They were successful in capturing the disruptive, non-linear, and contested aspects of the low-carbon transition. In doing so they were able to identify and highlight the importance of politics and supply side economics in facilitating a low carbon transition, and were able to support their conclusion that in addition to stimulating innovation, governments needed to focus on how to phase out incumbent technology (Geels et al., 2017). However the MLP has not been applied extensively to case studies in the global south.

2.2 Critiques of the MLP Perspective

Critiques of the MLP point out that it does not adequately capture the politics, power, and space relationships within each level, and it has been criticised for being too deterministic in its approach to new technologies (Lawhon and Murphy, 2012; Smith et al., 2005). The framework focuses on how the momentum of niche technological innovations that break into socio-technical regimes builds up but does not adequately allow for the study of the social and political contexts in which these innovations emerge (or perhaps more importantly fail to emerge in some contexts). Who gets to define the problems that result in niche innovations being created to solve them? Who governs and creates the rules and norms that guide the system, and on what systems of knowledge are these rules and norms based? Is the socio-technical regime set up to systemically exclude certain knowledge systems and constructions of norms?

The MLP also does not adequately capture the role of geographic scale in the socio-technical transitions. Most of the examples of socio-technical transitions are studied at a national scale. The framework is also designed to compare niche innovations, regimes, and developments which take place at the same scale. Coenen et al. (2012) argue that the MLP can benefit from understanding how innovations at different levels compete with each other (for instance how more visible innovations originating in the Global North – characterized in this thesis as global innovations – compete with national or local ones originating in the Global South). This is especially important when considering transitions in the Global South where the actors, power relations, and challenges involved tend to be at a variety of different levels and the constraints are often tied to unique geographies and cultures, and the relative power position of that country in the global economy. So far MLP case studies have overwhelmingly been situated in the Global North (Lawhon and Murphy, 2012).

Finally the MLP takes a largely apolitical approach to understanding socio-technical regimes and does not model the power relations between those who create and benefit from the rules and norms that constitute a regime, and those who bear the costs of these rules but are powerless to change them (Lawhon and Murphy, 2012). To model socio-technical transitions in a country like India – and especially to understand the equity implications of these transitions – in addition to using the MLP to understand the actors, processes, and interactions that shaped the transition pathways, there is a need to think more critically about the political contexts and international discourses within which these transitions emerged. In order to do this I draw on literature from critical development studies to analyze the socio-political context within which the transitions took place and how this context shaped both the actors involved and left out of these transitions, and how the actors involved interacted with one another.

2.3 Critical Development & Political Ecology

The end of World War 2 marked the decline of many colonial empires, and the beginning of the development discourse. This development discourse focused on solving the world's problems by attempting to replicate the high levels of industrialization, technicalization of agriculture, standards of living, etc. that are found in the “advanced” western societies of the world, in the economically “underdeveloped” regions of the world (Escobar, 1995). Several key problems of “underdevelopment” such as “malnourishment” and “poverty” were problematized in the West (Escobar, 1995). In 1965 however, Nkrumah (1965) published their book “Neocolonialism: The Last Stage of Imperialism” in which they made the argument that the development discourse propagated by the West was a form of western imperialism. Rather than bridging the gap between richer and poorer countries, foreign aid in developing states had the effect of creating the necessary infrastructure, political stability, and trained workforce that western economies could then use as a cheap manufacturing site (Nkrumah,

1965). This had the potential to widen the gap between richer and poorer nations rather than the reverse. At around the same time as Nkrumah introduced the concept of neocolonialism, predominantly in Central and South America Marxist economists introduced “dependency theory” (beginning with Paul Baran in 1957 and taken forward by Frank (1969), Cardoso and Faletto (1979), and Furtado (1964)) which also drew ties between development and colonialism. They critiqued the development discourse for not taking into account the fact that development in western states was achieved through a systematic destruction of the economies and industries in colonies. Newly independent colonies still maintained their colonial position in the economic pecking order of the world and were therefore economically still dependent on Western powers.

By the 1980s it had become apparent that the development discourse and the strategy through which development initiatives had unfolded had in many cases led to an exacerbation of inequities between developed and developing nations. However, developing nations had developed in a myriad of different directions, not all of which could be attributed to an economic power imbalance as a result of colonial era injustices. Against this backdrop, the deconstructivist approach to development began to question the historical roots of the development discourse. Many scholars pointed out that “development” was founded upon a system of knowledge situated entirely in the West. Mohanty et al. (1991) for instance, critiqued the development discourse as perpetuating the ideology of Western superiority - portraying specific cultures and geographic regions as backward, powerless, and in need of assistance from Western sources. Escobar (1995) goes a step further and points out that this point of view also perpetuates an ahistorical homogenous way of thinking about all non-Western cultures. Moving beyond dependency theory (which only took into account political and economic domination) this new school of self-aware (critical) development recognized the cultural domination inherent in the development discourse.

Escobar (1995) points out that the sustainable development discourse inherits many of the problematic features of the development discourse. The sustainable development discourse pushes forward the notion that “sound ecology is good economics” and the idea that through rational management of the world’s resources, all human beings can enjoy a quality of life conceptualized in the West for generations to come. Terms like “our common future” do not account for the myriad of different ways in which communities not situated in the West interact with nature, and instead reproduce the single world view of those at the top of the economic pecking order (Escobar, 1995). This is increasingly evident when looking at how intellectual property rights for biodiversity most often do not benefit the indigenous communities that are part of the ecosystems from which this biodiversity comes. Land rights (over forests and water bodies) for indigenous communities in developing countries that do not subscribe to Western notions of land ownership have also clashed with the growth of capitalistic modes of production within those economies. Escobar (1998) presents the strengths of a political ecology perspective in capturing the complex eco-cultural and spatial dynamics of biodiversity problems. In ‘After Nature’ (Escobar, 1999) they take this framework further to stress the importance of cultural pluralism in sustainability solutions. In ‘Designs for the Pluriverse’ (Escobar, 2018) they present how non-Western ideologies taken from the decolonial efforts of indigenous people can be incorporated into designing solutions for a more ecologically just society. Given that India was once a colony of the United Kingdom, drawing on this set of literature to understand how the discourse around agriculture and low carbon transitions were and are being shaped by India’s colonial history makes sense. The literature on critical development and political ecology focuses strongly on explaining the role of power and language in creating and perpetuating injustices within systems. It also focuses strongly on the role of power relations in the emergence and construction of technologies and systems of knowledge. This set of literature draws extensively on case studies in the Global South. The focus on geography and power disparities within this set of literature therefore addresses the critiques of MLP. This kind of analysis also helps predict the inequitable outcomes of

future transitions by exploring how power imbalances were at the root of decisions made during past transitions (Lawhon and Murphy, 2012).

This thesis contributes to the academic literature by adding a critical development and political ecology perspective to the MLP on Socio-technical Transitions framework. The thesis will demonstrate that doing so allows the framework to be better suited to analyzing Socio-technical transitions in India by allowing one to better understand the potential equity implications of the transition.

Chapter 3

The Green Revolution in India

In this chapter we will look at the history of the Green Revolution in India. We will also look at the role that India's colonial history had both on its agricultural systems, as well as in setting up the broader power diversity between India and more developed nations. This power diversity played a major role in shaping the Green Revolution transition, and continues to persist today. This chapter also examines the role of intra-national inequities like caste that pre-date colonialism in the Green Revolution. It examines how a combination of power disparities at the global and local levels shaped the path of the Green Revolution transition, and in the long term led to a widening of inequities in Indian agriculture and between the agricultural and non-agricultural communities.

The Green Revolution refers to a period during which agricultural practices across the world shifted from local, diverse, indigenous methods of farming to farming practices based on agricultural research driven by a single Western ideology – to increase the agricultural yield of the land. It involved a transfer of new technologies like heavy farm machinery and high yielding varieties of wheat and rice, along with the use of chemical pesticides and fertilizers. In India the Green Revolution was successful in eliminating the country's dependence on foreign crops and the political dependency that often accompanied these imports. However the Green Revolution has also been criticized as its benefits were inequitably distributed

(favouring primarily richer farmers in water-rich areas of the country) and led to financial hardships and sociological problems (displacement of communities, loss of land, etc.) for many communities with consequences that persist even today.

Indian agricultural technology at the time of the British invasion (mid-eighteenth century) was comparable or even superior to that of the Europeans (Parayil, 1992)¹. However once India was colonized by the British, agricultural innovation largely stagnated especially in the area of food crops since the British prioritized the growth of cash crops (Parayil, 1992). This created a scarcity of local inputs of water and manure, and interfered with the Indian system of maintaining the productivity of the land (Shiva, 2016). The push for commercial crop production during World War 2 further crippled the cultivation of food grains in India, and at the time of independence (1947) India was left with an agricultural system predisposed towards food shortages (Shiva, 2016).

In response, post-independence (1947) India's first agriculture minister, KM Munshi, developed a detailed strategy to rebuild and regenerate the ecological base of productivity in agriculture through bottom-up decentralized and participatory methods. Between 1952 and 1965, USAID, the Ford, and Rockefeller foundations invested in setting up agricultural research institutes in India (Parayil, 1992). However in the 1960s India was forced to devalue its currency by 37.5% owing to its economic condition at that time (Shiva, 2016). Simultaneously, the World Bank and USAID were exerting pressure on India for liberal reforms, such as offering favorable conditions to foreign investors in India's fertilizer industry, import liberalization, and elimination of domestic controls. The World Bank made these measures more politically and financially appealing by also providing credit for the required foreign exchange (Shiva, 2016). Within India, support for the Green Revolution package came primarily from C Subramaniam (at that time the Minister for Agriculture) and MS Swaminathan (director

¹Parayil (1992) quotes reports from the 1800s in which British reporters discussed how technology recently introduced in Great Britain (such as the drill plough) had been in use in India for some time.

of Indian Council of Agricultural Research, or ICAR). However the planning commission, the Prime Minister (Lal Bahadur Shastri), and economists like BS Minhas and TS Srinivas raised economic, foreign policy, and ecological concerns with the Green Revolution Package – they were concerned about the foreign exchange costs of importing fertilizers, and that importing foreign seeds could reduce India’s autonomy in agricultural research.

In 1966 there was severe drought in India which caused a massive food shortage. India was forced to depend on food grain supply from the US. Lyndon Johnson seized this crisis as an opportunity to increase pressure on India to adopt the agricultural modernization model, by refusing to commit food aid for more than a month unless an agreement was reached (Shiva, 2016). Consequently CS Subramaniam imported 18000 tons of High Yielding Variety (HYV) wheat which was distributed to farmers at subsidized rates. This kick-started the Green Revolution in India – the long term outcomes of which will be discussed later in this chapter.

3.1 The Green Revolution as a Socio-technical Regime Shift

3.1.1 At the Landscape Level

Colonialism and the Agricultural System in India

Patnaik (1972) makes the case that the legal system and property relations introduced by the British hampered innovation in the productivity of agriculture.

1. The British introduced the “zamindari system” where the zamindar (landlord) was the owner of the land, and the peasants paid a fixed rent. In the pre-colonial system, peasants paid the landlords a proportion of their crop production – however during the colonial period, rent had to be paid in cash regardless of crop yield. This meant in

times of poor yield tenants had to borrow (at high interest rates) from money-lenders in order to pay their rent. If they failed to pay, their assets were seized by the landlords. This meant the peasant class was usually in chronic indebtedness.

2. The British rule systematically destroyed the Indian handicraft industry. With no alternative source of employment, former artisans were vying for the tenancy of small plots of land.
3. The zamindars who paid a fixed tax (ten-elevenths of the rent collected) to the British Raj had no incentive to invest in increasing the productivity of the land – since their tenants paid them fixed rents regardless of yield. The peasants meanwhile could not afford to invest in innovative techniques.
4. This meant that during the colonial period, innovation in agricultural productivity in India was largely stagnant.
5. In addition to this, the British Raj created rates of exchange that favoured exporting commercial crops over growing food crops.
6. Ultimately this meant that population growth in India far outpaced the increase in food production (yield per hectare remained largely stagnant during the colonial period). Additionally, the amount of arable land that produced food crops had declined during the colonial period. Overall this meant that India's food production system was predisposed to famines.

In addition to the economic and social impacts of colonialism on the agricultural system of India, a broader landscape development was the setting up of the colonial discourse and power divide between developed and developing economies. As Bhabha (1990) put it, “The objective of colonial discourse is to construe the colonized as a population of degenerate types on the basis of racial origin, in order to justify conquest and to establish systems of administration and instruction ... I am referring to a form of governmentality that in marking

out a ‘subject nation,’ appropriates, directs and dominates its various spheres of activity”. Escobar (1995) goes on to show that this colonial discourse resulted in a development discourse where the technology, methods, and practices supported by developed nations were considered superior to their indigenous counterparts. The power divide between countries in the Global North and Global South meant that even in post-colonial times, countries in the Global North – through promoting development – exercised power over transition pathways in the Global South.

Famines in 1966

A more immediate landscape catalyst for the Green Revolution was a major famine in Bihar in 1966. In 1965 the crop yield in Bihar had been poor (Brass, 1986). Then in 1966 a severe drought caused another shortfall in crop production, leaving food grain production in India as a whole well below what was required to feed the nation (Brass, 1986). At a national level, the Congress government at the centre was already under enormous pressure due to rising discontent from the lower castes as to the dominance of elite castes in government (Brass, 1986). The famine only put more pressure on the Congress to take immediate action. Internationally, the US President Lyndon Johnson was known to be furious with Indira Gandhi’s disagreement with the US policy towards Vietnam (Brass, 1986). He adopted the policy of releasing food aid to India subject to India’s willingness to change their agricultural systems in line with US recommendations and foreign policy interests (Brass, 1986).

3.1.2 At the Niche Level

Apart from the Green Revolution package (HYV seeds, irrigation, heavy machinery, chemical fertilizers, and pesticides) another strategy being considered in India at the time was that of land reform. As mentioned in the previous section on landscape development, the British had set up a feudal ‘zamindari’ system in India which had dispossessed the peasants of their land while ensuring the support of rich landlords in using the land to grow cash crops.

After independence the zamindari system was abolished and ceilings on land holdings were introduced. In addition to that, village level co-operatives were introduced to supply farmers with cheap credit. Despite opposition from the landed class, studies from that time show that the agricultural productivity of India was rising slowly before the Green Revolution was introduced (Shiva, 2016; Frankel, 2015).

Of the two niche technologies available, the first one (the Green Revolution package) could be considered fully developed based on the Geels and Schott definition. The learning processes had stabilized, and powerful actors were backing it (the World Bank, Rockefeller Foundation, and USAID). It was already being used widely in markets in other parts of the world, most notably in Mexico for which it had been developed. Land reform practices meanwhile had been tried out with some success only in India, and enjoyed the backing of only a few socialist organizations within India. Moreover it did not present an immediate solution – which was required given landscape pressures caused by the 1966 famine.

However well established the Green Revolution package was in the global development regime, within India considerable resources had to be invested in convincing the farming population of its usefulness, and in providing financial support for its uptake. HYV seeds also needed chemical fertilizers and pesticides in order for their yield to be high. The government had to invest in expanding the infrastructure to deliver these to farmers (Chakravarti, 1973). The difference in what was considered ‘fully developed’ ultimately came down to the power difference between who was backing what niche innovation. In light of the power divide created by the colonial system, Global development regime actors situated in the Global North ultimately had more power in the decision than the farming community within India. This was especially true given the immediate need for food aid in India.

3.1.3 At a Regime Level

With a compounding of landscape pressures at a time when one technological niche was considered much more developed than the alternatives, the socio-technical regime went through a process of technological substitution. The Green Revolution package was adopted by the Indian government, funded by the World Bank, the Rockefeller Foundation, and USAID. Educational campaigns were launched to persuade farmers to adopt the Green Revolution package. For the first few years, credit lines and financial support were provided by the Indian government to assure farmers that losses made by adopting the Green Revolution package would be borne by the Government. In areas where the green revolution took off, small farm holdings gave way to large farm holdings more suited for mechanical farming. Polycultures made way for monocultures. Manual labour gave way to machinery, and traditional methods of fertilization and pest control – crop rotation, planting legumes, etc. were put aside in favor of chemical fertilizers and pesticides. The agricultural productivity of India rose to such an extent that India became an exporter rather than an importer of food grains (Parayil, 1992)

The costs for HYV seeds were 155 times more than the cost of indigenous seed varieties (Chakravarti, 1973). Consequently poorer farmers in India could not put up the capital to invest in HYV seed farming and were consequently left out of the Green Revolution. In order for the investments in the HYV seeds to pay off, farmers also had to invest in chemical fertilizers and pesticides for their crops. Poorer farmers living in more remote areas – away from railroads – lacked access to these inputs. HYV seeds also required reliable irrigation systems and could not be grown in rainfall dependent areas of India. This meant that only about 20% of India's arable land could be cultivated with HYV seeds (Chakravarti, 1973).

Agrochemical companies (which supply the hybrid seeds, fertilizers, and equipment required for Green Revolution farmers) have been major beneficiaries of the transformed rural

economy. With the opening up of the Indian economy in the 1990s, foreign Multinational Corporations such as Monsanto have further benefited from the acquisition of large amounts of Indian farmland (Shiva, 2016). Rural Co-operative Societies were set up in villages to loan seeds and fertilizers to farmers. However since their setups did not account for existing social hierarchies in Indian villages, they are often run for rich farmers by rich farmers. Richer farmers also found it easier to get loans than poorer farmers (Chakravarti, 1973).

In India, especially in the rice growing region, there was an abundance of agricultural labour. The introduction of modern methods of intensive cropping that were intended to raise labor productivity put many workers out of work (Shiva, 2016). Workers who held onto their jobs did see an increase in wages due to profits of the Green Revolution, but this was offset by inflation as a result of overall economic growth. Farmers protesting in the 1980s referred to the production of wheat to provide cheap food for the urban elite as a form of “urban colonialism” (Shiva, 2016).

The use of chemical fertilizers and pesticides in India has ultimately led to a decrease in soil fertility, erosion of soil, soil toxicity, diminishing water resources, pollution of underground water, salinity of underground water, and has increased incidence of human and livestock diseases (Rahman, 2015). The production costs of HYV seeds is rising and the yields are declining due to environmental degradation (Rahman, 2015).

The Green Revolution caused economic disparities between regions of India. Wheat growing areas benefited more than rice growing areas, since HYV rice is more prone to pests (Chakravarti, 1973). However substituting wheat for rice across India was not possible due to long established food preferences (Chakravarti, 1973). HYV rice is also shorter stemmed than its indigenous counterpart. Dwarfness is a desirable quality in HYV seeds as it allows the seed head (considered the valuable part of the crop) to be heavier without the plant lodging (Dalrymple, 1976). The long stems of the indigenous rice were previously used by

farmers to feed livestock. However in the absence of these long stems, rice farmers had to invest in cattle feed (Chakravarti, 1973). Note that although rice farmers considered the stem of rice valuable (as cattle feed) it was widely regarded as not valuable by agricultural experts situated outside India since it did not increase the yield of the food grain.

Within the same regions, poverty and the caste system meant that richer, upper caste farmers benefited more from the Green Revolution. Apart from being poorer, lower caste farmers had fewer connections with people in authority and therefore often could not get access to loans and irrigation systems as easily as their upper caste counterparts (Chakravarti, 1973). For instance, in 1976 the Haryana Seeds Development Corporation was started as part of the National Seeds Project (funded by the World Bank) to encourage farmers to buy seed producing land by allowing them to pay for the land over a five crop period (Dhanagare, 1987). A 1980 study by Satya Deva showed that all the scheme users were upper caste (Dhanagare, 1987). Similar studies in Karnataka showed that the acreage under upper caste farmers was growing after the adoption of the Green Revolution package in the area, while the amount of land farmed by lower caste farmers was declining steadily (Dhanagare, 1987).

Shiva (2016) examines the case of the Green Revolution in Punjab – one of the states where the Green Revolution technologies were most widely adopted. She points out that while statistically Punjab is one of the most prosperous states in India (the average Punjabi earns 65% more than the average Indian) it also has the highest number of conflict killings in peacetime India. This, she points out, goes against the traditionally accepted philosophy that peace and abundance go hand in hand, a point reiterated by Frankel (2015). Shiva (2016) then goes on to show that the reduction in land fertility and diversity of crops has meant that the Green Revolution – while increasing the quantity of agricultural produce – has produced a scarcity in ecological resources that is at the heart of the inequities and conflicts in Punjab. Green Revolution agriculture requires large quantities of capital to be invested in order to reap large crops – for smaller farmers this initiated a cycle of financial

distress, debt, and dispossession. While initially subsidies and support enabled farmers to invest in the switch to Green Revolution agriculture, over time the need to continually invest along with declining support has increased debt for many farmers. In Punjab, the farmers ultimately held numerous protests (in the early 1980s) on the grounds that they were being colonized to grow cheap wheat for the whole of India while sinking into deeper and deeper debt (Shiva, 2016).

The ‘Gurmata’ (collective resolution) passed at a Sarbat Khalsa (All Sikh Convention) on 13 April, 1986 expressed the communal tension in Punjab as the result of agricultural colonialism:

“If the hard-earned income of the people or the natural resources of any nation or region are forcibly plundered; the goods produced by them are paid at arbitrarily determined prices while the goods bought by them are sold at high prices and in order to carry this process of economic exploitation to its logical conclusion, the human rights of people or of a nation are crushed, then these are the indices of slavery of that nation, region or people. Today, the Sikhs are shackled by the chains of slavery.” (Shiva, 2016, pg 186)

Shiva (2016) stresses the political nature of the term ‘High-yielding-variety’ of seeds – noting that these seeds are not high-yielding in and of themselves, and in fact require the addition of fertilizers and pesticides to become high-yielding. Weeds and pests ultimately become resistant to herbicides and pesticides and new ones have to be produced – thus serving as a source of leverage for multinational agro-chemical corporations over the agricultural sector of India. Shiva (2016) notes that ultimately this means that foreign agro-chemical companies play a decisive role in the characteristics of crops produced. In India, for instance, this has meant that nutritious crops like pulses and oil seeds have had to make way for rice and wheat simply because HYV for these crops were not developed. The ecosystem of Indian villages – where some of the crops were kept aside for subsistence and the waste straw of oil

seeds was kept to feed animals – was therefore disrupted by the Green Revolution. Nutrition in villages declined since only rice or wheat was available and farmers needed to spend money to buy cattle feed. The abundant rice and wheat production made more food available to the urban elite, but created a scarcity of nutrition for rural communities. India's indigenous seed varieties were genetically and nutritionally diverse (Nelson et al., 2019). Since the Green Revolution however the production of these crops has dramatically declined and there has been a rise in anemia and other nutritional deficiencies in rural India (Nelson et al., 2019). The HYV were also developed to require large quantities of water, which in water scarce regions has been the root cause of a lot of conflict. In 1952, due to social agitation the Government of India abandoned a plan to develop rain rich regions of India over their drought-prone counterparts (Frankel, 2015). However the water intensive nature of Green Revolution agriculture naturally prioritized the needs of the water rich regions of India over those of water scarce ones. The de-facto impact of Green Revolution agriculture was therefore the same as that of the abandoned plan.

3.2 Conclusion

Niche actors do not attain the status of 'fully-developed' in a vacuum. When analysing the adoption of niche technologies by developing countries it is arguably as important to look at the absence of certain actors as the presence of others. In the case of the green revolution, this calls attention to the reasons why there were no local technological innovations or HYV developed specifically for the Indian climate, soil, and water availability by Indian scientists.

The Rockefeller foundation did set up Indian universities for agricultural research prior to the Green Revolution in India. However their focus was on adaptive research (adapting foreign seeds and methods to the Indian climatic and geographic context) rather than on development of local crops and building on traditional methods. If there had been local alternatives, the resulting Green Revolution package may not have led Indian farmers to

become so dependent on foreign-based technologies and capital-intensive practices. Local innovations might also have taken into account existing best practices in India such as natural methods for soil fertilization, use of polycultures, etc. which could have eliminated some of the costs (economic and environmental) of the Green Revolution. Moreover local developments were unlikely to have been suited to only 10% of the fertile land in India. Davis et al. (2019) in an assessment of post-Green Revolution cereals in India that are part of a government push for a diversification of crop production and a return to some local grains such as traditional coarse grains (millets, sorghum, etc.) found that these grains are better suited to the Indian climate, are more nutritiously diverse, and require much less water than HYVs (rice and wheat). They can be grown throughout India, not merely in water rich regions, and the yield in many areas is comparable to HYV cereals.

In this chapter we looked at the Green Revolution in India through the lens of a socio-technical transition. We showed how at a landscape level India's colonial history played a major role both in setting up an agricultural system that was predisposed to famine, as well as in setting up a global world order in which former colonies like India were at a power disadvantage compared to more developed economies. We saw how ultimately this has led to large foreign multinational corporations benefiting more from the Green Revolution than Indian farmers. We also saw how this power divide led to a situation where the views of international finance institutions and the United States government were more influential in India's adoption of the Green Revolution package than national level actors were. We also saw how much of the supporting financial infrastructure for the Green Revolution was blind to power inequities in Indian society (between upper and lower caste farmers and labourers) and how in the long term this has led to a further marginalization of these populations.

In the next chapter we will examine the low carbon transition in India using the same analytical framework. We will examine the role that similar power divides are playing in the ongoing transition, and look at inequities that are already emerging.

Chapter 4

Low-carbon Transitions in India

In this chapter we look at the ongoing low carbon transition in India as a socio-technical transition while also paying attention to the role that intra- and international power disparities are playing in shaping this transition. In order to do this we begin by looking at a history of global environmental negotiations within which the current dominant discourse on the need for low carbon transitions has emerged. We then go on to look at how India's position in these global negotiations has shifted over time, and the role that international power imbalances have played in shaping that shift. At a regime level we look at the role that intra-national power inequities have had in shaping the local environmental discourse, as well as who gets to represent India on a global scale. At a niche level we look at how these power inequities are shaping the technology that is increasingly being relied on to drive forward India's low carbon transition, and the emerging inequities resulting from the use of these technologies.

The 1960s was the first decade where industrialization and environmental pollution came into public focus. In 1962 Rachel Carson published 'Silent Spring', which documented the adverse effects of indiscriminate pesticide usage in the United States. In 1968, Hans Palmstierna published 'Plundring, svält, förgiftning' (Plunder, Famine, Poisoning) in Sweden (Paglia, 2021). His work documented the effect of population growth and natural resource

wastage on human survival. Both works became national bestsellers in their respective countries. Additionally several prominent scientists within Sweden warned of rising environmental risks. Environmental disasters like the 1962 fog in London and the Minamata Bay mercury poisoning in Japan (1960s) led to greater awareness internationally about the need to address environmental destruction (Chasek, 2020). Since many environmental problems were trans-boundary in nature, the Swedish government pushed the United Nations to create a forum for a global discussion on the human environment (Paglia, 2021). This led to the 1972 United Nations Conference on the Environment at Stockholm and the creation of the United Nations Environment Programme (UNEP) (Paglia, 2021). The Stockholm Conference was the venue at which differences in developing and developed country attitudes to environmental issues were first raised – unlike their more developed counterparts, developing countries stressed the need for their emissions to continue to increase in order to meet their social and developmental objectives. Developing countries also wanted the developed countries to acknowledge the role that their development has played in creating global environmental issues. In a victory for the developing country group, the headquarters of the UNEP was set up in Nairobi, Kenya. It was the first major UN office hosted in a developing country. The Stockholm Conference also led to the publishing of the Stockholm Declaration which was the first globally agreed upon set of principles to tackle environmental problems (Chasek, 2020). The declaration was groundbreaking in that it acknowledged the need for poorer countries to develop and introduced the concept of additional development assistance from richer to poorer countries in order to enable them to take environmental protection measures (Chasek, 2020).

In the decade following the Stockholm Conference, efforts were made by the UNEP to bridge the North-South gap in attitudes to environmental negotiations, and to reconcile economic development with environmental protections. To address this issue the UN created an independent organization – the World Commission on Environment and Development

(WECD)¹. The report produced by this organization (“Our Common Future”) was seminal in establishing economic growth, environmental protection, and social equality as the pillars of sustainable development. The report’s definition of sustainable development is still widely used today.

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

The results of the report called for and strongly influenced the next major meeting of world leaders around the issue of environment and development – the 1992 Earth Summit in Rio de Janeiro, Brazil.

The Earth Summit

The United Nations Conference on Environment and Development – the ‘Earth Summit’, was held in Rio de Janeiro, Brazil in June 1992. The objective of the summit was for states to come together to discuss sustainable development and arrive at a global blueprint to achieve this in the twenty first century. The summit resulted in the setting up of the UNFCCC (a treaty to tackle greenhouse gas emissions) and the establishment of the yearly Conference of Parties (COP) at which parties involved in the treaty meet. The UNFCCC also differentiates between Annexes I and II (developed countries and developed countries that pay for costs in developing countries) and developing countries. Annex II pays for low-carbon transitions in developing countries, and no legal restrictions on development are placed on developing countries. Other important documents that came out of the summit were Agenda 21 which emphasized the role of marginalized populations, and indigenous communities in the environment and the Convention of Biological Diversity whose goal was to preserve biodiversity and equitably share the benefits of genetic resources.

¹More popularly called the Brundtland commission as it was headed by Gro Harlem Brundtland, the former Prime Minister of Norway

The Kyoto Protocol

The Kyoto Protocol was the outcome of the 1997 COP in Kyoto, Japan. It was the first legally binding international agreement to reduce greenhouse gas emissions. Following the Annex based structure of the UNFCCC and the principles of Common But Differentiated Responsibilities (CBDR), the protocol only called on developed countries to reduce emissions. Due to a complicated ratification process, the protocol only entered into force in 2005. The USA most significantly did not ratify the protocol because it did not require developing countries to make emissions reductions.

Copenhagen

Following the Kyoto Protocol, COP 15 (in 2009) was expected to be the next stage for a decisive global agreement on climate change. The negotiations to ensure a legally binding agreement at Copenhagen had begun two years earlier at COP 13 at Bali – the Bali Action Plan. However the negotiations in Copenhagen fell far short of expectations and resulted only in a non-binding agreement to keep global temperatures from rising more than 2 °C above pre-industrial levels. The conference was however the first time the BASIC countries (Brazil, South Africa, India and China) came together on the issue of climate change (Hallding et al., 2013). The failure of the conference to reach any legally binding agreement was blamed on a variety of factors. One hypothesis was that the 2008 global recession placed domestic pressure on the US not to agree to significant emission cuts (Black, 2009). Rapid economic growth in emerging economies like India and China meant that their contribution to carbon emissions were too large to ignore (Black, 2009). The Copenhagen Accord – which was the result of this convention – introduced the format of non-binding country level pledges with periodic reviews, into global climate negotiations (Hallding et al., 2013).

The Paris Agreement

The idea of Nationally Determined Contributions (NDCs) was first suggested at COP 19 in Warsaw, and at COP 20 (Lima) all countries agreed to come prepared with draft NDCs to COP 21 (Paris). NDCs are outlines of climate plans released by each country. Taken together they outline the global commitment to keep warming below 1.5 °C preferably, or at least 2 °C. Countries are required to submit new and more ambitious NDCs every five years. The Paris Agreement – while still calling for all countries to contribute to climate mitigation efforts, acknowledges that emission reductions will be undertaken on the basis of equity (UNFCCC, 2015).

4.1 A History of India's Contribution to Global Environmental Governance

Mohan (2017) lays out the history of India's role in global environmental governance:

1972 (Stockholm) – At the United Nations Conference on the Human Environment, then Indian Prime Minister Indira Gandhi gave a speech that pitted socio-economic development against environmental protection, and accused the developed countries of the North of causing global environmental problems.

We do not wish to impoverish the environment any further and yet we cannot for a moment forget the grim poverty of large numbers of people. Are not poverty and need the greatest polluters? (Indira Gandhi, Prime Minister of India, Speech to the UN Conference on Human Environment, Stockholm, Sweden, 14 June 1972)

India emerged from the conference as a leader of developing country environmental concerns (Paglia, 2021). Along with its fellow G-77 nations, India was instrumental in pushing for the UNEP headquarters to be situated in a developing country (Chasek, 2020). India also withdrew its own bid to host the UNEP at New Delhi in favour of Kenya so as to not to

jeopardize the united position of the G-77 group (Chasek, 2020).

1992 (Rio) – In the build up to the Earth Summit in 1992, the Centre for Science and the Environment (CSE) in New Delhi released a report on ‘Global Warming in an Unequal World’ which accused developed countries of ‘environmental colonialism’ and called upon them to bear the brunt of responsibility for climate change (Dubash, 2013). The report also argued for per capita rather than per country emissions to be used in dividing up responsibility for emissions (Dubash, 2013). This led to the origin of the phrase Common but Differentiated Responsibility (CBDR) being used for the first time in Article 3 of the Convention. India was instrumental in changing the IPCC wording of common responsibilities to CBDR (Dubash, 2013). At Rio, India remained firmly on the side of the other developing countries. The New York Times reported that Indian environment minister Kamal Nath emerged as one of the powerbrokers of the summit – sticking fiercely to India’s position that developing countries have a right to social and economic development (Brook, 1992).

We are seeking that the developed world plow a little of their prosperity back into the earth. (Kamal Nath, 1992)

1997 (Kyoto) – At Kyoto, India, along with the other G77 nations, was able to successfully push forward its position that there was a need for socio-economic development in developing countries which was more urgent than tackling climate change, and that developed countries had a historic responsibility to reduce emissions. The Kyoto protocol required Annex I parties (developed countries) to commit themselves to “quantified emission limitation and reduction objectives”. However developing nations like India were exempted from legally binding commitments. This emphasised the globally adopted position of CBDR.

In the decade following Kyoto, India continued its position of strong support for CBDR despite attempts by developed countries at various COPs (COP 11, COP 12) to extend the Kyoto Protocol to include developing countries. However in 2009, India began to make concessions on its previous position that developed countries should be responsible for the brunt of the emission reductions required to address global warming.

2009 (Copenhagen) - At the thirteenth COP (Bali, 2007) India (led by environment minister Jairam Ramesh) softened its position and accepted that developing countries should participate in the global climate change mitigation effort, albeit on a voluntary basis. India also released its first National Action Plan on Climate Change (NAPCC). At the 2009 COP (Copenhagen), India along with other emerging developing economies formed the BASIC² group, and announced voluntary targets to reduce their emission intensity by 25% between 2005 and 2020. The BASIC group was also involved in several negotiations with the US independently of other developing countries, and indeed it was the US-BASIC group that first agreed on the Copenhagen Accord (Black, 2009).

2010 (Cancun) - At the 2010 COP in Cancun, India shifted its position to favouring legally binding commitments for all countries. India's flexibility in climate negotiations gained widespread international recognition in developed countries' media coverage of the COP.

2011 (Durban) - At the 2011 COP in Durban, the new environment minister Jayanthi Natarajan attempted to shift back India's position to that of CBDR. However this had little impact on the outcome of the conference, which called for a new global agreement that made no mention of equity or differences between developed and developing country actions.

4.2 An Examination of India's NDC

In the first NDC (submitted October 2015), India made the following commitments:

1. To put forward and further propagate a healthy and sustainable way of living based on traditions and values of conservation and moderation.
2. To adopt a climate friendly and a cleaner path than the one followed hitherto by others at corresponding levels of economic development.

²Consisting of Brazil, South Africa, India, and China.

3. To reduce the emissions intensity of its GDP by 33 to 35 percent by 2030 from the 2005 level.
4. To achieve about 40 percent cumulative electric power installed capacity from non fossil fuel based energy resources by 2030 with the help of transfer of technology and low cost international finance including from the Green Climate Fund (GCF).
5. To create an additional carbon sink of 2.5 to 3 billion tonnes of CO₂ equivalent through additional forest and tree cover by 2030.
6. To better adapt to climate change by enhancing investments in development programmes in sectors vulnerable to climate change, particularly agriculture, water resources, Himalayan region, coastal regions, health, and disaster management.
7. To mobilize domestic and new & additional funds from developed countries to implement the above mitigation and adaptation actions in view of the resource required and the resource gap.
8. To build capacities, create domestic framework and international architecture for quick diffusion of cutting edge climate technology in India, and for joint collaborative R&D for such future technologies.

In order to do the above the NDC states that India will prioritize

1. Introducing new, more efficient, and cleaner technologies in thermal power generation.
2. Promoting renewable energy generation and increasing the share of alternative fuels in overall fuel mix.
3. Reducing emissions from the transportation sector.
4. Promoting energy efficiency in the economy, notably in industry, transportation, buildings and appliances.

5. Reducing emissions from waste.
6. Developing climate resilient infrastructure.
7. Full implementation of the Green India Mission and other programmes of afforestation.
8. Planning and implementation of actions to enhance climate resilience and reduce vulnerability to climate change.

In order to meet these goals India put forward a preliminary estimated climate finance requirement of 2.5 trillion USD by 2030. India described its NDC as “fair and ambitious” considering its development needs. At the negotiations, India accepted the 1.5 °C goal despite the absence of stringent emission reduction strategies from more developed countries Mohan (2017). This is significant because the emission reduction requirements of a 1.5 °C goal could particularly hamper late industrialising countries like India. India also ratified the agreement early despite previous concerns that it would insist on developed countries fulfilling their Kyoto commitments.

As is evident from the NDC India is relying on a primarily technology driven approach to push forward its low carbon transition. Six out of eight of the NDC priorities are the development and deployment of technology or physical infrastructure to facilitate a low carbon transition.

4.3 The Low-carbon Transition as a Socio-technical Transition

4.3.1 At a Landscape Level

Mohan (2017) makes the case for looking at the broader foreign policy landscape when attempting to understand how India has shifted its position at climate negotiations. Post-

independence and throughout the cold war, India adopted a stance of non-alignment. India was one of the founders of the Non-aligned movement (NAM) and its foreign policy position was to preserve national sovereignty at all costs, and to avoid having to pick a side in the Cold War. In order to do this, India aligned itself with its fellow developing countries, particularly former colonies. The desire for autonomy is reflected in India's early position on climate change – which was to push for developing countries to not have to forgo any possible economic pathways (for instance high emission or fossil fuel dependent pathways) due to globally set climate policies. This preserved the right of developing countries to develop economically without any international environmental restrictions. In 1991 following an economic crisis and subsequent economic liberalization, India began to soften its stance on absolute sovereignty in exchange for economic benefits. The end of the Cold War hastened this shift in foreign policy. With the fall of the USSR the world became unipolar instead of bipolar. India's former position of non-alignment became obsolete. Moreover, in the past India had aligned itself more with the USSR than the USA and there was a need to take action to strengthen USA-India relations. India and the USA signed a nuclear deal in 2008 and India supported the USA in its sanctions against Iran (despite opposition from its fellow NAM countries). With these two actions India signalled a shift in its foreign policy towards pragmatism and material gain, which required the dropping of some of its more aggressive stances on equity and justice.

In the early 2000s rapid economic growth in India led to a sharp increase in emissions. Economically and emissions-wise India's position aligned more closely with other emerging economies like China and less with other G-77 countries. After the 2008 financial crisis there was a shift in the world's hierarchy from a unipolar US led globe to a more multi-polar world with a role for emerging economies like India. In order to adopt more of a leadership position globally, India would need to play a more active role in global negotiations. Climate vulnerable countries like the Maldives and Bangladesh had been critical of India's lack of

flexibility (refusal to accept binding restrictions on its emissions) in climate negotiations and India was counting on their support in its bid for a permanent seat on the UN Security Council. Environment Minister Jairam Ramesh pointed to this in his defence of India's Copenhagen position in the Indian parliament.

The current Indian government position in climate negotiations has been to abandon CBDR principles and instead take a leadership position in the fight against climate change. This reflects the government's frequently expressed foreign policy goal of moving into global leadership positions.

4.3.2 At a Regime Level

Conversations around low-carbon transitions in India often reference climate justice – 'working towards climate justice' is the topic of the draft NDC that India submitted to COP 21. The scholarship about climate justice in India focuses on the power divide between Western economies and developing economies, and routinely makes intra-national hierarchies of power like caste invisible. Instead the definition of 'Dalits' (in the hierarchy of the caste system Dalits are the excluded from the traditional four 'varnas' (castes) and are seen as untouchable and of the lowest status) is often merged with the poor, the marginalized, the rural etc. India's NDC is one such document that makes no mention of caste when speaking of climate justice. Sharma (2012) discusses how this is especially true of environmental politics in India. This is despite the fact that by necessity Dalit and adivasi (members of indigenous/tribal communities in India) actors have high stakes in these environmental decisions as they are often more dependent on natural resources than their upper-caste counterparts. They are also often the communities that bear the costs of environmental degradation or are displaced to make way for conservation projects in India. In environmental politics, conversations around justice and bringing in the 'local' or 'traditional' perspective in India ignore the fact that this traditional perspective is often the upper caste, brahminical

perspective and does not represent the diversity in people's relationships to the environment.

India's NDC for instance starts with a quote from the Yajur Veda (an ancient text)

Unto Heaven be Peace, Unto the Sky and the Earth be Peace, Peace be unto the
Water, Unto the Herbs and Trees be Peace

The NDC also goes on to say that India will promote a "sustainable way of living based on traditions". Discourses that blame ecological destruction in India on western colonialism and glorify ancient scriptures and the traditional village set-up ignore the fact that this same socio-ecological set-up relegated and continues to relegate Dalits to the status of 'untouchable'. These same vedic texts for instance speak about Dalits in the following way:

Now, people of good conduct can expect to quickly attain a pleasant birth, like that of a Brahmin, the Kshatriya, or the Vaishya. But people of evil conduct can expect to enter a foul womb, like that of a dog, a pig, or a Chandala³.

The lack of diverse representation in India's climate policy is likely due to the fact that at a regime level, climate governance and policy making in India is an extremely close knit, small group. India's negotiating teams at COP are usually much smaller than other nations of a similar size. India's negotiating team is usually composed of representatives from different government ministries (usually the Ministry of Environment, Forests and Climate Change (MoEFCC) and Ministry of External Affairs (MEA)) and does not include civil society actors and members of grassroot organizations. Moreover the MEA representatives usually lead the negotiations with input from the MoEFCC representatives. Higher positions in the government and private sector are monopolized by upper castes (The Economist, 2020). Despite upper caste members forming 20% of India's population, out of 89 high ranking civil servants only 4 are not caste privileged (The Economist, 2020). This means that the Dalit

³member of a lower caste

perspective is unlikely to be adequately represented in the Indian delegation to environmental negotiations.

4.3.3 At a Niche Level

As we can see from India's NDC at a niche level, India is relying on new renewable energy technology to push forward its low carbon transition. India is looking to advance its solar and wind capacity in particular. The NDC also mentions that India will rely on Clean Coal Technology and nuclear power. Simultaneously the country will reduce fossil fuel subsidies and promote energy efficient technology in transportation and waste management.

One reason for this focus on large scale energy technology is that domestically the climate mitigation debate in India is driven by concern for energy security (Dubash, 2013). This concern is because of a growing demand for energy in India coupled with rising coal and gas prices, and inadequate domestic supplies of fossil fuel based energy. Dubash (2013) suggests that these landscape level domestic pressures have contributed to India shifting its stance on climate mitigation activities – climate mitigation being a co-benefit of a politically motivated need to invest in technologies like solar and wind.

After the Copenhagen COP the Indian government set a target of generating 20 GW of grid-connected solar photo-voltaic (PV) and 2 GW of off-grid solar PV energy by 2022 (Yenneti et al., 2016). Before the Paris COP the government increased this pledge to a significantly more ambitious 100 GW by 2022 (Yenneti et al., 2016). However as Yenneti et al. (2016) and Stock and Birkenholtz (2019) point out, these mega-solar projects are not without equity concerns. The land acquisition required for these mega-solar projects is often taken from marginalized populations. Even in cases where the land does not belong to the marginalized population, the solar park can have the effect of cutting off these populations from sources of energy such as firewood that was present on this land. These populations lose their land and/or their livelihoods, but are not deemed qualified enough to gain employment

at solar parks. Ultimately these communities are left more energy poor than before the arrival of large scale energy projects in their neighbourhoods (Baka, 2017). Yenneti and Day (2016) showed through a case study of a solar farm in rural Gujarat how upper caste business developers gained from this project while lower caste, poorer farm labourers were significantly worse off – having lost access to the land they depended on for their livelihoods. In the same paper Yenneti and Day (2016) point out that at a national level “the taking of land resources from a minority is justified on the basis of achievement of a greater good in terms of national economic development and the meeting of carbon emission reduction targets”. Avila (2018) makes the same case for the inequitable impacts of wind energy projects in India. This suggests that already the low carbon transition is starting to widen existing inequities in India.

4.4 Conclusion

This chapter looked at the low carbon transition in India using the analytical framework outlined in Chapter 2. In doing so it showed how inter and intra national power imbalances have been instrumental in shaping the way the low carbon transition is currently unfolding in India. In the next chapter I will compare the inter and intra national power imbalances and their consequences during the Green Revolution (which were laid out in Chapter 3) to those in the low carbon transition. I will analyze how similar inequitable impacts are emerging in both transitions and liken those inequities to the power imbalances. I will then go on to draw lessons from the Green Revolution case study that can be applied to the current low carbon transition in India in order to mitigate some of the inequitable impacts.

Chapter 5

Lessons and Conclusion

Much like the climate crisis today, in the 1960s the need to feed the world's population prompted a call for international cooperation and technology transfer. In India, the political economy surrounding both transitions was multi-faceted. The Green Revolution, while successful in its direct goal of increasing food grain yield in India has had long-term, undesirable equity impacts. Similarly the policies and technologies being deployed towards a low-carbon transition are addressing India's goal to reduce its greenhouse gas emissions and fulfill its Paris pledges. However as discussed earlier there have been collateral equity impacts from these transition pathways. As this thesis showed, the transition pathway of the Green Revolution in India was on a global and national scale profoundly impacted by power imbalances – power imbalances between more developed countries and India as well as power imbalances along the lines of caste and economic status within India. Since the 1960s India's position globally has shifted from that of a developing country to an emerging economy but there is still a significant power gap between India and the developed nations.

In the absence of significant counter-balancing measures, power imbalances tend to sustain through disruptive transitions and often de jure power regimes are merely replaced with more informal de facto power systems (Acemoglu and Robinson, 2008). The case of the Green Revolution in India demonstrated the point raised in Escobar (1995) that de jure inequalities

of power in colonial rule were replaced by de facto power imbalances between the developed and developing world. These power imbalances meant that developed countries (the United States in the case of the Green Revolution) had more de facto say in the policy measures put in place in India than Indian citizens did. Within India the de jure outlawing of caste discrimination has done little to uplift the voices of oppressed castes. In this chapter we draw lessons from the Green Revolution that can be applied to help address some of the emerging equity issues in the low-carbon transition in India.

5.1 Who Gets to Frame Problems?

In the case of the Green Revolution hunger was problematized as an issue of food quantity. All solutions considered therefore aimed to increase the quantity of food produced in India. This framing paid little attention to the quality of nutrition. As we have seen in the long-term the Green Revolution in India has resulted in a decrease in nutritional diversity and malnourishment. Adequate attention was also not paid to access. Even in the face of abundant food supply there are communities whose economic/social position in society makes them unable to access this abundance.

Framing hunger as a problem of yield per hectare was problematic as it ignored the historical and political contexts within which hunger emerges in India. This framing also allowed for Western technology to be a more developed and more suitable solution. This framing also ignored the unique constraints that smaller farmers and members of lower caste communities face in India. Ultimately as we have seen the Green Revolution benefited richer, upper caste farming communities and upper caste urban communities in India, thereby exacerbating existing power divides and social conflicts in India. Globally the Green Revolution has been beneficial for multinational agrochemical companies owned by shareholders situated in the Global North.

As we have seen the emerging technologically driven low-carbon transition in India is already having inequitable impacts on marginalized communities in India – with members of these communities losing access to their land and livelihoods to large solar and wind farms. The problem of climate change has been overwhelmingly problematized in the Global North as a problem of quantities of carbon emissions. One of the outcomes of the Paris Agreement has been that the issue of climate change has been framed as a numbers game of how much of a reduction in emissions is required to keep global warming below 1.5 °C compared to pre-industrial levels. This frames the climate transition as one that is primarily a technological challenge - how can the world's energy systems reduce their carbon emissions. The case of the Green Revolution in India highlights the importance of framing the problem in a more holistic way that accounts for the diversity of communities' relationships with the environment. This will require significant effort to overcome the power disparities that suppress the voices of poorer countries and marginalized populations. We need a better understanding of who is being left out of conversations on low-carbon transitions, and how they can be made a part of defining the problem and consulted as 'stakeholders' during project implementation stages.

5.2 Economic & Social Disparity and Power

Although India and the rest of the developing world achieved early success in getting ideas like CBDR enshrined in climate negotiations, India has since softened its stance on holding developed countries accountable in order to forward its foreign policy objectives. That India faced a choice between intra-national equity and sovereignty on one hand, and material and political gain on the other was a direct result of intra-national economic inequity between India and the United States. As we have discussed earlier, much of India's shift in its position on climate policy can be traced to a desire to strengthen USA-India relations.

International financial aid to developing countries is already a central topic at climate negotiations. The mechanisms through which this aid is deployed need to be thoroughly examined. Historically, financial aid (as we have seen in the case of the Green Revolution) has led to a persistence in the power disparities between India and the United States. In the case of the Green Revolution, multinational agrochemical companies with shareholders situated in the Global North were major beneficiaries in the long-term. In order to be truly equitable, climate finance negotiations need to be independent from the political and financial interests of donor countries and private sector investors. Much of the finance needs to be deployed in a way that amplifies the voices of disempowered communities in India.

Within India an economic disparity between lower and upper caste communities has meant that the Green Revolution mechanisms primarily favoured upper caste, richer farmers. Even policies designed to assist poorer farmers (such as micro-finance schemes or loans) were less accessible to members of lower caste communities because they lacked the social capital to take advantage of these schemes. Similarly at a national level the emerging climate justice discourse is failing to take into account caste disparities, which is resulting in lower caste and indigenous communities being excluded from the benefits of environmental programs. In many cases they are disproportionately impacted by nature-based solutions and climate policies.

5.3 Shifting Power in Environmental Governance

This thesis has highlighted the role that international and intra national power imbalances have played in shaping both the Green Revolution transition, and the low carbon transition in India. These power divides shaped the Green Revolution at every stage – beginning from how the problem of hunger in India was defined. We are seeing a similar pattern repeat itself in the case of the low carbon transition. The long term inequitable impacts of the Green Revolution in India persist today. The ongoing farmers' protest in India against three

new farm laws is a culmination against exacerbation of environmental and social problems in Indian agriculture that came about as a result of the Green Revolution. Farmers across the country see these laws – which promote corporate investment in agriculture – as a strengthening of corporate control over agriculture that began with the Green Revolution. All of this seems to suggest that in order to avoid similar equity impacts down the road, there is a need to recognize the role that power imbalances have on shaping the low carbon transition in India, and to create the infrastructure necessary to bridge power divides at every step of the way and at all levels.

Internationally this means that the global environmental governance regime needs to recognize the colonial roots of the climate crisis. Recognizing the colonial origins of the power, knowledge, and economic imbalance between developed and developing countries will open the door for corrective measures to account for these imbalances. For instance – more representation from developing countries on international environmental commissions and committees so that the voices of scholars from these countries are not left out of global conversations on climate change. Currently 75% of the climate experts contributing to IPCC reports are of European and North American descent (Ho-Lem et al., 2011). Additionally the policy infrastructure surrounding environmental negotiations needs to be revised so that concessions on environmental positions (which have potential long term equity impacts for developing countries) are not made in exchange for short term aid or benefits from developed countries.

Nationally this means that the role that power hierarchies like the caste system play in environmental outcomes needs to be acknowledged. More effort needs to go into understanding and documenting the experiences of members of economically disadvantaged, lower caste, indigenous communities in India, to ensure that they are not left behind by the low carbon transition. Solutions like strengthening reservation programs so that there is adequate representation of lower caste, indigenous community members at higher level environmental

policy making need to be looked into. Additionally there is a need to rethink the land rights of indigenous and lower caste communities, and to give them some formal rights over the land on which they depend.

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