Material voices : articulating democracy through biodiesel's socio-material entanglements in India

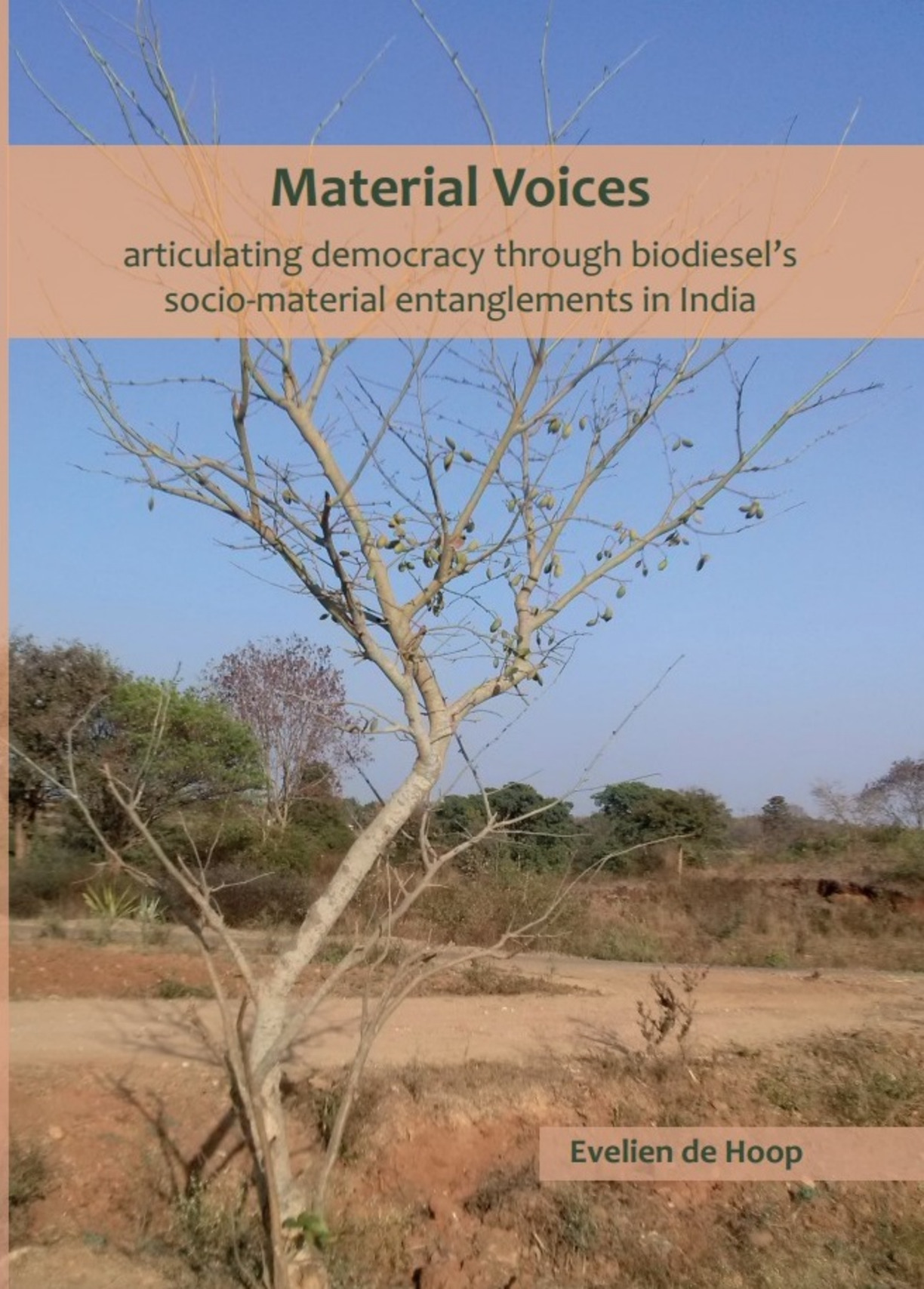
Throughout the world, biodiesel has been proposed as a technology that is renewable, economically profitable and that contributes towards reducing climate change. At the same time, these claims have been subject to controversy, particularly in relation to land-grabbing and competition with food production.

This thesis is concerned with the extent to which knowledge-making on biodiesel, biodiesel innovation processes and policy-making on biodiesel in India can be considered democratic. To do so, this thesis develops a framework on democracy, based on work by Bruno Latour and Isabelle Stengers. Furthermore, this thesis aims to raise the material voices of entities that have so far had little chance to do so, such as (waste)land, water, farmers, seeds, crops on research test fields and many more. To do so, this thesis travels down paths less frequently trodden: to archives where socio-material struggles around wasteland in colonial India are documented; to researchers' test fields; to activists; to ministries; to the offices of corporate CEOs; and to the fields, trees and homes of many farmers in Hassan district, Karnataka state.

Eindhoven University of Technology
School of Innovation Sciences

Material Voices

Evelien de Hoop



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PROEFSCHRIFT

ter verkrijging van de graad van doctor aan de
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At the beginning of this project, a few months before I officially started, Henny Romijn and I attended a conference that was part of the Responsible Innovation research programme that funded our biofuels project. During this conference, I often asked myself: should we always keep on innovating, while trying to make the innovation (process) at hand more responsible? Are there situations in which the most responsible option would be not to innovate at all? This question intensified when doing my fieldwork, when it became abundantly clear that using vegetable oils from oilseeds for the production of biodiesel could be a questionable endeavour. I am glad that my concerns resonated with Henny Romijn and Auke Pols, and that we were able to explore this question in depth in chapter five of this thesis. Henny and Auke, working with you was a very nice experience, not the least because of many explorative and enriching conversations and our shared interest in gardening and rhubarb-pies.

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My husband Jochem literally shared this PhD journey with me into India. While I was doing fieldwork in Hassan, you had the courage and perseverance to convince your employers in Eindhoven that they were better off placing you in their local office in Bangalore for the duration of my fieldwork. Thank you for the faith you have in me, for your open-mindedness, and especially for your loving, unconditional support. You are the best.

Introduction

On October 28 2013, I visited Kinnerahalli for the first time. Kinnerahalli is the poster village of Hassan Bio-Fuel Park, one out of a few biodiesel projects still that is still active in India in 2013. Hassan Bio-Fuel Park does research on biodiesel and engages in biodiesel innovation based on their findings. Its staff distributes seedlings of oilseed-bearing tree species to farmers. They encourage farmers to grow these seedlings on the edges of their lands, not on land used for food-production. They do this in accordance with the project's aim to increase biodiesel production using non-edible oilseeds. The project claims to be successful in doing so, and it supplies biodiesel to city buses running in Bangalore. According to Dr. Haleshi, a scientist working at Hassan Bio-Fuel Park, Kinnerahalli and a second village named Malige Walu are poster villages because they have been most co-operative in the project. To increase the ability of these two most promising villages to take care of their own energy needs, the project's president named Dr. Balakrishna Gowda had provided these two villages with an oil-expelling machine which he had bought from subsidies that the state government had awarded to this project. This machine seperates oilseeds into oil and seedcake. However, in Malige Walu, this machine is broken. In Kinnerahalli, the farmers took good care of the machine, says Dr. Haleshi. The village has been involved in the project since 2008, so the seedlings planted during the first year should be about 5 years, almost 6 years old now. When they are six years old, the trees start giving their first small yield.

Dr. Haleshi's words stand in stark contrast with stories about most other biodiesel projects in India. According to government officials, business representatives, activists and researchers I met during earlier fieldwork between September and December 2012, most of these projects closed

down because they were unsuccessful in raising feedstock. So when I enter Kinnerahalli, I do so with high expectations. I hope to see a lot of oilseed trees, a large storage of oilseeds collected during harvest season in March and people using self-expelled oil. But what I encounter is something completely different. An old and influential woman from the village tells me there were oilseed trees on both sides of the road leading into the village, for a length of about 1 kilometer. But recently they were cut down during road-widening works. She herself has no oilseed trees around her land, and never collects oilseeds from other trees. But she does go around the village at the onset of the season during which the most common oilseed, *Pongamia pinnata* (or honge in Kannada, the local language) is harvested, encouraging everyone to collect the seeds. Therefore, Dr. Balakrishna Gowda had recently taken her to Bangalore to represent the farmers' interest in biodiesel at a state-wide farmers' meeting. She proudly mentions that the chief minister of Karnataka had congratulated her on her achievements in biodiesel development.

Many farmers I meet that day complain about irregular weather patterns when I ask them whether they could show me any of the seedlings they received from Hassan Bio-Fuel Park's field staff. Invariably, they tell me that all seedlings died, except those in the school compound. Some of the village school students watered seedlings planted there during dry spells. So in a small area between the compound wall and a classroom wall, I can see some small trees that hardly fit the space. But not all seems lost. There are many farmers who still have some old, large honge trees growing on their land, despite the fact that many have already been cut for traders who use the wood as fuel that is necessary for brick production, in exchange for a large sum of cash. Most seedlings distributed by Hassan Bio-Fuel Park are honge seedlings, and virtually all biodiesel sold by the project is made from honge oil. But curiously, the same farmers say they barely collect the seeds from the old trees that still exist, because it is very hard work.

After this first day, I wondered what is happening in this project. In Hassan Bio-Fuel Park's office, I had not heard the voices of seedlings being unable to survive the first two years due to a lack of water, of trees getting cut during the widening of the village road, of farmers cutting mature honge trees in exchange for cash, or of farmers being reluctant to engage in the hard work of collecting honge seeds. Neither had I heard them during my earlier fieldwork that took place in the offices of policy makers, activists and business representatives as well as researchers' test fields. However, these voices of seedlings, village roads, farmers and many others may have serious implications for Hassan Bio-Fuel Park's project aims. This thesis seeks to address the silence of these voices. To do so, I explore to what extent human and non-human entities have been able to raise their voices and participate (or if not, how they could participate) in policy-making, knowledge-making and innovation processes, and I provide suggestions on how silent voices can get raised.

Controversial Biodiesel

The year 2003 opened with a news item on India's first trial run of a train on biodiesel, which was successfully conducted on December 31 2002.[1] The Hindu, one of India's leading English-language newspapers, reported: "[Biodiesel] contribute[s] to environment protection […] and contribute[s] to the national energy pool and the potential of creation of jobs in the rural sector" (Kumar, 2003). At the time, similar claims were being made throughout the world (Smith, 2010). On August 17 of the following year, Tamil Nadu's Chief Minister, Jayalalithaa, was present at the signing of a

[1] Biodiesel is a form of biofuel, which is fuel that is based for more than 80% on transesterified oil extracted from living organisms harvested within 10 years before the fuel's manufacture (Uhlenbrook, 2007). There are many different kinds of biodiesel, often referred to as first, second, third and sometimes even fourth generation biodiesel, depending on the feedstock used for biodiesel production. This thesis specifically focusses on biodiesel based on non-edible vegetable oils, which is usually referred to as second generation biodiesel (Dutta et al, 2014).

Memorandum of Understanding (MoU) by representatives of Mohan Breweries and Distilleries Limited and UK-based D1 Oils Limited, forming D1 Mohan Bio Oils Ltd. The two partners were going to manufacture biodiesel from oilseeds harvested from jatropha bushes, "pav[ing] the way for converting wasteland into cultivable land, enhancing employment opportunities in rural areas, ensuring economic development and maintaining a clean environment" (The Hindu, 2004). These and many other events, garlanded with promises of a better world, were spurred by the activities of the Committee on Development of Bio-Fuels, which was set up by the Planning Commission in July 2002. In April 2003, this committee came out with a report recommending the launch of a National Mission on Bio-Diesel, followed by further mushrooming of biodiesel projects funded by national and state governments as well as entrepreneurs (Planning Commission, 2003).

A few years later, D1 Mohan Bio Oils Ltd silently departed from Tamil Nadu where they had signed contracts with farmers for the cultivation of jatropha, leaving the farmers with highly disappointing yields and nobody to sell their harvest of oilseeds to at a reasonable rate (Ariza-Montobbio et al., 2010). When I visited Tamil Nadu's ministry of agriculture in 2013, I was told that all documentation on the state's engagement with biodiesel including official policy documentation had been classified as confidential because they feared criticism on some of the activities that had taken place.[2] Indeed, in 2007, a number of leading NGOs had congregated in Hyderabad, Andhra Pradesh, to discuss the implications of India's activities in the field of biodiesel, where the activities of D1 Mohan Bio Oils Ltd were discussed in relation to concerns about land-grabbing, coming to the conclusion that "the widespread propagation of plants like jatropha to be grown as 'oil from soil' is more destruction than deliverance" (Lavanya, 2007: 50). They particularly highlighted the crucial importance of so-called wastelands, on which these plants were supposed to be grown, to meet local inhabitants'

[2] Unfortunately, the official I met was unwilling to explain what criticism they feared, and on which activities.

needs for fuel-wood, fodder, grazing space, space for defecation and non-timber forest produce. In 2013, the Hindu reported on Nobel Laureate Hartmunt Michel's work titled "The Nonsense of Biofuels", in which Michel argues that biofuels only produce a little more energy than invested in them, while electric cars fueled with electricity from solar cells are 600 times more efficient than biofuels (Rathi, 2013). By 2015, it had become public knowledge that out of 25 bio-diesel units in India, with an installed capacity of 1.2 million tonnes a year, only 5 units were occasionally operating (Mallick, 2015).

Amidst this turmoil, political interest in this technology that made so many wonderful environmental and economic promises in the early 2000s nevertheless remained alive to this date. Papers on the potentially beneficial effects of biodiesel projects are still being published by scientists, and biodiesel initiatives undertaken by both government and industry are regularly documented in newspapers (e.g. Lokesh et al., 2015; Chandrashekar et al., 2012; Kumar and Sharma, 2016; Wani et al., 2016; The Hindu, 2015; The Hindu, 2016). In August 2015, the national government showed its continued interest and support by proposing changes to the current biofuel policy which will allow fuel producers to sell directly to consumers rather than through oil marketing companies in an attempt to increase production and sales (Mallick, 2015).

The promotion of biofuels, including biodiesel based on non-edible oils, has not been subject to contestation only in India, but worldwide. In 2004, activist and journalist George Monbiot already claimed that the production of biofuels at a large scale, large enough to affect climate change, would be a "humanitarian and environmental disaster" (Monbiot, 2004). Nevertheless, the EU adapted a strong pro-biofuel policy in 2006, targeting to replace 5,75% of all road transport fuel-use with biofuels by 2010 and 10% by 2020. (Van Thuijl and Deurwaarder, 2006). Recently, the World Resources Institute made an extensive plea against any form of bioenergy, arguing that they take up finite land resources at the cost of food production and carbon storage (Steer and Hanson, 2015). The Royal Netherlands Academy of Arts

and Sciences published a position paper entitled 'Biofuel and Wood as Energy Sources', which concludes that the use of biofuels as transport fuel does not lead to a substantial decrease in greenhouse gas emissions (Katan et al., 2015). This stirred great controversy in newspapers among scientists either supporting the position paper or dismissing it as ignoring a lot of scientific literature in favour of developing and using biofuels as transport fuel (Bouma, 2015). For example, Gerssen-Gondelach et al. (2015) maintain that using biomass for biofuel will lead to substantial decreases in greenhouse gas emissions and does not need to compete with food production if current agricultural practices are intensified smartly and sustainably (e.g. through effective use of artificial fertilizers).

India's engagements with biodiesel are embedded in, and feed into, this global turmoil on biofuels. For example, the food versus fuel debate that followed after sharp increases in global food prices played a role in the shaping of India's policy on biodiesel (Pradhan and Ruysenaar, 2014), while Indian cases of landgrabbing in the name of biodiesel production contributed towards activism against biofuels in many places across the earth (Lavanya, 2009). However, where most countries in the global South produce biodiesel to be (at least partly) sold to European countries aiming to meet the EU's blending targets, India's biodiesel policy is specifically focused on production for domestic usage (Biswas et al., 2010; Landeweerd et al, 2009). Moreover, India has a large research community working on biodiesel, mostly paid by government grants, and there is a wide array of Indian and non-Indian actors engaged in biodiesel research, production and activism.

Scholarship on Controversial Biodiesel Feedstock Cultivation and Policy in India

Biodiesel controversy in India has largely focused on feedstock cultivation and policy-issues, and took place both in the public realm as well as among people working for research institutions and publishing in scientific journals. Work grounded in a wide range of disciplines has contributed to

this scientific controversy. For example, studies coming from various kinds of agricultural sciences (biotechnology, agronomy etc.) were concerned with the question: how can biodiesel production be increased? Treating the desirability of increasing biodiesel production as a given and hence uncontroversial, this question has been addressed from various angles. These include improving agricultural practices, convincing farmers of using the 'right' growing methods, and selecting and breeding 'optimal' species and varieties that can be used to obtain non-edible vegetable oil. Such studies generally treat the human (e.g. farmers, people working at large plantations) and non-human entities (e.g. plants, soil) involved in biodiesel feedstock production as malleable: farmers can be convinced to use the 'right' growing methods by educating them, plants' oilseed yields can be increased by supplying more fertilizer and water, by using particular pruning techniques and by selecting varieties that have high yields (e.g. Divakara et al., 2010; Behera et al., 2010; Singh et al., 2013). However, the effects of this malleability (e.g. using large amounts of fertilizer or farmers missing out on farming opportunities because they are growing biodiesel crops) have largely been left out of the picture. For example, Kesari and Rangan (2010) argued that a sizeable, consistent source of biodiesel feedstock supply should be based on large-scale plantations of pongamia, a leguminous tree, and that the economic profits of such an undertaking depend on the creation of elite planting stock, using the right propagation techniques and implementing optimal plantation practices. The implication of growing Pongamia as a monoculture crop on large stretches of land using sizeable inputs for environmental and human well-being remained unaddressed. Others, such as Axelsson et al. (2012), studied why farmers had discontinued the cultivation of jatropha. Based on the problems experienced by farmers, Axelsson et al. recommended that yield levels and stability needed to be improved, and that policy should provide for more agricultural extension services to increase farmers' knowledge on the crop.

Other researchers argued against the desirability of biodiesel production or its large-scale promotion through policies with blending targets.[3] For example, encouraging large-scale biodiesel production has been associated with land grabs and displacing grazing and forage collection (Baka, 2014; Lahiri, 2009; Lavanya, 2007). Others have calculated that biodiesel feedstock cultivation requires irrigation and is therefore only profitable for large farmers with irrigation facilities while smallholders, with less access to resources of their own, would be vulnerable to economic risk and crop failure (Ariza-Montobbio and Lélé, 2010; Rittenburg et al., 2011; Ravindranath et al., 2011).

A third stream of literature offered suggestions on how India's national and state level governments could improve their policies and strategies in order to increase biodiesel production. Suggestions include amending land use policy to facilitate bringing more land under biodiesel cultivation (Altenburg et al., 2009), fixing prices of non-edible oilseeds for at least 3-4 years in advance (Biswas et al, 2010) or redirecting the biodiesel policy towards the use of locally available flora (Agoramoorthy and Patel, 2011). Others have taken a slightly more precautionary stance, arguing that scientific assessments on the impacts of growing biodiesel feedstock crops at a large scale must be made before policy is put into practice (Das and Priess, 2011), or that local land-use impacts should be accounted for in such policies (Findlater and Kandlikar, 2011).

Much of the literature discussed above focusses on specific issues such as the extent to which jatropha's yields can be improved by breeding high-yielding varieties. For example, many of these high-yielding varieties may only give high yields if they are grown on land that is perfectly suitable to grow other (possibly edible) crops. This clashes with India's 2009 policy on

[3] A blending target is the percentage of diesel that should be replaced with biodiesel. For example, India's biofuel policy, which was announced in 2009, stipulates a blending target of 20% by 2017, which means that by 2017, 20% of all diesel used in India should be biodiesel (Government of India, 2009).

biodiesel which clearly states that competition with food production is to be avoided. Nevertheless, many of these studies position themselves as contributing towards achieving the policy's blending targets by providing knowledge which they claim is needed to enhance feedstock production (Government of India, 2009). However, while most studies do discuss the direct implications of their findings (in this case: how using high-yielding varieties can contribute to meeting blending targets), they do not discuss the implications of using cultivable land in relation to the policy's stance on this issue (e.g. Divakara et al., 2010; Behara et al., 2010; Singh et al., 2013). Other studies do discuss these implications, such as Ariza-Montobbio and Lélé (2010) and Ravindranath et al. (2011). However, both strands of literature approach biodiesel production as having inherent characteristics and present their observations as static facts, detached from the processes (of growing crops, of doing research) through which they were generated.[4] My thesis will contribute to the existing literature by taking the role of these processes seriously. As I will explain in more detail below, taking processes of coming into being seriously highlights that research outcomes are conditional and presents these conditions as active participants in the creation of research results. By doing so, for example by highlighting that water availability plays an active role in test fields in which high-yielding varieties are being developed and tested, it is no longer possible to focus on increasing feedstock availability without relating to other aspects of India's policy on biodiesel at the same time.

Furthermore, it is crucial to note that a lot of voices that were raised in the introductory vignette of this chapter are absent from the bodies of literature discussed here, and which were not even raised as passive participants. These include for example pongamia seedlings needing water during the first two years in order to survive, farmers being interested to cut pongamia

[4] Of course, these papers do present their research methodologies, through which some of these voices can be heard, but these serve the purpose of allowing others to scrutinize the study with the aim of discovering a universal truth about biodiesel feedstock production.

trees in exchange for cash, farmers being reluctant to collect pongamia seeds because daily wages yield higher incomes, and pongamia oil being suitable and used for soap production. They are also largely absent in India's 2009 policy on biodiesel, and barely seem to partake in the biodiesel innovation that is taking place in the Hassan Bio-Fuel Park's offices.

In the next two sections, I will outline the theoretical underpinnings of my approach to these two problems, namely the observation that some voices remain completely silent in research and public controversy on biodiesel while others only get articulated in relation to a very specific aspect of biodiesel production. After that, I will present the research questions this thesis seeks to answer, which emerged out of my empirical observations in literature and in practice, and from my theoretical approach.

Material Voices[5]

There is a wide diversity in the way in which voices of farmers, agricultural land, wasteland, water, pongamia trees, jatropha bushes and other humans

[5] The theoretical underpinnings of my approach in this thesis were largely developed by researchers originating from the global North and based on empirical examples from the global North. Of course, neither the global North nor the global South are homogeneous entities. It is important to be aware of local specificity, and the extent to which the concepts deployed can be made to make sense in relation to specific socio-material entanglements. Indeed, ANT's concepts are malleable and can therefore be made to fit the situation at hand (Holifield, 2009; Latour, 2005). As Jensen (2014) argues, the conceptual and the empirical are unstable hybrids because the researcher's activities in the empirical domain always inform the conceptual outcomes of the study and vice versa. Hence the two should be seen in relation to each other rather than as separate entities. This is also why I present not only a literature review but also some of my theoretical approach before I present my research questions, which resulted from my theoretically-informed approach to the existing literature on biodiesel. The theoretical suggestions offered in the concluding chapter of this thesis are similarly based on a combination of my understanding of theoretical literature and the materials generated through fieldwork.

and non-humans have been raised in the scientific literature on biodiesel as introduced above, and in the public controversy on biodiesel discussed at the beginning of this chapter. For example, in Ariza-Montobbio and Lélé's (2010) work, jatropha gets to raise its voice as a plant that requires amounts of irrigation that not all farmers have access to in order to give high yields, and thereby as a plant increasing income gaps between farmers with and without irrigation facilities. In Singh et al.'s (2010) work, on the other hand, jatropha gets to raise its voice as a plant that can give sizeable yields in semi-arid areas and drylands based not only on small amounts of irrigation but particularly on close (2x2 m) spacing, no pruning during the first five years, and the application of two kilos of farm yard manure.[6] So in this case, jatropha's voice is that of a plant that needs careful attention from farmers who have been taught these specific cultivation practices. These two voices are not only discursive, but ontological: a jatropha plant that requires irrigation to give high yields is a different entity than a jatropha plant that gives high yields when specifically prescribed cultivation practices are used. So, an entity that may seem individual and univocal (e.g. a jatropha bush) can raise multiple voices, which may give rise to different courses of action (e.g. on planting jatropha bushes) that may even be contradictory. To understand how entities may raise these multiple voices, I turned to Latour's (2005) work on actor-network theory and Mol's (2002) work on multiplicity. Following these bodies of work, an entity (let's call it entity A) is socio-materially entangled: it has relations with other (human and non-human) material entities (let's call them B, C, and D) (Latour 2005). [7] Its ability to act, which includes the action of raising one's voice, comes from this collective. The actions of entity A are not caused by A, B, C and D in the sense that they determine those actions. Rather, A, B, C and D afford A's

[6] Farm yard manure is a preparation consisting primarily of cow dung, cow urine and straw.

[7] For Latour (2005: 11), the term social does not refer to a human realm separate from a natural realm, but it refers to the creation of association between any (human and non-human) entities.

actions, which means they may "authorize, allow, afford, encourage, permit, suggest, influence, block, render possible, forbid, and so on" (Latour 2005: 72). However when entity A's associations change, A's ability to act, and hence its voice, changes. This gives rise to Annemarie Mol's (2002) concept of multiplicity. An entity's voice is thus relational, multiple and material, because it results from its relations with other material human and non-human entities.

Knowledge and Politics

"[T]he construction and deployment of policy-relevant knowledge are a significant source of power in their own right […] that need to be subject to their own democratic critique." (Miller, 2007: 325)

Some voices remain silent in research and public controversy on biodiesel. In other cases, voices only get articulated in relation to a very specific aspect of biodiesel production, such as achieving high yields, while remaining silent in relation to other aspects, such as avoiding food vs fuel competition. Most of the academic literature and public controversy as outlined above engages with state-level policies on biodiesel, the 2009 national policy, or the preceding 2003 Mission on Bio-Diesel. In doing so, scientists in this field claim to be producing policy-relevant knowledge.[8] If voices of entities that play an active role in producing biodiesel feedstock are absent from knowledge and policy, this gives rise to concerns about the extent to which these processes may be considered democratic, if a democratic process is understood as a process in which entities that are somehow involved in a new development get to raise their voices and get to participate in decision-

[8] A key example of a framework used in science to present knowledge to policy-makers on the relation between innovations and the changes they may bring about in the environment is the ecosystem-service approach, which I will address in chapter five (Gasparatos et al., 2013).

making thereon.[9] But before I delve into this particular approach to democratic processes, which I will do in chapter three, it is first of all necessary to conceptualize the relation between knowledge and politics. In this thesis, I followed a constructivist approach to knowledge-making. This approach views the knowledge-making process as being inherently intertwined with making decisions that cannot be taken on what may be considered as an objective, rational or scientific basis (Wickson and Wynne, 2012). For example, in the case of GM governance, Wickson and Wynne (2012) show how scientists' choices on what test material, experimental comparators, timeframes for observation, statistical tools and interpretation methods would be used for a particular experiment influence the development of scientific knowledge and therefore also influence scientists' and public appraisal of GM as a technology. No single, universally correct answer exists for any of these choices. Hence, these choices cannot be purely based on scientific arguments. Depending on the choices made, many different research outcomes, each with their own normative implications regarding the desirability of GM technologies, can be constructed. Similarly, Jasanoff (2004: 2) uses the concept of "co-production" to propose that social (such as social practices, identities,

[9] Of course, this understanding of democracy, in which not only humans but also non-humans are considered as relevant actors in knowledge-making, policy-making and innovation processes, is very different from that of liberal democracy and deliberative democracy. Liberal democracy only refers to formal governance and policy-making, in which human voices are represented by other humans in parliaments based on free elections between political parties (Willard, 1996). Habermasian approaches to deliberative democracy are about discursive processes of collective deliberation conducted among free and equal individuals, based on rational arguments (Mouffe, 1999). My approach to democracy follows a different tradition, most notably represented by Latour's (2004) politics of nature. As I will show, this approach is valuable when interested in questions of better, more equitable, inclusive and therefore more democratic policy-making, innovation processes and knowledge-making. Or in other words, I will show how the voices of various human and non-human entities that are part of these processes are relevant for steering the direction in which these processes should be moving.

norms, conventions, discourses, instruments, institutions) and natural orders (such as knowledge and technology) are produced together (Jasanoff, 2004: 13, 14).

What these STS approaches hold in common is that facts and values cannot be neatly separated. If values are an inherent part of fact-making (and vice-versa), we are dealing with what Latour (2004a) calls propositions. These are associations of humans and non-humans, collectives that cannot be classified as true or false, or as society or nature. Rather, they can be considered more or less well-articulated. A well-articulated proposition allows for a richer, more interesting and more nuanced understanding of a situation at hand than previous propositions (Latour 2004a; Blok and Jensen, 2011). The construction of knowledge, based on collectives of humans and non-humans, is inherently political (Latour, 2004b). In this context, the term political is used to indicate that choices have to be made in the process of making knowledge, which may lead to contestation. And this is not only the case when knowledge is used to inform policy, but also when knowledge is used to inform (and is produced through) innovation processes.

The understanding that humans and non-humans participate in the construction of knowledge is a key characteristic of actor-network theory (ANT), which highlights material obduracy and argues that humans and non-humans both have agency (distributed in the collectives through which they act) (Latour, 2005; Latour, 1999). For example, in his study on soil sampling in the Amazon Forest, Latour (1999) shows how the materiality of the soils themselves as well as a host of entities that constitute the methodologies deployed (table, threads, measurement charts and many more) participate in the construction of knowledge on the ecology of the Amazon basin. However, for a non-human entity to raise its voice in relation to policy-making and innovation processes, it needs to be entangled with at least one or more human entities. For example, in a conference room, humans may discuss the future of biodiesel in India. Non-humans such as seeds may raise their voices in the words uttered by these humans,

in graphs and photos on projector screens or as samples in glass or plastic jars. All of these voices are raised with the assistance of humans (as well as a host of non-human entities), who created the graphs, who took the photos that appear on the screen or who put the sample in the jar.[10]

If knowledge-making is inherently intertwined with making disputable decisions, and if entities' voices are multiple, then questions such as 'which voices get raised?', 'which knowledges are constructed?' and 'which knowledges are (made) policy-relevant?' are political questions. Indeed, if the voices of entities raised in articulations with people such as landless farmers, smallholder farmers or village-level politicians are different from the voices raised in articulation with such authorities (scientists, policy-experts or innovators), then the domains of knowledge-making, innovation processes and policy-making should pluralize the sources of evidence that are considered valid and in this way, be (further) democratized in the sense of registering and accommodating the voices of all interested entities (Latour 2010; Lövbrand 2011). Particularly because, as Miller (2007) shows, knowledge that is accepted as 'relevant' and 'true' in relation to particular policy propositions or in an innovation process has the power to influence those policy-making and innovation processes. In the case of biodiesel, many voices that have an interest in biodiesel are absent from the body of knowledge put forward by scientists and in public controversy, as chapters three, four, five and six will show. Others may get raised in (scientific or

[10] Another example is that Hassan Bio-Fuel Park's researchers report the number of seedlings planted thanks to their efforts, while my engagement with farmers and their farming practices brought to the fore that these seedlings barely survived due to a lack of rainfall and irrigation facilities. So the seedling, in articulation with the Park's researchers and other entities involved in the event of planting them on farmers' lands, got to raise its voice as "having been planted", but not as "dying" or "dead" as happened through my fieldwork. So humans tend to be endowed with the capability of speaking in relation to policy-making, knowledge-making and innovation processes, while non-humans can only speak indirectly, through so-called 'spokespersons'. Latour (2004) reminds us to remain skeptical of spokespersons, putting whatever they say up for discussion.

non-scientific) knowledge-making, but remain absent from policy-making (e.g. India's national policy on biodiesel from 2009) and innovation processes (as is going on in Hassan Bio-Fuel Park). All these situations may be considered as undemocratic according to my approach to democracy briefly outlined above and developed further in chapter three.

Research Questions

To sum up, I understand entities voices as material, relational and therefore multiple. Raising their voices through the construction of knowledge is a political endeavour for two reasons. Firstly, it is political because of the many choices that have to be made while constructing knowledge, which implies that different knowledges could also have been constructed if different choices were made. Secondly, it is political because these knowledges participate in the making of policy and the steering of innovation processes. Yet, as highlighted in the vignette at the beginning of this chapter and at the end of the literature review, many biodiesel-related voices are absent from these processes, or only articulated in relation to a very specific aspect of policy or innovation. To address this problem, this thesis asks the following research questions:

How democratic are biodiesel knowledge-making, innovation processes and policy-making in India? In what ways can they be further democratized?

To provide answers, I scrutinize innovation, policy- and knowledge-making processes. In addition, I also make a plea for widening the notion of policy-relevant knowledge. These different knowledges, which explicate and take seriously the voices of socio-materially entangled entities that participated in the creation of these knowledges, can help perform democratic scrutiny by taking away the monopoly, or perhaps oligopoly, of formally recognized scientists and government-related research- and advice-institutions on policy-relevant knowledge. This thesis takes an active part in doing so, walking down paths that were less frequently taken by researchers, business people, policy-makers and activists in the field of biodiesel in order to listen to, document and become an accomplice in articulating human and non-

human voices that have so far been largely silent in societal and academic controversies on biodiesel.

To answer these main research questions, chapter two starts by travelling to the past, and focusses on the category 'wasteland'. Delving into history is crucial to develop a fuller understanding of the present. In this case, the colonial category 'wasteland' is being instrumentally deployed by present-day governments. This study brings forward the contested histories of this category and shows how the diverse materiality of lands classified as waste or jungle at times were able and allowed to speak back to government policy by some colonial administrators. This removes some of the category's present day power and opens up space for contestation. The third chapter takes the making of India's 2009 policy on biodiesel as its primary focus. These two chapters contribute to the main research question by providing a deeper understanding of how diverse human and non-human entities can have, had, did not have or should have a voice in formal policy-making. This is followed by a story on the life-journey of a honge tree – the main biodiesel feedstock used in the area where most research for this thesis was carried out, namely Hassan district in the state of Karnataka – from its birth until its death. This contributes to the main research question through thick description of many entities' voices as encountered and raised through my fieldwork. The fifth and sixth chapters are based on the story presented in chapter four and the theoretical approach proposed in chapter two and three. While chapter two and three are largely based on ANT and mostly focused on policy-related controversies, chapter five and six engage more directly with the elements of knowledge-making and innovation processes from the research question. Specifically, chapter five focusses on the ecosystem services framework, which I use as an example of (academic) knowledge-making that specifically aims to inform policy (Gasparatos et al., 2013). Chapter six engages with the concept of Responsible Innovation (RI), a process-oriented approach to innovation. This chapter shows how empirical insights brought to the fore using an ANT approach help identify some fruitful avenues for further theoretical development of this process-based approach aiming to make innovation more anticipative, reflexive,

inclusive and responsive (Stilgoe et al., 2013). These two chapters contribute to the main research question by analysing the extent to which knowledge-making using the ecosystem services approach and Hassan Bio-Fuel Park's innovation process can be considered democratic, and by making theoretical suggestions on how they may be further democratized. After discussing the methodologies I used to do the research on which these chapters are based, I will elaborate further on each of these chapters.

Methodology and Reflections

My research is based on a combination of archival documents, 72 extended conversations with people active in the field of biodiesel (policy-makers, activists, researchers, business people, representatives of business interests, and a number of farmers) that took place between September 2012 and December 2012, half a year of ethnographic fieldwork in Hassan district that took place between September 2013 and March 2014, and stakeholder meetings organized by politicians in various parts of India. The appendix lists the people with whom conversations were carried out, which organization they belong to and when the conversation was carried out. Furthermore, during these meetings with people active in the field and through internet searches, I collected research papers, policy documents and other kinds of reports on biodiesel. In addition, I presented my work at the end of my PhD trajectory at various academic and non-academic platforms in India and returned to my main field site in Hassan district in October 2015.

The archival research generated materials (cf. Whatmore, 2003) that were used to carry out the study on the colonial history of the category 'wastelands'.[11] To identify the agency of non-human (and human, but those

[11] I use the phrase 'generating materials' rather than 'collecting data' as suggested by Whatmore (2003). As a researcher, I do not make observations as a fly on the wall, as the phrase collecting data may suggest. Instead, I use the phrase generating materials to highlight the active role of doing fieldwork in creating knowledge.

are much more clearly documented in existing literature on wastelands than non-human) constituents of the category, I started this investigation by re-reading passages from documents referred to in existing literature on 'wastelands'. Next, I explored the archive's materials following keywords such as 'waste', 'wasteland', 'jungle' and 'uncultivated land' in the archive's digital search engine and the indices of collections of in-and outgoing letters from various district Collectors' offices in the province of Bengal.[12] These keywords were chosen based on re-reading passages used in existing literature, because they were used by the authors of those documents alongside or even instead of the word wasteland. The communications of collectors were very important in our analysis, because among all archival material identified, their letters came closest to describing the lands, their outgrowths, their users and associated practices. This was important to enable the materiality of the lands and their associated entities to speak as much as possible in the chapter based on this research.

People with whom I had extended conversations on India's biodiesel activities were initially identified based on their appearance in academic literature and activists' reports on biodiesel, or based on their responsibility for the field of biodiesel in national or state-level ministries as listed on government websites. Further identification also took place through snowballing. The main selection criterion was that people somehow had to have been engaged with India's biodiesel politics between 2003 and 2009, and I made sure to include scientists, people who self-identified as activists, government employees, farmers, business managers and people from organizations claiming to represent business interests. To make sure I did not only engage with the views of those operating in India's capital city Delhi and Karnataka's capital city Bangalore, and because a number of influential scientific institutions and activist organizations are located elsewhere, these conversations took place in Chennai (capital city of the state Tamil Nadu), Hyderabad (at the time capital city of the state Andhra

[12] In colonial India, the district collector is the main British official of a district.

Pradesh, and since June 2014 of the state Telangana as well), Coimbatore (major centre of academic and commercial research on *Jatropha curcas* and other biodiesel crops), Delhi and Bangalore.

Biodiesel was and is a sensitive topic among policy-makers. In fact, when visiting the Tamil Nadu ministry of agriculture, which held the state government's documentation on its biodiesel activities, I was only allowed to read a small part of this documentation and was not allowed to take notes from it let alone take photocopies. But not only policy-makers felt uncomfortable at times when asked about their engagements with biodiesel, the same holds for some of the activists who tried to influence policy, for researchers who were close to the policy-making arena and for businesses people who had withdrawn from biodiesel. In this setting, I soon started regarding what I initially intended to be semi-structured interviews as open-ended, two-sided conversations in which both my conversation partner and I got to ask questions, though I asked the majority of the questions. This started with an incident in which a policy-maker felt very uncomfortable with the term interview, and also refused to be interviewed. However, he keenly agreed to meet for a conversation. This conversation – and many more after this first experience – lead to insights that would not have easily emerged in a researcher-led interview setting. Furthermore, if these conversations were with people from organizations that were actively involved in biodiesel production or research, these meetings usually included visits to agricultural research tests fields, laboratories and experimental biodiesel production plants. I also made sure to ask for documentation on their activities in the field of biodiesel. All conversations were recorded and fully transcribed.

Next, I carried out ethnographic fieldwork in Hassan Bio-Fuel Park's office and associated villages, which was the main basis for chapters four, five and six, and which also contributes to chapter three. I selected Hassan Bio-Fuel Park because it was one of the few biodiesel projects that was still running by the time fieldwork was carried out, and because it promised to avoid most of the criticism that biodiesel had received (e.g. food vs fuel

competition, putting farmers' main income at risk, requiring sizeable amounts of agricultural inputs etc.). While doing ethnographic fieldwork in Hassan district, I was particularly guided by the proposition to 'follow the actor' (Latour 2005). Additionally, I would characterize my research as multi-sited, multi-object ethnography (cf. Yates-Doerr, 2015) because I follow Mol's (2002) notion of multiplicity, which entails that reality is not a singular entity but multiple, with each reality emerging through practice in different socio-material situations. Being interested in these different enactments of an object, the purpose of a multi-object ethnography is not so much to create knowledge about the object itself, but rather to study the specificities that create particular realities in order to open up towards ambiguity and contingency (Yates-Doerr, 2015). This shows how alternative realities to the one that was produced could also have emerged, and therefore this creates space for controversy and dissent. The actor of interest for this research was the pongamia, or honge in Kannada, tree. However, doing an ethnography following a specific tree and its enactment in various socio-material settings (which changes over time, while the tree may also get enacted in places other than where it stands) would not be a very fruitful endeavour for this research, because in the timeframe available I would only be able to capture a small part of a tree's life. Therefore, I studied how different versions of this species were enacted in different places and during different stages of the life of the tree, showing how alternative realities to those presented by Hassan Bio-Fuel Park's researchers and Karnataka state's policy-makers emerged. The story presented in chapter four is the main result of this endeavour, in which I followed young honge seedlings moving from the Hassan Bio-Fuel Park's nursery into farmers' fields, growing up (or dying), yielding seeds and more. Of course, I could not follow all seedlings and join the extension workers on every trip to villages. Neither would that necessarily be very insightful: in the presence of extension workers, farmers interacted differently with me, helped me to observe different aspects of their material lives than they did when my translator and I (repeatedly) visited a place by ourselves. Rather, my visits were guided by information provided by Hassan Bio-Fuel Park's

office staff on which villages were most keenly appreciated by those staff members and which villages collected most oilseeds – the basic product necessary for the production of biodiesel. Additionally, I visited villages that were very new to the project, villages that had been participating for a while, villages near the district capital and villages in different parts of the district. I also spent time in villages surrounding the project's most popular village, a village that represented best practice according to the project's staff. In total, the fieldwork was spread across 14 villages, carried out between September 2013 and March 2014, with a follow-up visit in October 2015. Throughout this multi-object, multi-sited ethnography, I strived to strike a careful balance between the imperative of 'following the actors' as they travelled between settings, and ensuring depth of understanding of different socio-material settings (Boccagni, 2014; Yates-Doerr, 2015). Following the project as a whole as an actor also brought me to attend government-organized conferences, resembling stakeholder meetings which were mostly attended by scientists and policy-makers from all over India, as well as some business representatives and a farmer.

During these meetings as well as throughout the ethnographic fieldwork in Hassan district, I took notes by hand and also recorded the more substantial conversations for backup purposes. Throughout the process I documented not only what I observed, but also how I came to make those observations: which questions I asked, how I had focused attention on specific things and not others. While transcribing these notes into a substantive set of typed-out fieldnotes, I also kept track of analytical notes. I noted down theoretical observations and questions that emerged after reflecting on my observations and of emerging narratives. Along with the 'follow the actor' imperative (Latour, 2005), these analytical notes steered the research directions taken throughout my fieldwork. They were also the basis for a gradual build-up of theoretical insights, constantly comparing my growing theoretical insights with new and existing observations.

Democratizing biodiesel in India

This thesis starts with an analysis of the history of the category wasteland. This arose from the prominence of the category wasteland in India's policy on biodiesel and in public and academic controversy on biodiesel. The category wasteland plays an important role in the legitimization of India's biodiesel policy and subsequent activities undertaken in the field, because it enables government and other biodiesel proponents to claim that food production is not affected by the cultivation of biodiesel feedstock since it takes place on wastelands that are supposedly not suitable for agriculture (Baka, 2016; Government of India, 2009, 3-4). Crucially, the category 'wasteland' and controversial policy-making thereon is not new in India. For example, India's policy on biodiesel was preceded by wasteland regeneration programmes using eucalyptus and subabul, which many regarded as compromising the various uses those lands had for people living in and around them (e.g. Jodha, 1986; Singh, 2013). The concept wasteland was introduced in India by the British under colonial rule (Gidwani 1992; 2008; Whitehead, 2010, 2012). Literature discussing the colonial and/or postcolonial role of the category 'wasteland' tends to overlook the extent to which the entities constituting this category – the material lands to which this category referred to, as well as these lands' outgrowth and people engaging with those lands – participated in controversies on categorizing land as 'wasteland' or what meaning should be attributed to the category. Therefore, this study investigates the multiple material voices of these entities, how they were articulated and to what extent they were registered in colonial policy-making in the field of wasteland. By focusing on the material associations in processes through which domination was achieved – in this case domination by the colonial administrators of wastelands and people who related to those wastelands – avoids framing history in the victors' terms. This brings to the fore how alternative realities (alternative to those according to the controversy's victors) were alive and thriving during controversies on wastelands and shows how land categories' multiple meanings were variously informed by different material associations such as large carnivorous animals, pastures and valuable trees from densely forested

areas. Importantly, the chapter documents how pathways other than the one that was followed were very much possible at the time of debate, and also shows that the diverse materiality of lands classified as waste (or jungle and other related categories) and their outgrowth were at times able and allowed to speak back by some colonial administrators. By doing so, this study contributes to the overall research questions in two ways. First of all, the insights of such an analysis show why it may be important to study how entities' relational and thus plural voices can be raised (or raised more loudly) in relation to policy-making and knowledge-making processes. Secondly, this study provides some initial understanding of how the voices of both human and non-human entities have been raised and registered in the past.

Chapter three focusses on the period between 2003 and 2009, starting with the publication of the first milestone document on biodiesel, namely the National Mission on Bio-Diesel which came from the national government's Planning Commission, until the publication of India's policy on biodiesel in 2009. During this period, a lot of contestation on biodiesel took place among scientists, civil society actors, policy-makers and business representatives – each acting as spokespersons for a wide range of human and non-human entities involved in growing crops for the production of biodiesel feedstock. This chapter draws on this contestation, listening to the different ways in which entities' multiple voices were raised through articulation with various kinds of spokespersons, and using this to analyse to what extent India's policy on biodiesel can be considered democratic. To make such a normative judgement, this chapter proposes a set of evaluation criteria, based on the work of Bruno Latour (1999; 2003; 2004a; 2004b; 2010) and Isabelle Stengers (1997; 2010). The central concern in these criteria is the extent to which entities' multiple voices were raised during this controversy and how they got challenge and recompose the national policy on biodiesel. As such, this study builds on the previous one by widening and deepening the understanding of how entities' voices have been raised in relation to policy-making on biodiesel, and by showing how certain voices came to be registered in India's policy on biodiesel while others were not.

The second and third chapters are followed by a story on the life journey of honge tree, starting with a seedling raised in Hassan Bio-Fuel Park's tree nursery. This story and the fifth and sixth chapters are markedly different from the second and third chapters. Namely, while second and third chapters are primarily concerned with the extent to which the voices of entities related to biodiesel have been raised through associations with others and in relation to policy-making, the remaining chapters actively raise the voices of entities that were not at all or differently raised so far. Also, these chapters study knowledge-making and innovation processes more directly through their engagement with the ecosystem services approach, as an approach to knowledge-making, and responsible innovation (RI), as an approach to innovation processes. Each of these chapters participates in the raising of these voices in a different way, so chapter five and six also reflect on the implications of the way in which they contribute towards raising those voices.

In the story in chapter four, I follow the life-journey of a honge tree that is born out of a seed in the nursery of Hassan Bio-Fuel Park. In fact, I do not only write about the life of that particularly tree, but also about the many other lives the trees could have had, depending on its associations with the entities it encounters along its life-trajectory. The story makes visible how the tree and its variously associated entities act in the Hassan Bio-Fuel Park project. The presentation of this material is through a story, rather than a common research paper. The story is exploratory, and travels where most research papers on biodiesel have not travelled so far. With this story and the fifth and sixth chapter, I aim to make an empirical contribution to the Indian and global literature on biodiesel. Small-scale biodiesel production projects with a high level of community involvement in growing, processing and/or using of biodiesel crops have been associated with a number of promises, including low environmental impact, no competition with food production, reduced rural poverty and enhanced access to energy (FAO, 2009; Energia, 2009). However, these promises are largely based on conjectures, calculating or imagining what could be possible in what the authors of the documents referred consider to be "ideal futures" in which

things work out according to the wishes of project planners, ignoring human and non-human relational agency.[13] As such, there is very little work that engages with what has taken place in practice in these kinds of projects so far, which is what I do in this thesis.

The fifth chapter uses the ecosystem services approach to document the voices of entities encountered during fieldwork in Hassan district. The main reason to do so is that the ecosystem services approach specifically aims to inform policy-making and has successfully managed to enter policy-discourse (Gasparatos et al., 2013). This makes the framework an interesting candidate to contribute towards the democratization of knowledge-making and policy-making on biodiesel in India. The main aim of the chapter is twofold. Firstly, to examine the ecosystem services approach as an attempt to contribute towards and participate in raising the voices of both humans and non-humans towards policy-makers (e.g. Gasparatos et al., 2012). As such, the chapter shows how the ecosystem services framework privileges some voices, such as the availability of water for irrigation purposes or the presence of fuel for cooking, while it silences others, such as the social and political benefits that farmers can gain from participating in the project or oilseeds' diversion from its existing use as a key ingredient for soap production. In the specific case of Hassan Bio-Fuel Park, the chapter shows that there are very few "impacts" to be observed, which is what the framework documents, and that the framework silences the voices of entities that play a crucial role in the creation of this lack of impacts. Secondly, I make some suggestions as to how the approach could be improved in line with this thesis's focus on democratic knowledge-making and policy-making. In doing so, I introduce the concept 'matters in the

[13] An exception is work by Fatimah, Raven and Arora (2015), who analysed why small-scale biodiesel pilot projects were stalled in Indonesia. Additionally, some quantitative analyses on the socioeconomic benefits that can be derived from decentralized biodiesel production projects were carried out in Tanzania (van Eijck, 2014). While van Eijck used empirically observed data whenever it was available, she also had to make a lot of assumptions and relied on secondary data for a lot of her work.

making', inspired by Latour's (2003) contestable, malleable and unstable 'matters of concern' and uncontested, fixed and stable 'matters of fact'. The concept matters in the making denotes creating knowledge on processes, such as the creation of (a lack of) impacts. Such knowledge focusses on how entities are continuously being brought into being rather than on static impacts, and treats the socio-material entanglements that bring entities into being as active actors that should be taken seriously. Matters in the making are not the same as matters of concern. Matters of concern can be stabilized into matters of fact once controversy calms down and some sort of temporary agreement is reached (Latour, 2004). Matters in the making will never get stabilized into matters of fact. Rather, this concept simply highlights that entities – matters – will never be static but are always in an ongoing process of becoming for they emerge through the actions of others. The concept matter in the making does not focus on a process of contestation that can be stabilized, like matters of concern, but highlights how entities come about through socio-material entanglements. I argue that the making of policy may be democratized and do more justice to the plural, material voices of human and non-human entities if it is informed by matters in the making rather than matters of fact.

The sixth chapter specifically focusses on a body of theory that engages with innovation, namely that of Responsible Innovation (RI). Hassan Bio-Fuel Park aims to contribute towards an environment-friendly, pro-poor and profitable biodiesel innovation which resembles Koops' (2015) characterization of responsible innovation: creating a societally desirable and ethically acceptable combination of profits, societal welfare and environmental sustainability. In this chapter, I study the implications of documenting 'matters in the making' for this approach to innovation. If 'matters in the making', raising the material voices of a wide range of human and non-human entities involved in the production of biodiesel in India, are to democratize the RI process, then what theoretical implications does that have for the RI process? In particular, this chapter shows that studying matters in the making highlights the relational agency of entities such as water, fertilizer and the trees themselves. In this case, I will show how these

entities' agencies make it very difficult to do biodiesel innovation responsibly according to Stilgoe et al.'s (2013) dimensions of RI, namely anticipation, reflexivity, inclusion and responsiveness. This raises concerns about the extent to which this framework allows for discontinuing innovation.

The thesis as a whole, through the questions it asks and the approach it chooses to answer that question, takes a clear normative stance.[14] This normativity is undergirded by an understanding of knowledge-claims being inherently political due to science's countless indeterminacies (Wynne, 1992; Wynne, 2007). Because of these indeterminacies and the many possible routes to be taken, the development of science is directly intertwined with ethical questioning. If there are no separate facts and values (cf. Latour, 2004b), and if knowledge – particularly knowledge constructed and deployed at science-policy making boundaries (cf. Miller, 2007), then knowledge-making should not be left to scientists, secluded from the rest of society.

Why Read this Thesis?

Although my work is largely based on STS-approaches to knowledge and politics, and specifically ANT, this thesis aims to be of interest to a wider audience. This obviously includes scholars engaging with the ecosystems services approach and the literature on responsible innovation. But I also hope my work will be of interest to scholars working in the field of transition studies, which is increasingly concerned with the direction towards which 'sustainability transitions' should be transitioning. For example, some scholars argue that the deliberation thereof should explicitly be included in transition frameworks, based on an understanding of scientific knowledge as inherently political (e.g. Loorbach, 2014; Wittmayer

[14] While it has been argued that ANT is too descriptive and therefore unable to take a normative stance (e.g. Swyngedouw and Heynen, 2003), I will attempt to show how ANT is very well able to do so (cf. Holifield, 2009).

and Schäpke, 2014; Jhagroe and Loorbach, 2015). Jhagroe and Loorbach (2015) suggest that what they call an 'extra-institutional' transition management process can facilitate more democratic transition governance. Their notion of democracy, namely post-foundational democracy, resonates with some of characteristics of democracy as used in this dissertation and as presented in chapter three, namely the focus on struggle, controversy and suspending closure. Furthermore, my research engages directly with the relationship between knowledge-making and policy-making. As such, it is also relevant to those who work on improving knowledge-making for the purpose of policy-making, such as for example Turnheim et al.'s (2015) recent attempt to bridge three analytical approaches (quantitative systems modelling, socio-technical analysis and initiative-based learning) to address sustainability governance challenges. Indeed, this thesis is part of a long-standing and growing interest in engagement, participation and inclusion. As such I hope it will be of interest to all kinds of research on the (human and non-human relational) democratization of knowledge-making, innovation-processes and policy-making.

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Material meanings: 'Waste' as a performative category of land and the permanent settlement in colonial India[15]

Abstract

Nearly seven decades after 'decolonization', policymaking in India continues to be haunted by colonial categories. Focusing on the category 'wastelands', which has been central to recent debates on India's biodiesel policies, we study how it was heterogeneously constituted during the Permanent Settlement in late 18th and early 19th century colonial India. In particular, we trace how this category (and other, associated, categories) took on multiple meanings through its encounters with different human and nonhuman entities in disparate spatio-temporal settings. These entities included not only ideas and moralities derived from theoretical notions such as Locke's 'natural rights', but also the soil and water on diverse lands, their outgrowth and the beings living or made to live on these lands. The multiple meanings of the category led to debates and controversies between colonial administrators regarding the ways in which the Permanent Settlement should be introduced and extended. These debates were won and subsequent domination was achieved not only by mobilizing a wide range of human and nonhuman entities in support of a particular meaning, but also by leaving some entities unmobilized or excluded. And although these debates contributed to changes in wasteland reallocation rules, the latter continued to be shaped predominantly by 'economic rent and cultural improvement' imperatives of the colonial administration rather than by the 'thing-power' of the lands' material diversity. Despite this, by emphasizing the debates and controversies about the category's meanings, we attempt to frame our historical narrative not just in the terms provided by victors of the debates in the colonial administration, but also by their losers.

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[15] This chapter is based on the following paper: de Hoop, E., Arora, S.. Material meanings: 'waste' as a performative category of land and the permanent settlement in colonial India. Accepted for publication in the *Journal of Historical Geography*. Because this paper is a co-authored piece, this chapter is written using the pronoun 'we' rather than 'I'.

Introduction

'Waste', a colonial category of land, continues to haunt 21st century policy-making in India. This has been particularly salient in the case of India's biodiesel policies. In 2003, launching the National Mission on Bio-Diesel, the Planning Commission of India published a report claiming that 13.4 MHa of land was 'available' for the cultivation of jatropha for biodiesel production (Planning Commission, 2003). In 2009, the Indian national biofuel policy claimed that the available land was actually 'waste-land', on which the cultivation of biodiesel feedstock will prevent competition with food production (Government of India, 2009). A large body of scientific literature follows this line of reasoning, such as suggesting policy changes so targets can be met, studying the potential benefits to be reaped based on this premise or an economically optimal arrangement of the product's supply chain (Francis et al., 2005; Leduc et al., 2009; Barnwal and Sharma, 2005). Others explore the extent to which using those 'wastelands' for the cultivation of jatropha, pongamia or other feedstock crops is economically and/or technically feasable (e.g. Ostwald et al., 2015; Jain and Sharma, 2010; Sarin et al., 2007). Indeed, the use of wastelands for the cultivation of biodiesel crops, just as the issue of "wasteland regeneration" through eucalyptus and subabul plantations in earlier decades, has provoked significant criticism (e.g. Jodha, 1986; Gidwani, 1992; Singh, 2013). First, the biofuel policy has been criticised for assuming that land classified as waste is somehow un- or under-used land not utilised for food production, on which biofuel feedstock therefore can be grown. Activists asked to what extent 'wasteland' was readily available for conversion into biodiesel plantations. For example, Friends of the Earth reported several cases in Chattisgarh where lands classified as wastelands were actually used for livestock grazing. Attempts to convert these lands into jatropha plantations were met with resistance by existing users (Lahiri, 2009). Similarly, others have argued that if 'wastelands' can be used to get profitable yields from jatropha or other biofuel crops, they can also be used for food production or for grazing and sourcing non-timber forest products (Jain and Sharma, 2010; Das and Pries, 2011; Ariza-Montobbio et al., 2012; Rajagopal, 2008).

Secondly, 'wastelands' granted to companies for jatropha plantations were later used for profitable real estate development. Such occurrences have fed into larger debates on how agrarian policies enable landgrabbing (e.g. Baka, 2013; Baka, 2015; Borras and Franco, 2012; White and Dasgupta, 2010).

In this chapter, we attempt to show how a fuller understanding of the present controversy, and of ways to challenge powerful categorizations that trample upon existing uses and materiality of lands, may be gained by delving into the history of the term 'waste' as deployed to classify and transform land in colonial India. Within the discourse on India's biofuel policy, Baka and Ariza-Montobbio et al. have discussed how the term was introduced by the British in late 18th century in the process of developing agricultural tax collection systems (Baka, 2013; Ariza-Montobbio et al., 2012). They base their historical discussion of wastelands on the work of Gidwani and Whitehead, who have both persuasively argued that the category was most centrally informed by the writings of John Locke on private property (Gidwani, 1992; Gidwani, 2008; Whitehead, 2010; Whitehead, 2012). In this paper we contend that both Gidwani and Whitehead, by arguing that the category 'wasteland' was constituted predominantly by ideas alone, sideline the encounters between the category and the materiality of the lands (and the beings dwelling on it) in Bengal and Orissa where it was first enacted. Through these material encounters, not only did the category attempt to transform the land and the lives of its inhabitants, it also took on new meanings. We focus on the latter process of the multiplication of meanings.

These multiple meanings eventually led to a multiplicity of rules for 'wasteland reallocation', even though these rules were focussed, more narrowly than the meanings, on transferring land to planters and cultivators so as to extract rents for the British administration. Thus, while some of wasteland's initial economic and technical meanings (such as non-productive land and non-tax yielding land) may have been dominant in rule-making, and may have been handed down from the late 18th century for instrumental deployment by 21st century Indian governments, these were

definitely not the only meanings attached to it by contemporary actors. By uncovering these different more marginal meanings and the controversies generated by them around the turn of the 18th century in Bengal and Orissa, we aim to go beyond framings of history that ascribe unidirectional power to colonial categories to reshape extant socio-material realities.[16] Colonial governance categories such as wasteland were not always victorious and when they did achieve victory, it was not through processes of unilateral capture by a colonial category of diverse realities. These realities resisted their capture. And as a result, the constitution and enactment of colonial categories were unpredictable events, situated in specific relational-material settings and multiple in their meanings.

Wastelands in the Permanent Settlement

On the 22nd of March 1793, Lord Cornwallis, the then Governor-General of British India proclaimed the Permanent Settlement of Bengal.[17] This event has been viewed as a watershed in colonial agrarian history, most notably by Guha (1963). It is supposed to have radically altered land rights and land use patterns. At the heart of this agreement between the East India Company and the landlords in Bengal was the aim of installing a 'permanent' system of land taxation (Guha, 1963). Once the tax rate on a certain piece of land was fixed, it was never to be changed, regardless of increasing or decreasing yields or change of ownership. According to Guha, the imperative underlying this policy was twofold. The first aim was to set up an agrarian policy to be implemented uniformly in all of Bengal, abandoning the frequent changes characteristic of earlier agrarian policies of

[16] Such accounts include not only the work by Whitehead (2010; 2012) and Gidwani (1992; 2008), but also for example Brara's (1992) work documenting diminishing availability of grazing lands in rural Rajasthan after the 1920s and Gadgil's (1989) work on the colonial and postcolonial exploitation of forests and disintegration of indigenous institutions.

[17] The Governor-General was the head of the British administration in India.

the East India Company. It was assumed that unchanging tax rates on a specific parcel of land would make it more conducive for its owners to invest in 'improving' the land's fertility since all benefits from such improvement activities would be reaped by the landowners themselves. Secondly, the proponents of the Permanent Settlement aimed to install private property rights. Guha showed how the policy was informed by three sets of ideas: mercantilism, physiocracy and free trade. The many facets of 'waste' – the concept, the lands it was supposed to categorize, practices carried out on those lands and even the voices of users of these lands – were all missing from Guha's account.

Gidwani therefore criticized Guha and others for overlooking the importance of waste, as a concept and a category, in the creation of the Permanent Settlement of Bengal:

> "The idea of 'waste' is richer, and more politically significant, than most histories of the Permanent Settlement have indicated. The concept of 'waste' not only possessed an ecological dimension that described land types, but also a moral dimension that described undesirable kinds of human behaviour." (Gidwani, 1992, p. 44)

Even though Gidwani notes that waste as a concept had an ecological dimension, he considered this to be uninteresting and unproblematic, even insignificant, in comparison to the 'moral' dimension of the concept. To demonstrate the politics of this moral dimension, Gidwani argued that the wasteland's techno-economic meaning, as "land which did not yield tax", must be situated within a wider set of intellectual affiliations (Gidwani, 1992, p. 43). He traced the category's intellectual roots in John Locke's theory of property, the physiocrats' emphasis on land as the primary source of wealth, and 'Benthamite utilitarianism'. Out of these, Gidwani deemed Locke's labour theory of private property to be particularly important. According to Locke, people have a "natural right" to a piece of land, a right that comes as a consequence of their value-adding labour input on that land. This was used as a rationale for furthering the transition from commonly-held lands to private ownership (Whitehead, 2010). In fact, Locke argued

that land was put to 'better and higher use' if it was privately owned. And this better and higher use then buttressed the claim that individuals who owned land were morally superior to those who did not own land (Gidwani, 2008). Conversely, land classified as 'waste' was not just land that could be used more productively, but also land that lacked productive individual proprietors who had a "natural right", arising from diligent labour, over it. The widespread existence of such wasteland in India was thus taken as proof of the moral inferiority, ignorance and indolence of India's human inhabitants (Gidwani, 1992).

Therefore, according to Gidwani, British efforts to 'improve' wastelands (through agrarian use) were not just geared toward generating rents for the East India Company but also to improve Indian morality. As such, 'waste' as a category (of land) was performative, in informing as well as legitimizing the Permanent Settlement. At the same time, Gidwani argued that colonial administrators disconnected the term from the lands it was supposed to describe. He argued that colonial administrators' accounts of the character and extent of wasteland in India were "impressionistic […], generated by a network of premises that had already rendered "India" as an object in imagination". (Gidwani, 2008, p. 22). In this way, for Gidwani, colonizers' own imagination and ideas about wastelands overruled any connection with the actual materiality of India's land or the diversity of its dwellers. Instead, he attributes differences in the meaning which institutions may attribute to the term may arise from the institutions' origins. For example, in the context of contemporary debate around wasteland, government institutions may argue that waste is generated by villagers' mismanagement and population growth, while NGOs argue that corruption and lack of law enforcement is to blame. In contrast, Kuletz (1998) argues that the materiality of desert lands, sacred landscapes and aboriginal homelands of Native Americans, informs environmental science's understanding of those lands as marginal wastelands and supports the use of those lands for the purpose of dumping nuclear waste and testing weapons. This approach extends to the people living on the lands, who are similarly characterized as 'marginal' and possibly even as expendable subjects for radiation

experiments (Kuletz, 1998). On the other hand, Cronon has shown that 'wasteful' Native Americans living in ecologically abundant areas were ousted from such areas under conservationist regimes looking to protect those areas from humans (Cronon, 1996; Cronon, 1983).[18]

Whitehead concurs with Gidwani by arguing that colonial administrators in India (as a whole) 'applied' Locke's original use of the term 'waste' (and 'wasteland') as an opposite of the term 'value'. In colonial India, she argued, wasteland referred to "common land, land used unproductively or left idle" (Whitehead, 2010, p. 86). This land categorization, for Whitehead too, was loaded with moral values and it was performative: it helped to make "legal and administrative maps that divided wilderness from the settled, wildness from civilised, wasteful from productive, and the civilised from the savage" (Whitehead, 2010, p. 93).

While rich in their accounts of the ideological underpinnings of the term 'waste' and path breaking in demonstrating the moral-political power of that term, Gidwani's and Whitehead's narratives end up simplifying the history of 'wastelands' in several ways. First, Whitehead claims that colonial policies related to 'wasteland' in India aimed to increase the productivity of the land while 'improving the moral qualities' of landless Indians by making them landowners and thus responsible for those lands. While this might have been attempted for specific castes and tribes, such as in many so-called 'criminal settlements', it is not universally applicable.[19] For example, Basu's (2008) work on the allocation of lands classified as wasteland in the Madras Presidency showed that joint rights to these (communal) lands were held under the *mirasi* system mostly by the rather privileged 'upper' castes of land-owners (Basu, 2008; Kumar, 1965). Landless labourers (often

[18] There is also Yeh's (2009) work on wastelands in China's Tibet, which traces how Lhasu's Lhalu was a 'wasteland' that had not been cultivated for thousands of years, according to government officials of the early Chinese regime, and how the rise of tourism turned the area into 'wetland' with 'pristine nature' that should be preserved.

[19] For work on criminal settlements, see M. Radhakrishna (2001) and Arora (2014).

belonging to the 'lower' castes) were usually prevented from obtaining any rights to use, let alone own, those lands. This points to the fact that the performative 'power' of (the Lockean underpinnings of) the category wasteland might have been situated, restricted to specific localities, and even in these situations, the power of the category was negotiable and indeed negotiated in practice as it encountered local material and social relations.

Secondly, Gidwani and Whitehead treat the category 'waste' (or wasteland) as if its meaning and power were fixed a priori. Gidwani for example concludes that "the idea of 'waste' was instrumental in serving the needs of colonial rule." And that the wastelands' widespread presence, for the British, "was testimony to the inability of Indian people to rule themselves properly: hence colonial intervention was justified" (Gidwani, 1992). Now if the idea of waste and the category of wasteland were of such crucial importance to colonial rule, and their influence as widespread as claimed by Gidwani and Whitehead, it is quite likely that their imposition was resisted.

There is also a related third point: as we will attempt to detail later, there was not one formal or technical definition of wasteland, but rather a broad range of overlapping understandings of this notion or category. In fact, wasteland could mean anything from forested land to 'uncultivated land' and 'land not privately owned'. Importantly, these different definitions or multiple meanings should not be overlooked because they fuelled important debates in the making of the Permanent Settlement of Bengal and other policies (of "wasteland regeneration") that followed. However, these debates and controversies occupied very limited space in Gidwani's and Whitehead's work. We argue that, by overlooking the controversies, both authors end up inadvertently framing their historical narratives in terms and meanings favoured by the winners in these debates.

To address these issues in what follows, we document controversies about what elements constituted a wasteland and on how it should undergird the Permanent Settlement. We also document the many ways in which waste-lands as well as humans and non-humans dwelling on those lands resisted being categorized as 'waste' and resisted policies associated with this

categorization. By highlighting these controversies and resistances, we aim to show how any ideological, moral and economic dimensions of 'waste', as documented by Gidwani and Whitehead, were imbued with the material struggles involved in the making of actual tracts of wastelands by the colonial administration. These struggles were material not only because of divergent economic interests of the different actors involved, but also because of the diversity of land cover and land use practices. Enactments of wasteland, as a category, during the Permanent Settlement of Bengal and later of the 'ceded and conquered provinces' were thus materially contested.

Without taking these contested enactments of wastelands into account, historical narratives may end up giving the impression that the colonial administration simply did what it intended to, without any contestation and debate among the administrators, without much (successful) opposition, and without any modification or evasion by the humans and nonhumans that were governed. Below we attempt to demonstrate that these dissenting agencies and voices, from among the colonized and from within the colonial administration, were plural and hybrid, their actions always afforded by other associated humans and nonhumans. Through this account, we hope to show how land and its classifications have been historical actors of great importance, often refusing to play the roles that were expected of and assigned to them by (some) colonial administrators. Furthermore, by allowing acting nonhumans into our historical narrative, we hope to facilitate an expansion of the archive that can now be revisited and reinterpreted to reveal not just what is on its pages but also for the material encounters through which the content of these pages was constituted (cf. Trentmann, 2009).

Abstractions and Enactments

Connections, links, relations or, following Latour, 'associations' form the starting point of our theoretical approach (Latour, 2005). Associations between humans and nonhumans, and between different (non)humans, highlight the extensional nature of time and space (Whitehead, 1925). Any

individualized category, such as 'waste', is then carved out of this extensional time-space as an *abstraction*. In other words, it is distilled from the tangle of associations which constitute it. It can, under felicitous conditions, find "renewed relevance in circumstances that have yet to be determined" (Stengers, 2011, p. 327).

An abstraction is not simply a product of thinking done by a human being alone (Deleuze and Guattari, 1994). Meanings are formed not inside human minds and ascribed to things, nor are they essential attributes of the things in themselves, but rather they are relational, immanent to an assemblage (Malafouris, 2013; Deleuze and Guattari, 1994). We think of an assemblage as a tangle of associations between human bodies, the physical world beyond them, and values and ideas. Any abstraction is thus a product of such an assemblage. An assemblage is not just a network of clearly identifiable actants. Instead it is a nebulous and dynamic gathering of associations, which produce and perform abstractions (such as individual categories) within them. An abstraction, even after it has been extricated from the assemblage that produced it, bears the imprint of that assemblage.

Thus, any individual idea or category, as an abstraction, is brought into existence out of active and changing associations between humans and things (including concepts, categories and other ideas).[20] For example, the meaning of a farm may be formed, made possible, through associations with human efforts entangled with the work of notions such as 'natural resources' as well as of associated materials including soils, seeds, plants, fertilizers, wells and tillers. However, in the constitution of an abstraction, not all associations play an equally important role. Some associations are more forceful than others. This power of non-humans (including categories and ideas), as 'thing-power', then is located in associations, rather than in the (individualized) entities themselves (cf. Bennett, 2010). Yet, whenever we locate power in specific entities or associations, we incur the risk of what

[20] This also implies that nothing is brought into existence ex nihilo, it is rather re-created through changes in its associations.

Alfred North Whitehead called the 'fallacy of simple location' (Whitehead, 1925). We must therefore avoid treating an association as a mathematically specifiable and stable tie in a network. We must retain a degree of uncertainty in our understandings about how power is distributed, and where/when asymmetric power is localized, in an assemblage.

Now when an abstraction travels out to encounter other assemblages, as part of a process of 'universalization' (cf. Tsing, 2005), or as part of 'scaling up', (cf. Weid, 2001) it is translated into the new assemblages and attempts to reconfigure the latter. Borrowing a term from Annemarie Mol (2002), we refer to this process of translation as *enactment*. Enactment thus is not a one-way process of transformation of the meaning of a category but also entails an attempted reconfiguration of the receiving assemblages. It points to the formation of specific meanings and thoughts (e.g. of the term wasteland), and to changes in associated materialities (e.g. of the lands associated with the term, and this land's composition, weights and textures). In fact, through processes of enactment within assemblages, ideas and materials are both ideationally and materially constituted. It is in this sense then that meanings and ideas are not just ideational but also material, blurring the boundaries between ideas and materials, representations and realities.

In general, when an abstract entity such as a category encounters a new assemblage, a *faithful transfer* of its extant meaning will be resisted by the new assemblage. This material struggle, if successful, leads to the category taking new meanings, performing different actions. The kinds of new meanings taken by the category depend on which of its (material and ideational) associations in the new assemblage are more or less powerful in shaping the meanings. At the same time, the inclusion of the category is likely to reconfigure the power distribution inside the assemblage. Thus, unless concerted efforts are made to keep resistance at bay and keep meanings stable (as in a strictly regulated standardization process), a category's meaning is transformed as it is enacted through a new assemblage. This implies the production of a *multiplicity* of enactments of the 'same' idea-entity as it travels across time and space (Mol, 2002). However, it is worth

noting that the meaningmaking action of an assemblage, according to Deleuze and Guattari (1987), is not a causal or universal process. There is no cause to effect continuity here, which transcends a specific spatio-temporal juncture. An assemblage is immanent to a particular spatio-temporal juncture (even if it may be extended or pared, as it opens out on to an outside or closes in on itself). It is this situatedness in space and time that leads to the making of a multiplicity of enactments (of a category such as wasteland).

Wasteland Enacted

In order to capture the multiple enactments of wastelands, this chapter is based on archival material from the India Office Records located at the British Library and published volumes, located at the libraries of the University of Oxford, containing letters written around the time of the Permanent Settlements of Bengal.[21] Before narrating the colonial enactments of the category 'wasteland', we must highlight that our work required sensitivity to a range of categories that overlap with it. Where one archival record referred to a piece of land as 'wasteland', others may have referred to that same land as 'uncultivated land', 'land which is not privately owned', or 'jungle'. An interesting illustration of this comes to the fore when one traces the following claim by the 19th century Scottish historian W. W. Hunter, which was later mobilized by Gidwani, to highlight the importance of the category 'wasteland' in the making of the Permanent Settlement of Bengal (Gidwani, 1992, p. 39). In 1894, Hunter wrote: "Even in regard to the all-important question of *Waste Lands*, whose vast extent and difficulties of reclamation determined both Cornwallis and the Court of Directors to declare the Settlement permanent, the exact area was absolutely

[21] For the sake of clarity, all unpublished sources will be referred to in footnotes. A lot of the archival documents on which this chapter is based have been published, and these volumes were accessed at the India Office Records section of the British Library and at the University of Oxford's libraries.

unknown in any District" (Hunter, 1894, p. 86; Gidwani, 1992, p. 39. Italics by Gidwani). Hunter's claim was referring to an estimation by India's governor-general in 1789, Lord Cornwallis, according to whom about one-third of the company's territory in Bengal was jungle (Cornwallis, 1789, p. 562). Curiously, however, instead of using Cornwallis' term jungle, Hunter and later both Whitehead and Gidwani following him refer to Cornwallis' estimation using the term wasteland. Nineteen years after Cornwallis' original statement, in 1808, Colebrooke, member of the Governor General's council from 1807 until 1812, also reflected on the extent of jungle, arguing that these were all "lands fit for cultivation," just not cultivated yet.[22]

Furthermore, in letters written by various colonial administrators in Bengal, discussing local situations, both the terms waste and jungle feature prominently. Similarly, Chakravarty-Kaul's (1996) work demonstrates how there was a wide range of terms used by the British colonial administrators in Punjab. Chakravarty-Kaul herself predominantly uses the term 'common lands', which is her own umbrella term for the lands she studied. But her work shows that even though the British often referred to any kind of land that was not both individually owned and cultivated as waste, they also deployed a wide range of categories to describe those lands. Those categories were partly British inventions, but many also originated from different kinds of existing institutional arrangements in the area. These include for example banjar kadim (long fallows inside village boundaries, but outside the residential area), extensive wastes (uncultivated land, used mostly for grazing, located outside village boundaries), and riverain grazing. While some of the terms clearly brought to the fore the specific materiality of those lands – riverain grazing land for example was located along a river and sometimes got inundated – others categorized as 'wastes' could be anything from forests to shrub land to grasslands. Similarly, Gidwani highlights that administrators in south India distinguished between five different kinds of 'waste', including commons that were to remain under the

[22] Colebrooke, Mr. Colebrooke's Minute, 1808, paragraph 14, in: Selection of Papers from the Records of the East India House Vol 1 London, 1820. Italics by author.

jurisdiction of villages (Gidwani, 1992, p. 43). Indeed, in debates on the enclosure of common lands in England between 1700 and 1820, the terms commons, common waste and simply waste were all used without clear demarcation of their different meanings (Neeson, 1993).[23]

Two issues emerge out of these observations. First, we need to narrate more than the enactment of the specific term wasteland, by including other related (and it appears, partially substitutable) terms such as jungles, uncultivated lands, and arable land which is not privately owned. While doing this, we must remain attentive to the subtle differences between these terms as well as the differences in meaning of a single term as it moves from one archival source to the next. Second, not all categories akin to waste were abstractions of the same order: some bore an imprint of the materiality of the lands more overtly, and in them, these categories, the thing-power of the lands' materiality was more clearly observable. Some categories or meanings were therefore more material than others.

Bengal, Late 18th Century

By the late 1780s, Lord Cornwallis was eager to proclaim Bengal's Permanent Settlement, to declare all rates of tax on landholdings as permanent from the date of the Settlement's introduction (Firminger, 1918). A quick introduction of the Permanent Settlement, as desired by Cornwallis, was to be based on (existing) tax rates that were already being levied, which would then be fixed forever. John Shore, the President of the Board of Revenue of the British government of Bengal at the time, doubted whether this taxation strategy was wise.[24] In a 120-page 'minute', he argued why the

[23] Neeson's (1993) work clearly shows that the debates on enclosure in England at the time focussed around the question of how to reap the greatest benefit from lands for specific groups or society as a whole. The fact that land referred to as waste was central to the livelihood of parts of society living on very meagre means was recognized by all, regardless of their position in the debate.

[24] John Shore was a senior official of the government of Bengal from 1787 until 1793, and Governor-General of British India from 1793 until 1797. In 1789 he was

introduction of the Permanent Settlement should be slowed down (Shore, 1789). Shore felt that any permanent tax rate must take into account the enormous diversity of lands (in terms of their material characteristics), even within a single district of Bengal:

> "It would […] be impossible, I conceive, to fix specific rates for any one species of produce, in any district generally; the quality of the soil and the situation of the land, as enjoying the advantages of markets and water-carriage, must determine it." (Shore, 1789, p. 86)

Shore's minute is interesting for two additional reasons. First, because it demonstrates the importance of lands' associations with a host of other entities including (quality of the) soil, markets and water, which are critical for making land productive in diverse ways. Second, because Shore effectively challenges Hunter's and later Gidwani's claim that classification of land as 'waste' was central to the implementation of the Permanent Settlement of Bengal. Shore does not mention wasteland, waste, jungle, unassessed lands or any other related category. He did mention the category 'uncultivated land' once, but only to highlight the differences in the proportion of uncultivated land in different districts. In some districts, according to Shore, this proportion was negligible. But in areas where the proportion of 'uncultivated lands' was higher, Shore argued that a Permanent Settlement in which tax rates were independent of the material condition of the lands might cause two kinds of 'problems':

First, such a Permanent Settlement would fix (in perpetuity) the tax rate on a parcel of land based on crops produced in its existing condition as un- or under-cultivated (i.e. a very low or zero tax). The conversion of this land into productive farmland, after the introduction of the Permanent

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responsible for the completion of the decennial settlement of the revenues of, amongst others, Bengal (Dictionary of National Biography 1885-1900). In 1789, there were two Boards of Revenue in British India, one in the province of Bengal and one in the province of Tamil Nadu. These boards were British colonial institutions which carried out revenue collection and general administration.

Settlement, would change the land's material condition (from being associated with trees or shrubs to being associated with crops, workers and irrigation for example). However, this change in material associations will be irrelevant for tax collection purposes if the tax rate on this land was fixed in advance. Eventually then, the tax revenue collected (under the permanent settlement policy favoured by Cornwallis) would be lower than the revenues in a situation where the tax rate was tied to the actual materiality of the land.

Second, under Cornwallis' Permanent Settlement, the 'uncultivated land' that had been converted into farmland would continue to be classified as 'uncultivated' or 'unused' or even 'waste'. This category mistake may be avoided if the Permanent Settlement was undergirded by land categories which articulated the actual, changing, material condition and associations of the lands more directly (Shore, 1789, p. 114).

Lord Cornwallis replied to John Shore's minute twice, and with great vigour. To emphasize the importance of immediately introducing a Permanent Settlement in Bengal, he claimed that one-third of the territory under the East India Company was jungle "inhabited only by wild beasts", from which no rent could be extracted.[25] In addition, Cornwallis claimed that nobody would be willing to clear this jungle for cultivation if s/he is only allowed a short (ten years') lease on the land. Overall, Cornwallis' appeared to be mainly concerned with the quick conversion of uncultivated land into cultivated land. While this conversion may have also been important for Shore, it did not dissociate him from the diversity of lands, based on their actually changing conditions and materialities. Cornwallis, on the other hand, by referring to 'uncultivated lands' as 'jungle' and by associating that land with 'wild beasts', managed to dissociate the lands from many of the material elements (such as soil and water) considered important by Shore. Critically, for Cornwallis, these dissociations were operational not just in the late 19th century but for a long time to come.

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[25] It is this very same utterance that Hunter refers to as discussed in the paragraph on the observation that wasteland as a category overlaps with a host of other categories.

Eventually, as tax rates were fixed in perpetuity (Guha, 1963), Cornwallis' assemblage of 'wild beasts' entangled with an overwhelming desire to collect rent, appears to have prevailed over that of Shore with its materiality and diversity. These two assemblages constituted different meanings of the category 'jungle' or 'uncultivated land'. And the abstraction produced by Cornwallis' assemblage is the less materially articulated of the two. Associations in Shore's assemblage thus exercised the 'thing-power' of materials such as soil and water more persuasively. By largely ignoring this materiality of lands, Cornwallis' assemblage produced a category that could, in principle, be applied across Bengal, forming the basis of British Permanent Settlement policy.

The category jungle produced by Cornwallis' assemblage was also contested on another front. Often the land classified as jungle was already being used for various purposes and was therefore not available for cultivation. Upon associating with the land's outgrowth, its users and colonial administrators who are in direct contact with these lands and their users in new assemblages, the category jungle took on new meanings. For example, consider an episode that began in 1793 with a debate between the Board of Revenue, the collector of the Burdwan district at the time, named Samuel Davis, a European trader named Robert Heaven and the East India Company.[26] Mr Heaven was the de facto owner of a large parcel of jungle land in Bishenpore, Burdwan, and charged a duty to anyone collecting wood from this jungle. The East India Company employee in Burdwan reported

[26] This debate is documented in a series of letters written by S. Davis in 1793, published in R. Guha and A. Mitra (Eds.) (1956). The letters are entitled Letter to Mr. R. Heaven, Soonamookey, 25th of June 1793; Letter to J. Cheap Esqr., Resident at Soonamookey, 25th of June 1793; Letter to John Cheap Esqr, Resident at Soorool, 26th of June 1793; Letter to Mr. Heaven, Soonamookey, 30th of June 1793; Letter to William Cowper Esqr., President & Members of the Board of Revenue, Fort William, 11th of July, 1793; Letter to Robert Heaven, Soonamookey, 11th of July 1793; Letter to Heaven, Sonamookey, 9th of August 1793; Letter to William Cowper Esqr., President & Members of the Board of Revenue, Fort William, 2nd October 1793.

to the district's collector named Davis that he had received numerous complaints from weavers, manufacturers and sugar contractors regarding the high duty that Heaven exacted for cutting wood from the jungle. This man, and the weavers, manufacturers and sugar contractors who were all directly related to the lands which were referred to as 'jungle' could not ignore the materiality of these lands. As such, the assemblage into which the category 'jungle' had landed, through associations with trees, wood and diverse users, was quite different from Cornwallis' assemblage (constituted 'only by wild beasts') out of which the category had been abstracted. Moreover, the 'jungle' of Bishenpore was not land that did not yield any revenue: the jungle users' complaints were precisely about the revenue already being extracted from them, for using the jungle, by Robert Heaven (who would in turn have to pay taxes to the government).

Like jungle, the category wasteland also appears in documents from late 18th century Bengal. In one such appearance, the category was deployed in a colonial administrative assemblage constituted by the collector of Burdwan, the Board of Revenue, a Zemindar, and the goal of making a profit, to facilitate the transfer of a large parcel of land to a European trader named John Cheap who planned to start Indigo production on the wasteland, thus ostensibly bringing this land with its "very proper" soil into cultivation using his "own bullocks and servants" (Davis, 1795). The collector of Burdwan and John Shore, as President of the Board of Revenue, by deploying the category in their assemblage, argued that these lands should be leased at reduced rates to John Cheap to facilitate this initiative (Cheap, 1795).

In other instances, 'wasteland' was used interchangeably with other categories. Consider an episode from 1789 again involving John Shore. On behalf of the Board of Revenue, Shore sent out requests to all district collectors of Bengal, asking them to inform him about the extent and condition of 'rent-free lands' that could be (re)allocated for cultivation (Mercer, 1789). He also asked them to provide assessments of the probable amount of alienations and protest resulting from allocating these lands to

cultivators at reduced rent. Such land allocation was in principle to be carried out by Zemindars, followed by approval from the government.[27] Lawrence Mercer, the collector of Burdwan at the time, replied that the extent of rent-free lands could not be easily determined, and "that on pretense of improving the country by granting waste lands to individuals he [a Zemindar] may alienate those already in cultivation" (Mercer, 1789). Nevertheless he felt that this alienation and any subsequent protests should not stop the government from granting these so-called waste lands to individuals. The collector clearly deems resistance against land transfer, and against the classification which undergirded it, as being inadequate for halting the eviction of some people (and of their practices) from the wastelands.[28] What appears to prevail here, just as it did in the debate between Cornwallis and Shore, is the central importance afforded to increasing the amount of land under cultivation as quickly as possible. Thus even though the category 'waste' encountered new assemblages constituted by lands, their existing users and Zemindars, the 'thing-power' of these new associations appears to have been less important than the association with the strictly economic concern of increasing land rents.

In sum, many categories and meanings, with their associated materials and practices, were active at the time of the debate between Shore and Cornwallis on the Permanent Settlement. While the concern with increasing British revenues by increasing the land area under cultivation may have been critical for all prominent colonial administrators, some of them, such as Shore and the collector of Burdwan, managed to associate the categories with many different (material) entities that constituted the categories' changing assemblages. Shore also took into account the possibility that

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[27] Zemindars were the landlords in Bengal, who played various roles in rural areas. One of their most prominent roles was to collect tax from farmers in their locality (Metcalf & Metcalf 2006).

[28] Interestingly, Hunter (1894, p. 87) writes that "[Government] could not give away the rights of the cultivators to the 'waste' or pasture lands attached to the village commune, and necessary for the subsistence of the village cattle.

associations of any parcel of land may change over time and with it a relevant category's meaning. Cornwallis, on the other hand, refused to acknowledge the dynamic diversity of lands' materiality. His assemblage out of which the category 'jungle' was abstracted remained populated only by 'wild beasts' that must be displaced to make way for rent-generating cultivation. Despite this sparsity, or perhaps due to it, Cornwallis' assemblage succeeded in bringing a temporary closure to the debate in his favour, with the introduction of the Permanent Settlement of 1793.

Thus, in depicting the Permanent Settlement primarily in economic terms (Guha), or by giving primacy to the ideational (and 'moral') bases of categories Waste and jungle as defined by Cornwallis (Gidwani, Whitehead), historians have tended to ignore how encounters with the materiality of the lands in question (through their associations with specific human actors) reconstituted the meaning of those categories. In sidelining these attempted redefinitions based on material encounters, and by emphasizing the categories' definitions as abstracted out of dominant assemblages such as that of Cornwallis, existing scholarship on the Permanent Settlement ends up imbuing the colonial categories (in their 'original' or dominant meanings) with unidirectional power to shape social and material realities. As a result, this scholarship marginalizes the 'thing-power' of lands' socio-materiality in reconstituting categories, in all spatio-temporal settings, even though its influence may have been marginal only in some settings such as those dominated by Cornwallis' 'jungle'. In contrast, our aim above has been to document how in some assemblages the force of material things (in shaping the categories' meanings) played a more central role than in other assemblages. We demonstrate this in greater detail below.

Ceded and Conquered Provinces, Early 19th Century

As the Permanent Settlement was extended to the so-called Ceded and Conquered Provinces, similar debates and controversies ensued as they had

two decades earlier in Bengal.[29] A report by the provincial Board of Commissioners from the 13th of April 1808 called for a careful and slow approach.[30] It also argued that more knowledge should be acquired on the diversity of resources (such as irrigation structures) and the many ways in which lands were currently assessed, and on the extent of wasteland that could actually be 'recovered' for cultivation.[31]

In a response to this Board of Commissioners, Mr Colebrooke, a member of the Governor General's council from 1807 until 1812, wrote a long minute stating that the Collectors and Commissioners had overlooked several important factors that made it crucial to immediately install the Permanent Settlement in the Ceded and Conquered Provinces. According to him, the Commissioners were delaying the settlement because they wanted to 'participate' in the future 'improvement' of lands – to levy taxes on previously unassessed 'wastelands' once they were successfully brought under cultivation.[32] Colebrooke felt that this obsession with tax collection would "counteract, if not wholly damp that spirit of industry and improvement […] which is the greatest object of fixing the tax on each estate".[33]

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[29] The Ceded and Conquered Provinces were a region in northern India, ruled by the East India Company from 1805 onwards. Its capital was Agra (Mann 1995).

[30] A commissioner is the head of a division of a province. The provincial Board of Commissioners consists of all commissioners of a specific province, which is called the Ceded and Conquered Provinces in this case.

[31] Board of Commissioners in the Ceded and Conquered Provinces, Report, 13th of April 1808, in: Report from the Select Committee of the House of Commons on the Affairs of the East-India Company, London, 1832.

[32] Colebrooke, Mr. Colebrooke's Minute, 1808, in: Selection of Papers from the Records of the East India House Vol 1 London, 1820.

[33] Colebrooke, Mr. Colebrooke's Minute, 1808, paragraph 22, in: Selection of Papers from the Records of the East India House Vol 1 London, 1820.

Colebrooke's point was that he and Lord Cornwallis before him were not driven by narrow taxcollection interests, but rather by the ultimate goal of promoting the 'spirit of industry and improvement'. This ultimate goal underlined the urgency with which they treated the matter. Such general urgency was important, he wrote, and here the same claim about one-third of the land being jungle was re-invoked, because "Lord Cornwallis [had] estimated no less than a third part of the company's territory to be a jungle".[34] Regarding this 'jungle', Colebrooke was of "the opinion that the estimate may, with great approximation to accuracy, be understood as applicable to lands fit for cultivation, and totally exclusive of lands [that were] barren and irreclaimable".[35] Unfortunately, he did not explain what was to be done with the wild beasts and forest clearing work noted by Cornwallis when he had made this same statement about the size of the jungle. Here, Colebrooke's assemblage, just like Cornwallis' assemblage before, managed to obscure the enormous diversity of lands classified as jungle while also ignoring the wild beasts whose presence is clear in Cornwallis' assemblage.

However, Colebrooke did elaborate that there were "two sorts of wasteland; first, those in the level country, interspersed in more or less extensive tracts among the cultivated lands; and secondly, the Sunderbunds, at the foot of the vast range of mountains which nearly encircle the Bengal provinces".[36] According to him, the former could be brought into cultivation easily, though they "furnish pasture for the great herds of cattle that are necessary for the plough, and also to supply the inhabitants with ghee and milk, two of the principal necessaries of life in this country." But, he continued, "the lands in this desolate state far exceed what would suffice for those two

[34] Colebrooke, Mr. Colebrooke's Minute, 1808, paragraph 14, in: Selection of Papers from the Records of the East India House Vol 1 London, 1820.

[35] Colebrooke, Mr. Colebrooke's Minute, 1808, paragraph 14, in: Selection of Papers from the Records of the East India House Vol 1 London, 1820.

[36] Colebrooke, Mr. Colebrooke's Minute, 1808, paragraph 23, in: Selection of Papers from the Records of the East India House Vol 1 London, 1820.

purposes".[37] As such, he argued, cultivating this type of pasture land could make (future) landholders affluent which, for Colebrooke, was crucial in preventing 'domestic' uprisings as it would ensure the welfare and general satisfaction of a large landholding community. Thus, Colebrooke's assemblage, while excluding forests and beasts by narrowing down 'wasteland-jungle' to 'uncultivated lands' that were deemed fit for cultivation, managed to include 'herds of cattle', 'ghee and milk', ploughs and the (future) affluence of the landholders. Nonetheless, these rich associations were still only adequate for Colebrooke to term the condition of this land as 'desolate'.

By 1812, the Board of Commissioners was still refusing to introduce a Permanent Settlement in the Ceded and Conquered Provinces in the short run (within a span of a few years). They argued that a Permanent Settlement should only be applied to lands that were already in a "sufficiently improved state of cultivation".[38] In addition, they felt that the tax rate for any 'unsettled' land should only be fixed in perpetuity after it has been brought under cultivation. This would enable the government to secure higher tax revenue from the lands that were newly brought under cultivation. To increase the tax revenues further, they suggested a revision of the tax rate at a regular interval.[39]

The Commissioners further argued that a Permanent Settlement should only be introduced based on detailed knowledge of the current productivity and revenue collection from the land in question. Lands which did not fall

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[37] Colebrooke, Mr. Colebrooke's Minute, 1808, paragraph 24, in: Selection of Papers from the Records of the East India House Vol 1 London, 1820.

[38] Board of Commissioners in the Ceded and Conquered Provinces, Extract revenue letter to Bengal, 15 January 1812, paragraph 67, in: Selection of Papers from the Records of the East India House Vol 1, London, 1820.

[39] Board of Commissioners in the Ceded and Conquered Provinces, Extract revenue letter to Bengal, 15 January 1812, paragraph 73, in: Selection of Papers from the Records of the East India House Vol 1, London, 1820.

into the category of 'revenue land under cultivation' were considered problematic by the Commissioners not because they were uncultivated or 'waste', but rather because they were all different: some were fertile, others were not, some were in use as grazing lands, others were under tree cover, revenue may be collected from some, while still others may be under cultivation despite an absence of revenue collection. This heterogeneity of land blocked access to easy information collection and subsequent categorization. As such, this inclusion of diverse lands in the Commissioners' assemblage effectively challenged Colebrooke's plans for a single permanent settlement rule for all land in the Ceded and Conquered Provinces. The diversity as well as the general lack of information on existing settlements continued to fuel debate on a Permanent Settlement for the Ceded and Conquered Provinces until the enactment of the Bengal Tenancy Act in 1885 (Mann, 1995).

While the assemblage of diverse lands classified as 'waste' or 'uncultivated' may have effectively challenged the free extension of Permanent Settlement to the Ceded and Conquered Provinces in the first decade of the nineteenth century, this diversity became particularly pertinent and visible again when new wasteland rules were announced after 1863. This began when the Governor-General of India passed Act No. XXIII, "to provide for the adjudication of claims to wastelands."[40] The act required district Collectors to collect claims made on 'wasteland' that was about to be sold or leased. It suggested that if there were any such claims the sale or lease may be cancelled or subject to particular conditions. However, the act gave no guidelines on how to weigh existing claims, or on the conditions under which the land was to be sold or leased, the size of each allocation, and who could apply for such wastelands. Following this Act, the various Provinces of British India formulated their own rules for allocation of 'wastelands'. For example, Bengal now had many different rules for wastelands in different areas, for allocation to 'small capitalists' or 'large capitalists', for

[40] Government of British India, Waste Land (Claims) Act, 1863.

generally arable lands, and specifically for the cultivation of tea, attempting to suit the socio-material specificity of each type of wasteland-allocation.[41] Accompanying the proliferation of these rules, the meanings of 'wasteland' had also multiplied since the late 18th century, with new meanings (and often new categories) being formed as the category 'waste' encountered, and was enacted in, different assemblages constituted by entities such as cattle, milk, mountains, provincial boundaries, water, soils, crops, trees, shrubs and their diverse (human) users.

The rules for wasteland allocation changed regularly, roughly every ten years, since the time of Cornwallis' Permanent Settlement of Bengal. Perhaps the most consistent change in the rules over time was that the size of the plots to be allocated increased considerably. For example, while the rules for the lease of waste lands in the districts of Julpaiguri and Darjeeling (in Bengal) from 1888 stated that 800 acres was the maximum plot size to be allotted to any single applicant, the same rules from 1904 allowed for the granting of 1500 acres, illustrating the growing strength of the assemblage of wasteland rules and their beneficiaries.[42]

In summary, the diverse assemblages that (re)composed the categories of land for permanent settlement ended up producing many different rules rather than a uniform one to be applied everywhere in British India. Even within a single province, such as Bengal, many different rules were being enacted. The development and changes in those rules over time shows that the lands' diversity, and the relational power of (some) things covering these lands, was to a limited extent taken into account by colonial administrators.

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[41] Board of Revenue, Bengal Waste Lands Manual, Calcutta, 1878, 1888, 1904, 1909, 1919, 1936.

[42] Board of Revenue, Section III Part I: Rules for the lease of waste land for tea cultivation in the districts of Julpigoree and Darjeeling in: Bengal Waste Lands Manual, Calcutta, 1888, paragraph 7; Board of Revenue, Rules for the grant of leases of waste lands for tea cultivation in the districts of Jalpaiguri and Darjeeling, in: Bengal Waste Lands Manual, Calcutta, 1904, paragraph 7.

However, more critically, the diversity of lands was marginalized in the creation of a new set of rules aimed at continued allocation of larger parcels of 'waste' lands to 'productive' individuals or companies. Acquiring land under these 'wasteland' rules was popular, for example for the production of tea. These rules thus successfully facilitated the exploitation of lands for the cultivation of cash crops, for 'modern' plantations which were necessarily accompanied by the dismissal and eradication of existing land-use practices (LaFavre, 2013). Thus, as we have documented above, while the categories definitely encountered the (diversity of) lands' materiality in the different assemblages, and the meanings of the categories were multiplied, the official rules for 'wasteland' reallocation marginalized this multiplicity (and thereby the lands' materiality) and promoted a transition toward cash crop cultivation. Even though the rules stipulated procedures that sometimes allowed the raising of objections to the official assessment of a particular parcel as wasteland, these rules primarily functioned to facilitate land transfer, for turning forest, grazing land, common lands, and many other types of lands – which had many important benefits for various groups – into cultivated lands controlled by individuals or companies and often producing cash crops.

Discussion and Conclusions

The introduction of the Permanent Settlement of colonial Bengal in late 18th century has been argued to be undergirded by ideas of mercantilism and Benthamite utilitarianism, among others, as well as by moral ideologies derived from Lockean theory of 'natural rights' over (privatized) property. In this chapter, we have argued that debates about the lands' materiality were central to the Permanent Settlement. Meanings of categories such as waste, initially designed to facilitate the transfer of land to cultivators and planters, thereby allowing the colonial administration to extract rent from the land, were (re)shaped by the lands' diverse materiality in different colonial assemblages constituted variously by large carnivorous animals, pastures and (the cutting of) trees in densely forested areas. In fact, it was by taking new meanings that the categories could find relevance in assemblages other than the ones in which they had previously been constituted. Also, depending on how the relational 'thing-power' of materials was able to act on the categories, multiple meanings of 'wasteland' (and associated categories of land) were enacted, which in turn led to changing rules for wasteland reallocation to planters and cultivators. However, the latter rules nevertheless favoured the development of plantations and (cash) crop cultivation, leading to the marginalization and eventual destruction of extant land covers and land use practices. In this sense, the influence of the lands' materiality, the force of their 'thing-power', on the rules was limited, with precedence being afforded to the economic motive of rent collection and to furthering the "spirit of industry and improvement."

Past work on this theme by Gidwani and Whitehead has emphasized the ideological underpinnings of the category 'wasteland' (Gidwani, 1992; Gidwani 2008; Whitehead 2010; Whitehead 2012). While such an emphasis might be justified when it comes to appreciating the thrust of wasteland reallocation rules and their enactment, it marginalizes the multiplicity of meanings that the category took, through its encounters with different assemblages constituted by the lands and the cattle and forests that thrived on them. This lack of attention to material encounters, as the category

travelled into assemblages that were different from the one out of which it had been carved out as an abstraction (Cornwallis' assemblage of wild beasts and rents), creates the impression that once the category was defined, it unidirectionally classified land as waste or productive and made available a land classification system that segmented and then dominated over a material reality that pre-existed it (Stengers, 2010). Such narratives might however appear pre-programmed to describe the colonial programme of 'divide and rule', 'define and dominate', once we take into account the processes of debate and controversy out of which socio-material domination had to be negotiated, achieved and maintained.

In this chapter, we have attempted to unravel this process of achieving domination in three ways, by: a) documenting the controversies entailed in classifying land as 'waste' or 'jungle' and the role played by those controversies in shaping the Permanent Settlement (or wasteland development); b) showing how different sides in a variety of controversies were undergirded by different meanings of the category 'wasteland' (or 'jungle'), which themselves were constituted through associations in different socio-material assemblages; and c) showing that victory in each controversy or debate depended not only on the range of human and nonhuman associations mobilized by the proponents of a position, but also crucially by what was left unmobilized or excluded. Thus, the power of British colonial categories of 'waste' and their proponents, unlike the power of Portuguese colonial 'explorers' (Law, 1986) and of technologists (Latour, 1991), was not a function of the sheer number of humans and nonhumans enrolled into assemblages. Colonial power during the Permanent Settlement was not just built on what the administrators were associated with, in terms of ideas and material resources, but also on what was excluded from their assemblages.

We have also argued that by devoting attention to controversies and material associations in processes through which domination is achieved, we are able to avoid an inadvertent bias in existing work on colonial categories such as 'wasteland'. This bias led to narratives framings that privileged

institutional rules and their application rather than the debates and controversies that lay behind them, and thereby favoured the terms of the victors of the controversies and underlying material struggles. Recovering these controversies and struggles has the following implications.

First, it demonstrates that before any material realities and practices were disregarded and transformed by the victors in a debate, and by the colonial administrative apparatus more generally, these realities on the lands in question were exerting their force in some assemblages through some of the positions taken in the controversies. In making this argument, we do not lay a claim to novelty. For example, Wilson (2008) argues that colonial political thought came about through interaction with the materiality of colonial practice: the material, political and economic crises (a failure of crops, the near collapse of the Company's solvency and British officials' failure to engage meaningfully with Indian society and history) that took place before Cornwallis became the governor general in British India contributed towards his policies, including the introduction of Permanent Settlement. Travers (2007) presents how India's history as a colonial empire is not only based on European ideas of empire but was also generated through interaction with ideas of empire outside Europe. More importantly, he also shows how British ideas on India as a 'land of despotism' which the British needed to improve were informed by material developments in India such as Lord Cornwallis' victories over Tipu Sultan of Mysore, who was generally regarded as an enemy and despotic leader. Lands' materiality and associated practices have been discussed in existing literature in colonial Indian history, most prominently by Chakravarty-Kaul (1996), who documented debates in Punjab in relation to 'common lands'. Her work carefully documents the many considerations that finally informed the acquisition of large tracts of land by the colonial administration, even though those very same lands had also been considered as essential grazing lands for both pastoralists and agriculturalists. For example, she writes that "in areas where water was deficient, both under the ground and on the surface, large areas of fallow waste were required for barani or rain fed cultivation and for pasture. […] In such areas, official policy modified communal control over the use of the

regional commons, but could not remove the influence of ecological considerations over land-use patterns" (Chakravarty-Kaul, 1996, p. 70). Unfortunately, the role of these material realities largely disappears from the scene in her conclusions, and emphasis is placed on changes in the governance of common lands due to issues such as village landholders attempting to avoid free-riding. Similar marginalization of materialities can also be found in literature on wasteland in other parts of the world, such as Cronon's (1996; 1983), Yeh's (2009), and, to a lesser extent, Kuletz' (1998) work on waste in New England, China's Tibet and the contemporary US. With regard to the history of the Permanent Settlement specifically, Iqbal (2010) has also argued that the decline of the Permanent Settlement at the turn of the 19th century into the 20th did not only take place because of changing institutions and ideas, but also happened due to "an ecological regime that offered an expansive surface water network, optimum rainfall, extensive river transport and above all nature's own ambiguity, which obviated the coercive intrusion of the state's modern classificatory arms".

By pointing to the role of extant material realities and associated land use practices in historical debates and by giving them analytical importance, we aim to take a preliminary step toward a form of material anamnesis (cf. Stengers, 2010), in the hope that this anamnesis will open up new debates on what colonial categories such as wastelands might mean in the 21st century. We do we claim that ideas about, meanings of and decisions about the category wasteland were created by land's materiality alone. Of course, institutions, ideas and philosophies, and a wide range of other entities that may be associated with the lands and categories on which this paper focussed also play an important role, as existing literature on colonial history already shows (e.g. Gidwani 1992; Guha 1963; Wilson 2008; Iqbal 2010; Travers 2007). However, we do hope that perhaps variants of some material realities and practices that were disregarded and marginalized can now be found in spaces 'hidden' from or ignored by state administrative apparatuses. And perhaps, to contribute to the continued project of decolonization, these marginalized practices can be re-valorized and preserved, while the unidirectional power of categories and associated rules

defined in powerful and spare ideational assemblages is reined in. Together the reining in and the revalorization will then open up the possibility of realizing new practices that are different from those prescribed by the powerful (or handed down as the way things are in historical narratives).

Second, by bringing different human and nonhuman entities to the fore, and showing some of their multifarious associations with each other in different 'wasteland', 'jungle' and 'uncultivated land' assemblages in Bengal and elsewhere in colonial India, we aim to provide a new relationally collective figuration for individual historical actors (who are generally human). This new collective figuration is based on the premise that no single entity, human or nonhuman, is able to act (make a difference) on its own: every being or thing comes into existence through active relations with others in different situated assemblages (cf. Latour 1994). In the narratives we have constructed, this relational coming into being, or enactment, was an inherently uncertain process, which depended on the material and ideational characteristics of the entities that were mobilised in different assemblages. This uncertainty should not lead to a suspension of (decolonizing) struggle or action, simply because disqualifying and destructive actions of the past have to be distributed across associated entities in an assemblage and cannot now be easily attributed to a colonial administrator and his office. Instead it should serve as a call to work with the uncertainly distributed nature of colonial power and help trigger continuing multiple ongoing struggles to counteract colonial power's equally dispersed and shifting legacies in post-colonial governmental apparatuses and beyond.

Third, these theoretical and methodological insights have important implications for our empirical problematic of wastelands: they allowed us to demonstrate, a) that there were instances in which assemblages of 'wastelands', their outgrowth and people using those lands resisted the implications of being classified as wasteland by the colonial administration; b) the difference between Cornwallis' static conceptualization of land-use under the absence of colonial policy that could then change the extant land-use (i.e., 'jungle' was to remain populated by 'wild beasts' unless the

Permanent Settlement was introduced) and Shore's dynamic understanding in which land use and land quality necessarily changed over time (and thus recognizing the agency of lands outgrowth and their users); c) that associating 'wasteland' with a range of extant uses and materialities (e.g. forests, pastures) does not necessarily mean that land was not eventually reallocated for cultivation or a tea estate. Rather, as we hope to have shown, these rich associations may instead lead to the formulation of slightly different rules on wasteland allocation, so as to facilitate the new land uses despite all existing practices; d) that the effects of resistance against the re-allocation of wastelands were variable. In some cases, resistance may have resulted in barely any or no change at all. For instance Mercer, Collector of Burdwan, expressed unwillingness to change his understanding and plans of 'wasteland allocation', even if other assemblages of land and people has resisted them severely. At work here was another set of associations, which were deemed more powerful than the resisters.

Moderately successful episodes of resistance would have managed to slow down and modify colonial administrative plans. In more successful cases, resistance by some assemblages had indeed played an important role in halting the extension of the Permanent Settlement, as witnessed in the Ceded and Conquered provinces. This implies that victory for one assemblage, one set of meanings and its associated rules, in a spatio-temporal juncture does not guarantee a repeat of this success in a new juncture, even if extant meanings (and the same entities) are adjusted into a new assemblage in the new juncture. Each meaning, in each assemblage at every juncture, is thus founded on its own constitutive web of associations in which some associations were more forceful in (re)shaping a category's meaning(s) than others.

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Policy democracy? A constructivist analysis of biodiesel policy-making processes in India[43]

Abstract

Following its 2003 biodiesel mission, the Indian national government released its policy on biodiesel in December 2009. We study the making of this policy, viewing it as a set of propositions that have been progressively assembled, constituted by many voices. This policy-making process is considered democratic if the propositions were well-articulated. A well-articulated proposition, following Isabelle Stengers and Bruno Latour, is one that has enabled and allowed all interested entities, including particularly those that were hitherto mute, to raise their voices. In addition, the process of making a well-articulated proposition must have registered these voices by allowing them to challenge and recompose the proposition; must not have turned the entities' actions and voices into a repetitive singularity; and resulted in propositions that are not easily transferrable between different socio-ecological situations. Based on 65 qualitative interviews and ethnographic fieldwork, we provide a thick description of the engagements of multiple human and nonhuman entities with the policy-making process. We conclude that while the Indian government's policy-making may be viewed as an attempt to perform '*policy democracy*', which partially responded to some entities' recalcitrance, it failed to register crucial voices associated with biodiesel production such as water and CO_2. It also turned many voices into repetitive singularities, discounting the different articulations through which an entity may speak in multiple voices and be enacted in different socio-ecological settings. In this way, the policy's propositions have remained easily transferrable between diverse socio-ecological situations, ignoring how the immense diversity of India's lands, their inhabitants and their practices, matters in biodiesel production. Finally, many entities' voices that were relevant for the entire policy, such as 'environmentally sustainable development' were only articulated in relation to one proposition. The latter may therefore be viewed as a lack of overall consistency.

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[43] This chapter is based on: de Hoop, E., Arora, S.. Policy democracy? A constructivist analysis of biodiesel policy-making processes in India, submitted to *Geoforum*. This paper is a co-authored piece and written using the pronoun 'we' rather than 'I'.

Introduction

For more than a decade now, biodiesel in India, as in many other parts of the world, has been embroiled in a multi-sided and multi-dimensional controversy. Focusing on India's 2009 National Policy on Biofuels (Government of India, 2009), we study if and how different voices in this controversy were raised and registered in the making of India's national policy on biodiesel. In the wake of India's 2003 biodiesel mission and the 2009 policy, prominent academics and civil society organizations have debated the government's biodiesel plans. First, biodiesel production was criticized for encouraging land grabs and displacing grazing and forage collection (Baka, 2014; Lahiri, 2009; Findlater and Kandlikar, 2011; Lavanya, 2007). This critique was partially countered by scholars such as Gopinathan and Sudhakaran (2009), who reiterated the Mission's calculation that there are millions of hectares of so-called wasteland waiting to be cultivated for biodiesel feedstock. Second, Ariza-Montobbio and Lélé (2010) and Rittenburg et al. (2011) argued that cultivation of biodiesel feedstock crops such as jatropha can, under the most favourable conditions, be profitable only for large farmers while smallholders growing jatropha will be vulnerable to economic risk and crop failure, even under 'well-planned' biodiesel policies. Countering this, scholars such as Kumar et al. (2012) and Misra and Murthy (2011) conclude that the cultivation of biodiesel cash crops will be highly profitable. Third, research that came out of programs initiated by the Indian government was criticized for not taking actual cultivation circumstances of smallholders into account (Lavanya, 2007), and for being insufficiently focused on the development of so-called high-yielding varieties (TERI, 2005; Raju et al., 2009). Others warned that a research agenda focused on high-yielding varieties is likely to increase the gap between poor and rich farmers (e.g. Ariza-Montobbio et al., 2010; Ravindranath et al., 2011). These debates have resulted in a wide range of policy advice, including encouraging the use of locally available flora (Agoramoorthy and Patel, 2011) or multi-purpose short-duration annual crops (Rajagopal, 2008), amending land use policy to facilitate bringing 'under- or unutilized land reserves' under cultivation (Altenburg et al.,

2009), or being more respectful of existing uses of government-owned 'marginal' lands such as cattle husbandry (Biswas et al., 2010).

In addition to debates on possible effects of biodiesel policies, Nagar (2011) and Pradhan and Ruysenaar (2014) have explored the making of the 2009 biofuel policy. Nagar (2011) describes how the policy came out six years after the Mission due to the global food vs. fuel debate and the importance of food security for the Indian government. Pradhan and Ruysenaar (2014) show how India's biofuel policy gained legitimacy through the use of 'win-win' narratives that combine environmental sustainability with poverty reduction (on the controversial nature of this win-win aspect, see also Ariza-Montobbio et al., 2010) and support from a group of high-profile individuals. This group included people such as Dr. Abdul Kalam, president of India at the time, and Dr. D. N. Tiwari, who was the chairperson of the Committee on Development of Bio-Fuel and who also held a range of other key positions in various government bodies.

We direct attention not only to lobbying networks and discourses that helped constitute the policy, but also to how the policy included voices raised by humble human and non-human entities (through various spokespersons). Our aim is to analyse the policy-making process in terms of its openness to diverse dissenting voices, studying how the policy registered the dissent. In doing so, we understand the 'policy-process' as distributed across society. This paper is therefore not concerned with India's 'formal', institutional decision-making procedures but rather with those places where contestation can be found. Starting out with a brief overview of different perspectives on policy-making, we begin our analysis by building our theoretical framework using work by Isabelle Stengers (1997; 2010), Bruno Latour (1999; 2003; 2004a; 2004b; 2010) and Stuart Hall (1980). We then use this framework to analyze the politics of India's biodiesel policy, discussing our conclusions in a final section.

Perspectives on policy-making

Different perspectives on policy-making include Foucauldian discourse analysis, the advocacy coalition framework, interpretive policy analysis, as well as other approaches from anthropology of policy, science and technology studies and (human) geography. Foucauldian discourse analysis has focused on the study of language in policy-making, showing how common notions such as 'nature' are contested, how discourses shape thinking and therefore policymaking, and how discourses can work to discipline society (Hajer and Versteeg, 2005; Beck, 1995; Killingsworth and Palmer, 1992; Darier, 1999). The 'advocacy coalition framework' (e.g. Sabatier, 1998; Weible et al., 2011) focuses on influences on policymaking by groups of people sharing a particular set of beliefs and financial, knowledge-based or material resources. These advocacy coalitions can change their composition due to learning or shocks, which are considered to be the fundamental cause of policy change (Nowlin, 2011). Interpretive policy analysis is interested in the underlying meaning of policy, the way policy-makers represent the world based on how they interpret the world, the problems at hand, and the sciences deployed to find solutions (Yanow, 2003; Wagenaar, 2007).

Anthropology of policy uses anthropology's basic tenets of paying attention to the combination of language, symbols and action to study policies (Rabo, 1997; Mackey, 1997; Lewellen, 1993). Treating policies as entities that act, or even as assemblages, rather than as passive objects, anthropology of policy is interested in the question 'how does a policy mean?' rather than 'what does a policy mean?' (e.g. Shore and Wright, 2011: 20). Studies have shown how a policy can render its approach (to objectives such as gender equality or tenant management) neutral or natural and hence uncontestable, which is then instrumental in constituting self-disciplining subjects (Hansen, 1997; Rabo, 1997; Hyatt, 1997). For example, in the case of Sweden's policies on gender equality in education, Rabo (1997: 100) argues that women are represented as and turned into 'childlike' citizens who need to be induced to make the 'right choices' – choices considered good for the Swedish

economy. More recent work in anthropology of policy has studied the ways in which policy's human subjects attempt to contest and reconstruct policies both before and during their 'implementation' (e.g. Però, 2011; Zinn, 2011; Kugelberg, 2011; Müller, 2011). For example, Zinn (2011) shows how people living in an area in south Italy where Berlusconi's government had planned a nuclear waste disposal plant protest this plan by putting forward an alternative to the governments' definition of the 'common good'. Kugelberg (2011) describes how African migrants in Sweden try to access international development funds to help their families in African countries by forming 'associations', transforming themselves into association-members. Only well into the process they come to realize that such associations can only apply for support for ethnic minority communities in Sweden. This work does not focus on the role of policymakers or the government's policymaking apparatus, but rather on people who are supposedly governed by the policy and whose subjectivities a policy constitutes in its implementation. Our focus is also on those who are supposedly governed by the policy. We study how those entities (get to) participate in policy-making.

Human geography and science and technology studies have been particularly concerned with participation and science-making in relation to policy-making. For example, Jasanoff (2004: 2) uses the concept of "co-production" to propose that political choices are inseparable from how scientists know and represent the world, demonstrating that there is always some form of 'participation' (from scientists and the entities they represent) in policy-making. This co-production approach has been useful to study how particular networks, institutions, identities, knowledge-claims become powerful while others remain contested (Swedlow, 2012).

According to Lövbrand (2011), Jasanoff's co-production and other terms highlighting the intertwined nature of science and policy can be used purely as descriptive or interpretive tools, but they also have a strong prescriptive, normative dimension. Indeed, in both STS and human geography, the inclusion of non-scientific forms of knowledge (e.g. of patient associations

or environmental activists) has been described as a characteristic of good policy-making (e.g. Ng'ombe et al., 2012; Mosse, 2004; Marres, 2005; Wynne, 2007; Callon et al., 2009). This normative stance can arguably be undergirded by one of two different logics, that of ontology and of accountability (Lövbrand, 2011; Barry et al., 2008). The logic of ontology starts from the understanding that universal knowledge-claims preempt political discussions on science's many indeterminacies (Wynne, 1992; Wynne, 2007). In addition, the development of science is argued to be directly intertwined with normative framing (Wickson and Wynne, 2012). Taking this one step further, Latour (2004b) argues that there are no separate facts and values to begin with, terming their mixes as factishes. Miller (2007) observes that the knowledge constructed and deployed at science-policy organizations is an important source of power. As such, co-producing knowledge with non-scientists should be able to generate more open-ended deliberations on the political questions implicated in the development of science, thereby enriching democracy (Wynne, 2007). Also, public controversies help reveal groups that consider themselves implicated by the issue at hand but were initially isolated and hence difficult to include in policy-making processes (Callon et al., 2009). Inclusion undergirded by this logic of ontology should not be aimed at problem-solving without putting the problem itself up for debate, because issues may arise over the very problem or goals at hand (Marres, 2005).

Yet inclusion of non-scientific actors based on a 'logic of accountability' is focused on responding more adequately to societal problem-solving, in line with the needs of societal decision-makers (Lövbrand, 2011; Barry et al., 2009). Participation undergirded by this logic has often led to disappointing results, due to the instrumental and legalistic ways in which it has been *applied* in most participatory policy-making programs (Wesselink and Paavola, 2011; Stirling, 2006). The extent to which participatory programs are able to render visible issues and groups hitherto hidden, or question the premises and goals of the particular field of science or technology, remains to be seen (Callon et al., 2009).

In our view, which relies on a normative stance associated with the logic of ontology, participation – as the inclusion of diverse interests and concerns – should not only be treated as an characteristic of avowedly participatory policy-making programs. Rather, understanding policy as something that is assembled, constituted by movement of various entities (Freeman, 2012; Prince, 2010), one can examine how and to what extent *any* policy-making exercise is participatory. This provides a rich basis on which to explore alternative possibilities for policy actions and outcomes, different from the ones that took place in the event examined. However, Lövbrand et al. (2011) has rightfully pointed out that there is a need for principles by which encounters for participation and deliberation should be evaluated, even if the logic of ontology tends to sit uneasily with prescribed principles. In the following, we develop such a framework of principles.

Theory: Democratic policy-making?

Following Latour (2003; 2004a; 2004b), we make a distinction between statements and propositions. A proposition does not claim certainty like a statement does. A proposition, carrying in it the word 'propose', is literally an uttered proposal. As such, it is always up for discussion, it is malleable and does not carry any definitive a priori authority. Propositions are constructed, or articulated (see below), in processes that are always uncertain and never given: the coming into being of anything is inherently political (Stengers, 2010).

Propositions are articulated. Articulation has two meanings: linking up and giving expression to (Hall, 1980). This double meaning highlights the performative character of articulation: a) linking up two or more different things allows one to compose or give expression to something new, a composite proposition that upholds the difference between the things linked while transforming them (Stengers, 1997); b) giving expression to something that then helps us to relate to one another in specific ways (Latour, 2003). Focusing on the first aspect, we posit that policy propositions become articulated through the assembly of (i.e. formation of

connections between) diverse entities. The concept of articulation foregrounds the fluid and situated character of connections that constitute propositions, as well as their politics, by emphasizing that propositions can always be re-articulated as new connections are made and older ones severed (cf. Featherstone, 2011).

Assembling propositions is done by linking up not only humans but also non-human entities. In fact, it is through linking up with others (words, ideas, things, animals or humans) that individual humans and non-humans are able to speak (Stengers, 1997). For example, as shown by Latour (1999), it is soil scientists who afford the soil to speak using various kinds of measurements and tools, while the soil is supposed to act as the reliable witness for scientists' statements (Stengers 2010).[44] Here it is important to note that scientists are not the only human actors who help nonhumans speak. Any (non-human) entity can speak in multiple voices depending on who/what it is articulated with. Non-humans are often represented only or mostly through the work of scientists in policy-making, which may have created a "narrowing of vision" (cf. Scott, 1998; Palmer, 2014; Whitehead et al., 2011; Hertin et al., 2009).

Thus, a democratically-constructed proposition is one which, in its making, allows diverse human and nonhuman entities to raise their entangled voices and ask (perplexing) questions. We call such a democratically constructed proposition well-articulated (Latour 2010; 2004a). Inspired by Latour (2004a) and Stengers (2010), we develop a set of criteria for evaluating propositions, which we will then use to analyse if India's 2009 biodiesel policy propositions can be considered as well-articulated.

[44] Holbraad (2011) makes an attempt to approach things as entities able to speak by themselves, but we will limit ourselves to Latour's relational approach to thing-speech.

1. A policy proposition is well-articulated if the process of its construction enables and allows all interested entities, including particularly those that were hitherto mute, to raise their voices.

Any human or nonhuman entity with an interest in a proposition that is being designed should have played a role in articulating the proposition, in the sense that its voice must have been registered and therefore should be recognizable in the proposition. Whether or not an entity has an interest, or is interested, should be determined using the concept 'perplexity'. The new entities should leave the existing entities 'perplexed': confused and uncertain about what to do next due to the complication brought in by a new entity (Latour, 2004b). It is this uncertainty about future courses of action which provides a fertile starting point for deliberations between new and old entities of a proposition. Further, entities (human or non-human) that may have been silenced while composing previous versions of a proposition must be explicitly invited to speak in successive re-compositions (Latour, 2004b).

2. A proposition is well-articulated if it registers these voices by allowing them to challenge and recompose the proposition at hand.

If a new voice joins a proposition without bringing about any change in the state of the proposition, no real articulation has taken place. A well-articulated proposition should instead allow its newly registered voices to challenge and recompose the proposition based on interactions between all (new and incumbent) entities involved.

This criterion as well as the first address issues of power. If entities are unable to challenge and recompose a proposition, it implies that there is an unequal balance of power between incumbent entities and the (new) entities that are now raising their voices. As Hall (1980) argued, power is also visible through the observation that none of the links were preordained or destined to be part of the proposition and that articulations can always be severed and remade. Hence, the authority to make knowledge claims in and about the proposition must be opened up to include the voices of many different entities, voices that are articulated with other non-humans and humans

rather than only the scientists or the policy experts (Latour, 2010; Stirling, 2008).

3. A well-articulated proposition does not turn the entities' actions and voices into a repetitive singularity, registering instead their multiplicity.

A well-articulated proposition must recognize differences between its constituent entities, differences which are perhaps unexpected. If such differences are erased, entities have effectively lost their capacity to speak and to act (Latour, 2004a). Similarly, if an entity is repeatedly invoked only to speak in a single repetitive voice, then its multiplicity is not being registered. This multiplicity, as noted above, emerges as an entity speaks in different voices through articulation with specific humans and non-humans. For example, a biodiesel feedstock such as jatropha when articulated with a smallholder may speak in a different voice than when it is articulated with a scientist and her laboratory, or with a politician and his party discourse. In other words, if entities are not allowed to speak in multiple voices by being differently articulated, they are robbed of their ability to do relational politics (cf. Mol, 2002). Again, the concept of perplexity is important for this criterion. Fully registering multiplicity is not possible, for an entity will multiply along with the associations that get built and severed. Also, not all aspects of an entity's multiplicity are relevant (interested in, cf. criterion one) for the topic at hand. Rather, entities' actions and voices should be registered as multiple as long as each of them creates perplexity.

4. A well-articulated proposition is not easily transferrable between different socio-ecological situations.

A well-articulated policy proposition is specific to the socio-ecological situation that constitutes it. Any socio-ecological setting may be viewed as a web of relations between humans and non-humans. This web not only acts a substratum that enables (and forecloses) specific voices and actions, it may actually be the collective that speaks or acts when an individual entity appears to speak or act (cf. Callon, 2008). Such a collective is situated and cannot be built purely on the basis of another world elsewhere (Latour, 2010). In other words, there is no disembodied view or voice from nowhere

and everywhere: there is no god-trick, only situated knowledges (Haraway, 1988). This also implies that an entity will speak in a different voice as its socio-ecological setting, or its constituting collective, changes. Conversely, easy transferability of propositions from one setting to another would imply that entities in the new setting are not being allowed to raise their voices and produce perplexity. As such, in a well-articulated policy proposition, the relational web of the socio-ecological situation that constituted it and of a new situation in which it is entangled should be visible in the proposition.

The foregoing four criteria are designed to qualitatively assess the democratic inclusion of diverse entities (without standardizing their voices) in the articulation of propositions. Such propositions may be part of a policy-making process, such as the Indian policy on biodiesel as analysed in this chapter. But knowledge-making and innovation processes, which are studied in chapters five and six, similarly proceed through the articulation of propositions. The policy-making process studied in this chapter using the proposed criteria is the constitution of what we call *policy democracy*, and is located throughout society and not only in India's formal, institutional decision-making procedures. The inclusion of diverse entities, as demanded by the four criteria, is likely to slow down the policy-making process. This may be argued to be problematic, especially in the case of policies addressing large and 'urgent' problems such as climate change. However, as Stirling (2014) has argued, democracy must not be 'put on hold' in addressing such large and 'urgent' problems, especially if the emancipatory potential of large-scale socio-ecological-technical change is to be mobilized. Furthermore, Bingham (2008: 115) interestingly argued that slowing down may be productive in the sense that it allows for paying more attention to "all those other things, other stories, other trajectories, other becomings that were defined as not counting in the name of progress". Challenging current distributions of power and working with fundamental uncertainty about the nature of solutions to these problems inevitably takes time.

Using the four criteria to evaluate policy-making is not a truth-finding exercise. Our assessments based on these criteria may themselves be

controversial i.e., when we argue that entities have been allowed to challenge and recompose propositions, others may disagree with that. If contestation over such assessments did not exist, or if the outcomes of our analysis would not be negotiable, then our use of these criteria would be producing definite statements rather than debatable propositions. We will briefly reflect on our role as policy evaluators in the conclusions.

Methods

If non-human entities speak variously through different associations with human entities, listening to them requires using a wide range of empirical materials from many different sources. Therefore, this paper relies on numerous documents on the topic of biodiesel in India, collected through internet search, from libraries in India, and obtained from many people involved with the topic of biodiesels in India. In addition, this chapter draws heavily on the conversations I had with people active in the field of biodiesel carried out between September and December 2012. Lastly, the paper also draws on the ethnographic fieldwork carried out in Hassan Bio-Fuel Park between September 2013 and March 2014.

Analysis: Articulating biodiesel propositions in India

In 2009, India's national government released its biofuel policy which addresses both bio-ethanol and biodiesel. Although controversies on these two products overlap, entities involved in their development are very different. This study therefore analyzes articulations in the biodiesel part of the India's 2009 biofuel policy. In the case of biodiesel, the 2009 policy was preceded by the National Mission on Bio-diesel, a policy document from India's Planning Commision in 2003. By studying the performative consequences of this National Mission – the practices and controversies that arose – in relation to the 2009 policy propositions on biodiesel, we are able to identify which voices were included in the making of the 2009 policy (Asdal, 2015; Muniesa et al., 2007). The practices and controversies arising out of the National Mission constitute an important part of the policy-

process that informed the 2009 policy. Our analysis thus focuses on those practices and controversies, rather than India's formal, institutional decision-making procedures that may traditionally be associated with the term policy-process.

We speak of multiple policy propositions because, for purposes of detailed analysis, we have identified five interconnected propositions that together form the 2009 biodiesel policy. Such a segmentation of the policy attempts to take into account the presence of individual entities in some propositions and their absence in others. Each of the five propositions selected from the 2009 policy has an equivalent in the government's 2003 Biodiesel Mission. In addition, in selecting these propositions we have tried to ensure that they cover as many constituent entities of the biodiesel policy as possible, while listening carefully to our conversation partners in understanding which entities were controversial and therefore important to include in our analysis.

Why biodiesel?

The first policy proposition to be evaluated provides legitimization for biodiesels, claiming that they will contribute to "energy security, climate change mitigation, apart from creating new employment opportunities and leading to environmentally sustainable development" (Government of India 2009: 4). The constituent conceptual entities (energy security, mitigation, employment opportunities and environmentally sustainable development) of this proposition may be argued to have limited the entire policy's transferability by encouraging biodiesel production only when all four of them are actually enacted in a socio-ecological setting. Thus, by displaying some of the socio-ecological politics from which the biodiesel policy emerged, these entities set boundaries around the policy's promotion of biodiesel production.

In the 2003 Biodiesel Mission, the emphasis was on 'meeting rural energy needs' instead of energy security. The move towards energy security could be viewed as a widening of the policy's aims since 2003. However, the 2009

policy disarticulated and muted rural energy needs, dwelling instead on reducing dependence on oil imports through the use of biofuels. This disarticulation was undergirded by a number of socio-material practices between 2003 and 2009. Encouraged by the 2003 Mission, some non-governmental organizations (such as Chennai-based AHIMSA) set up biodiesel production chains explicitly in order to meet rural energy needs, operating without a profit motive. In practice, however, AHIMSA's project sold small quantities of seeds produced by Tamil farmers to a Swiss company and the Indian Railways, and did little to meet rural energy needs. Some foreign companies started commercial joint ventures with domestic companies. One such example is D1 Mohan Bio Oils Ltd. This joint venture contracted farmers in Tamil Nadu to grow jatropha, but failed to keep their promise of buying the seeds that were supposed to be harvested three years after planting the seedlings. The seedlings had also failed to deliver the kinds of yields promised to the farmers by the company's extension workers (Ariza-Montobbio et al., 2010). In fact, the bulk of jatropha-oriented projects that started after 2003 never aimed to supply energy to the rural areas, though there was a wide range of purposes like supplying biodiesel to run trains (by the Indian Railways Association of Alternative Fuels), fuelling Bangalore's busses (by Hassan Bio-Fuel Park) and blending with diesel sold at petrol stations (by Southern Online Biotechnologies Ltd). These practices indicate that the policy proposition's transition from 'meeting rural energy needs' to 'energy security' started soon after the 2003 Mission.

Many other voices that were raised through biodiesel production practices between 2003 and 2009 may have contributed to the 2009 policy. These voices include the active presence of foreign companies and the import of feedstock, which were often highlighted by people involved in the making of the 2009 policy, such as policy makers from the relevant ministries, some researchers, and activists doing policy advocacy. Registration of these voices in the policy proposition may have led to the emphasis on 'energy security'. Obviously, the explicit noting of 'energy security' may also be viewed as a

discursive curtain behind which import of feedstock and deep involvement of foreign corporations can conveniently hide.

The second entity constituting this legitimation proposition was climate change mitigation by avoiding CO_2 emissions (through biodiesel production). A number of academic studies have suggested that biodiesel based on jatropha does not necessarily result in carbon savings. Rather, the articulation of CO_2's divergent behavior, for example through models taking into account the role of practices such as replacing existing biomass with jatropha and the use of inputs to cultivate the crop (e.g. fertilizers), brings to the fore that the amount and timing of CO_2 emissions (associated with biodiesel production) varies greatly (Reinhardt et al., 2007; Romijn, 2011). The registration of different calculations of CO_2 emissions, in relation to a wide range of biodiesel production practices, did not take place in India's biodiesel policy. In fact, the CO_2 particles were isolated from the many ways in which they can come into existence. In this way, their 'voices' were turned into a repetitive singularity of "reduced and avoided emissions" when producing and using biodiesel. The resulting proposition can also easily transcend individual socio-ecological situations, dissimulating general applicability.

Thirdly, biodiesel production was argued to generate employment. To promote this, biodiesel projects in various parts of India were linked to the National Rural Employment Guarantee Act (NREGA) – a scheme through which the government provides 100 days of employment at relatively high wages to people living below the poverty line (Lavanya, 2007). Through this scheme, people were paid to plant jatropha or other biodiesel bushes and trees on government-owned land. According to activists and forest department government officials, this was mostly a one-off event: people were not paid for recurring work such as taking care of the plants or for collecting seeds. Jobs on large plantations or in biodiesel production facilities such as transesterification plants would also provide employment opportunities. However, there are very few companies and other organizations that were still running by 2009 due to financial failure related

to jatropha giving lower yields than expected (Kant and Wu, 2011). Importantly, the voices of the very people about whom it was assumed that they wanted such employment were only registered as 'people in need of employment' in the policy proposition, without any reference to the complexities of their everyday life (or indeed their alternate occupations). Scientists and businesspeople, who observed farmers being reluctant to join or continue being part of biodiesel projects, registered them as, for example, 'people who did not participate properly in biodiesel projects because they did not realize how much income they could earn from it'. The rural people's voices were thus disconnected from – and not articulated with – their everyday concerns (as farmers), alternative employment opportunities and materiality (of farms).

Similarly, the voices of the plants and technologies were only registered as entities able to generate employment in the policy, obscuring the many entities on which the plants/technologies have to rely in order to generate employment. The same plants were represented by scientists who modelled, bred or grew them in their research institutes as 'plants that did not perform [well in the farmers' fields] because they did not receive the right agricultural inputs or because they had not been carefully bred and selected'. In this case, the scientists articulated the plants with their own concern in the form of yields achieved through the use of 'right inputs'. At the same time, they shifted the responsibility of poor performance on to farmers and other (poor) people who were supposedly in need of rural employment.

Farmers (and their NGO partners) discussed the desirability of such employment in voices that were rather different from the versions registered in the policy or among scientists and businesspeople. Farmers, for example from Hassan district, argued that income from a day's work as a farm-labourer (coolie) is higher than from a day spent collecting biodiesel feedstock seeds. The initiator of the MGR Jatropha Biodiesel Project in Tamil Nadu, Mr Alagarsamy, similarly observed that a lack of people willing to take up this work against the wages offered was one of the reasons why this jatropha project failed. These (and other divergent) voices of reluctant

biodiesel labourers, if raised and registered, could have created perplexity in this policy proposition. Thus, as noted above, farmers and the plants and technologies which had to afford biodiesel production were turned into a repetitive singularity as entities that 'did not participate properly'.

The plants and technologies that were supposed to generate employment opportunities could also have been registered differently, in articulation with (conceptual) entities such as energy security, climate change and environmentally sustainable development. For instance, the use of sizeable amounts of farm inputs such as water, pesticides and fertilizers to boost yields may not have been compatible with achieving environmentally sustainable development, mitigating climate change (fertilizer production can be very energy intensive) and energy security (does domestically produced biodiesel lead to national energy security if that production depends on possibly imported inputs?). Had the farm-workers' voices or those of the technologies and plants been registered in their multiplicity and allowed to recompose the proposition, the policy outcome could have been very different.

Setting targets

The 2009 policy announced: "An indicative target of 20% blending of biofuels, both for bio-diesel and bio-ethanol by 2017 is proposed. Blending levels prescribed in regard to bio-diesel are intended to be recommendatory in the near time" (Government of India 2009: 4). This differs from the text on targets in the 2003 Mission: "Targets need to be set up for bio-diesel production. The objective is to gradually raise it to take it to 20% in the year 2011-12 beginning with 5% in 2006-07" (Planning Commission 2003: x). The 2003 document also contains a calculation on the achievability of that target, using estimates of yield from a single stand-alone jatropha bush, number of bushes that can be grown on one hectare, oil percentage in jatropha seeds, and the projected diesel demand in 2011-12. It was calculated that a total of 11.19 Million hectares of land would be needed to reach a blending target of 20% in 2011-12. Many entities that play an important role in the production of oilseeds as elements of farmers' and

labourers' practices, such as rainfall levels, irrigation, fertilizer use, diseases, and pruning techniques are not articulated in this calculation for the proposition. All jatropha production is thus turned into a repetitive singularity and the resulting proposition is easily transferrable between different socio-ecological settings.

This calculation from 2003 was criticized by many scientists, policy-makers and activists for its extrapolation of the observed yield of one stand-alone jatropha bush to the expected yield per hectare of block-plantation. They argued that it had been a mistake to take the yield of a stand-alone bush to be representative of a bush in a densely-planted field.[45] Between 2003 and 2009, a number of projects recorded highly variable yields articulated with different production practices. For example, scientists at the Tamil Nadu Agricultural University (TNAU) in Coimbatore and plant scientists working for the private company JOil, also in Coimbatore, recorded differences in yield articulated with carefully monitored maintenance practices and soil types (see image on the next page).

[45] The work by Heller (1996) is frequently cited as the root of this 'mistake', who first extrapolated the yield of a large, single *Jatropha curcas* bush to the yield of a jatropha plantation per hectare.

Board that hangs in the maintainance shed of one of JOil's trial plots. Each part of the trial plot (letters A-R) receives a different number of hours of irrigation on different weekdays.

Most smallholders growing jatropha as part of an NGO project (such as AHIMSA) or for a multinational company (such as D1 Mohan Oils Ltd) faced very low yields. There were also researchers starting to measure yields from experimental plots on which biodiesel varieties were intercropped with various kinds of lentils (for example in test fields around the office of Hassan biofuel park).[46] These diverse practices of jatropha cultivation are each constituted by a different set of entities that had been muted in 2003, including water sources, irrigation patterns, rainfall, lentils, soil types, fertilizers etc. Through these varying practices, those entities raise their voices differently due to the different sets of entities with which they are

[46] There are many ways in which jatropha and other crops were being grown. Here we list only the major characteristics of some of the most frequently used methods. Yet, as one zooms in on the particularities of each and every practice, the way one farmer grows a crop is likely to differ from the way her neighbour will do it (cf. Arora et al., 2013).

articulated. For example, in the fields of smallholder farmers growing jatropha, the absence of water got articulated as a factor reducing yields, while in JOil's test fields, water supply was something to be optimized (Ariza-Montobbio et al., 2010).

These voices raised between 2003 and 2009 were not registered in the policy text. Instead the 2009 policy only articulated "high-yielding planting material" as being able to facilitate more feedstock production and hence higher biodiesel blending percentages, regardless of the conditions that such 'material' may require in order to give those high yields with high oil content. In most research practices, such as those of JOil, TNAU and TERI, constraints on cultivation were hardly comparable to the constraints present in everyday life of smallholder farmers, regarding the availability of water and other agricultural inputs. A group of activists, for example from Grain and the Society for the Promotion of Wasteland Development (SPWD), as well as one scientist from the Directorate of Oilseed Research, flagged this problematic disjuncture between smallholders' conditions and research practices. Some environmental NGOs also questioned the desirability of using external farm-inputs in large quantities because of the environmental impact of their production (e.g. chemical fertilizer). Two researchers, a junior plant-breeder from TNAU and a molecular biologist from TERI, also noted the importance of placing constraints on water and fertilizer use when breeding so-called high-yielding varieties because they felt that those resources should be used as little as possible. Yet, while the TERI molecular biologist tried to develop high-yielding varieties of *Jatropha curcas* by growing his test varieties under rainfed conditions without applying any fertilizers, another department at TERI tried to maximize the yield per hectare by experimenting with spacing, fertilizer regimes, amounts of irrigation and pruning without placing any a priori limits on the use of these resources. Similarly, while representatives from plant breeding company Metahelix stressed that biodiesel production was only desirable if it did not compete with food production and did not require large amounts of farm-inputs, they simultaneously encouraged the work of organizations such as JOil in developing high-input, high-yielding varieties

Few of these contradictory voices, particularly those emphasizing limits to high-input cultivation, are recognizable in the 2009 policy, which calls for research to produce high-quality planting materials, without noting any (smallholder's) constraints on the inputs needed to grow them.

Where to grow

The 2009 policy stipulates the kinds of land on which biodiesel crops are supposed to be grown: "Plantations of trees bearing non-edible oilseeds will be taken up on Government/community wasteland, degraded or fallow land in forest and non-forest areas. Contract farming on private wasteland could also be taken up […]. Plantations on agricultural lands will be discouraged" (Government of India 2009: 7). Further specifications can be found a few paragraphs later: "In all cases pertaining to land use for the plantations, consultations would be undertaken with the local communities through Gram Panchayats/Gram Sabhas, and with Intermediate Panchayats and District Panchayat where plantations of non-edible oil seed bearing trees and shrubs are spread over more than one village or more than one block/taluk" (Government of India, 2009: 7).

In contrast, the 2003 Biodiesel Mission claimed that a total of 13.4 Million hectares, subdivided among categories ranging from agro-forestry (jatropha plantations on land owned by absentee landlords, accounting for 2.0 million hectare) to fallow lands (of which an estimated 2.4 million hectare was to be used for jatropha cultivation), would be available for biodiesel production. These propositions on land availability for the cultivation of jatropha were based on calculations carried out by the Planning Commission, without the consultations with local panchayats mentioned in the 2009 policy. How did the entity 'consultation' enter the 2009 proposition?

Between 2003 and 2009, activists, articulated with so-called wastelands and its users, raised their voices against the idea that there is uncultivated land waiting to be taken up for biodiesel cultivation. For example, a meeting of various civil society actors (including Anthra and SPWD) in Hyderabad in

2007 stressed that the so-called wastelands are at the core of food sovereignty of many families:

> "Widespread propagation of plants like jatropha to be grown as 'oil from soil' is more destruction than deliverance. It takes over lands which are core to the food sovereignty of several families, falsely considering them 'waste', and converts them to monoculture plantations which are susceptible to all the problems of industrial agriculture" (Lavanya, 2007, 50-51)

Resisting the whole idea that any land can be 'waste', waiting to be used for and improved by biodiesel production, they also asked: if high yields of biodiesel crops could be gotten from so-called degraded lands or wastelands, then why could the lands not be used for growing food? Activists' voices on behalf of the land, its various uses and outgrowths, were informed by farmers with whom they had worked closely. There was a sense of urgency and distress expressed by the activists, who said that injustice was being done to people already living in poverty in the name of 'sustainable' energy like biodiesel. When visiting the offices of NGO Anthra in Hyderabad, farmers narrated how government officials had entered their village's grazing lands between 2003 and 2009, and planted jatropha everywhere on these common lands without having asked anyone's permission. They had angrily uprooted the unwanted seedlings. Nevertheless, as observed by the first author during the fieldwork, the forest department continues to plant biodiesel varieties on what they call wasteland till now, arguing that any kind of bush or tree planted on these lands is better than leaving them 'unused'. By displaying the many uses of land referred to as wastelands, these entities described above perplexed – made controversial – the policy assumption that the lands presented as available for jatropha cultivation in the 2003 Mission did not perform any extant functions. These dissenting voices may have been critical in getting 'consultation' included in the policy.

However, it is unclear in the policy what 'consultation' means and how binding the outcomes of such consultations are. Also, no differentiation

between differently articulated voices within 'local communities' was ever made: diverse community members, each with their own associations, are represented as a repetitive singularity. However, the first author also met farmers, such as those who had few animals or those who fed their livestock with industrially-produced feed rather than locally-grown grasses and shrubs, or who had enough private land to meet their own cattle-grazing needs, did not mind the plantation of biodiesel crops on non-privately owned land around the village. For example, in a village in Hassan district, a local leader took the initiative to invite the government to plant biodiesel crops on public land used by the village as grazing land, even though not everyone in the village agreed to this. Besides farmers, shepherds who travel hundreds of kilometers with their sheep or goats also use village common lands, in addition to private lands after harvest, to allow their animals to graze. When the first author met these people, they told me they were heavily dependent on both public and private land, but that their voices are not represented through existing government bodies such as gram panchayats. The voices of uncultivated land and its users, articulated in relation to a wide host of other entities such as different kinds of animals, privately owned lands and edible crops, were thus very diverse. The diversity of so-called 'wastelands' and the user practices on them are also absent from the policy proposition. Due to this absence and the repetitive singularity of 'local communities', the policy proposition is made generally applicable to all socio-ecological settings across India.

Crucially, a number of recent reports on the topic of landgrabbing have been published (e.g. World Bank, 2010 in Baka, 2013; Lahiri, 2009; Shiva and Shankar, 2008). Corporations could get easier ownership over large amounts of land thanks to exceptions for biodiesel production from the land ceiling act, which is an act which stipulates how much land any individual person is allowed to own. After failure of a biodiesel undertaking, the land would remain in the hands of the corporation that claimed to be working on biodiesel cultivation and that corporation is then free to make the land more profitable from alternate businesses such as real estate (Baka,

2013). The reported land grabs took place before 2009, yet their voices were not registered in the policy.

India's 'unique' feature: avoiding food versus fuel competition

"The Indian approach to biofuels, in particular, is somewhat different to the current international approaches which could lead to conflict with food security. It is based solely on non-food feedstocks to be raised on degraded or wastelands that are not suited to agriculture, thus avoiding a possible conflict of fuel vs. food security" (Government of India, 2009: 3-4). This proposition clearly tries to set India apart from approaches assumed to characterize biodiesel production elsewhere in the world. This was not the case in 2003, when the choice for jatropha, a crop to produce non-edible oil, was explained on the grounds of being productive without requiring a lot of inputs, and therefore being cheap to produce. The only reference to avoiding competition with other uses of oil can be found in a foreword to the Mission by deputy prime minister L. K. Advani: "The nation is facing a shortage of edible and non-edible oil. The existing high price of edible oil and the full use of tree borne oil seeds for various purposes suggest that organized biodiesel production for blending is possible only if plantation of selected species is taken up in compact areas" (Planning Commission, 2003).

L. K. Advani's understanding of competition with alternative uses of non-edible oilseeds was absent from the 2009 policy. Yet, such competition did often take place, for example in Hassan district of Karnataka where *Pongamia pinnata* seeds were and still are a key ingredient for the soap industry. Pongamia oil is also popular as lamp-oil in religious settings. A proportion of these seeds became feedstock for biodiesel. Oil from another biodiesel candidate, neem (*Azadirachta indica*), has traditionally had a wide range of (medicinal and bio-pesticidal) uses. However, the voice of this diverted trajectory of pongamia seeds (and of neem in a possible future), which most oilseed traders and one ex-member of India's administration who is currently an activist were aware of, was never articulated with India's biodiesel activities during the post-2003 controversy.

The 2009 policy proposes to avoid a food versus fuel conflict by using a non-edible crop and growing it on land that was not previously used to grow food. However, none of the other entities involved in growing a crop – water, labour, farm-inputs, sunlight, root-space – were included in the policy proposition on resource competition between food and fuel. For example, farmers in Hassan district were advised to grow biodiesel crops, particularly pongamia, on the boundaries of the land on which they grow food. However, large pongamia trees took away sunlight that the food crop adjacent to the trees needed. The extensive root system of the tree also made it harder for the roots of food crops to grow, and many farmers complained about this. Yet none of these entities ever got to raise their voices in relation to food vs fuel competition, through articulation with researchers, industrialists, policy makers, and even activists. Only through articulation with farmers did they get to raise their voices, for example when farmers demonstrated them to the first author while working in their fields.

Secondly, if biodiesel crops are planted on the bunds around farmers' lands, there is competition with the many other uses such bunds may have. This may be growing fruit or timber trees, grazing or walking to access other people's lands. No one we met throughout this research, except farmers in Hassan district, raised these issues. Additionally, Baka and Bailis (2014) calculated that the *Prosopis juliflora* currently growing on many lands classified as wasteland actually yields much more energy than *Jatropha curcas* could do – a form of competition which never got raised between 2003 and 2009. Activists did point out that if land is currently used for grazing and firewood collection, then growing biodiesel crops on those lands competes with access to fodder and fuel (e.g. SPWD). Also, there may be competition with biodiversity and wider ecological aims and values if any of the targets on biodiesel production are reached (e.g. Lavanya, 2007). These multiple forms of competition, were rarely raised by non-agrarian and non-activist actors in India. As such they stayed almost completely mute in the policy realm and remained disarticulated from the 2009 policy. If registered, these entities (as parts of farming pratice) would have created perplexity in the policy proposition because they contradict the proposition. Conversely, by

excluding them, the proposition became very easily transferable, assuming that growing non-edible oilseeds in any location where food cultivation is not taking place will not result in food vs. fuel competition.

Jatropha curcas and 399 other non-edible oilseed species

From which feedstock should biodiesel be produced? The 2009 policy writes: "There are over 400 species of trees bearing non-edible oilseeds in the country. The potential of all these species will be exploited, depending on their techno-economic viability for the production of biofuels" (Government of India, 2009: 7). The 2003 Mission states:

"There are many tree species which bear seeds rich in oil having properties of an excellent fuel and which can be processed into a diesel-substitute. Of these some promising tree species have been evaluated and it has been found that there are a number of them such as *Pongamia pinnata* ('Honge' or 'Karanja') and *Jatropha curcas* (Ratanjyot) which would be very suitable in our conditions. However, to start the programme, the advantage is clearly in favour of Jatropha" (Planning Commission, 2003: 111).

Going from a focus on jatropha to more than 400 oilseed species is a clear widening of the scope of biodiesel production in the country. However, the choice out of these four hundred different species rests on techno-economic viability, a term that is left undefined. The lack of a definition makes it possible to adopt a situation-specific definition but also takes the politics of defining the term out of sight. The situation was different in 2003, when jatropha was selected for a number of concrete reasons: its supposedly high yield, low input requirements and short maturation time, as well as having specific medicinal value of the plants' non-seed parts and carbon storing ability.

Between 2003 and 2009, jatropha plants, had refused to yield the amounts mentioned in the 2003 document, afforded by the fields on which they grew, the care they received and the inputs applied to them. Some plants yielded lots of seeds, but little oil in each seed, while others just grew branches. Plants also needed much longer than the two years mentioned in

the 2003 Mission to start giving any kind of sizeable yield. Many of these issues got raised in the research reports produced in research insitutes as well as during biofuel meetings organized by government bodies (e.g. Singh et al., 2006), in which large farmers, businesses and researchers participated. As such, the voices of these jatropha plants became more audible through spokespersons among the researchers and farmers. Yet the diverse ways in which the jatropha plants behaved in relation to a range of entities such as irrigation, different kinds of land, fertilizer etc was not recorded in the 2009 policy propositions. As a result, jatropha's poor performance, which was afforded by a range of other agrarian entities as documented above, got turned into a repetitive singularity. Despite the repetitive singularity, however, this poor performance created perplexity: feedstock was difficult to create, hence impeding the ability to fulfill the blending targets. As a result, the scope of the policy got broadened by the inclusion of a large number of oilseed species.

Conclusion

Using our four criteria to evaluate the (democratic) making of policy propositions on biodiesels in India has brought a host of important considerations to the fore. Firstly, there were some voices that were not registered in the 2009 policy. These entities, such as CO_2, labouring farmers and food crops that were deprived of resources due to biodiesel bushes/trees, could have created perplexity in the propositions had their voices been registered. Also even if one voice of an entity, such as jatropha's disappointing oil-yields, was registered in a proposition, the multiplicity of articulations of jatropha remained rather limited. Relationships between jatropha and water, jatropha and nutrients, jatropha and its distance to other jatropha plants got to raise their voices. However, they were only registered through formal scientific research even though those differences do have policy implications. Other articulations, different voices, as recounted by farmers (for instance, to us) were not invited and not registered in the 2009 policy.

Secondly, some form of re-composition of policy propositions took place based on the registration of many new voices, even if they were biased toward particular types of scientists. The number of oilseed species was increased, targets were delayed, consultations with village-level politicians were included, research for high-quality planting materials was more explicitly encouraged, and meeting rural energy needs was changed to achieving national energy security. Yet these forms of re-composition, by being driven by 'expert-led' voices, also closed down other possible re-articulations of the policy propositions.

Thirdly, a wide range of entities got turned into repetitive singularities in the policy propositions: CO_2 emissions are always lower when replacing fossil diesel with biodiesel irrespective of how the biodiesel was produced, land always yields a fixed amount of oilseed-yield, and there are no differences within local communities. On the other hand, the inclusion of 'public consultation' on land use change may mean that there is an implicit recognition of differences between diverse communities and socio-ecological settings.

The fourth criterion, which states that a well-articulated proposition is not easily transferrable between different socio-ecological situations, turned out to be of crucial importance. Many important elements of the specific socio-ecological situation that constituted the policy as a set of discursive propositions were registered in such a way that the propositions were easily transferrable to other settings. For example, the limited availability of water was important in shaping the choice to encourage growing jatropha on non-irrigated land. However, water was rarely considered as a factor of limited availability in relation to potential yields, making propositions on potential yield easily transferrable and compromising the consistency among the policy's propositions. Similarly, the first policy proposition, legitimizing India's biofuel policy, could have played an important role in ensuring that the policy is not easily transferrable, especially to situations in which the legitimation criteria (of enhancing energy security, climate change mitigation, creating new employment opportunities and leading to

environmentally sustainable development) do not hold. However, this did not happen. The involvement of foreign companies and dependence on imports of feedstock do not bode well for energy security. Climate change mitigation is likely to vary depending on land use changes and farm-inputs used, but such contingency was not registered in the policy. Most importantly, environmentally sustainable development got almost completely erased in discussions on the potential blending targets that were to be achieved through biodiesel plantations, no matter how much water, chemical fertilizers and pesticides they consumed. This further enhanced the lack of consistency among the policy's propositions. Indeed, had the first policy proposition truly limited the transferability of the policy as a whole, then India's policy on biodiesel promotion would have looked very different or perhaps would not have been made at all.

Our analysis clearly underlines the importance not just of Foucauldian discourse analysts' understanding of knowledge and truth as principally contestable, or of public controversies in Science Studies, but also of opening up authority garnered through articulation with other humans and non-humans beyond scientists or policy experts (Feindt and Oels, 2005; Latour, 2010; Stirling, 2008). For example many crucial voices about biodiesel production, such as the unattractive economics of collecting oilseeds or the many ways in which bunds around farmland may already be in use, are not visible in mainstream (social) scientific research on biodiesel. These voices were only articulated, by us and some activists/NGOs, through the links established with and by farmers and landless labourers. Thus, a slow and democratic policy-making process, a policy democracy, has to enable not just many recalcitrant and hitherto silent entities to speak, it also has to register multiple voices of each entity which are produced as the entity gets articulated with *different* other entities.

Throughout this research, we have attempted to capture the voices of as many interested entities, in as many diverse voices, as possible. This process was facilitated by reading widely, by speaking to many different people and by closely observing their material practices. Ours was thus a humble

attempt to practice 'slow' research (Stengers, 2011). Yet, there are surely interested (and interesting) voices which we have missed out on. And perhaps in the future, these unheard, unregistered entities will 'raise their heads' and force us to recompose this paper.

Finally, overall, we believe our set of four criteria has been useful to study the making of India's biodiesel policy. The criteria have enabled us to show which entities were included in the policy, and how their voices were registered (through what kind of articulations, in what kind of voices), and which entities were excluded and eventually left without recognition in the policy's text. This is a fruitful basis for understanding how things could have been differently articulated i.e., how the policy could have been alternately composed by registering other voices, by including other entities. We hope that our work contributes to a wider reflection about strengthening policy democracy, asking how policies can be (re)constructed through processes that are open, inclusive and democratic, leading to policies that are better able to care for the complex and multiply-entangled entities they try to govern.

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Honge tree's travels

This is a story about a young *Pongamia pinnata* seedling. In Kannada, which is the language spoken in this part of the south Indian state Karnataka, the pongamia tree is called honge tree. This seedling grew out of a seed, planted by a lady named Jaya. She planted the seed, transplanted the seedling that sprouted into a plastic bag with soil and watered it regularly according to the instructions her supervisor, a scientist working at Hassan Bio-Fuel Park, gave her. The seedling just recovered from a disease that damages its leaves. Without health leaves it cannot grow as fast and as tall as seedlings without this disease. Therefore, Jaya had been asked to apply pesticides to the seedling as well, and so it recovered from this disease that had been tormenting the seedling's leaves. Would it be right to say that this seedling exists together with and through the work carried out by nursery staff like Jaya, the water she uses, the sunlight captured by the seedling's leaves, the soil hosting its roots, a plastic bag, the disease and pesticides?

The seedling seen from above, still carrying marks from its sickness

My research assistant Shruthi and I encountered this seedling in Hassan Bio-Fuel Park's tree nursery when it was about to set out on a journey. This story will follow the seedling's paths through life based on the way Shruthi and I learnt about it through our research activities in villages participating in Hassan Bio-Fuel Park's biodiesel production work. Hassan Bio-Fuel Park is a research station in a village named Madenur. It is located along a wide, smooth highway that connects the city of Hassan to the metropolis of Bangalore. The research station belongs to the University of Agricultural Sciences Bangalore and attempts to popularize growing biodiesel feedstock crops among farmers in the district. Jaya's boss is the director of this institute. Along with the other researchers working there, he told Shruthi and me that their approach to biodiesel production avoids competition with food production. Furthermore, it would not require farmers to give up their existing cultivation practices and it was supposed to provide a welcome addition – but nothing more than an addition – to farmers' incomes. This university-based project could be described as a large experiment, doing a form of action research. They also do innovation, developing new ways of growing biodiesel feedstock crops and new ways for farmers to organize themselves. And it is entangled in Karnataka state's biofuel politics: the director of the Hassan Bio-Fuel Park contributed to the writing of Karnataka state's biofuel policy, and the Karnataka state agency that is supposed to oversee biofuel related activities (called Karnataka State Biofuel Development Board) paid for the Park's expenses for many years. The Park's achievements are often mobilized by the members of the Board to legitimize all of Karnataka state's biofuel-related activities. The director says his field staff has interacted with 54506 farmers and other interested people between 2006 and 2010, and established 70 biofuel villages in which each household has planted at least one biofuel species. He claims that 1108827 seedlings of five biodiesel crops were planted thanks to his project. Honge seeds contributed most towards the biodiesel produced at the production facilities of Hassan Bio-Diesel Park. This story follows a honge seedling on its journeys through life because of the claims made about it. On its way the tree encounters all sorts of entities, like water, people, soil, other trees or

machines which take part in the seedling's conversion into biodiesel. By studying these encounters, Shruthi and I also learnt how the seedling's journey could have been different, based on the associations it enters into. On its way, the seedling will remain connected to Hassan Bio-Fuel Park through the oilseeds that may grow on the tree's branches and that will be brought back to the Park, through the visits of field staff working for Hassan Bio-Fuel Park, and through documents listing the names of people belonging to so-called "biofuel associations" in each village that received seedlings like the one this story is about. These documents are stored at the Hassan Bio-Fuel Park office room.

The journey starts when the honge seedling gets loaded onto a truck along with many other varieties of oilseed-producing seedlings by the nursery staff. Those varieties are new to the farmers' fields, are planted in smaller quantities, and most do not make it to maturity. Therefore their seeds are barely available for biodiesel production. The truck with seedlings goes to a village that has already been visited by a member of the Bio-Fuel Park's field staff. This person, called Suresha, had asked one of the most influential people in the village to gather the village's inhabitants for an information meeting. In this particular village, called Kinnerahalli, a senior lady named Bharathi was very influential on these kinds of topics as I learnt from my research assistant. Together with a younger, charismatic man named Rama, who engaged in politics, farming and 'electric works' (i.e. doing the electric wiring of a new house), she organized a meeting as requested by Suresha. During that meeting, Suresha had introduced the tree species that are now travelling to the village by truck as trees that are useful for the production of biodiesel. His explanation of the concept 'biodiesel' had excited the villagers. They expressed that they liked the idea of running their vehicles, such as motor bikes and tractors, with oil from their own lands though they did not want to try it in practice for fear of harming the engine of the vehicles that had been a big expense for them. At the same time, raising honge tree was familiar to them, and this tree was quite a common sight in their fields. Suresha had tried to excite farmers about planting new seedlings to increase the number of trees. He also encouraged them to collect the

seeds from existing trees in the meantime, arguing that they'd earn good money by doing so and that the product, biodiesel, was very useful for society at large.

As such, the healthy seedling travelling on a truck arrives in a place populated with a number of mature honge trees. There are many people who know about the possibility of producing biodiesel from the honge tree's seeds. In addition, the place contains many kinds of land that are used to grow seasonal crops like corn, rice and ragi. Along those lands, there are edges which are sometimes empty, but often full of trees like mango, jackfruit, silver oak and teak. Suresha had called Rama and Bharathi before arriving with the truck, and they had gone through the village to announce the arrival of the seedlings. Everyone who wants a few seedlings is invited to gather in a central place in the village. When the seedling gets unloaded from the truck, it immediately meets with a number of eager hands from villagers who have come to take some seedlings. They are eager, because the seedlings are free of cost. Someone has taken care of the seedling to raise them in a nursery for a year or more, and therefore it is valuable, say the farmers. There is quite some pulling going on, and Suresha and Rama work hard to make sure each villager receives a variety of seedlings. Finally, the seedling ends up in the hands of Vidya, wife of Mukunda, Rama's close friend. She gets a few honge seedlings, and some of the varieties she does not know so well yet, such as Simaruba glauca. She carries about eight seedlings in total to her home, where she shows them to visiting relatives. They are happy with this gift, and enjoy spending some time discussing what the new varieties look like. Because Vidya knows that the seedling will have higher chances of survival if she plants them when it rains, she complains to her husband that 'those biodiesel people' handed out the seedlings a few months ahead of the rainy season. The seedling, in the meantime, is still in its bag but since it has received plenty of water, fertile soil and sunshine when it was still in the nursery, it's almost growing out of that bag. Therefore, Vidya takes the seedling, along with the other seedlings she received, and carries them to the half an acre of land she and her husband own. Their land is small, compared to what others in the village

own, which is usually between two and five acres. In a corner, she has a piece of fence on which she grows some climbing vegetables like bitter gourd, for consumption at home. There is also a row of teak trees which she planted a few years ago. Teak trees are valuable: once grown, they can be sold to traders for quite a large amount of money. Those traders want the stems for their durable timber which is suitable for a wide range of purposes such as furniture-making, house-building and more. In addition, there are a few coconut trees and a mango tree on the edge of the land. The central part of the land is currently in use to cultivate a crop called ragi. Ragi is also called finger millet, and it is a nutritious staple food. Vidya plans to use about half of the crop to feed her family, selling the other half for cash. Vidya plants the seedlings on the edge of the land. She also pours some water, to make sure the seedlings do not die right away. So the seedling is now a seedling that can no longer be carried from here to there. It has its roots in the soil of Vidya and Mukunda's land. It has plenty of water, for now. Also, it is no longer a seedling from the Bio-Fuel Park, it is now Vidya and Mukunda's seedling. Upon meeting Vidya, Vidya's relatives, land, an amount of water, ragi growing nearby, and a range of tree species, the seedling becomes Vidya and Mukunda's seedling which is growing in soil with water, among other trees and besides land planted with ragi.

While the seedling is growing, Suresha visits Kinnerahalli quite often. He passes it frequently on his way to villages that are located a bit further from the main road than Kinnerahalli (so the seedling is also a seedling growing in soil close to the main road). This is special: he visits other villages only a couple of times. There are more than a thousand villages involved in the project, and while there were seven people doing Suresha's work a few years ago, there are only two when Shruthi and I start doing research in this area, or three during the season in which honge seeds can be harvested. So it is not possible to visit all those villages more than twice when a village joins the project. But in Kinnerahalli, Suresha becomes a common sight, thanks to its location but also because the inhabitants are keen to talk to him. Bharathi likes to receive him on the sitting area in front of her house, where Rama and his close friend Mukunda join them. When we come to the

village, she also likes to call Shruthi and me to sit there with her when she is not visiting her children in nearby city Mysore. Others also come and go during these informal gatherings, such as the secretary (main person) of the village's milk cooperative named Krishna. They are not very closely associated with this story's seedling, they don't talk about its current state unless Shruthi and I ask about it. However, the seedling is not doing very well. It has not rained during the months after planting the seedling, and the land in which it is planted is not irrigated. The seedling is alive, but barely. The leaves of the other seedlings that were planted at the same time are almost completely brown. Nobody really knows why this story's seedling is still surviving while others are dying. Perhaps the slight amount of shade the seedling gets from a nearby tree is the reason, or maybe the seedling's root system is better at extracting water from the dry soil.

But the people sitting in front of Bharathi's house do talk about the seedling's future. In a few years, the seedling will become a tree and start yielding oilseeds. At the moment, farmers can get about Rs. 14 at the local market for a kilo of those honge oilseeds, after they harvested, dried and cleaned the seeds.[47] Suresha's seniors, the scientists working at the Bio-Fuel Park, would like to buy these seeds directly from the farmers, at the same rate. Therefore, the scientists came up with the idea of forming 'biofuel sangams' (biofuel associations) in the village: groups of ten farmers who are responsible for bringing all harvested seeds together and calling Suresha or other field staff members to come and buy the seeds. The sangams are also supposed to inform the field staff if the farmers would like to get more seedlings. So Suresha asks Rama and Bharathi to form such an association, consisting of a president, a secretary, a treasurer and seven general members. Five members should be women, five should be men. Rama refuses to be a member of the sangam, although he has been the most important person facilitating all biofuel-related activities in the village so far. In fact, he will continue doing so throughout the life of the seedling, but he

[47] At the time of fieldwork, one euro was equal to approximately 75 Indian rupees (Rs.).

does not want to have an official title and sangam membership. Bharathi becomes the president, while another lady named Parvathi is the treasurer and the milk cooperative secretary Krishna is the secretary. Mukunda becomes a general member. All the other members are appointed by this group of people. In fact, Parvathi was also appointed, she didn't volunteer for the position. When Shruthi and I ask her about her role in the biofuel sangam, she tells me that she's sure she's the treasurer, but that she does not really know why she became the treasurer. When Parvathi says this, Shruthi tells her that this is strange. I ask Shruthi to please tell her that I don't mind whether she knows or not, and to ask her if she has any idea at all. Shyly, Parvathi replies: "Perhaps, it is because I am also the president in the ladies' self-help group I am part of? Or perhaps it is because I am Bharathi's niece?"

Once Bharathi, Rama, Mukunda and Krishna have decided on the composition of the sangam, Suresha comes to the village and organizes an inauguration to mark the birth of this new institution in the village. The researchers from the Bio-Fuel Park would like Suresha to organize such an inauguration in every village where a biofuel sangam is formed to make sure everyone in the village knows that they can sell their honge seeds to this group of people and that they can ask them for seedlings. Yet, such a celebration does not always take place. In fact, in many villages, members of the biofuel sangam – whose names are written on sheets of paper titled 'biofuel sangam members' kept in files at the Bio-Fuel Park office – are unaware that they are, in fact, members of the biofuel sangam. In Kinnerahalli, the frequent presence of Suresha and the active involvement of Rama, Bharathi and Mukunda make that the existence of the biofuel sangam becomes well-known, even though there are just a few active members. The seedling legitimates the sangam. Yet the sangam does not really look after the seedling.

While the sangam was being formed, the seedling is trying to grow. It is having a hard time doing so, for the simple reason that it needs water to grow. Mukunda and Vidya do not have access to water on their land, but

others have irrigated land. Krishna, for example, planted some seedlings on the edges of irrigated land that he uses to grow ginger. Those seedlings with water are doing fine. Another farmer, in another village, also planted seedlings on the edge of his land. This edge is along a water channel. One day, when he was not there, the seedlings meet machines that are cleaning the channel. The result of this encounter is that the seedlings die, they are ready for composting. Seedlings may also encounter animals, which turns the seedlings into animal feed. In Kinnerahalli, there are many seedlings planted along a simple road that connects Kinnerahalli to the main road. They were planted just before the rainy season, and Rama made sure to ask the local forest department to water them with a water lorry during dry spells. Those seedlings with plenty of water grow up, and are a few meters high after about three years. But then they meet with plans to improve and widen the road. So they get cut. And as they lay rotting in farmers' compost heaps, the seedlings became part of a practice that has nothing to do with biodiesel.

In another village, a member of Hassan Bio-Fuel Park's field staff had handed out seedlings as part of a government programme called Soovarna Bhoomi. This is a large government-run scheme that spans across a range of rural activities such as agriculture, sericulture, forestry and more. Instead of giving farmers as many seedlings as they felt they could plant on the edges of their land, the field staff gave each interested farmer 50 seedlings and was supposed to give Rs. 5000 as 'wages' for planting the seedlings. However, many farmers report they did not get any money at all, while others say they were made to pay an amount between Rs. 500 and Rs. 1000 for the seedlings, leaving them with a subsidy of Rs. 4000 to Rs. 4500. The field staff was supposed to come and check the seedlings' survival after one year, and give farmers another Rs. 5000 by that time. However, we did not meet any farmer who had been checked and who had received this second instalment. Most did not mind, because their seedlings hadn't survived anyway. However, in one village we encountered a different situation. When we visited this particular village for the first time, we were spending some time to get to know some of the farmers in the village. But unexpectedly,

Shruthi stopped translating and got into a heated argument with some of the farmers. When I asked her why she was raising her voice, she explained to me that the farmers had been insulting us as cheaters from the Bio-Fuel Park. I asked her to calm down and explain carefully that we were not associated with the Bio-Fuel Park. However, the farmers present remained careful and did not quite trust that we had nothing to do with Hassan Bio-Fuel Park. They did say that if we wanted to know more, we should visit a man living a little outside the village. When we arrived at his house, this man welcomed us. Even though he also thought we were associated with the Bio-Fuel Park, he was more easily convinced that we were not because he was in direct contact with the field staff working there and never heard about us before. He talked very negatively about biodiesel, and we asked him to explain this. It turned out that the field staff active in this area had asked Rs. 1000 from all farmers interested in this programme. He had given them 50 seedlings each to plant on the edges of their land, which the farmers had done. The farmers had hesitatingly given this money, because the field staff had said he needed this to fill out government forms to get the subsidy of Rs. 5000 for each participating farmer. However, four months later he had not yet come to fulfil his promise, and he had stopped answering phone calls from this village's inhabitants.

In the meantime, this story's seedling is among the small number of seedlings that survive the hardships of the first years and becomes a tree. By the time it is two years old, it is able to deal with dry spells, and since there is no reason for Vidya and Mukunda to cut the tree, it grows tall with the help of nutrients in the soil, sunlight and water deep inside the soil or fresh rainwater during the rainy season. It starts having a couple of seeds hanging from its branches from the age of about six years onwards. It is still quite small, compared to some of the mature honge trees in the landscape, and does not give much shade yet. Each of the mature honge trees have their own stories. Rama has a few trees that are about 25 years old, planted by his father. Krishna has one honge tree in front of his house to shield the house from direct sunlight. Bharathi does not have any. She estimates that she is about 65 years old, she has severe knee problems and she is the only one

left in her household. Her children have gone to cities for work, and helped her to remove all labour intensive aspects from the land. All she has left is a field of coconut trees, and she hires labourers for the heavy work. So she does not actually do any of the work that she advises her neighbours in the village to do: raising biodiesel feedstock varieties and harvesting their seeds. Another old man has eight large honge trees, he estimates that they are around 40 years old. They stand at the edge of his land, beside a pond he dug as water catchment to use during dry spells. Yet, while the seedling has been struggling to survive the hardships of its first years, this man's trees are about to be cut. He does not want to cut them because the trees would not produce a nice quantity of seeds, or because they would hamper the growth of nearby crops with their shade. In fact, the trees are standing next to a pond so the shade is useful to keep the water cool and prevent it from evaporating. Rather, this man says it is a lot of work to collect, dry and clean the seeds. This is why he is going to cut the trees, dig out as much of the roots as he can, and sell the timber. This will provide him with a lot more money than harvesting seeds, and will give him space to plant silver oak, a fast-growing timber species.

This man is not the only one cutting his honge trees. In Kinnerahalli, many farmers, young and old, say they've cut most if not all of their mature honge trees, trees that were planted decades ago. Those trees, upon being cut, became timber. This timber got turned into fuelwood as brick-makers lit the tree trunks and stems to make fire that hardens out bricks used to build houses. One may wonder whether this happens because the trees, upon growing older, were not producing a lot of seeds anymore? This is not the case, the trees were producing plenty of seeds according to the accounts of the farmers. Rather, farmers tell me that they were no longer interested in collecting these seeds, a lot more money was to be earned in various other ways. Cutting a tree and selling the stem means instant access to cash. Furthermore, farmers say they kept the trees in the past in order to use its branches as fuelwood in their kitchens. However, they explain they do not need as much fuelwood anymore as they used to because many people in this village have started cooking on (bio)gas. There was a practice of using

the leaves of the tree as fertilizer for the soil, but this has disappeared as well. So as (bio)gas, new labour opportunities and different cultivation methods arose, the tree changed from being a valuable tree for various purposes (e.g. branches for fuelwood, leaves for fertilization) into a rather useless tree that requires a lot of work to earn any money from its seeds.

When the tree produces its first seeds about six years after it was planted, it is still very small. The seeds are ripe in March/April, and Vidya can collect them quite easily. She can reach the branches to pick those which haven't yet fallen, and collecting the few that did fall on the ground below the tree does not take much time and effort either. But the amount she collects is just enough to fill a small basket, so it will only give her a couple of rupees when she sells this on the market. When Suresha talks about the potential of these trees during one of his visits, he portrays a very different picture. Suresha told the farmers that mature trees may yield 100 kilos of seeds, and will therefore be a substantial, yearly source of income alongside what farmers earn from cultivation and keeping cows for milk.

In Kinnerahalli, Krishna has a mature honge tree standing in front of his house. He knows that Shruthi and I are interested in his honge tree. When he sees us in the village in March, he shows us that the seeds are ripe now: they reached their mature size, and they are starting to fall. He adds that he is planning to harvest the seeds because he knows that Suresha wants them, but that he would not do so if the tree was far away from his house. Seeing my interest in everything he is telling me about this tree with ripe seeds, he suggests that he may harvest the seeds right away so I can witness the process. And so he climbs the tree, armed with a long, strong stick, and starts beating all the branches of the tree with that stick. The seeds, about five to seven cm long, two to four cm wide and a few grams in weight, start to fall. It is not an easy task, Krishna has to be very careful moving around on the tree's branches. His wife, who brings a vessel to collect the seeds, joins me in watching him up in the tree. "See," she says, "this is why we ladies cannot do this work. It is too dangerous for us. Older boys and men can do this. We women can only pick the seeds from the ground, or from

branches that we can reach easily." After a while, Krishna comes down and there are no seeds left on the branches. Krishna, his wife and I bend over and start collecting the seeds, throwing them into the vessel brought by Krishna's wife. Shruthi does not join us. Krishna's wife says I should sit or stand in the shade, like Shruthi, instead of doing this hard work. I continue collecting seeds, while Shruthi takes photographs to document what collecting seeds looks like in practice. There are a lot of thorny plants growing beneath the tree, so we have to be careful not to get hurt by them, though at times this is unavoidable. Krishna, his stick and the tree with ripe seeds create two separate entities, forcing Shruthi and me to choose a direction in the tree's journey: to stay with the stem that has no seeds left after harvest, or to go with the seeds lying on the ground between thorny plants. This does not only happen because Krishna beat the branches with a stick, but also because the seeds' connection to the branches was weak enough to be broken by Krishna's stick. And while navigating carefully around the thorny plants, which slows us down, we turn those seeds lying between thorny plants into seeds collected in a vessel. Someone unfamiliar with the process of preparing honge seeds for sale may think that we are ready now, ready to take the seeds to a trader or sell them to Suresha. But this is not the case. Krishna carries the vessel to a slab of concrete in the sun which is used for drying all kinds of harvested crops. Ragi, rice and some other crops have just been harvested, so most places which are suitable for drying are already occupied. Using a small area that is still empty, Krishna spreads the seeds. They should not lay on top of each other, because each seed needs to be exposed to the sun to dry. It takes up to a week for the seeds to dry, they have to change colour from green to brown. Because of the sun and heat, and the availability of a space where the seeds can lay side by side, fresh green seeds full of water get turned into lightweight dry brown seeds.

Krishna, high up in the tree. Beneath are the thorny bushes.

During the season when honge seeds are ready for harvest, I meet many people in the village and in the fields, and I talk to them about the process of harvesting honge seeds while at the same time joining those who regularly collected honge seeds. Some people say that a man or grown boy is needed to harvest seeds from high trees because they are the only ones who climb trees. But most of the time I meet women going out by themselves to collect these seeds, the men being occupied with other things. For example, one day Shruthi and I meet a lady, named Gouri, on the road leading out of Kinnerahalli, the leashes of her two goats in one hand and a vessel in the other. She calls out to us, knowing that we are in the village to study the honge tree. "I am going out with my goats so they can graze, and in the meantime I may collect some honge seeds if I find any, you can join me if you like". So we join. Once we get out of the village, we leave the main road. We are walking in between other people's fields. The goats stop once in a while, eating some grass here and there. After walking like that for some time, we come to a few small honge trees, with seeds still hanging from them. The trees are not Gouri's, but, she says it is ok to collect the seeds.

Like many people explained to me, she says that one can collect honge seeds from anybody's tree in the land. There are very few people who mind it if others collect seeds from their trees. Collecting seeds and getting them ready for the market is hard work and results in just a little bit of money. Therefore, whoever is willing to do it can do so. So during harvest season, the material difficulty of collecting the seeds (because of the light weight of each seed, the thorny bushes growing below trees, the tree's tendency to grow very high, and human bodies' abilities to cope with this situation) and the low market price of seeds turn honge trees into trees with seeds that belong to everyone. Gouri secures the goats to an anchor in the soil, so they can graze but do not walk away. I follow her in taking the seeds from the branches and bending over to collect those which have already fallen on the ground. Here, too, we have to be careful because thorny plants are everywhere, hampering our work. This tree did not grow many seeds, somehow, so our vessel fills up very slowly. When Gouri feels her goats have eaten enough, we return to the main road and walk home, with a few kilos of seeds that still have to be dried and cleaned. This amount will eventually result in perhaps half a liter of biodiesel.

Overall, people in Kinnerahalli are not very keen on collecting honge seeds. If they collect seeds, they only collect a few kilos alongside other work they had to do. In another village, called Dodda Kanagal, it is common to collect about 100-200 kilos of seeds per household (some 30-80 liters of biodiesel can be made from those seeds, depending on their oil content and the strength of the machine that crushes the seeds). Dodda Kanagal has a biofuel sangam, just like Kinnerahalli, and one year before I visit the village, the president of the sangam managed to collect some 2000-2500 kilos of seeds from all the households, and sold them to another member of the Bio-Fuel Park field staff, named Ranga. He does the same work as Suresha. Everyone in the village knows about the concept of biofuels: Ranga has told them about it in a large meeting in the village and about half of the village has visited the Bio-Fuel Park with Ranga. However, curiously, when I visited the village, I was only able to find the biofuel sangam's president in

this village, even though staff from the Bio-Fuel Park told me that they have a list with ten names of people who are members of the biofuel sangam.

Because people collect honge seeds in much larger quantities than in Kinnerahalli, the collection practices are different from those deployed in Kinnerahalli. Therefore, Shruthi and I go along with a lady named Latha to collect seeds. We leave her house around 9.00 am. While we are walking between the fields, searching for seeds which have not yet been harvested by anyone else, she says she prefers to go just before sunrise, around 5.30 am. If her household works allows such early departure, she spends about one and half hour walking to a wide irrigation canal, along which there are many large honge trees, with lots of seeds under them. But today she could not leave so early, and so we do not walk very far since it would get too hot in the afternoon to walk back. Unlike Gouri, who carried just a small vessel, Latha brings a large bag. We stop at every honge tree we see, trees which are usually clustered and growing in a row on the edges of people's lands. The fact that they are on these edges makes our work more difficult because there are differences in height between one field and the next. The slope is very steep, so we have to take care not to fall, and we cannot walk around the trees because of this steep slope. Instead, we have to find places where going up and down is possible. After collecting as many seeds from the ground as possible from three short rows of trees on such slopes, we come to a few trees that mark the separation of two pieces of land that are of equal height, so we do not have to deal with the slope. However, these trees are surrounded by high thorny bushes, much higher than the ones we encountered on collection trips around Kinnerahalli. We have to work carefully, and the thorns of the plants catch hold of our clothes quite often. In some cases the plants make it impossible for us to collect the seeds in between them, when the thorns are too dense and the thorny branches too intertwined for us to be able to reach the seeds. Finally, after about half a day's worth of work, we return home with half the bag filled with seeds. A lot more work is waiting for us before the seeds are ready to be sold.

When we get back to the village, Latha has to remove the previous honge seeds from the place she uses for drying before she can spread out the new ones. The lightweight dry brown seeds that resulted from the process of drying them in the sun for almost a week are ready for the next task. The seeds consist of a seed coat and an inner seed. Since the seed coat barely contains any oil, it has to be removed. Buyers are not interested in the seed coat, they need oil so they want the inner seeds. Latha tells me removing the seed coat usually takes just as much time as collecting the seeds, and that she is not going to do that now. There are other tasks she wants to do.

The sloping edges of the land on which a honge tree, among all sorts of other trees, is growing. Note the height difference, indicated with the arrow.

Close to Latha's house, I see a very old lady with a big heap of lightweight, dry brown seeds next to her. She is sitting on the tarmac road, with a stone in front of her, about ten cm high with a flat surface. She takes the seeds one by one, holds them sideways and breaks them open by hitting the seed with a stick. The stone on which she holds the seed to hit it with a stick helps her in this task. It makes her workspace a bit higher, so she does not need to bend forward too much. A young girl is sitting next to her, perhaps she is seven years old. While the old lady throws all open seeds on a pile, the girl takes the open seeds, again one by one, and separates the inner seed from the seed coat. She cannot keep up with the old lady's speed, so I join her. Soon it becomes clear that my fingers are not adjusted to this kind of work, the young girl works much faster while she is having a lot of fun with the old lady about my clumsiness. We sit and work like this for a long time. Some seeds are rotten, so we have to throw them away. Other seeds are extremely small or shrivelled. Those, too, have to be thrown away. When the old lady is fed up with the work, we have perhaps three kilos of clean seeds, ready for sale. This will yield less than a litre of biodiesel and will give her Rs 45 at most, an amount one would easily earn for a few hours of work as a labourer. I ask her what she will do with the seed coats. Like everyone else with whom I discussed this, she says those are a useful fuel, she uses them to heat water for her morning bath. She puts the ashes, which still contain some nutrients, on her land along with compost.

The old lady crushes honge seeds with a stick to remove the seed coat

In Kinnerahalli village, Vidya's seeds from the honge tree that was once the seedling with which this story started, also turned into dried seeds as a consequence of the sun's rays and the characteristics of the seed coat. Therefore, one day during a warm afternoon she sits down to remove the seed coats. She finds a stick on the street, one that is strong enough so it doesn't break under the impact of hitting each seed. She also finds a stone of about five to ten cm in height, and sits down in the shade. While she hits every seed, she says she has to do this work during the daytime. Hitting the seeds with a stick to crack their seed coats, in order to take out the oil-rich inner seed, could damage the floor in the house. That means that she needs to do this work on the road or somewhere else outside the house on a stone floor. During the evening, when it is dark – darkness falls around 6.00 pm – she cannot do this kind of work outside. So, the presence of daylight, the strong tarmac, Vidya's arms and hands, the stick, the stone, and the hard seed coat with valuable inner seed inside together make that the dried seeds get split into seed coat and inner seed. This story continues to follow the inner seeds.

Those inner seeds are still not as dry as they should be to go to the market, so Vidya leaves them to dry for another one or two days. If she does not dry the seeds completely before taking them to the market, the trader will either not buy her harvest or lower the price a lot. After that, the seeds are very light and suitable for processing in an oil expelling machine, which splits the seed into oil and a residue called seed-cake. Kinnerahalli village has a very small oil expelling machine to do this, because the scientists at Hassan Bio-Fuel Park would like farmers to be able to use the seeds for their own energy needs, although they also aim to sell biodiesel to companies based at Bangalore airport. As a first step towards achieving that goal, they used their research funding to buy two small motorized oil expelling machines, which they installed in two villages in the district. These two villages, according to the scientists, are the most enthusiastic and successful villages among the approximately one thousand participating villages. This machine has been in Kinnerahalli for about one year when Shruthi and I come to see it. Rama says he usually runs it to demonstrate how it works to interested visitors, who are brought to the village by the Hassan Bio-Fuel Park scientists and Suresha. He keeps a small stock of seeds to run the machine during such demonstrations. However, the village does not use the machine to expel oil from the seeds they collect, because they do not harvest many seeds anyway and because they feel expelling the oil using the machine takes a lot of time. Furthermore, apart from burning a small quantity of such oil in lamps used at religious ceremonies in the temple or at home, they do not really have a use for the oil. One can add it to the diesel in tractors and motorbikes, but the quantities of seeds collected are too small to yield an amount of oil that could replace a substantial amount of diesel. In addition, the farmers distrust the safety of the oil for the engines and scientists at Hassan Bio-Fuel Park told them that vegetable oil needs to go through a chemical process called transesterification before it is real biodiesl. And they do not have the facilities to do that in the village. All these issues make that the seeds from Vidya's honge tree never meet this oil expelling machine in the village. In any case, when Rama runs the machine to show Shruthi and me how it works, a stick which he uses to push the seeds into the machine gets

stuck in the machine's engine. Although he immediately notifies Suresha about this, the machine remains broken throughout my stay in Hassan district.

Because the machine is broken, Vidya cannot ask one of the four men who were trained by Hassan Bio-Fuel Park's staff to use the machine to extract oil from the seeds she collected in her own village. She does not really want to do so either, because she does not have a use for this oil in her home. Expelling oil does not only result in oil, but also in seedcake: the remaining material. According to both farmers as well as scientists from Hassan Bio-Fuel Park, this material is a good fertilizer. But Vidya is not really interested in the seedcake either. She has such small quantities of seeds that the seedcake is far from sufficient to fertilize her family's small plot of land. So Vidya is looking to sell her few kilos of seeds. Suresha is only interested in large quantities, at least 200 kilos. Otherwise the costs of petrol needed to drive to Kinnerahalli are too high. For some years, Rama and Bharathi have been trying to convince people to give their seeds to them, so that they can collect a few hundred kilos for Suresha. This is one of the tasks of the biofuel sangam installed by Suresha. But it is very complicated: people like Vidya want money immediately. So Rama or Bharathi would have to give them money from their own pockets, which Suresha will reimburse when he comes to pick up the seeds. Also, Rama and Bharathi, as they gather seeds from everyone, do not really know at which point in time they will have the minimum of 200 kilos ready so they can call Suresha. And when they call him, he may come very soon, or he may not. So there is a lot of uncertainty.

Therefore, Vidya takes her seeds to the local market along with other products she has harvested from her land to sell. There are a number of traders who buy the seeds. Most of them are small traders, selling the seeds to bigger traders, or to people with oilseed mills. They pay at least as much as Suresha offers per kilo of seeds. Vidya sells her seeds to an old woman, who sells salt and buys honge seeds. She sells the seeds to bigger traders, and pays Vidya in salt rather than cash. Seeds become a barter good. In the hands of the big trader, they may be sold to millers or soap producers for

cash. The millers also sell most of the oil they extract to soap producers. The seedcake they obtain when extracting oil is sold to farmers. The seed factories are located at least 1000 kilometres away from where this story's honge tree stands, in different states of India. The millers and traders often have been in the business of buying and selling honge seeds for decades, along with a range of other agricultural products. For a number of them, honge seeds constituted a large share of their trade volume. But about ten years ago, this started declining. Farmers are not selling so many honge seeds anymore, and the traders think this is because people have lost interest in collecting the seeds, and because they have been cutting and selling the timber of their honge trees. Prices per kilo have gone up: the distant soap producers are willing to pay more for the seeds now.

Many of the honge seed traders in the district also trade with field staff from the Bio-Fuel Park. Ordered by senior scientists, they visit farmers' markets and traders to buy seeds to make biodiesel. Hassan Bio-Fuel Park has to produce biodiesel to be able to gain knowledge about the biodiesel's property, and to demonstrate that they are really able to produce biodiesel. Also, there are some customers for the biodiesel, such as the Bangalore Metropolitan Transport Corporation (BTMC). They buy biodiesel from Hassan Bio-Fuel Park to run a few of their busses. So the park staff, money and the need to demonstrate capabilities make that our seeds (as a rare trade commodity) get transformed into seeds owned by the Hassan Bio-Diesel Park. There, they get crushed to expel their oil. While this is happening, a neighbouring farmer with a lot of land visits the Park's processing facilities. It is time for him to put fertilizer on his land, and he buys the seedcake of our seeds from the facility manager, named Arun, who operates the machines. Next, the oil is poured into the transesterification machine. This machine turns the oil into biodiesel and glycerine in the presence of a catalyst, natriumhydroxide (NaOH). Arun explains that glycerine is used in a wide range of industries, such as cosmetics. Here, the story arrived at the seedling's final junction because we follow the oil that got turned into biodiesel as it gets transported to Bangalore and mixed with fossil diesel. The Bangalore Metropolitan Transport Cooperation, the government body

responsible for Bangalore's public transport system, runs some of its busses on fossil diesel blended with biodiesel. So on an early morning, when one of the many busses driving through the city pulls into the BMTC petrol bunk, this biodiesel gets poured into the bus. As the driver starts the engine, the biodiesel burns. Before the bus reaches the first stop of its day-to-day trajectory, the biodiesel made from the seedling with which this story started has been burned and got turned into exhaust fumes.

Perhaps I should have taken you, the reader of this story, along on another trajectory. Following this seedling, we could have travelled down so many paths.

P.S. I went back to Kinnerahalli more than a year after Shruthi and I had joined Vidya collecting seeds from the seedling that had become a tree. At the time, Vidya could not use the oil-expelling machine in the village to obtain oil from the seeds, because the machine was broken. When I came back more than a year later, it had been repaired. Rama and Bharathi enthusiastically told me and the local translator who joined me instead of Shruthi who was unable to come with me from Bangalore this time. But they were not particularly enthusiastic about the repaired machine. A video crew had come to document the village's remarkable achievements in the field of biodiesel. The crew interviewed every farmer about their interest in this practice. New seedlings had been distributed and this had been recorded by the cameras, along with some of the older trees still present in the area. This story's seedling was now a tree of eight years old, an unusual sight because it was neither very old nor a recently planted seedling. A few days before the crew came to the village, the main researcher from Hassan Bio-Fuel Park had sent an engineer to Kinnerahalli to repair the machine. The old school building, used as general storage space by several villagers and to keep this machine, had been colourfully painted by students from the Hassan's college of agriculture. When the crew arrived, Rama had taken out the machine and ran it.

The colourfully decorated old school building which is used as storage space by Kinnerahalli's inhabitants. It is also home to the village's oil expelling machine.

No Impact on Ecosystem Services? Biodiesel Cultivation Practices in Hassan Bio-Fuel Park, India[48]

Abstract

Small-scale biodiesel production with a high level of community involvement in the growing, processing and using of biodiesel crops has been associated with a number of benefits, such as low environmental impact and no competition with food production, reduced rural poverty and enhanced access to energy. This paper is a qualitative study of the cultivation of biodiesel crops in such a small-scale project in practice, Hassan Bio-Fuel Park in Karnataka, India. I present these findings using the ecosystem services framework and evaluate the extent to which this form of knowledge-making can be considered democratic, in particular because the ecosystem services framework has been presented as a useful tool to create policy-relevant knowledge (Gasparatos et al., 2011). The changes in both ecosystem services as well as human well-being as a consequence of this project turn out to be marginal if presented using the ecosystem services framework. This provides a very meagre basis for policy-making and does little to challenge the grand promises of small-scale biofuel production: the marginal changes in ecosystem services may simply be due to mismanagement of the project, for example. Therefore, this paper highlights the importance of understanding not just which impacts are generated but especially how those impacts are generated. I suggest the concept 'matters in the making' to indicate this shift from studying entities' static characteristics to studying the relational emergence of entities and their actions, in order to democratize knowledge-making using this framework.

[48] This chapter is based on the following paper: de Hoop, E.. Understanding marginal changes in ecosystem services: a study of Hassan Bio-Fuel Park, India. Revised and resubmitted to *Biomass & Bio-Energy*.

Introduction

India's biofuel policy promises that biodiesel and bio-ethanol "contribut[e] to energy security, climate change mitigation, apart from creating new employment opportunities and leading to environmentally sustainable development" (Government of India, 2009). The extent to which those promises can be kept in the case of biodiesel production strongly depends on the organizational model that is deployed. Firstly, there are large scale block plantations of which the produce is sold on national or international markets. This model has been associated with low environmental sustainability, employment opportunities for a limited number of people and even land-grabbing, while another model, the outgrower system, has been documented to impoverish farmers who grow biodiesel crops except those that have good access to resources like water, pesticides and fertilizers (Kesari and Rangan, 2010; Lahiri, 2009; Ariza-Montobbio and Lélé, 2010; van Eijck et al., 2014). A third model is the small-scale model with high community involvement in growing, processing and using the oil. In such projects, biodiesel crops may be grown as hedges around the main cropland or other locations that are designated as suitable by the community (van Eijck et al., 2014; Gasparatos et al, 2011; FAO, 2009; Energia, 2009). The documentation on such projects, particularly by the FAO and Energia, has been positive so far, creating the impression that those projects successfully contribute towards rural development, in particular for women, and improve local energy access. There are some exceptions to this literature on small-scale projects, such as the work by Arora et al. (2014) which highlights problems in gaining farmers' trust as well as the lack of buyers for their biodiesel as the main causes for the severe financial problems of a biodiesel company in Tanzania with high community involvement. Baka and Bailis (2014) calculated that *Prosopis juliflora*, which is widespread in South India on lands not used for the cultivation of crops, provides more useful energy than *Jatropha curcas* can provide. Ariza-Montobbio and Lélé (2010) have shown that the cultivation of biodiesel crops on farmers' lands is likely to exacerbate inequality among farmers.

However, little in-depth research has been done on projects referred to in the FAO and Energia documentation or on resembling projects, and therefore it is unclear whether these projects really make the contributions as claimed.[49] In India, most projects that started during the 2000s or even earlier had been closed down by the beginning of the 2010s because of a lack of feedstock production (Ghose, 2012; Ramakrishna, 2012; Kant and Wu, 2011). Hassan Bio-Fuel Park in Karnataka, south India, which promotes the small-scale production and use of biodiesel in Hassan district, is an exception. This paper studies practices taking place in the fields of farmers who participate in the Hassan Bio-Fuel Park project, and attempts to understand and present those findings using the framework of Ecosystem Services as outlined by Gasparatos et al. (2011, 2012), a framework which has been used to evaluate the impacts of human activities on both ecological and human well-being.

By doing so, this paper aims to make three contributions to the existing multi-disciplinary biodiesel literature. First of all, most biodiesel literature that explores biodiesel's potential benefits and costs is based on modelling and data from carefully maintained test plots, while this study is based on farmers' day-to-day practices (Kesari and Rangan, 2010; Wang and Shi, 2015; Achten et al., 2010; Gopinathan and Sudhakaran, 2009). Secondly, the exploratory nature of this qualitative study highlights various forms of competition that arise through the production of biodiesel that have not been discussed so far, including competition with soap industries for oilseeds and competition with other crops for not only land but particularly

[49] An exception is work by Fatimah, Raven and Arora (2015), who analyzed why small-scale biodiesel pilot projects were stalled in Indonesia. Additionally, some quantitative analyses on the socioeconomic benefits that can be derived from decentralized biodiesel production projects were carried out in Tanzania (van Eijck, 2014). While van Eijck used empirically observed data whenever it was available, she also had to make a lot of assumptions and relied on secondary data for a lot of her work. Importantly, Nygaard's (2010) review of the multifunctional platform in West Africa shows that local fuel production actually hampered rather than facilitated local energy access.

water, nutrients and sunlight. Thirdly, the Ecosystem Services framework enables the discussion of Hassan Bio-Fuel Park's wide variety of outcomes as well as comparability to the work of others. At the same time, this paper will also evaluate to what extent doing research using the Ecosystem Services framework can be considered democratic, following the criteria on democracy proposed in chapter three. In particular, not all results fit the framework's pre-defined categories, and how the framework irons out conflicting priorities among stakeholders. This is problematic, particularly when the intention is to use it to inform policy-making as proposed by Gasparatos et al. (2013).

Methodology

This paper draws primarily on the ethnographic fieldwork carried out between September 2013 and March 2014 and in October 2015. In addition, the conversations with policy-makers, scientists and activists, as well as the author's participation in a conference organized by the Karnataka State Biofuel Development Board (KSBDB) as described in chapter one were used to understand the wider embedding of this project in both science and policy-making in the area.

Analysis was done manually and consisted of three rounds. During the first round, research materials on specific ecosystem services and aspects of human well-being were identified and categorized following the categories proposed by Gasparatos et al. (2011, 2012). In addition, data on impacts created by Hassan Bio-Fuel Park which could not be categorized in the proposed categories were collected in a separate document. This provided the basis for mapping the project's impacts. The second round of analysis consisted of an iterative process during which factors that contributed towards the creation of each of the impacts were identified in the research data. The third round of analysis consisted of physically drawing the connections between all factors identified, and the impacts they created in different compositions.

Theory

Chapter two and three discussed that both humans and non-humans raise their voices through associations with others, that these voices are multiple because they vary along with changes in their associations, and that those voices should be raised in order to do knowledge-making democratically. This paper examines the Ecosystem Services (ES) approach as an attempt to raise the multiple voices of both humans and non-humans. I evaluate the extent to which this approach can be considered democratic and suggest how the framework could become more democratic using empirical insights generated by understanding entities' voices as relational, material and multiple.

The ES approach has been used to evaluate a wide range of human activities with regard to the changes they bring about in socio-ecological systems (Jakubowski et al., 2010). It is an interesting approach to knowledge-making for two reasons. Firstly, unlike other approaches, the ecosystem services framework aims to make research findings synthesizable with other research on biofuels – or other human activities, if that is the topic being studies – carried out in different locations and using different methodologies. Secondly, it aims to generate a cohesive body of knowledge linking environmental changes to human well-being for policy-makers. Particularly unique about the framework is that these policy-makers have so far widely accepted this approach (Gasparatos et al., 2011; Gasparatos et al., 2012; Stromberg et al., 2010).

The framework starts with the understanding of 'ecosystem services' as being the benefits that humans derive from ecosystems, both directly and indirectly (TEEB, 2010). The Millennium Ecosystem Assessment (MA), which was initiated by the World Resources Institute, UNEP, the World Bank and UNDP, categorized those ecosystem services into four themes: provisioning services, regulating services, cultural services and supporting services (MA, 2005). According to Gasparatos et al. (2011; 2012) and Stromberg et al. (2010), the main ecosystem services affected by biofuels are fuel, food, fibre and freshwater (provisioning services), air quality, climate

regulation and erosion regulation (regulating services), biodiversity (supporting service) and cultural services. All of these ecosystem services are supposed to have an impact on human well-being, which according to Gasparatos et al. (2012) consists of five elements in the case of biofuels, namely rural development, energy security, food security, health, and land tenure.

Impacts on ecosystem services and human well-being are generated through direct and indirect drivers of change. In the case of biofuels, Gasparatos et al. (2011) identify issues such as energy security and climate mitigation as indirect drivers of change, while direct drivers of change include land use change, introduction of foreign species and intensifying agricultural activity as a result of biofuel development. Figure 1 displays this graphically.

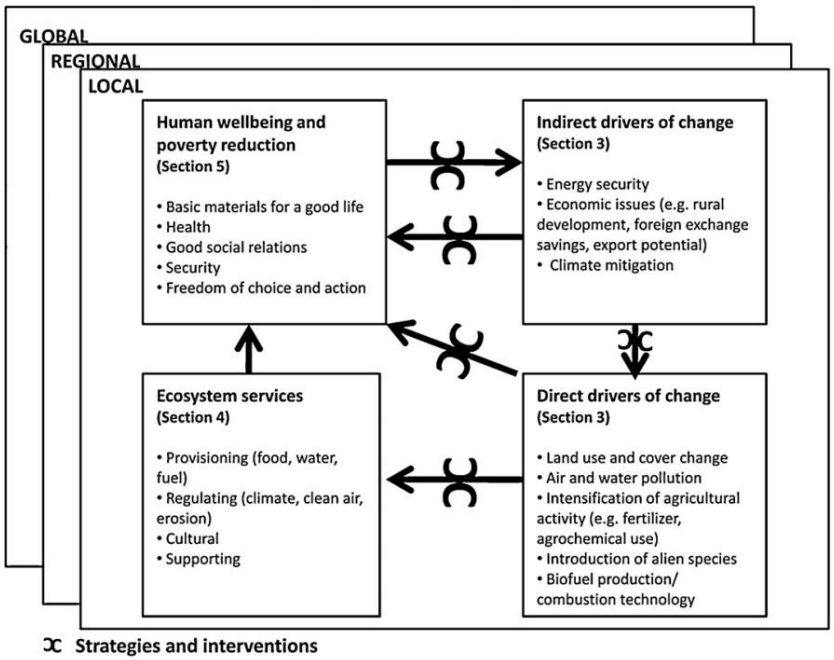

Figure 1 The MA conceptual framework adapted for biofuel production and use by Gasparatos et al. (2011). Note that the 'human well-being and poverty reduction' categories in this figure differ from the categories outlined above. Gasparatos et al. (2011) argue that the MA categories of human well-being are not well suited for the study of biofuels because existing literature barely reports on issues such as social relations, security and freedom of choice/action in relation to biofuels.

Observations

Hassan Bio-Fuel Park

Hassan Bio-Fuel Park covers most of Hassan district with its extension work and has been running since 2006. Extension workers visit villages to inform farmers about biodiesel and the trees one can grow to obtain oilseeds that are suitable for the production of biodiesel. They also bring farmers to the head office to attend special events organized for them to learn more about biodiesel. For such events, transportation and food is arranged by the Park staff. At the head office, farmers watch an informative movie about biodiesel, interact with scientists, and visit a tree nursery and biodiesel production facilities. Seedlings of a range of species, mostly *Pongamia pinnata*, *Simarouba glauca*, *Azadirachta indica*, *Madhuca lungifolia* and *Jatropha curcas*, are offered to interested farmers free of cost, and farmers are advised to plant those seedlings around their main cropland or near their homes. They are not supposed to use a lot of water, just a little bit during the first two years. When seedlings are handed out, extension workers also form biofuel committees in the village. Such a committee consists of 10 members and is supposed to communicate all biofuel-related needs to the Park's field staff. Moreover, they are expected to gather the collected seeds during harvest season (for the main feedstock, which is pongamia, this is March-April) and contact the field staff to arrange for pick-up and payment, although farmers are free to sell their seeds to other traders, who offer the same rate per kilo of seeds. This collection work is supposed to be done when farmers have no other urgent works. As such, it should augment their income without posing any severe risks because the main cropland is left untouched by biodiesel trees. The two villages in which farmers have been participating most keenly, according to the researchers working at Hassan Bio-Fuel Park, have also been supplied with a small electrical expelling machine, which they have had in their possession since 2013. Using this machine, the village is supposed to extract oil from the seeds locally, so they can use the oil directly to blend with diesel for tractors or as lamp oil for

religious ceremonies. They also have direct access to the seedcake, which farmers can use as a fertilizer.

Based on this narrative, which I learnt about from Hassan Bio-Fuel Park's brochures as well as from conversations with Park's research staff and field staff, one can expect positive changes in local ecosystem services by following this method of growing feedstock to produce biodiesel. Fuel provisioning would increase, while food, fibre and water would not or barely be affected. The planted oilseed varieties would capture carbon which means climate regulation would improve. Biodiversity would increase thanks to the variety of trees planted around farmers' lands and the nitrogen fixing ability of pongamia trees would enhance supporting ecosystem services. With regard to human well-being and poverty reduction, the project could also increase access to basic materials for a good life, particularly income, and freedom of choice and action are part of the project's setup. However, the observations made through ethnographic fieldwork show a completely different situation in which biodiesel from Hassan Bio-Fuel Park turns out to be largely produced from seeds that got diverted from their usual trade flow towards soap factories.

Cultivating biodiesel feedstock in practice

This section follows the process of biodiesel production from the moment an extension worker from Hassan Bio-Fuel Park enters a village until seeds reach Hassan Bio-Fuel Park's biodiesel production facilities. Tracing this process will allow for the mapping of changes in ecosystem services, including trade-offs with existing practices, and human well-being following the ecosystem services framework. The material presented here partly overlaps with the observations made in the previous chapter, in which I followed the life-journey of a pongamia seedling. However, it is not entirely the same because the use of the ecosystem services framework requires paying attention to issues that were not raised in the last chapter. In the last chapter, my primary focus was the tree, its journey through life and its transformations during that journey. The ecosystem services framework, on

the other hand, is focussed on impacts on ecosystem services and human well-being.

When extension workers from Hassan Bio-Fuel Park came to visit for the first time, farmers in the villages where I did research were enthusiastic, except in one village. Some farmers particularly appreciated that there was a new outlet for the pongamia seeds collected from trees already present in the area and which they sold to traders at rather low prices. The pongamia tree has cultural significance, being described as the tree under which the breeze is most refreshing during summer days. As such, the project's close relationship to this tree also appealed to many farmers, while others were proud of their increased knowledge on a number of new tree species and the interesting concept of turning vegetable oils into diesel. These village-level extension meetings and meetings at the Hassan Bio-Fuel Park barely increased farmers' agronomical knowledge of the pongamia tree as well as jatropha bushes, because they were very familiar with it. In the village that was not so enthusiastic, farmers had negative experiences with a company that supplied jatropha bushes and promised to return to buy the seeds but which never showed up afterwards. This contrasts with cases in the literature, in which the failure of some jatropha projects was partly attributed to a lack of knowledge for cultivating jatropha (Agoramoorthy et al., 2009).

However, the various kinds of seedlings supplied by the extension workers were generally well-received and many farmers would plant between 5 and 15 of them around their lands. Other trees that were already present around farmers' lands were timber species like teak and silver oak or fruit trees like mango and jack fruit. Many farmers already had mature pongamia trees and were familiar with neem. While they had heard about and sometimes seen the other species they were given, growing them was new to most farmers. This raised their curiosity, and many farmers told me that they planted those new kinds of trees simply for the sake of experimenting and being able to witness how the tree would develop.

While planting new seedlings was done quite eagerly, giving those seedlings the amount of care that they require during the first two dry seasons was more problematic. Parts of Hassan district are very dry, and erratic rainfall has worsened this condition. Farmers rarely planted the seedlings around irrigated land, where they used the edges of the land for rows of profitable trees like coconut. Carrying water from scarce water sources to the seedlings planted around dryland was something most farmers were unwilling to do. They often asked "how can we water our plants, if we do not even have drinking water for ourselves?" They also added that they would have made more effort if the trees had large long-term cash benefits (in the case of timber) or very clear direct use- and cash value (such as in the case of fruit). In fact, if they had been given fruit or timber seedlings, they would have planted those rather than the biodiesel seedlings supplied by Hassan Bio-Fuel Park because they were more useful to spread their farms' sources of income and food. Other seedlings that did survive the most precarious first two seasons still did not always make it to adulthood. For example, in one village the seedlings planted along the roadside – which were therefore easy to maintain thanks to easy access – got cut when the road was widened. In another village, seedlings planted along an irrigation canal were accidentally crushed by a machine used to clean the canal. All in all, the most common answer farmers gave when asked whether they could show any of the biodiesel seedlings they planted was "no". The provisioning of ecosystem services, so far, remained largely unchanged: very few inputs are used to grow these seedlings, except land. Yet because no inputs are used, and because other seedlings are in places that have many other uses, most seedlings die. Hence there is no long-term change of land-use either. On the other hand, if the seedlings would be given what they need to grow, ecosystem services would be affected, particularly provisioning services like food, water, timber and fuel.

Given this situation, Hassan Bio-Fuel Park produces biodiesel from seeds collected from existing trees. Mostly, these are pongamia seeds because this tree is most prominent in the area and its seeds are less costly than seeds from the less common neem tree, of which the oil is also suitable for

conversion into biodiesel but which has a range of other high-end uses such as medicines. Yet the number of pongamia trees in the area had declined strongly over the past decade according to both farmers and seed traders. Where many farmers had a number of those trees in the past, most had been cut. Those who still had many trees were contemplating replacing them with silver oak, mango or any other timber- or fruit species they could get their hands on. Brick-makers regularly visited villages to buy the stems and trunks of people's pongamia trees. As per the custom, pongamia trees were owned by the person who owned the land on which it grew, but its seeds were freely available for anyone to collect. The benefits of cutting the tree thus accrued entirely to the tree's owner, whereas the fact that seeds can no longer be collected from it may be felt by those who were perhaps not the tree's owner but who used to collect those seeds. Furthermore, farmers complained that the trees had large canopies and root structures, creating shade and obstructions for their main crop to grow. According to farmers' accounts, this characteristic of the tree was acceptable to their parents and grandparents, during whose lives the tree had been valued for its leaves, which were mixed with the soil for extra fertility. This had declined with the increased promotion, availability and use of synthetic fertilizers. Apart from enjoying the shade of the pongamia tree, which according to popular culture has the coolest and most soothing breeze of all trees, its seeds are now the only benefit to farmers. Collecting those seeds is a labour-intensive task that many farmers are unwilling to engage with.

For men, collecting pongamia seeds takes relatively little time. They may climb the tree and, using a stick, force all seeds to fall down and collect all of its seeds at once. Women, on the other hand, only collect whatever they find lying on the ground under a tree at a particular point in time or what they can reach from the branches. Once the tree is fully matured, the branches are too high to reach from the ground. Therefore, women can only collect a few seeds under each tree rather than collect a large amount from a single tree at once. The surface under a tree is often uneven and may in many cases be overgrown with thorny bushes, increasing the difficulty and time required to collect the seeds. After collecting the seeds, they need

to be dried and decorticated. Since each seed weighs only a few grams, this is a lot of work. Every seed has to be hit with a stick or stone, after which the coat cracks open. Then, the seed and coats have to be separated. The work cannot always be done indoors, for the physical impact is likely to damage the floor. This means that people must do this during daytime, when there is light outside. All in all, farmers testified that a day of work as daily wage labourer was a few times more remunerative than collecting and selling pongamia seeds.

Because of the labour intensive nature of collecting these seeds, the quantities that people sell are not very large. Village's biodiesel committees had a hard time getting a quantity of seeds together that makes it interesting for Hassan Bio-Fuel Park field staff to come out to buy the seeds directly. In fact, selling a few kilos of seeds at a time at weekly farmers' markets was more attractive to most people because it provided them with a little bit of cash to pay for basic items such as soap. Therefore, the biodiesel committees that were installed in every village were mostly dormant. In many villages, most or all of its members were unaware of their status as biodiesel committee member. Yet active members of such biodiesel committees in the more successful villages did gain from their participation. A few of them were sometimes asked to attend meetings at the district capital or even in Bangalore, the state capital, to represent the interests of farmers. This allowed them to meet important officials and broaden their networks, which helps to access all kinds of rural government schemes.

Hassan Bio-Fuel Park, which sold biodiesel to the Bangalore Metropolitan Transport Corporation, required sizeable quantities of seeds, which they purchased from bulk traders who also sold seeds to soap makers and other kinds of industries throughout India. Those traders reported severely declining trade volumes since the onset of cutting trees about a decade ago, and considered the purchase of seeds by Hassan Bio-Fuel Park as a diversion from the existing trade channels. Considering the observation that most newly-planted seedlings do not reach maturity and hence the failure of Hassan Bio-Fuel Park to truly enhance the number of biodiesel trees in the

area, one can conclude that Hassan Bio-Fuel Park largely diverted seeds that would otherwise have been used for other purposes such as soap production. Yet, the project did distribute large numbers of seedlings and is able to produce biodiesel from seeds purchased at existing seed markets, and hence has something to show at conferences such as the National Conference on Accelerating Biofuel Programmes in India that took place on the 22nd of February 2014 in Bangalore. Politicians and other stakeholders continue to be attracted by the projects' promises of producing biodiesel that addresses issues of climate change, rural poverty without affecting food production, and hence the activities at Hassan Bio-Fuel Park continue.

(No?) impact on ecosystem services?

In its current state, Hassan Bio-Fuel Park has very little or no impact on any ecosystem service. Except for the brief cycle of planting and dying of young seedlings, farmers' fields including their edges remain to be quite the same. The young seedlings only receive water when planted on the edges of land that is already being irrigated, so water availability does not change. While farmers also use the edges of their land for food and timber tree species, attempting to grow biodiesel species in its place does not affect the food and timber provisioning ability of that land because most seedlings do not survive. Fuel provisioning, be it in the form of biodiesel, non-edible vegetable oil or fuelwood, also remains unchanged. If the seeds converted into biodiesel by Hassan Bio-Fuel Park had been used to produce soap or other oil-based products, the climate regulating effects of the project are likely to be negative, while clean air and erosion regulating services remain unaffected. The tree's cultural significance as giving the most refreshing breeze helps the project, but there are no changes in the provisioning of cultural services, while biodiversity (supporting ecosystem service) may increase a little bit if a few of the seedlings – which are largely of native species – provided by Hassan Bio-Fuel Park survive.

With such marginal changes in ecosystem services, there are also very few changes in human well-being. This case study shows no changes in energy security and access to energy, food security and access to food, health, and

land tenure among the farmers I interacted with. With respect to rural development, the project's extension work increases farmers' knowledge on the use of pongamia seeds and the alternative tree varieties they could grow on the edges of their lands. Most farmers feel proud of obtaining such knowledge. Although the collection of pongamia seeds is largely women's work, gender roles do not really change because the project has been unsuccessful in popularizing the collection of seeds: doing such work is already a considerable burden with little remuneration, and increasing that practice would only worsen their situation.

These constituents of human well-being overlook the direct political, social and economic benefit of being in contact with Hassan Bio-Fuel Park's extension workers and researchers. Those who assist extension workers in organizing village level meetings, who communicate with the extension workers to ask for seedlings or sell seeds in the rare event that collected quantities were large, or who came to represent the farmers' perspective on this project in Bangalore all have or hope to have something to gain from the project, even if that has nothing to do with biodiesel. One may dismiss such practices as rent-seeking behaviour or otherwise being out of tune with the spirit of the project. However, from the perspective of a (politically already influential) farmer, such behaviour is very understandable. In fact, the field staff and researchers working for Hassan Bio-Fuel Park are aware of this and accept it as a necessary part of their attempts to raise biodiesel production. Another important impact which is overlooked by the ES framework is the ecosystem's decreasing ability to provision a raw material for soap production because pongamia oil that would previously have been sold to soap factories was now bought and used by Hassan Bio-Fuel Park to produce biodiesel.

Understanding the lack of impact on ecosystem services

Hassan Bio-Fuel Park's extension work and its distribution of seedlings create very little change in seed collection. Therefore, changes in ecosystem services are also small. Taking this one step further, the lack of changes in ecosystem services of this project – a project that has been documented as

having the potential to be beneficial for rural poor and women in particular (Chandrashekar et al., 2015; Narayanaswamy et al., 2009) – raises questions regarding the extent to which other small scale projects that have also been documented as success-stories actually live up to their promises (FAO, 2009; Energia, 2009).

However, more valuable and insightful for the purpose of informing policy-making would be understanding how (the lack of) changes in the provisioning of ecosystem services came about. The materials generated through qualitative research methods to observe day-to-day farmers' practices provide a rich basis to do so. Specifically, issues such as scarcity of water, the attractiveness of other trees that can also be planted instead of pongamia and other biodiesel trees, the height of pongamia trees, their wide canopy and extensive root systems obstructing the growth of the main crop, thorny bushes growing under the trees, road widening projects, market prices for pongamia seeds, brick-makers buying pongamia trees and many more all participate *together* in the creation of nothing but minor changes in ecosystem services. Or to use the terminology from actor-network theory as used in the first three chapters of this thesis: the small changes in ecosystem services come about through these ecosystem services' socio-material entanglements with entities such as roots, canopy, market prices, roads etc.. These issues cannot be listed as independent 'obstructions to run a successful project' to be addressed one by one in order to make the project 'successful'. For example, to eradicate the issue of water scarcity, one could increase the water supply to the area. There are many ways of doing so, including increasing the number of bore wells, digging irrigation channels that connect to rivers further away, or bringing water in trucks during dry spells. All of these solutions may create a range of new problems, such as the environmental impact of using water from a bore well in an area where ground water levels are decreasing and the diversion of water from rivers that are already used intensively for irrigation purposes. Therefore, strategies used to address obstructions to increase biodiesel production should always be evaluated using the same criteria that are used for the production of biodiesel itself. Moreover, some of the other issues on the 'list of

obstructions to success' may get aggravated by doing so: unless the increased supply of water is very large, competition for water with farmers' main crops and with the other kinds trees that can be planted instead of pongamia is likely to increase.

Conclusion and discussion

The ecosystem services framework has been shown to be a powerful and valuable tool to inform policy-making (Gasparatos et al., 2013). Projects similar to Hassan Bio-Fuel Park have been heralded as promising examples of improving ecosystem services and human well-being (FAO, 2009; Energia 2009). The ecosystem services framework has been helpful in evaluating the project on a wide range of criteria, something which has rarely been done in the biofuels literature so far (Gasparatos et al., 2013). Interestingly, from the perspective of this framework, Hassan Bio-Fuel Park would seem to be of little interest to policy makers: there are very few changes (both positive and negative) in the provisioning of ecosystem services and human well-being to be seen except a diversion of seed flows from soap making to biodiesel as observed by seed traders.

Yet, given the fact that this project already informs Karnataka's and India's policy on biodiesel and given the aim and ability of the ecosystem services research approach to produce policy-relevant knowledge, this case study also shows the importance of exploring the practices that create both a success story and very small changes in ecosystem services. Because pongamia seeds can be bought from traders that have been trading these seeds for decades, Hassan Bio-Fuel Park is able to make claims about its production of biodiesel without harming people or environment. While key policy-makers in Karnataka are aware of the fact that there is barely any added feedstock production despite the efforts of Hassan Bio-Fuel Park, the project's seductive promises continue to fuel belief in the project's potential success and there are no immediate negative effects that can be easily observed and which would call for a direct discontinuation of the project. As such, policy makers use it as an important showcase example to justify

their policy. Yet the many factors that participate in the failure to enhance feedstock are silenced when a project is studied and represented through the ecosystem services framework. Following the democracy criteria as outlined in chapter three, and particularly the first and second criteria, this is undemocratic.[50] To be able to engage with this situation, an understanding of why the project fails to augment feedstock production along with a listing of the project's outcomes based on the ecosystem services framework would be particularly valuable to policy-making.

The failure to enhance feedstock production is created by the concerted efforts of a range of factors. This suggests that the ecosystem services framework could benefit from a move from a linear cause-and-effect model to one based on co-creation (cf. Latour, 2004b). Various kinds of competition, the seeds' and trees' material characteristics, markets (e.g. for labour, synthetic fertilizers, pongamia stems etc.) and farmers' practices and preferences all act together to produce the (lack of) effects. There is competition among different kinds of trees and crops for land, shade, root space and water. Existing uses of the seeds, like soap production and lamp oil make that there is a market which the Hassan Bio-Fuel Park project can tap into. Pongamia leaves are not so popular anymore because farmers prefer the now widely available synthetic fertilizers. Seed collection is an arduous and time-consuming task because of the trees' height, the low weight of each seed and the thorny plants from among which the seeds have to be picked up. With increasingly remunerative opportunities for labour in the area, collecting pongamia seeds is not very popular. As such, the current surge in the cutting of existing pongamia trees is not simply caused by rising prices for the tree's stem offered by brick makers. Rather,

[50] A well-articulated proposition is one that: 1) invites and allows all interested entities, particularly those which were hitherto mute, to raise their voices; 2) registers the voices of the newly included entities by allowing them to challenge and recompose the proposition at hand; 3) registers the multiplicity of each entity's voice and actions, rather than turning them into a repetitive singularity; 4) avoids easy transferability between different socio-ecological situations.

farmers' interests in the tree have reduced because they no longer use the tree's leaves and are less interested in collecting its seeds due to alternative, more remunerative employment opportunities. Considering these changing circumstances, the fact that the tree competes with other crops for things like sunlight and space now becomes a reason for farmers to cut the tree. Hence brick makers coming to a village looking to purchase the stems find farmers interested to cut and sell the tree. All these factors together make that it is impossible to identify one or a few isolated causes of the cutting of pongamia trees. The same holds for other observations made in this paper, such as the lack of seedling survival. The factors that create particular impacts interact with each other and produce the impact jointly. These factors and their interactions are likely to figure in other projects as well. Therefore, it is important to take note of them to inform policy-making fruitfully. Hence, the ecosystem services framework as a tool to synthesize knowledge for the purpose of informing policy making could benefit from a combination of mapping effects or impacts with the mapping of how effects or impacts come about. Not only the changing ecosystem services and changing constituents of human well-being deserve to be given a voice in the policy-making process by listing them in the framework, but also all those entities that brought about those changes following the democracy criteria developed in this thesis (following for example Turnhout et al., 2014). Indeed, as suggested in this paper, giving the entities that participate in the co-construction of the effects documented in this paper a voice also enables researchers and policy makers to think about the possible ecosystem services and human well-being effects of a project like Hassan Bio-Fuel Park if it does manage to enhance feedstock production. Also, documenting this process of co-construction limits the transferability of research findings between different socio-ecological situations, following the fourth democracy criterion. The research findings presented here through the ecosystem services framework do not explicate the specific socio-material setting in which these findings were generated, making them easily transferrable.

To contribute towards the democratization of the ecosystem services framework, I propose the concept of matters in the making (cf. Latour's (2004a) matter of fact and matter of concern).While Latour's (2004a) matter of fact are stable forms of knowledge about entities' static characteristics, matters of concern are disputed and understand knowledge-making as a process. Matters in the making are both disputed and focus on knowledge about entities in the making. The ecosystem services approach and its framework turns knowledge into static entities that (are made to) fit into the framework's typology. Studying matters in the making means being attentive towards the way in which both human and non-human entities come into being, towards relational affordances that enable this process of creation.

In addition, not all of Hassan Bio-Fuel Park's effects could easily be presented through the ecosystem services framework, which is undemocratic following the first and second criterion. The framework predefines categories of relevant ecosystem services and constituents of human well-being. Therefore, only those observations which fall in one of those categories get registered as relevant. Despite the fact that the framework is open to methodological pluralism, this creates a form of unification: research findings have to be made to fit pre-existing categories, hence turning them into repetitive singularities (criterion three) while some findings cannot be documented at all. In the case of this project, there are clear indications that the biodiesel produced in Hassan Bio-Fuel Park is based on seeds that previously would have been sold to soap factories rather than seeds that are grown and collected as a result of Hassan Bio-Fuel Park's efforts to popularize these activities among farmers. Yet, the provisioning ecosystem services do not contain a category for soap production. Furthermore, it is unclear where to categorize the benefits gained by those who were invited to meetings with important officials at the Hassan Bio-Fuel Park research station or the University of Agricultural Sciences in Bangalore. In addition, these benefits are only gained by a small group of farmers: presenting the effects of Hassan Bio-Fuel Park through the ecosystem services framework aggregates the research results, making it difficult to differentiate between different groups who may benefit

differently from the project's activities. And while the social recognition in the village gained by farmers who coordinated communication with the Bio-Fuel Park's field staff may partly fit under 'good social relations', it is unclear what 'good' constitutes, or who is expected to define 'good'. For those who gain social recognition, this may be 'good', while others in the village may feel differently.

Indeed, the pre-existing categories may not be very clearly defined. That could be considered a good thing: if the exact contours are blurry, it could be adapted to fit the observations of any piece of research. One could even argue for the inclusion of space for the 'unexpected' (cf. Stengers, 1997). However, that hampers the comparability of research findings, one of the reasons why the ecosystem services approach was used to begin with (Gasparatos et al., 2011; Gasparatos et al., 2012). An example is that of rural development, one of the constituents of human well-being. For the Hassan Bio-Fuel Park researchers, rural development meant, among others, being able to gain an income from collecting pongamia seeds. However, for most farmers, rural development actually meant moving away from that practice, engaging with more remunerative kinds of agricultural activity. The meaning of a concept such as rural development is thus constituted by the socio-material setting in which it is deployed, and cannot be pre-defined in a top down manner.

I would therefore like to end with a word of caution which resonates with and builds on the concluding remarks of the debate on the desirability of unified appraisal frameworks such as the ecosystem services framework between Gasparatos and Stromberg on one side and Lehtonen on the other side (Gasparatos et al., 2012). They jointly conclude that "unified synthesis frameworks can be appropriate in "structured" policy situations, when facts are relatively certain and policy priorities consensual" (Gasparatos et al., 2012, 79). At this point in time, the priorities among biodiesel stakeholders are highly diverse in India and Karnataka. For example, while India's biodiesel policy sets blending targets – which require enhanced feedstock production – as its main priority, Hassan Bio-Fuel Park's achievements are

heralded in meetings that celebrate the project's ability to present biodiesel production as a technology that can contribute to the eradication of rural poverty without affecting food production. Such different (policy) priorities produce different facts. For example, if one's priority is to enhance 'rural development', constituting increased income among farmers, then the project makes little or no contribution. If 'rural development' constitutes widening farmers' knowledge base, then the project teaches farmers about the use of oilseeds for biodiesel production and allows farmers to experiment with varieties of trees they are less familiar with. Within this setting, it is unlikely that the creation and dissemination of knowledge, however well-organized, will be able to inform policy-making in a linear fashion, as has repeatedly been demonstrated by policy studies (Jordan and Russel, 2014; Dunlop, 2014). Therefore, the ecosystem services approach would possibly gain political saliency if it starts with the identification of the priorities among the different kinds of actors involved, and then documents the impacts of biodiesel production as matters in the making based on the identified priorities. This would create more openness regarding the values at stake when policy decisions are being made, the way those values inform different understandings of biodiesel production's impacts, and contribute to more democratic knowledge-making (cf. Stirling, 2008).

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Chapter 6 |

Limits to Responsible Innovation[51]

Abstract

Hassan Bio-Fuel Park's work can be considered as an innovation process which demonstrates supports for the values of Responsible Innovation (RI). RI is a young field of research that has nevertheless had remarkable successes in dissemination within academic and political circles. However, because the field is so young and popular, there is relatively little awareness of its limits, blind spots and situations in which it cannot be successfully applied to actual innovation trajectories. Without such awareness, there is a risk that RI may get hollowed out and turned into a tool for 'greenwashing'. This paper examines Hassan Bio-Fuel Park's innovation process, questions the extent to which it can be considered democratic, and evaluates how RI processes can be made more democratic. This case study demonstrates that there are important barriers which may make it difficult to conduct innovation according to RI values and the democracy criteria proposed in chapter three. In particular, we highlight the following factors that emerge from our case study and need more attention in order to be included and adequately theorized in the RI literature: relational agency of both human and non-human entities, engagement with abandoning or reducing existing practices as a consequence of innovation, power differences, and different, diverging and even contradictory interests. We demonstrate that such factors may obstruct the possibility for responsible innovation, leading us to our core observation, namely that RI should be about innovating responsibly – or not innovating at all. Therefore, this chapter argues that the RI literature should pay more attention to the way in which decisions on how to continue or discontinue an innovation process can be taken democratically and responsibly.

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[51] This chapter is based on the following paper: de Hoop, E., Pols, A.J.K., Romijn, H.A.(2016). Limits to Responsible Innovation. *Journal of Responsible Innovation*, online first, 1-25. Because this paper is a co-authored piece, this chapter is written using the pronoun 'we' rather than 'I'.

Introduction

Research and innovation are vital for progress, increasing human welfare and solving societal challenges. At least, that is the common claim within the neoliberalist modernisation paradigm adopted by many Western countries (e.g., Grossman and Krueger, 1995). 'Innovation' in this paradigm is mostly conceptualised as technical, economically profitable and inherently good (Blok and Lemmens, 2015). Yet research and innovation do not automatically lead to a societally desirable and ethically acceptable combination of profits, societal welfare and environmental sustainability: the 'division of labour' model in which universities do research, businesses innovate and citizens and consumers automatically benefit has been criticised on a number of grounds.

Van den Hoven (2014) gives the Dutch examples of the smart electricity meter and the electronic patient record system, two cases in which top-down, large-scale technical innovations were initially rejected by the public. Both projects have since been restarted, but their initial failures represent a substantial investment of effort and money, and they are hardly exceptions to the rule. Clashes between scientists/innovators and public stakeholders regarding biotechnology, nanotechnology and new energy technologies such as biofuels and shale gas have raised the demand for legitimisation of research and innovation. More generally, Funtowicz and Ravetz (1993) have argued that many current challenges to society are characterised by high complexity, much uncertainty and strong value disagreements. They claim that expert-driven disciplinary science is poorly equipped to deal with these kinds of challenges and rather advocate systemic, interdisciplinary research, abandonment of the fact-value distinction and participation of public stakeholders. In short, it has been argued that tackling current societal challenges requires new ways of doing research and innovation. This has led to the development of various approaches such as participatory design, (Constructive) Technology Assessment and Value-Sensitive Design; a recent addition is Responsible (Research and) Innovation (RI).

Responsible Innovation is a relatively young field of research that has nevertheless had remarkable successes in dissemination. It has its own journal, conferences and book volumes. Responsible innovation as a praxis is promoted by policy-makers. In the EU, it is a cross-cutting issue under the Horizon 2020 research program, and part of the mission of the Directorate-General for research and innovation of the European Commission 'to bridge the gap between the scientific community and society at large.'[52] In the UK, it is adopted by the Engineering and Physical Sciences Research Council (EPSRC) as a framework of high-level principles with which its activities and funded research should be aligned.[53] In the Netherlands, it is a separate funding scheme of the Netherlands Organisation for Scientific Research (NWO) that has been created as part of the government's policy to stimulate the Dutch 'top sectors.'

RI is hardly a consolidated approach, but one definition that is often quoted is that by Von Schomberg (2011, 9), who defines Responsible Research and Innovation as 'a transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view to the (ethical) acceptability, sustainability and societal desirability of the innovation process and its marketable products (in order to allow a proper embedding of scientific and technological advances in our society).' Various characteristics can be assigned to this process: Stilgoe et al. (2013), for example, argue that it requires at least *anticipation*, *reflexivity, inclusiveness* and *responsiveness* on the part of the researchers and innovators. Anticipation is needed to foresee potential risks, dangers, and public worries. Reflexivity is needed to remain aware of one's own assumptions, values, role in and responsibility for society as a researcher or innovator. Inclusiveness is necessary for legitimation, public acceptance and bringing in a diversity of insights and values. Responsiveness is needed to ensure that all

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[52] Opening statement of the 'about' section on the EC's 'Science with and for Society' programme, http://ec.europa.eu/research/swafs/index.cfm?pg=about. Accessed 6 March 2015.

[53] http://www.epsrc.ac.uk/research/framework/

of this properly affects the research or innovation trajectory rather than being just another form of window-dressing. These characteristics, particularly inclusiveness and responsiveness, resonate directly with the criteria of democracy proposed in chapter three, while anticipation and reflexivity can be considered as characteristics that help entities to raise their voices (democracy criterion one). Different actors characterise RI in very different ways: as an 'ideal', a 'concept', a 'strategy', a 'discourse' or a 'discipline or field of study' (Koops, 2015, 3). Of course RI can be all of these things (Davies, Glerup and Horst, 2014; Van Oudheusden, 2014). In this paper, we focus on RI as a process or method.

Current discussions in literature that explicitly identifies itself as concerned with RI mostly focus on its possibilities and scope for applications to specific cases: so far, there is relatively little work on RI's limitations and failures, and what we can learn from them. In this paper we take a critical look at scholarschip on RI. Given the popularity of RI and the ethical as well as societal benefits of making innovation more responsible, let us explain why we would take this critical stance. Our intention is to identify circumstances in which it may be difficult or impossible to make an innovation process take place responsibly, even when a serious attempt is made to follow RI norms. Without an awareness of its limits and blind spots, there is a risk that many uses of RI values will not be able to yield innovations that are responsible in any sense of the word. Our motivation for this investigation is pragmatic as well: we think that the worst thing that can happen to RI is not that it fails, but that it is hollowed out and turned into a tool for 'greenwashing' irresponsible innovations and unjustifiedly preserving companies' reputation.[54] This would not be a democratic RI

[54] This worry is shared by Jack Stilgoe in an interview with the Netherlands Organisation for Scientific Research (NWO) at http://www.nwo.nl/en/research-and-results/programmes/responsible+innovation/interview+jack
+stilgoe. Accessed 30 January 2015. A similar view is expressed by Federico Vasen in his opinion piece "'Responsible innovation' is already too European."

process according to the criteria put forward in chapter three of this thesis. Indeed, this paper also analyses to what extent the current process of innovation taking place in Hassan Bio-Fuel Park can be considered democratic, and how the concept matters in the making as proposed in chapter five can help to improve this process.

This paper proceeds in the following way. In the next section we outline our theoretical inspiration which we use to approach the RI framework. These include actor-network theory, older participatory approaches to innovation developed in the global North, which include several predecessors of RI, and approaches to study innovation developed in relation to innovation processes in the global South. We subsequently move from theory to practice by presenting a case study on biodiesel innovation in the Indian Hassan Bio-Fuel Park. Here we demonstrate that, even if innovators demonstrate support for RI values, innovations may nevertheless fail to proceed in a responsible way - or even at all. In the last two sections, we evaluate to what extent the innovation process taking place in Hassan Bio-Fuel Park can be considered democratic and responsible, and distil a number of limits to the application of RI processes from this case study. Our core observation is that RI is not about 'innovating responsibly': it is about 'innovating responsibly - *or not innovating at all.'* Conceptualising RI in this way makes clear that not innovating should always be a possible outcome of an RI process, which raises hitherto unasked questions regarding which factors make it likely that an irresponsible innovation process continues.

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http://www.scidev.net/global/innovation/opinion/responsible-innovation-european.html. Accessed 3 March 2015.

Family Resemblances

The RI literature is not the only body of literature in which dimensions like anticipation, reflexivity, inclusion and responsiveness play a major role (Stilgoe et al., 2013). First of all, STS work on the politics of knowledge-making as discussed in the introduction to this dissertation and the ANT-based democracy criteria presented in chapter three are very much about inclusion and responsiveness. Secondly, the RI literature overlaps with approaches like participatory design, constructive technology assessment (CTA) and value-sensitive design (VSD). Thirdly, there is a clear resemblance with strands of development studies literature that deal with innovation, in the broad sense of the word (e.g. Shove and Pantzar, 2005), in and for developing countries. The following paragraphs briefly survey these three bodies of literature and highlight some of the insights that may be of use to deepen the theory(ies) of RI.

In this chapter, ANT as developed by Latour (e.g. 2004, 2005), Callon (1986a, 1986b, 2006, 2007), Law (2009) and Mol (1999, 2000) is used as a tool to scrutinize and enrich the RI approach. ANT and RI share some important interests and ANT can be useful to deepen our understanding of RI. For example, Voeten et al. (2013) have used ANT to provide detailed understanding of why some innovators acknowledge responsibility where others do not. They argue that ANT helps to study informal institutions and the role of materiality, by which they mean the (non-intentional) behaviour of everything that is material, in network development. We are primarily interested in ANT because of its overlap with RI in terms of its focus on inclusion and responsiveness as highlighted in the first and second democracy criteria in chapter three: A well-articulated proposition is one that: 1) invites and allows all interested entities, particularly those which were hitherto mute, to raise their voices; 2) registers the voices of the newly included entities by allowing them to challenge and recompose the proposition at hand. Anticipation and reflexivity are both tools that can help entities raise their voices. In ANT, inclusion takes a different shape than in RI: ANT is particularly well-known for its symmetrical approach to humans

and non-humans. The category 'non-human' includes everything which is material but not human: animals, things, reports, etc.. Inclusion, then, becomes the inclusion of both humans and non-humans in a similar way: humans and non-humans both can and should be able to modify the situation at hand (e.g. an innovation process) through the relations those humans and non-humans have with others (Latour, 2004). The innovation process is a political process in which both humans and non-humans participate. This allows us to study the role of materiality, and how materiality enables, shapes and especially blocks innovation at times: the role of material barriers to innovation are put on equal footing with ethical/social/economic/psychological barriers to innovation that arise from the human domain.

Secondly, ANT takes an interesting approach to the RI-concept of responsiveness through the combination of its concepts of translation and performativity. The concept of translation, which refers to attempts by an actor to enrol others into its network by changing those others' identities, characteristics and/or behaviours, helps to see when and how initially divergent interests are being changed, through persuasion or perhaps coercion (Callon, 1986a). Callon (1986b) has used this concept for his case study on the failed innovation process of the electric vehicle in the 1970s in France. He highlights that the success of translation is never a given but depends on the capacity of an entity's network to define and enrol new entities. For example, the agency stimulating the development of the electric vehicle, the 'electricité de France' (EDF), failed to enrol car company Renault into its network as the maker of car bodies because EDF was unable to position itself as an 'obligatory point of passage': creating a situation in which Renault, in order to continue to exist, must join EDF's ventures. Translation is intimately related to the concept of performativity as for example proposed by Callon (2007) in his studies on economics and markets. 'The market' as defined in theory is not a state of nature, something that is simply out there. Neither is EDF's understanding of 'the most desirable path of innovation for electric vehicles' a state of nature. Rather, such theoretical representations of the world are performative. They

are brought into being through practice. The practices performed on the basis of these theoretical representations of, for example, 'the world's economic mechanisms' may (or may not, if translation fails to be successful) create those mechanisms. To understand the creation of such worlds, we need to 'trace how the webs of heterogeneous material and social practices produce them' as the proposal to study matters in the making rather than matters of fact from chapter five highlights (Law, 2009, 151). In this chapter, the concept matters in the making will be used to reflect on the RI approach.

With regard to the second set of literature, one of the key issues that has been highlighted in relation to the 'politics of design' approach is the difficulty of creating technology that meets the needs of the target group when operating within existing, consolidated power structures (Pols and Spahn, 2014). In their review of the literature on CTA, Genus and Coles (2006) highlight that there are often large differences in participants' ability to express themselves, and that power differences – or the ability to influence a technological development – can take many shapes. VSD has been criticized for a lack of regulation when one has to deal with intractable disagreements or competing values that cannot be reconciled (Manders-Huits, 2011). Yetim (2011) argues that such situations ought to be solved by active reflection on those competing values in order to choose 'the most important one' – a solution which may not always be satisfactory and falls outside the ideals of value-sensitive and participatory design according to some. As such, the issue has been highlighted repeatedly but remains unresolved, while the RI literature interestingly has barely acknowledged that this difficulty should be dealt with.

The third set of literature with which RI shares considerable conceptual groundwork consists of different kinds of work on innovation in and for the global South. Korten's (1980) seminal work on the learning process approach highlighted that technological innovations for development projects were much more likely to be successful if there was room for learning not only from successes but especially from problems throughout

the project. These observations are valuable if one wants to deepen Stilgoe et al.'s (2013) dimension of reflexivity. Bond and Hulme (1999) write that process approaches during the 1980s engaged with topics like experimentation, adaptation-based learning, participation, flexibility, building local capacities and organic expansion, many of which also figure prominently in the RI literature. However, the authors lament the subsequent narrowing of focus in this literature on participation during the 1990s, arguing that participation alone will not make technological innovation for development successful. Anthropologists warned about elite capture in community-driven projects that prevent them from benefiting the truly poor (e.g., Dasgupta and Beard, 2007). One can infer from this that RI, if it does not start paying attention to unequal power relations and situations in which irreconcilable diverging interests come up, risks becoming similarly hollow.

In this connection we should also consider the Bottom-of-the-Pyramid (BoP) literature that came up in leading American business schools during the 2000s (e.g. Prahalad and Hart, 2002) in response to a general political move away from government- and NGO-led development towards pro-poor development driven by the (western) private sector. After a few years of BoP projects that pushed low-cost, low-margin products to a mass of low-budget consumers while failing to make profits, the realisation dawned that BoP strategies should emphasize innovation as a participatory co-creation process, harnessing entrepreneurial talent within communities for the creation of local income-earning opportunities through business development (Simanis and Hart, 2008). "Inclusive" partnerships between transnational corporations, local communities and other societal stakeholders became a favoured way of working, and continuous co-learning based on participatory reflexivity and responsiveness became widely advocated – very similar to current-day RI approaches. However, these so called "BoP 2.0" approaches still have not cracked the "code to success" (Cañeque and Hart, 2015). Projects typically encounter a range of social, institutional and material barriers to innovation reminiscent of the power and interests-related obstacles encountered in the earlier-mentioned

process approaches, while beneficiaries, if any, frequently turn out to be the middle classes rather than people living below the poverty line (Sesan et al., 2013). Cañeque and Hart (2015) now propose to expand the focus towards a broader "ecosystem" view of BoP projects, but one could ask whether this strategic zooming out is not in fact a variation of the one-sided pursuit of participation in the 1990s. The difficult implementation problems encountered by both appear to be strikingly similar. An interesting example of otherwise rare work engaging with RI and the global South suggests that these same roadblocks are also an issue in RI. Based on discussions between UK-based and Brazilian scholars, Macnaghten et al. (2014) write that for RI to be useful in the global South without becoming a neo-colonial instrument, a number of changes have to be made. These include paying explicit attention to questions of the politics of complex economic inequalities and power relations, opening up the current focus on emerging and potentially disruptive advanced technologies to include technologies that are relevant for day-to-day life in Brazil, including the explicit recognition that in some cases it might be preferable not to innovate at all, and the need to consider responsibilities in a more systemic way instead of as an issue placed at the level of the individual actors. We argue that these issues are not only specifically important in the global South as Macnaghten et al (2014) seem to suggest. Just as we argue that the existing development studies literature has important contributions to make to the RI literature, we also claim that our case study from Hassan district, Karnataka, India, highlights a range of important problems that RI cannot yet address, whether in the South or in the North.

Methodology

The empirical material presented in this paper comes from ethnographic fieldwork carried out in Hassan district, and particularly the Hassan Bio-Fuel Park offices and villagers participating in the project, between September 2013 and March 2014. This fieldwork was useful to understand how both farmers and biodiesel researchers-cum-innovators engaged with the biodiesel project in the area. Furthermore, from the materials described

in chapter one, I used the conversations I had with researchers and politicians based in Hassan and in Bangalore, the capital of Karnataka state, while doing the ethnographic fieldwork and between September and December 2012, and the observations I made at stakeholder meetings organized by politicians in various places. Analysis was done manually, and consisted of three rounds. First of all, I collected all notes that touched upon the four dimensions of Responsible Innovation as highlighted by Stilgoe et al. (2013). Secondly, among these four sets of notes I identified situations that made it particularly difficult to conform to Stilgoe et al.'s (2013) dimensions. Thirdly, I separated these into groups of situations that were similar, and identified their commonalities.

Hassan's biodiesel project – in theory

One of the very few biodiesel projects in India that was still active at the time of writing, when interest in biodiesel had decreased because it became clear that "wonder-crop" jatropha struggled to give commercially attractive yields, is the Hassan Bio-Fuel Park, located in Hassan district, Karnataka state (van Eijck et al. 2013; Axelsson et al., 2012; Kant and Wu, 2011). Run by the University of Agricultural Sciences Bangalore and partly funded by the Karnataka State Biofuel Development Board (KSBDB), its promoters argue that their approach is innovative: it is supposed to avoid food versus fuel competition and support farmers without putting them at risk. Rather than focusing on jatropha alone, the researchers-cum-innovators and their field staff distribute seedlings of a range of species to farmers, free of cost. As observed when visiting villages along with Hassan Bio-Fuel Park field staff, these farmers are advised to plant them only on the edges of their land or in their backyards, after having been informed about the fact that the oil from these trees can be used to run diesel engines. The field staff tell the farmers that, except during the first year, the trees would not need any inputs due to their vicinity to cropland and actively encourage farmers to participate in the project because of this low care characteristic of the crop. An elaborate system, discussed in chapters four and five, of mobilizing farmers to collect oilseeds and sell them directly to the Bio-Fuel Park

through the formation of 'biodiesel associations' in each village is also part of the project. In short, the researchers-cum-innovators and their field staff attempt to 'translate' farmers into people who grow these biodiesel seedlings on the edges of their lands, take moderate care of them, collect the seeds and sell them to the field staff.

The researchers-cum-innovators who run this project do not explicitly present their project under the RI banner, but their conceptualization of the project includes some of the dimensions of responsible innovation as outlined by Stilgoe et al. (2013). Furthermore, according to the project's coordinator and all other staff working at the research centre, the project is specifically focussed on developing an innovation (biodiesel production) that will lead to responsible outcomes: more income for small-scale farmers, the availability of a green fuel and avoiding negative impacts on people and the environment. As far as RI as a process is concerned, following Stilgoe et al. (2013), there is a substantial amount of anticipation. For example, the project coordinator repeatedly stressed he wanted to avoid risk as much as possible for the farmers who participate in the project by making sure that the project never infringed on farmers' main source of income. He also dealt with a wide range of 'what if' questions with regard to the marketing of biodiesel by building up relations with different kinds of potential buyers of the biodiesel such as petrol company Bharat Petroleum, Bangalore's public transportation company BMTC and Boeing. Farmers also expressed anticipation and reflexivity. For example, they said they only planted a limited number of oilseed trees on the edges of their land because they were not yet sure what to expect from these new species so they also kept space for trees of which they already knew the usefulness. In addition, they were reflexive about their choices to gather or not to gather oilseeds during a particular season, explaining these choices in great detail when asked about this during fieldwork. The project also aims to be inclusive, with an explicit focus on involving farmers and soliciting their feedback on the project during visits to villages, while events organized at the Hassan Bio-Fuel Park research station always included both formal (during plenary meetings) and informal (during lunch) farmer feedback sessions. This information is

sometimes used to change the project. For example, a senior researcher working at Hassan Bio-Fuel Park, explained how farmers' complaints about a particular machine to extract oil from the harvested Pongamia seeds led to the design of a more robust machine: a clear example of being reflexive and responsive. This person had recently obtained his PhD from the University of Agricultural Sciences in Bangalore, and strongly believed in the potential benefits farmers and the environment could gain from the project's innovative approach to the production of biodiesel. He also stressed that the project was still in its start-up phase, and that a lot needed to be learnt through experimentation and interaction.

Hassan's biodiesel project: matters in the making

Studying the making of biodiesel feedstock (as a matter in the making) in farmers' fields highlights that there are a lot of problems with this project. Farmers were generally willing to plant seedlings of various kinds of oilseed-producing trees and shrubs around their land or near their houses, but they did not become the kind of farmers that the Bio-Fuel Park was trying to translate them into. For many farmers, the number of seedlings that could be planted was limited: these spaces were also used to grow timber and fruit trees as well as bushes of various kinds for firewood and animal grazing. Hence, upscaling this project from growing just a few biodiesel trees or bushes during the experimental phase to growing twenty, thirty or more on the land of one farmer would imply discontinuing these practices. Furthermore, very few seedlings reached maturity due to a lack of water: the rains were not sufficient and most farmers resisted the suggestion of watering the seedlings because during dry spells there was not even enough water for their household needs. Only seedlings planted on the edges of (scarce) irrigated land survived. The 'human' farmers' practices and the 'non-human' absence of sufficient quantities of water for irrigation as well as the presence of other, more useful trees together made that farmers did not plant seedlings in large numbers and that those seedlings that were planted had trouble surviving. So together, these entities formed a material barrier to biodiesel innovation. While farmers continued their farming

practices as usual, in response to these barriers, the responsiveness of the project's researchers was limited. They testified they could not solve these problems and instead put more effort into convincing farmers of the benefits they could gain from participating more actively even though farmers clearly said they did not gain much from growing biodiesel trees and collecting oilseeds.

Some of these biodiesel trees and bushes had been present in the rural landscape for a long time, which means that mature specimens could be found as well, and which could therefore be a rich source of oilseeds. However, people noted that there were fewer and fewer of these trees. The following remark from a farmer, proudly presenting his still-standing mature pongamia trees, is representative of a widely present attitude towards these trees:

> "See, these are my pongamia trees. My father planted them. They are nice, big. Every year I collect about one hundred kilos of seeds from the lot of them. But it is hard work. Nowadays, the people who earn money from brick-making offer a good price for the stems of these trees. I need some cash now. After I cut them and sell them, I am planning to grow silver oak [a fast-growing timber species popular in pulp- and paper industries]. No need for maintenance, and I will earn a lot of money when I cut them after ten years."

Silver oak trees are able to provide this farmer with good income within a reasonable timespan considering the growth rate of trees, and he barely has to do any work for this. Collecting oilseeds and preparing them for the market is a very time-consuming task. Pongamia's characteristics made the tree not only a producer of oilseeds but also a producer of timber that the local brick-making industries desired. So changing conditions (e.g. higher wages to be earned as daily wages-worker, a good market for the wood of

these trees) meant that the overall trade in pongamia seeds had reduced considerably over the past decade: traders in the region estimated that the volume of oilseed trade had dropped to only one fourth of what it used to be ten years ago. While the oil from these seeds was originally mostly sold to soap producers located about 1000 kilometers away, this product flow had declined. Since the onset of the Bio-Fuel Park project this had only decreased further because the Bio-Fuel Park bought up a lot of the seeds in the area while failing to increase oilseed production. This shows that achieving a sizeable production of biodiesel is difficult because such production would require 'exnovation' of important existing practices: the production of soap, and the use of gardens and edges of cropland to grow a wide range of trees and shrubs for fruit, timber, fodder and firewood. Of course, innovation and concomitant exnovation are going on all the time, and farmers may exnovate long-standing practices themselves. However, a good, democratic (particularly following criteria one and two) RI process should anticipate and take into account what kinds of exnovations the innovation at hand would require at that point in time rather than silence these exnovations. While the researchers-cum-innovators at Hassan Bio-Fuel Park told me they were aware that many people were cutting their mature pongamia trees, they did not consider this as a serious threat to the project or something that could possibly be in farmers' best interests. Rather, they explained that they wanted to counter this development by informing farmers of the benefits they could gain from keeping these trees.

At the same time, the Bio-Fuel Park Hassan project is influential in promoting the creation of strong pro-biofuel policy in Karnataka state. Yet while this policy accommodates for projects such as the one in Hassan, it primarily facilitates and promotes large-scale plantation-type biodiesel projects. These are likely to attract the kinds of critiques mentioned at the start of this section, such as land-grabbing and competing with food production for a range of inputs including land, fertilizers, water, and pesticides (Shashidhara, 2009). While there may be little sign of the inclusion, anticipation and responsiveness that the project coordinator, who contributed heavily towards the making of this policy, claimed to be keen

on. For example, the large plantations promoted by the Karnataka policy have been repeatedly shown to exclude people from lands they used to have (informal) rights to, while the policy provides no measures to prevent such situations (e.g. Baka, 2013). At the same time, Hassan Bio-Fuel Park itself did not result in responsible innovation from a product point of view either: farmers were not keen to produce more biodiesel feedstock because they said they had more remunerative income opportunities. To understand how this could have happened, and to study whether or how this project can be understood as RI from a process perspective, we extend our focus on the interaction between many of the different entities involved in the project's innovation process.

Hassan biodiesel project: an innovation process

While the previous section focussed on barriers to responsible innovation emerging from the materiality of the specific innovation at hand, this section focusses on barriers that emerge during the innovation process. Hassan Bio-Fuel Park's researchers and field staff are the ones who provided knowledge and materials (seedlings) to the farmers. They also paid the villagers for the seeds they collected if farmers decided to sell to the Park's staff and not to traders on the weekly market. In addition, farmers who associated themselves with these higher-educated, well-networked people got considerable political benefits by acting as spokespersons for the entire village. In other words: the project staff had a lot to offer which the farmers wanted: money, status, information. Farmers who engaged with the project usually tried to draw the Park's staff into their network, translating them according to the farmers' needs and wishes: to be access points to knowledge and to government schemes, and of course providers of some money. At the same time, they rarely contributed to the production of biodiesel as the project's staff wanted them to do. However, the researchers-cum-innovators from Hassan Bio-Fuel Park, trying to translate these farmers into their biodiesel project in order to make their innovations work out in practice, were the ones who took decisions on the exact shape of the project. And while they were aware of farmers' reasons for

participating, accepting these as a necessary part of their attempts to raise biodiesel production, they did not question their approach based on farmers lack of interest in taking care of young seedlings and collecting oilseeds during harvest season. This shows that while democracy criterion one, which stipulates that entities get to raise their voices, is being met, criterion two, stipulating that these entities get to challenge and recompose the proposition at hand, is not being met. Power dynamics and the role of interests that go beyond the specific innovation at hand (e.g. farmers' interests in access to money, status and information, which they tried to obtain by building connections with the projects' research and field staff) are crucial factors in a democratic responsible innovation process, particularly to ensure that all relevant actors are included and have a chance to speak up.

Hassan Bio-Fuel Park's innovation process is tightly intertwined with the policy arena in Karnataka. In this arena, both the researchers-cum-innovators and farmers associated with Hassan Bio-Fuel Park had their own agendas. Researchers-cum-innovators could represent their work to policy-makers, which mostly took place behind closed doors according to both these researchers and policy-makers in Karnataka. These researchers, as well as others working for private companies or public research institutions, were able to decide how to represent it: which information they did and did not give, and the conclusions they drew from their experiences. A limited number of farmers got invited to public meetings that were supposed to inform policy-making. Researchers-cum-innovators and policy makers did not only attempt to translate farmers into their projects; farmers also had their own projects into which they tried to translate the researchers-cum-innovators and policy makers. Examples of such projects included raising one's political and social standing in the village and gaining access to government schemes or privileges. In these meetings, the roles to be performed by participating researchers-cum-innovators and farmers were clearly visible: the researchers-cum-innovators provided knowledge based on their research and experiences gained through their innovation practices. They were there to educate the public and politicians on the different

possibilities associated with biodiesel production. The farmers were there to testify that the implementation of research results obtained by the researchers-cum-innovators had been beneficial for them. Curiously, lives of farmers are very different than those of researchers. Knowledge production based on these different life experiences of farmers would look very different as a consequence. This would mean that different stakeholders in the project would be able to play the role of knowledge-producers (Norton, 2005; Van Oudheusden, 2014).

An important consequence of these unequal power relations, described above as differences among people's abilities to enrol others into their projects, is that they make stakeholders act strategically instead of putting their ideas and wishes across in a straightforward manner. Farmers generally told us – and farmers were well aware after we had spent some time in the villages that they would not get any benefits from us – that they did not really see the use of participating in the biodiesel project for the official purpose of oilseed production, though there was not much harm in it for them either. Yet to the project's researchers and field staff some expressed considerable interest, in the hope of benefitting from the project's financial budget or from the oil press machines that were distributed to a few villages, even though they had no direct use for this machine. Farmers who were antagonistic to the project often did not speak up: they were in most cases less influential in the village and did not want to get on bad footing with others in the village because of their views on the biodiesel project. The researchers-cum-innovators presented the whole project in a very positive way to policy-makers: they needed money to continue their work, which meant they had to create political support in order to obtain government funding. These observations are rather generic: similar issues are part and parcel of any participative innovation project that needs to generate political support, as has been richly illustrated in the literature on participation in development projects (e.g. Bond and Hulme, 1999). Because of the fact that these dynamics around the generation of political support play up in many RI-processes, and because this threatens both inclusiveness and responsiveness, they deserve more attention in the RI literature.

Another issue that could be observed in the activities of the Bio-Fuel Park project in Hassan, both in relation to farmers as well as in relation to politicians, is that there were many different, diverging and even contradictory interests at stake. Some farmers testified they participated because they were curious to see how the seedlings of new tree varieties would grow, others said they were mostly involved because of the prestige associated with being in direct contact with the Park's staff, which could help them in their political activities in the village or region. There were also a few farmers who participated because they genuinely wanted to raise these trees – though not always with the goal of collecting the trees' seeds but rather because they said they were curious how some of the newly introduced tree species would grow. A prevalent interest among all farmers was to diversify income and livelihood sources to maintain some resilience. This resulted in a preference for growing a range of crops on the edges of farmland for both monetary income and direct use like fruit, fodder and firewood. While the researchers-cum-innovators said that augmenting farmers' income was among their priorities, their main interest was to get biodiesel (feedstock) production off the ground. As such, farmers and researchers-cum-innovators had a common interest in planting a small number of seedlings. But the most prominent interests of farmers and researchers-cum-innovators clashed as soon as researchers tried to scale this up because that was not in the farmers' interests.

These clashes move up a level if one thinks about the way in which this plays out in policy. The strategic presentation by researchers-cum-innovators of their work to policy makers fits their overall concern with securing sufficient funding for the Bio-Fuel Park, including funding that pays the researchers-cum-innovator's salaries and secures their jobs. The outcome is that the Karnataka state biofuel policy goes against the interests of the average smallholder farmer in many ways: it promotes block plantations on government-owned land which is often used by farmers for various non-agricultural purposes. It promotes the large-scale cultivation of crops which, so far, has not been financially remunerative nor a stable form of side-income for farmers (Shashidara, 2009). Enacting this policy would

mean that many resources (not only time, but also water, fertilizers and pesticides, amongst others) have to be used for the production of biodiesel, resources which are scarce in the lives of farmers. This form of biodiesel-innovation clearly differs strongly from the activities taking place in Hassan. Interestingly, when we questioned the researchers-cum-innovators about this outcome of their lobbying activities, they tended to defend the policy: to achieve sustainable biodiesel production, it needed to be promoted as much as possible, they argued. For example, in order to interest policy-makers in their biodiesel work, these researchers-cum-innovators felt they had to appeal to big business' interests with their policy texts and the way in which they did their research. This situation highlights that it is important to pay explicit attention to the existence of interests that diverge between actors operating in different settings in which RI norms may or may not be followed, and to how these diverging interests translate in different knowledges following the work of e.g. Wickson and Wynne (2012) as discussed in the introductory chapter of this thesis. Without explicitly acknowledging the different interests of all parties that are affected by the innovation at hand and the different knowledges that emerge from these interests, a solution that does justice to these different interests can never be found. In effect, this threatens responsible innovation's dimension of responsiveness. However, both the responsible innovation framework as well as the ecosystem services framework discussed in chapter five present 'good knowledge' as being inherently value-free and do not acknowledge the role of actors' diverging interests played in the construction of knowledges that are used to take decisions on innovation or policy-making. Yet, this is of crucial importance, as demonstrated by the difference between the knowledge on biodiesel as presented by scientists working at Hassan Bio-Fuel Park and the knowledge on biodiesel as presented by farmers participating in the project.

The significance of these observations for the specific case of biodiesel extends well beyond the context of Karnataka state, or India. In the Netherlands, too, many parties are interested in replacing a significant proportion of our fossil fuels with biodiesel, and this vision cannot be

realised without sustained significant imports of biodiesels (Bindraban et al. 2009, 11). Despite the fact that biodiesel imports from developing countries are relatively modest at the moment, EU biofuel policy has had clear negative impacts on those countries already (Diop et al., 2013). Also, discourse on 'unused land' (which is supposedly freely available to grow biodiesel crops on without competing with food production) and 'win-win situations' has so far kept interest in biodiesel imports from countries in the global South alive – a discourse set within unequal power relations and underlain with a great diversity in vested interests (Baka, 2013; Borras and Franco, 2012; Levidow, 2012; Exner et al., 2015). Yet many of those countries in the global South are characterized by similar adverse conditions and constraints to responsible innovation that we highlighted for the case of the Hassan project. Indeed, while this empirical case can be used to draw lessons on that may be of relevance to democratize biodiesel innovation projects and policies outside Hassan district, it is especially valuable in terms of the many reflections it offers to deepen the work on RI.

Discussion and Conclusion

The case study clearly shows that Hassan Bio-Fuel Park's innovation process on biodiesel is not fully democratic – following the criteria proposed in chapter three - and responsible following Stilgoe et al.'s (2013) four dimensions despite attempts to do so as suggested by those in charge of Hassan Bio-Fuel Park. With respect to the dimension of inclusion and the first democracy criterion, which stipulates that entities should be able to raise their voices, the project is doing quite well. A lot of human and non-human voices get raised and heard by the researchers-cum-innovators, such as farmers' interests in the project and existing pongamia trees getting cut, although the researchers-cum-innovators rarely showed an interest in the many different ways in which entities such as farmers, seedlings and seeds raised their voices (criterion three). Neither did these voices get to challenge and recompose the innovation process (criterion two). Or, in the language of the RI literature, the innovation process was not responsive, researchers-cum-innovators barely adjusted their innovation strategies beyond

strengthening their attempts to explain farmers why they should not cut their mature pongamia trees. With respect to criterion four, stipulating that the transferability between different socio-ecological situations should not be easy, this particular innovation project performed in a mixed way. On the one hand, the researchers-cum-innovators made clear to a wide range of audiences (such as policy-makers, the first author of this chapter and the farmers) that this particular way of growing biodiesel was only to take place on non-agricultural land, with involvement of local farmers whose financial well-being should and would not be put at risk. On the other hand, the researchers-cum-innovators did collaborate with policy-makers, drawing on their experience running Hassan Bio-Fuel Park, in the making of a policy that advocated completely different ways of growing biodiesel feedstock.

This chapter's analysis of this innovation process as a matter of concern at Hassan Bio-Fuel Park also displays a number of factors that may limit or threaten democratic and responsible innovation. These factors include the relational agency of human and non-human entities, the price of exnovation of competing practices and innovations, various factors related to the theme of participation and inclusion, and the absence of theories on how to turn the decision to discontinue a particular innovation process into as much a valid outcome of an RI process as the decision to innovate in a particular direction. As we will argue, these factors need and deserve more attention in order to be included and adequately theorized in the RI literature.

Relational agency of human and non-human entities

First of all, studying biodiesel as a matter in the making highlighted how a wide range of human and non-human actors complicated biodiesel feedstock production in Hassan (Latour, 2005). This actors include young seedlings with their need for water in the absence of sufficient rainfall and irrigation facilities, the limited availability of other inputs needed to grow biodiesel crops, the presence of other trees that were more useful for farmers and farmers' lack of interest in the collection of biodiesel seeds, arising from farmers' relations with the material characteristics of a pongamia tree and its seeds (light seeds to be collected from high branches

or from soil covered with bushes) and the availability of more remunerative forms of labour in the area. Both human and non-human entities, which as shown here and in previous chapters act through their relations with other entities, can enable and hamper the possibilities for the innovation process itself. If their voices are not heard and registered, following the first criterion on democracy as proposed in chapter three, there cannot be any responsible innovation as per Stilgoe et al.'s (2013) process-based understanding thereof. It is important to learn to recognize entities' enabling and disabling agency in an innovation process and to give this a place in the RI literature: if these are not recognized as such but rather treated as technological problems that can be overcome using yet another set of technologies without going through the same 'responsible innovation process' for those problem-solving technologies, one can no longer say one is doing RI. Using actor-network's symmetrical approach to humans and non-humans is a valuable starting point to theorize this, while the practical experience portrayed in studies reflecting on attempts by corporations to carry out BoP projects may be a source of inspiration for dealing with a range of barriers to innovation as well (Latour, 2005; Andersen and Esbjerg, 2012).

The price of exnovation

Secondly, the Hassan project clearly showed that a sizeable production of biodiesel would require abandoning or reducing engagement with various existing practices, such as growing trees for timber, fruit, fodder and firewood, the practice of risk-spreading, working as a daily wages-worker who earns more than someone collecting oilseeds, using the oilseeds for soap production, etc. Yet, what we dub *the price of exnovation* here is rarely conceptualized in RI, as highlighted by Blok and Lemmens (2015), even though innovation generally uses resources that were previously used for other purposes, makes existing technologies obsolete and thereby overthrows social and economic systems (Kroesen et al., 2015). Indeed, innovation is not only the creation of something new, but inherently involves destruction. This may be the destruction of something that is so

good, so beneficial or otherwise so valuable that the reasons for innovating could be outweighed by the reasons against it. An example of these kinds of technologies are first-generation biodiesels: many people have opposed using food crops for fuel on the grounds that having more fuel should never come at the cost of driving up food prices and exacerbating hunger (Gamborg et al., 2012; Pols and Spahn, 2014). Clearly, innovation can only be responsible if it takes into account what has to be sacrificed during innovation, which means that this should be adequately theorized in the RI literature. If the sacrifices are so large that they delegitimize the innovation process at hand, all those included in the RI process may come to abandon a particular test or innovation. Hence our observation that RI is at its core about innovating responsibly – or not innovating at all.

Stakeholder involvement

Thirdly, our account displays a range of problems related to stakeholder involvement and participation. This lies at the heart of the responsible innovation literature, for the term 'responsible' or 'responsibility' has been strongly tied up with this theme (Koops, 2015) to the point where RI has even been defined in those terms (e.g. Taebi et al 2014). As such, RI has been criticised for assuming that stakeholders will generally cooperate, try to align interests and harmoniously strive for consensus (Blok, 2014; van Oudheusden, 2014). Doing RI in practice, as these authors note, can be difficult, and this can at best complicate a successful RI process and at worst make it simply impossible. Indeed, our case study shows several ways in which both human and non-human stakeholders did not cooperate, try to align interests or harmoniously strive for consensus. For example, the project was full of power differences, or differences among actors' abilities to enrol others into their projects. Researchers-cum-innovators had power over the way they went about implementing the project, and farmers had to function within the boundaries set by the researchers, while a lack of rainfall killed the seedlings distributed by the project and planted by the farmers. While farmers of course tried to stretch these boundaries, they were dependent on their seedlings to be able to harvest oilseeds and on the

researchers-cum-innovators and their field staff for knowledge, seedlings, and monetary compensation for their participation. Researchers-cum-innovators were similarly dependent on policy-makers for various kinds of material and non-material support for the project, while the policy-makers were the ones who got to decide what Karnataka's biofuel policy would look like and how much support Hassan Bio-Fuel Park was to receive. These are just a few examples of the way power, or the ability to translate others into one's project, was unequally distributed in this particular case. Much of this cannot be changed very easily: power differences always remain, if only because certain parties such as the government have to turn the results of deliberation into policy and enact that policy, while others do not. Indeed, it is in many cases questionable whether or how these unequal power relations should be changed. It is nevertheless important to take note of these unequal power relations because they play important roles in the innovation process, both directly as well as indirectly.

Furthermore, stakeholders have different, diverging and even contradictory interests in the innovation process. In Hassan, interests were contradictory for example when biodiesel crops were not able to provide farmers with a secure and reasonably high income compared to other income-generating activities. This made it impossible for researchers-cum-innovators to make sure their interests were met, namely to scale up biodiesel production among smallholder farmers. Within the RI literature, this has been discussed as the stakeholder paradox (Blok, 2014). Any decision process, including responsible innovation processes, gains more legitimacy as more affected parties are involved in the process. The paradox is that if all those involved parties have clear viewpoints and problem framings, deliberation becomes meaningful but it will also become more challenging to achieve a consensus. Depending on the nature of the diverging or contradictory interests, it may be possible for parties to alter their viewpoints through a good RI process, for conflicts to generate new ideas and options (Swierstra and Rip, 2007) and for ideologically opposed parties to agree upon actions or policies that serve the interests of both (Norton, 2005, Ch. 4). All of this, however, depends on the willingness of parties to be open to each other, to see the

process not only as a venue for self-expression, but also as a way to get to know the other and as a means of self-evaluation. My work in this chapter and preceding chapters adds to the concern with dealing with different, diverging and contradictory interests in an innovation process by highlighting how knowledge-making is not a neutral endeavour but rather informed by a wide range of normative decisions that are an inherent part of knowledge-making (e.g. Wickson & Wynne, 2012). This means that knowledge on biodiesel, for example as made by the scientists working in Hassan Bio-Fuel Park, or as presented by scientists at the conference discussed in this paper, is partly informed by the interests these scientists have in biodiesel. Knowledges produced by farmers with whom interactions took place in Hassan districts' villages were very different than those of farmers. One of the reasons is that those farmers have different interests than scientists: for example, they are keen on secure income that matches existing labour opportunities in terms of wages and time spent, and on using land and water for purposes that meet their needs. Scientists in Hassan Bio-Fuel Park were rather concerned with providing farmers with any form of income and scaling up biodiesel production to be able to produce larger quantities. Therefore, the role of 'knowledge producer' should be redefined and distributed differently across participating stakeholders. Not only scientists but all stakeholders should be legitimate producers of (contestable!) knowledge in a responsible innovation process.

RI is about innovating responsibly – or not at all

There will be cases in which diverging interests turn out to be irreconcilable. This may occur due to disagreements on a fundamental level or when too many different aspects of a problem clash, making meaningful progress impossible (see e.g. Bovenkerk (2012) on the biotechnology debate). This particular case study is in fact an example of innovation which has to cope with interests that the actors involved may consider irreconcilable. In the current situation, it seems impossible to us as authors to combine a profit-driven interest (both farmers and companies would want to earn money from labour and money invested) in biodiesel production using non-edible

oil as feedstock with a sustainability-driven interest of replacing petro-diesel with environmentally-friendly biodiesel. Our observations as well as those by many others (e.g. Ariza-Montobbio et al., 2010; Kant and Wu, 2011) suggest that financially viable biodiesel production for large-scale blending with petro-diesel requires the use of sizeable quantities of water, land, pesticides and fertilizers. These are also needed for food production as well as the production of soap, timber, fodder etc. The production of pesticides and fertilizers as well as their use on agricultural land can have considerable environmental impacts. Indeed, the well-meant attempts by Hassan Bio-Fuel Park researchers-cum-innovators to foster the cultivation of biodiesel crops in a way that aligns with farmers' interests have failed so far, as is evident from the lack of yields.

If interests cannot be reconciled to the point that some compromise can be reached, a valid outcome of an RI process as described by Stilgoe et al. (2013) would be not to innovate, or to exnovate the ongoing innovation process. In this case study that would mean to discontinue attempts to produce biodiesel to be used for large-scale blending with petro diesel. In other words: the option of discontinuing the innovation project altogether should be an explicit and possible option in the RI framework. It is important to highlight that we do not imply that a (social) scientist responsible for the RI process in innovation (if such a person has been appointed at all) should, when he/she deems this to be right, suggest to exnovate. Indeed, following Stilgoe et al. (2013) and the democracy criteria proposed in this dissertation, the role of the social scientist should rather be to safeguard the process and reflect on this process. In order to facilitate the decision to exnovate the ongoing innovation process when appropriate, including this option in the RI framework is not enough. Rather, the framework should also take non-human relational agency, power inequalities, strategic action and diverging interests much more seriously. Of course, diverging interests could lead to a situation in which no consensus can be reached on whether to innovate (and if so, how) or not to innovate (and if so, how to phase out whatever was already in place). This means that our core observation, namely that 'RI is about innovating responsibly – or

not at all' should be the start of further thinking about this conundrum, raising a call to pay more explicit attention in the RI literature towards the way in which decisions on how to continue or discontinue an innovation process can be taken democratically and responsibly.

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Chapter 7 |

Conclusions

In this chapter, I will first of all answer the main research questions raised in the introduction to this thesis. These answers are based on an interaction between the empirical case of biodiesel in India and the theoretical approaches used to study these. Hence, the answers to the main research questions are also empirical and theoretical at the same time. This is followed by a section that only discusses empirical implications of the work presented in this thesis, particularly for those readers who are primarily interested in biodiesel in India. I will end with some reflections and offer suggestions for future research based on those reflections.

Answering the Main Research Questions

The work presented in this thesis was carried out with the aim to answer the following research questions:

How democratic are biodiesel knowledge-making, innovation processes and policy-making in India? In what ways can they be further democratized?

In the following sections, I will set out how this thesis approached democracy and answer both research questions

How democratic are biodiesel knowledge-making, innovation processes and policy-making in India?

'Democracy' was conceptualized as 'articulating propositions well' (cf. Latour 2004a) in chapter three. A proposition, unlike a statement, is a matter of concern that is open for debate and discussion. It is not simply an individual entity, but rather a gathering constituted by multiple heterogeneous entities. The term articulation, following Hall (1980), denotes both linking up and giving expression to: when two or more different

entities form a new connection, the entities themselves change and jointly give expression to something new. The construction of democratic or well-articulated propositions should meet the following criteria:

1) Invite and allow all interested entities, including particularly those that were hitherto mute, to raise their voices.
Whether or not an entity has an interest, or is interested, should be determined on the basis of the concept *perplexity*. An entity is interested and interesting if it leaves the existing entities constituting a proposition 'perplexed': confused and uncertain about what to do next due to the complication brought in by the new entity (Latour, 2004b);

2) Register the voices of the newly included entities by allowing them to challenge and recompose the proposition at hand.
This criterion suggests that an entity should not only be able to raise its voice, but that a well-articulated proposition should allow the newly raised voice to be registered, and thereby contribute to the re-making of the proposition at hand, in and through interactions with other entities involved.

3) Register the multiplicity of each entity's voice and actions, rather than turning them into a repetitive singularity.
A well-articulated proposition recognizes differences between its constituent entities' voices, even when they ostentatiously belong to the 'same' category. If this is not done, an entity's multiplicity is not registered, while erasing the differences between a proposition's constituent entities. This undermines the entity's capacity to speak in its own relationally-constituted voice (cf. Mol, 2002; Latour, 2004a).

4) Avoiding easy transferability between different socio-ecological situations. A well-articulated proposition is specific to the socio-ecological situation that constitutes it. Easy transferability of propositions from one situation to another would imply that the entities in the new setting are not being allowed to raise their voices and produce perplexity.

These normative criteria are based on work by Latour (2003; 2004a; 2004b) and Stengers (2010). Underlying these criteria, particularly criterion three, is a conceptualization of an entity's voice as material, relationally constituted and hence multiple. By material I mean that a voice is never purely ideational. By relational, I mean that an entity can act (and therefore raise its voice) because it is afforded to do so by its socio-material entanglements (Latour, 2005). The terms afford and affordance refer to the active participation of these socio-material entanglements in raising the voice of an entity (Latour, 1994). This active participation can come in many forms and shapes, such as allowing, encouraging, permitting, suggesting, influencing, blocking, forbidding, rendering possible etc. (Latour, 2005). As such, the voice an entity gets to raise differs along with the entity's articulation with other entities which afford it to do so, giving rise to multiplicity (Mol, 2002). These articulations are political, in the sense that the linking up of entities could have been done differently.

Drawing on the concept of multiplicity, I show how entities' voices get raised differently through their articulations with others, including farmers, researchers, me, plants and the soil. For example, when a researcher from the molecular biology department at research institute TERI in Delhi was working on developing high-yielding varieties of *Jatropha curcas*, he was keen to avoid the need to irrigate the crop to ensure high yields. Therefore, he grew his test varieties under rain fed conditions, and selected those varieties which performed best under these conditions to carry out his breeding programme. As such, water raised its voice through articulation with this researcher and many other entities that were part of his work (such as the varieties growing under rain fed conditions, the researcher's measuring instruments etc.) as an entity that is only present if it rains. Another researcher at TERI was interested to identify the maximum yield of oilseeds per hectare of land planted with jatropha. This man therefore experimented with a wide range of farming practices, such as spacing, pruning, applying pesticides and fertilizers and various irrigation regimes. In this case, water – along with all the other entities involved in maximizing the plant's yield – raised its voice as a resource that is available as and when required according

to the researcher to increase yields. In the case of the work by Ariza-Montobbio et al. (2010), water gets articulated very differently. Interested in the effects of cultivating jatropha on the overall income of large-scale and small-scale farmers, they study the costs and benefits of growing jatropha under rain fed conditions in the fields of smallholder farmers, and of growing jatropha in irrigated fields of larger, richer farmers. The balance is negative for small farmers, while it can be positive for large farmers with easier access to water and financial resources. As such, water – when acting together with jatropha plants – acted as an entity capable of increasing the gap between rich and poor through articulation with Ariza-Montobbio et al. and their research methods. Lastly, as highlighted in the introductory vignette with which this thesis started, young seedlings raised their voices through my own research as requiring a sufficient supply of water during the first two years after planting to survive – water that was usually not available. So in this case, water raised its voice as an unavailable yet crucial element in the survival of young Pongamia seedlings through articulation with farmers, the young seedling and myself. Each of these empirical examples of water's multiple voices should be understood as arising out of the specificities of all socio-material characteristics of the entities, both human and non-human, that participated in their making.[55]

The reason why it is important to pay attention to entities' multiple voices is that each of these voices have different implications for knowledge-making, policy-making and innovation processes, and therefore they should be heard in a democratic process. For example, if water in relation to biodiesel feedstock cultivation raises its voice as increasing the gap between rich and poor, it creates perplexity among the incumbent entities of India's current

[55] All of water's voices highlighted here were raised with the help of a human actor. This may give the impression that democratization would simply require including different kinds of experts and stakeholders. However, apart from human actors, water was associated with a wide range of non-humans as well, which also afforded water its multiple voices. These entities include, for example, the young seedling, the cost of irrigation and crops' ability to grow more oilseeds when irrigated well.

policy on biodiesel which claims to increase equity and human well-being (Government of India, 2009, p. 2). Chapter two specifically elaborated on this point of listening to entities' multiple voices, arguing that studying wasteland's material multiplicity in colonial India shows how a wide range of entities created controversy regarding policies that should be implemented, particularly with respect to the Permanent Settlement of Bengal. Chapter three extends this argument to the case of biodiesel in the 21st century, in its discussion of the policy proposition on the use of wastelands for biodiesel production. In particular, this chapter highlights the diversity of wastelands, and the many uses of these lands and their outgrowths. It also shows that the users of these lands are highly diverse: there are rich farmers with plenty of private land, poor farmers who were dependent on common lands for grazing, firewood and more, and travelling shepherds who depended on both public and private land but whose voices would never be represented through conventional government structures such as gram panchayats. The multiple voices of these various interested entities were not all raised and registered during the controversy on biodiesel between 2003 and 2009. This controversy was not only part of policy-making but also of knowledge-making, as shown in chapter five, and innovation, as shown in chapter six.[56] This means that these processes are not fully democratic, according to criterion first democracy criterion.[57] With respect to the second democracy criterion, there was very little re-composition taking place in Hassan Bio-Fuel park's innovation practices,

[56] Chapter three gives an elaborate answer to the policy-making aspect of the first research question, and therefore I mostly focus on the extent to which biodiesel innovation processes (as taking place in Hassan Bio-Fuel Park) and knowledge making (as taking place using the ecosystem services approach) in India can be considered democratic.

[57] This also holds for the framework of Responsible Innovation as outlined by Stilgoe et al. (2013) and many others (e.g. Voeten et al., 2014; van Oudheusden, 2014; van den Hoven, 2014 etc.), in the sense that this framework is entirely focussed on the inclusion of various viewpoints of human stakeholders and largely ignores material, relational (human and) non-human agency.

while the knowledge produced using the ecosystem services approach silenced many entities' voices. In Hassan Bio-Fuel Park's innovation process, this limited re-composition also turned entities' voices into repetitive singularities, because material diversity was barely able to challenge the ideas that informed the innovation processes that were initiated in Hassan Bio-Fuel Park. And as discussed in chapter five, the ecosystem services framework, with its pre-defined categories and its focus on impacts silences many entities' voices and turns those which it does register into repetitive singularities by fitting these voices within pre-defined categories. While there may be valid arguments to do so, this is not democratic following the first, second and third democracy criteria. At the same time, the framework has little room to present the context in which particular impacts are generated. Unless a researcher specifically documents these, such as the scale of production or the specific feedstock raised, the framework does not limit transferability from one socio-ecological setting to the next, following criterion four. Hassan Bio-Fuel Park's innovation practices, on the other hand, which were specifically focussed on raising biodiesel on non-agricultural land in cooperation with small scale farmers, made this explicit in its work and its communications and thereby performed better on the fourth democracy criterion although the Park's researchers-cum-innovators also participate in state-level policy making that promoted a very different feedstock cultivation approach than the ones developed in Hassan Bio-Fuel Park.

In what ways can knowledge-making, innovation processes and policy-making be further democratized?

In short, my answer to this question is that those entities which are already part of a proposition should take an interest in what I propose to call 'matters in the making' (cf. Latour's (2004c) matters of concern and matters of fact). This concept starts from Annemarie Mol's (2002) term enactment, which is used to express that an entity comes into being through acting in relation with others. A matter in the making is knowledge about dynamics rather than inherent, static characteristics. It directs one's attention towards

an entity's process of coming into being and towards the relational affordances of entities involved in this process. This makes it similar to a matter of concern. However, Latour's (2004c) matter of concern is a matter of fact that has not yet reached stability and closure, and highlights that there is uncertainty and debate about the issue at hand. A matter in the making will never become a matter of fact, highlighting primarily that matters (entities) are always in an ongoing process of becoming.[58]

By taking an interest in the relational affordances that bring entities into being, the concept matters in the making widens the ambit of relations that matter for policy-making, knowledge-making and innovation, and hence the number of entities with which those processes engage, enhancing democratization as defined at the outset of this conclusion. The ecosystem services framework as discussed in chapter five is a key example of an approach that claims to create stable, static matters of fact – called impacts. Doing so has the effect of silencing, rendering inaudible, the voices of entities that were involved in the creation of those matters of fact but that do not fit in the static framework through which those matters of fact are articulated. The concept matters in the making, in contrast to matters of fact, explicitly directs attention to those entities and the role they play in this ongoing, creative process. To come back to the example of water discussed in the previous section, a policy-maker could benefit from being informed about the diverse roles water can play in relation to a range of other material entities in raising biodiesel crops, in addition to evaluating the impact of a biodiesel project on water usage (which is very little in a non-successful project, and thus not very informative). Using the insights proposed in this thesis on the diverse roles water plays in relation to raising biodiesel crops to do quantitative studies on biodiesel could for example give information

[58] I acknowledge that the concept matter of concern also includes this focus on becoming rather than being. However, while Latour's (2004b) matter of concern and matter of fact jointly focus on controversy and closure, the proposed concept matter in the making does not focus on controversy and closure, but on the way in which entities come into being.

about: a) the viability of the project (not very promising if there is insufficient access to water for most Pongamia seedlings to survive the first two years after being planted in the field); b) the wide range of consequences growing biodiesel crops could have (e.g. creating larger inequalities between farmers because of the influence irrigation has on the yield from jatropha bushes); and c) important choices that must be made (e.g. what should be done if economically profitable methods to grow biodiesel feedstock crops require sizeable amounts of inputs that have damaging environmental consequences?).

Enabling these otherwise mute entities (mute in relation to knowledge-making, policy-making and innovation processes, but not mute in relation to farmers living in the area) to raise their voices as active participants creates more room for those entities to resist dominant narratives and participate in their reconstruction. In the creation of matters of fact, their roles – if at all there – are fixed, static. As such they are unable to resist the roles they are made to play in a proposition. Matters in the making are inherently dynamic, which creates space for resistance. For example, the analysis of the colonial history of the category wasteland presented in chapter two shows how research that does not pay attention to the relational affordances of a host of material entities (land, wild beasts, trees etc.) that were involved in the process risks reproducing history in terms of the dominant narrative that got created at the time, even if the person doing the analysis opposes that dominant narrative. Studying lands', wild beasts' and trees' relational affordances brought to the fore that pathways alternative to the dominant narrative were alive and thriving at the time: alternatives that were silenced (at least partially, many alternative pathways continued to exist, although this had become more difficult than before) by the narrative that ultimately became dominant. Enabling entities that are part of alternatives to a dominant narrative in present-day time to raise their voices, by paying attention to material entities' relational affordances, can contribute to policy democracy, democratic knowledge-making and democratic innovation processes. Such alternative narratives include exploring the use of different technologies (other than biodiesel) to reduce CO_2 emissions or taking into

account the many other possible uses to which land can be put besides the cultivation of biodiesel crops.

Furthermore, tracing entities' associations in the making of innovations (and categories) helps raising the voices of entities that get silenced in the process of creating something new. This is particularly important when understanding what a particular innovation in the making competes with. For example, most literature and societal debate is concerned with competition for land to produce food (the food vs fuel debate). In addition, some attention has been paid to competition for water (e.g. Ariza-Montobbio et al., 2010; Agoramoorthy et al., 2009; Lavanya, 2007). However, by tracing the associations of growing biodiesel feedstock trees in practice, many more forms of competition came to the fore: competition with soap production, competition with fruit and timber trees that could be grown on the same piece of land, competition with cash crops for sunlight and root space, competition with alternative forms of employment that are more remunerative than collecting oilseeds suitable for the production of biodiesel etc. Of course, many of these forms of competition could also be understood as impact-style matters of fact, presenting information on crop loss due to growing biodiesel tree varieties along farmers' main cropland, for example. However, to create such impact-style matters of fact, it is necessary to identify these forms of competition and to understand how these forms of competitions work within a specific socio-material setting. Considering biodiesel as a matter in the making helps to do so.

Furthermore, propositions do not get articulated in isolation, but in relation to other propositions. Even if the incumbent entities of one proposition allow some form of recomposition based on the voice of a newly joint entity, there may be related propositions in which this should also happen. Chapter three shows that this was problematic in the case of India's biodiesel politics: for example, the voices of entities such as land, water and

farmers only got raised in relation to the policy's legitimation proposition.[59] The incumbent entities constituting other policy propositions, such as propositions on blending targets and land availability, reduced the voices of land, water, farmers etc. to repetitive singularities that were instrumental to the proposition at hand. Putting forward the concept of matters in the making is a call to pay attention to the relational affordances of entities involved in the topic at hand, to their interaction and their dynamics. As highlighted in the introduction, a lot of literature claims to be contributing towards India's biodiesel policy but only focusses on a narrow aspect of this policy, such as achieving high yields to meet blending targets. This overlooks how the affordances of other entities in achieving those high yields, such as water, pesticides, and fertile soils, may clash with other aspects of the policy. For example, the policy stipulates that competition with food production for land should not take place (Government of India, 2009). If fertile soils are required to achieve high yields, then this goes against the policy. Paying attention to the relational affordances of entities involved in the topic at hand helps opening up to the wider implications of the study's focus, and makes it difficult to maintain a narrow focus on a specific issue, such as achieving high yields.

So to sum up, how may my propositions contribute towards biodiesel democratization as defined by the four criteria developed in chapter three and outlined at the start of this concluding chapter? First of all, with regard to raising the voices of all interested entities, and enabling those that were hitherto mute to speak, I proposed the concept of matters in the making. Tracing the associations of an entity that is part of a (policy-/knowledge-/innovation-) proposition by studying how the entity came about brings forward the relational affordances of other entities that contributed towards that entity's coming into being, hence enabling them to speak. Secondly, these entities should be able to challenge and recompose the proposition at

[59] The policy will contribute towards "energy security, climate change mitigation, apart from creating new employment opportunities and leading to environmentally sustainable development" (Government of India 2009: 4).

hand. To achieve this, attention needs to be paid to differing abilities to enrol others into one's programme, or in other words: power differences and power redistribution.[60] Creating knowledges that are specifically attentive towards the voices of entities that are currently nearly inaudible because their socio-material entanglements do not enable them to raise their voices more clearly would contribute to power redistribution. The third criterion suggests that the multiplicity of entities' voices should be registered. The concept of matters in the making is helpful to do so. Matters in the making, rather than matters of fact, help to understand how an entity's voice comes about and hence the role played by the collective of entities that constitute this particular entity's voice. An entity's voice changes when its socio-material entanglements change. If that collective of socio-material entanglements are registered along with the entity's voice, which is the case when focussing on matters in the making, those changes in the collective's constitution and resulting voice of the entity at hand will also be registered. This, then, avoids reducing an entity's multiplicity to a repetitive singularity. Lastly, the criteria stipulate that easy transferability of propositions between different socio-ecological situations should be avoided. The concept of matters in the making helps explicate the material specificity of a particular situation from which a proposition arose, tying the proposition to that specific socio-ecological situation.

Empirical Implications

In this thesis, I tried putting the theoretical ideas proposed above in practice. I studied matters in the making, in farmers' fields, through interviews and within scientific papers, even if those claim to be creating

[60] Latour's (2004) politics of nature, and Callon et al.'s (2009) work on hybrid forums would be a suitable starting point for further exploration in this field beyond the scope of this thesis. Also interesting is work by Venturini (2010) on the role of power in mapping controversies, and Farías and Bender's (2010) edited volume on actor-network theory's relationship to urban studies, in which power and democracy figure prominently.

matters of fact. I attempted to be open to the unexpected, followed entities' diverse associations and studied how they were articulated in multiple propositions at a time. This lead to three contributions to the literature on biodiesel in India. First of all, this thesis identifies a wide range of issues that have so far been missing in India's biodiesel controversy as registered in academic literature, in newspapers and in my conversations with business representatives, activists, researchers and government officials. Secondly, the thesis contributes towards a better understanding of the specificities of small-scale biodiesel production projects, which were often heralded as highly promising for social and environmental sustainability (FAO, 2009; Energia, 2009).[61] Thirdly, this thesis allows one to critically assess the usefulness of asking 'What are the implications of biodiesel cultivation?' and 'How can biodiesel production be improved?' Instead, I suggest a number of questions that may need to be addressed more urgently.

First of all, two important examples of voices that have so far been rather silent India's biodiesel controversy are CO_2's multiple voices and the voices of farmers who are supposed to grow these biodiesel crops. India's policy on biodiesel as well as the preceding National Mission on Bio-Diesel quite simply state that using biodiesel rather than conventional diesel reduces CO_2 emissions (Planning Commission, 2003). None of the actors I met as part of this research considered this assumption as problematic. Some only cautioned that CO_2 emissions are not the only measure of environmental sustainability. Most research on biodiesel in India also assumes that using biodiesel rather than conventional diesel will reduce CO_2 emissions or simply leaves the issue unaddressed (e.g. Ostwald et al., 2015; Kumar, Chaube et al., 2012; Latschan, 2009). There are a few exceptions, such as work by Kumar, Singh et al. (2012) and Achten et al. (2010). Kumar, Singh et al. (2012) calculate how CO_2 emissions vary depending on whether "by-

[61] Work by Fatimah, Raven and Arora (2015) is an exception to this observation. They analyse why small-scale biodiesel pilot projects in Indonesia were stalled, arguing that this is due to misalignment between the design of the project and the actual practices that took place when the project was running.

products" of the process of producing biodiesel are used or not, and depending on whether the crop was irrigated because irrigation, in their research area, required the use of a pump-set based on diesel. Achten et al. (2010) calculate that in the case of a 'small scale, low-input jatropha biodiesel system established on wasteland in rural India', a '55% reduction in Global Warming Potential compared to the reference fossil-fuel based system' could be observed (p. 3652). While these studies do register the multiple voices of CO_2 particles to some extent, namely by mentioning the circumstances within which particles CO_2 to come to existence in smaller or larger quantities, they could be improved in two ways. First of all, I would argue that more importance needs to be attributed to the wide diversity of methods used to grow biodiesel crops in order to understand the many ways in which CO_2 particles come into existence, because if CO_2 emission reduction is a goal of India's policy on biodiesel or of biodiesel innovation processes, and if this emission reduction only takes place in specific circumstances, policy and innovation decisions should take this into account. This means taking serious how CO_2 emissions are afforded by the many different entities those particles can be associated with, including the type of soil in which a crop is grown, the inputs such as fertilizers and pesticides used to cultivate the crop, machines that could help to speed up the harvesting procedure, different types of oil expelling methods, and crucially: the previous and alternative practices that could take place instead of raising a biodiesel crop variety on a particular piece of land. This leads to the second point, which is that by following a Pongamia tree through its life, it became clear that these trees are usually planted on land that could have been used to grow fruit trees or timber trees. Such trees absorb CO_2 particles, turning them into building blocks for their stems, branches, leaves, fruits and other parts. Burning oilseeds turns such building blocks back into CO_2 particles (with the help of oxygen, and releasing a number of other particles in the process as well). However, if a farmer uses the tree to make furniture, doors or windows for his house, the CO_2 locked in the tree's

timber does not get released.[62] These observations are largely absent from existing work on CO_2 emissions in relation to biodiesel production, but they should be taken into account in biodiesel politics, knowledge-making and decisions on innovation trajectories.

My research also brought to the fore some voices of farmers that were not very clearly audible in the existing literature.[63] Past research for example studied why farmers discontinued the cultivation of jatropha. Axelsson et al. (2012) investigated farmers' expectations of the crop, their knowledge about the crop and their experiences when growing it. They conclude by making recommendations how farmers can be convinced to take up jatropha cultivation again. However, they do not question whether or not growing jatropha would be more beneficial for smallholder farmers (according to those farmers themselves) rather than taking up other activities on their land. Ariza-Montobbio and Lélé (2010) do analyse to what extent growing jatropha may be beneficial for farmers, and conclude that the crop would impoverish "poor and socially backward farmers" (Ariza-Montobbio and Lélé, 2010, 189). In my own fieldwork, farmers' understanding of the extent to which growing biodiesel crops rather than using their land for other purposes figured prominently. Many farmers participated in the Bio-Fuel Park's activities hoping to gain benefits such as a wider network and new knowledge. But they only did so to a limited extent: while many planted

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[62] Of course, the human labour, and perhaps the use of electric/diesel-run tools does release CO_2 from sources other than the tree itself. When doing an LCA to compare CO_2 emissions of burning oilseed-bsed biodiesel to using the tree itself for furniture while growing a new tree in its place, such processes may also need to be taken into account.

[63] An exception is that it has been widely noted that many farmers have objections to the use of village grazing lands – referred to as wastelands in India's biodiesel policy – to grow biodiesel crops because of the many uses this land has to them (e.g. Baka, 2014; Lahiri, 2009; Lavanya, 2009; Ravindranath et al., 2011). Indeed, India's policy on biodiesel does require consultation with local government bodies before land can be used for the cultivation of biodiesel crops (Government of India, 2009).

some biodiesel crop seedlings on land that was not used to grow other trees at the time, they did not take much care of the young seedlings for the simple reason that they preferred to grow timber or fruit trees, which they said were much more useful to them. Collecting oilseeds was done as much as before the Bio-Fuel Park project came to the area because of the many difficulties encountered when collecting the seeds and because of the availability of more remunerative work in the area. Most farmers who did collect seeds preferred to sell them at local markets rather than to the project's field staff because the rates were equal while selling at the local market was easier (no need to coordinate seed collection with others in the village to get together a sizeable amount of oilseeds for the staff to come and pick it up) and gave fast access to money that was needed for basic household expenses such as soap, sugar and salt. Similar to the multiple voices of CO_2 particles highlighted above, these concerns raised by farmers should be part of knowledge-making, policy-making and innovation processes on biodiesel, rather than being dismissed on the grounds that calculations based on assumptions and data coming from test fields show that farmers could earn a decent income from growing biodiesel crops (e.g. Pandey et al., 2012).

Secondly, this thesis makes a start in filling an important gap in literature on biodiesel with regards to the potential of small-scale biodiesel production projects with a high level of community involvement. Such projects have been associated with a number of promises, such as having a low environmental impact, no competition with food production, reduced rural poverty and enhanced access to energy (e.g FAO, 2009; Energia, 2009; Pandey et al., 2011). However, these promises are largely based on conjectures, calculating or imagining what could be possible in "ideal futures" if things work out according to the wishes of project planners. This ignores the relational agency of all entities that have to be enrolled in project planners' programs if their promises are to materialize. However, the importance of these entities' relational agencies was prominently visible in Hassan district. For example, the benefits from growing fruit trees and timber trees, namely access to large amounts of cash in the future and

access to fruit, made farmers much more keen to grow such trees than to grow biodiesel trees. The size of the Pongamia tree, the thorny plants that tend to grow under the tree, the low weight of the seed, and the seed's seed coat make the process of collecting seeds and preparing them for sale at the market an arduous process. All of these relational affordances, and more as shown in chapters four, five and six, contributed towards difficulties in the project in terms of its ability to raise farmers' income and producing biodiesel from oilseeds that were grown and collected thanks to the project's efforts: the project currently produces biodiesel from seeds that are likely to have anyway been on the market, and which would normally have been sold to others such as soap producers. Understanding the role of these relational affordances was especially useful in a place in which there are large income inequalities and a lot of people with low income: many studies on the economic viability of growing biodiesel crops are based on data produced in test fields. In such test fields, resources such as water, diesel to operate pump sets, pesticides, fertilizers and even time for maintenance of the plantation are mostly readily available. This contrasts sharply with the situation in which smallholder farmers in villages in Hassan district, having a much smaller budget for farm maintenance than the researchers running test plots, had to raise their biodiesel crops. This matter in the making, the way in which farmers can raise their biodiesel crops, should be taken into account for the purpose of knowledge-making, policy-making or taking decisions on innovation processes.

Thirdly, most of the literature on biodiesel reviewed in this thesis asks questions such as: what are the implications of large-scale/small-scale/any kind of biodiesel crop cultivation? How can biodiesel be made to work? Yet as highlighted above, biodiesel production creates various kinds of competition. Similarly, Baka and Bailis (2014) observe that existing uses of land categorized as wasteland, namely growing and harvesting *Prosopis juliflora* wood, would be compromised if those lands get turned into plantations of jatropha, pongamia or another biodiesel species suitable for biodiesel production. Such observations raise different questions, namely: which practice would respond most democratically to the needs of entities

involved in a specific socio-material situation? Which potential use of a particular piece of land or other inputs (seeds, perhaps water, fertilizer etc) would best meet the needs of various groups of entities that take an interest in those inputs? These entities may include people living near the land, making use of it at the moment or having an interest in making use of it, people concerned with climate change, animals living on the land, plants that need those inputs to grow, etc. Answering these questions requires opening up possibilities rather than closing them down (prematurely).[64]

Reflection and Avenues for Future Research

In this section I will reflect on the relationship between my empirical and theoretical propositions, on some of the strengths and weaknesses of the methodology used and on the insights gained and missed through the theoretical approach proposed in this thesis. Based on this reflection, I will also make some suggestions for future research.

As highlighted by Jensen (2014), 'the conceptual' and 'the empirical' are not separate categories, but rather form unstable hybrids. When doing research, it is impossible to avoid conceptual-empirical mixtures. This is quite clearly visible in my research. For example, the discrepancy between my own observations of biodiesel feedstock cultivation on the one hand and the accounts I read thereof in academic literature and heard about during the conversations that were part of this research on the other hand partly informed the formulation of the four criteria on democracy. These criteria are also based on my understanding of actor-network theory, which played an important role in my decision to focus on the behaviour of both human and non-human entities in biodiesel feedstock cultivation. This focus took

[64] An example of what I consider to be premature closure with regards to biofuel research in Europe could be the work of Gerssen-Gondelach (2015). She argues that so-called smart innovations in agriculture can free up 4-25% of agricultural land in the east of Poland, and that this land should then be used to meet about 1,5-4% of fossil fuel use for transportation in Poland.

part in bringing the discrepancies that partly informed the formulation of the criteria on democracy to the fore. Furthermore, a specific feature of this controversy has been that actual biodiesel production was low, and the suggestion to focus on matters in the making rather than matters of fact partly arises from this specific feature: if you only study the static outcomes of India's biodiesel policy and projects, there will be very little to observe in this case.

My methodological choices also had their implications for both my empirical and my conceptual contributions. This thesis is based on a wide range of qualitative research methods, including archival document analysis, conversations with important actors in India's biodiesel policy-making arena, ethnographic fieldwork in farmers' fields and homes and the analysis of research papers, policy documents and reports. This approach was suitable for the purposes of this project: through slow movement, I was able to follow how entities came into being and to understand the roles played by entities' socio-material entanglements therein. Bringing this to the fore contributed to my suggestion to call such process-based forms of knowledge "matters in the making". However, if the aim is to strengthen entities' voices, it could be very helpful to articulate them through numbers along with the descriptive articulations as provided in this thesis, doing qualculation (cf. Callon and Law, 2005). For example, Baka and Bailis' (2014) calculations and comparisons of the energy yield from the current prosopis economy versus the jatropha economy as proposed by the state government of Tamil Nadu raises the voices of a number of entities that were hitherto mute, and fortifies the stance that trade-offs with existing practices need to be considered: they do not only show that there are trade-offs when jatropha cultivation would be promoted, but that this particular trade-off with the prosopis economy is actually more productive in terms of the energy harvested through the collection of prosopis wood or jatropha oilseeds. Of course, deciding which parameters matter, which calculations are done, how those calculations are done and how they are used should be subject to a democratic process. The example of the work by Baka and Bailis (2014) only allows some possibly interested entities to raise their

voices, but the authors do not explicate that their calculations are conditional on the entities that took part in these calculations, the choices made and the methodologies used.

Furthermore, while I spent a few days at different research institutes' test plantations, the bulk of my fieldwork on the physical production of biodiesel took place in one specific project, called Hassan Bio-Fuel Park. Thanks to the willingness of farmers in the area to talk to me, letting me participate in their day-to-day work and allowing me to roam through their land, I observed a wide range of material diversity among the ways in which oilseeds (oilseeds that were ready to be sold on the market) came into being in different farmers' households (and even among individuals within those households), different kinds of land, different climates, and so on. While the material diversity presented in this thesis is likely to be a useful starting point for others trying to understand growing biodiesel crops elsewhere, there are still many ways of bringing these oilseeds into being which I did not study. These include large block plantations on lands referred to as wastelands with low inputs, companies running small or large intensively managed plantations, smallholder farmers growing biodiesel feedstock crops through a contract system etc. And there is probably a lot of diversity to be found among each of these categories. If an entity's voice is afforded by its socio-material entanglements, carrying out fieldwork in these different settings (different from those encountered in Hassan Bio-Fuel Park) is likely to raise different voices. Hence, knowledge about these different matters in the making should inform policy-making and biodiesel innovations as well.[65]

In addition, my work engaged little with policy-making procedures, the roles of institutions in innovations and wider demands placed on researchers (or

[65] Of course there is already a lot of literature on these different organizational models, based on fieldwork carried out in various parts of the world and highlighting these models' impacts on economic benefits, water availability, income inequality, greenhouse gas emissions etc (e.g. Kesari and Rangan, 2010; Lahiri, 2009; Ariza-Montobbio and Lélé, 2010; van Eijck et al., 2014). What I argue for here is to study these different organizational models through the lenses of matters in the making.

other human and non-human actors) for example in terms of research funding availability, just to mention a number of specificities that may distinguish policy-making, knowledge-making and innovation processes from each other. In the theoretical innovations proposed in this thesis, I did not distinguish between these groups of processes: I do not treat any of these practices as being substantially different from the other two. The making of knowledge is always intertwined with the politics of making choices (which is commonly understood to be the basis of policy-making) (cf. Wickson and Wynne, 2012), while choosing paths in innovation processes is in essence no different from formulating policy: both are informed by the weighing of different actors' interests and knowledge-politics hybrids which Latour (2004a) calls factishes. Or, following Jasanoff (2004), science and social order are co-produced and therefore the two processes cannot be disentangled completely. However, it may be useful to distinguish between policy-making, knowledge-making and innovation processes for a specific socio-ecological controversy such as India's controversy on biodiesel and to adjust the criteria of articulating propositions democratically to each of the three. For example, knowledge-making may be more explorative in nature than policy-making geared toward producing a policy-document. Innovation processes may have an explicit goal. For example, Hassan Bio-Fuel Park focussed on innovations in the field of raising feedstock with the explicit goal of producing biodiesel and improving farmers' lives.[66] Knowledge-making does not necessarily have such an explicit goal. An investigation of the material specificities of each of these three practices, and their implications for these criteria could be a fruitful and interesting avenue for future research.

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[66] On the premises of the Hassan Bio-Fuel Park research station, innovation was also going on in the fields of oil expelling and transesterification. However, this thesis does not cover these two aspects of biodiesel production because feedstock production in itself is already a large challenge, and because there is no biodiesel production possible when there is no feedstock available.

With this thesis, I hope to contribute to the empowerment of those who have been unable to raise their voices so far. Besides writing this thesis, I have for example discussed my observations with policy-makers in Karnataka state, raising the voices of entities that were hitherto mute. I also presented my work to a group of young environmental journalists in Karnataka state, who were surprised to hear my account on Hassan Bio-Fuel Park because news coverage on this project had only been positive so far. One may argue, however, that this thesis and the concept matters in the making addresses power differences insufficiently to truly contribute to this empowerment. If an incumbent entity's ability to enrol others into its project is much bigger than that of entities aspiring to join, the incumbent entity will not allow itself to be perplexed by the voice of the new entities. Neither will the incumbent entity allow those new entities to challenge and recompose the composition at hand. Hence, I would suggest that future research on the way in which some entities become powerful – through the socio-material associations that enable them to enrol others into their programmes – while others are less able to do so or even get silenced in the specific case of biodiesel would be a useful contribution to the agenda of biodiesel democratization that this thesis sets out to encourage.

Furthermore, the voices of policy-makers, innovators and researchers with respect to their view on what would be a good policy-making, knowledge-making or innovation process are rather silent in this thesis. They do not only afford other entities to raise their voices, but of course they also have their own (socio-materially entangled) voices. This means a wide range of issues remain unaddressed, such as: what kinds of knowledges do policy-makers and innovators consider useful, and why? How do they make use of these knowledges in the process of creating policy and innovations? There is a wide body of literature which suggests that these processes are anything but linear (e.g. Keeley and Scoones, 1999; Dunlop, 2014; Jordan and Russel, 2014; Cowell and Lennon, 2014), so if policy-makers and innovators are to take any interest in matters in the making, as I suggest they should, it is necessary to know more about the ways in which knowledge plays a role in the decisions these actors take. Of course, this does not mean that

knowledge based on matters in the making should be completely adapted to the needs of these key actors; that would mean that their needs cannot be challenged.

In addition, one could argue that this thesis slows down solving some very urgent problems (and that this wastes the precious time of those in charge of addressing these problems): alleviating poverty, improving India's economy by avoiding fossil fuel imports and particularly combating climate change (e.g. Hommels et al., 2007; Hajer et al., 2015). Others may object that stakeholder participation may not take place at all if a large multiplicity of voices needs to participate in addressing an urgent problem. However, as Stirling (2008) argues, if decision-making takes place based on closing down rather than opening up for deliberation, then the incumbent policy-making actors get to make the decisions through a process in which a wide range of issues remain covered. Opening up the deliberation brings to the fore – as this thesis has also shown – alternative questions, neglected issues, marginalized perspectives, ignored uncertainties and much more. Even if this is a difficult process, with a wide multiplicity of voices participating, this should be done: if not, current inequalities may be reproduced or worsened.

However, if the reader is interested in this thesis' proposed approach to democratization, there would be three more interesting chances for further research. First of all, in chapter six, this thesis argued that Stilgoe et al.'s (2013) four dimensions of Responsible Innovation overlap with the first and second criteria democracy criteria proposed in chapter three, and that these democracy criteria can therefore be used to study the empirical case of Hassan Bio-Fuel Park in order to enrich the Responsible Innovation approach. An interesting avenue for future research would be to use the democracy criteria for a deeper reflection on the theoretical approaches and empirical practices in the Responsible Innovation literature and research programmes. How do the ideas and practices of research projects, funded by programmes that aim towards Responsible Innovation, actually measure up to the democracy criteria? Secondly, in my own attempt to document matters in the making, I have written a story in chapter four and described

my observations in chapters five and six. However, there are many ways in which matters in the making can be represented. Ideas include, but are not limited to, visualizations of actor-networks or sets of equations. Each of these options would create a new association (or new associations) with the matters in the making at hand, and hence alter their voices (Latour, 2005). It would therefore be useful to study these alterations as they take place through the use of different ways to present matters in the making, and to what extent they meet the criteria of democratization. Doing this through action research would be particularly interesting, because it also allows for a better articulation of the relationship between the observer and the observed along with the relationship between the observed and its representation through particular ways of documentating in order to document how the observer, the observed and the representation of the observed co-constitute each other (Chataway, 2001). Thirdly, as highlighted in these reflections, the theoretical propositions co-emerged with the empirical material presented in this thesis. Hence, it is important to see what happens when the democratization approach presented here is used to understand and democratize other socio-ecological controversies.

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Appendix: List of Conversations

29-09-2012	SPWD	Viren Lobo
25-09-2012	Institute of Green Economics	Promode Kant
26-09-2012	Ministry of New and Renewable Energy	V K Jain
26-09-2012	Ministry of Rural Development	A K Gautam
27-09-2012	Indian Railways Organization for Alternative Fuels	Anil Kumar
28-09-2012	National Oilseeds and Vegetable Oils Development Board	M. Paramathma
01-10-2012	Cambridge University alumnus	Shailesh Nagar
01-10-2012	German Development Institute	Nilanjan Ghose
03-10-2012	The Energy and Resources Institute	Bhushan Tripathi
05-10-2012	Honeywell	Anjan Ray
08-10-2012	Centre for Science and Environment	Arnab Dutta
08-10-2012	Ministry of New and Renewable Energy	A K Dhussa
08-10-2012	The Energy and Resources Institute	Varghese Paul
09-10-2012	Indian Council of Agricultural Research	S K Tandon
09-10-2012	Ministry of New and Renewable Energy	Ajit Gupta
10-10-2012	The Energy and Resources Institute	Alok Adholeya
10-10-2012	Indian Council of Agricultural Research	A K Singh
10-10-2012	Individual entrepreneur	S K Panigrahi
11-10-2012	Confederation of Indian Industry	Suprotim Ganguly
11-10-2012	GRAIN	Shalini Bhutani
11-10-2012	The Energy and Resources Institute	A. Goswami
08-11-2012	MS Swaminathan Research Foundation	E. Palanisami
09-11-2012	AHIMSA	R Kanakaraj
09-11-2012	MGR	Alagarsamy

12-11-2012	D1 Mohan Bio Oils Ltd	A Duraiswamy
12-11-2012	Karnataka Forest Department	A K Varma
16-11-2012	Ashoka Trust for Research in Ecology and the Environment	Sharad Lélé
17-11-2012	Karnataka State Biofuel Development Board	Y B Ramakrishna
17-11-2012	University of Agricultural Sciences	Balakrishna Gowda
19-11-2012	Metahelix	K K Narayan
19-11-2012	Greenpeace	Manish Ram
20-11-2012	Rashtra Bandhu	B N Sureshwara
21-11-2012	Karnataka Forest Department	Yellappa Reddy
21-11-2012	National Law School	M K Ramesh
22-11-2012	Karnataka Renewable Energy Development Ltd.	A Selvaraj
22-11-2012	Karnataka State Biofuel Development Board	Divakar Rao
23-11-2012	Karnataka Forest Department	G V Sugur
26-11-2012	JOil	6 people
27-11-2012	Tamil Nadu Agricultural University Forest College	K T Parthiban
27-11-2012	Tamil Nadu Agricultural University Forest College	V Murugappan
27-11-2012	Tamil Nadu Agricultural University Forest College	J Sudhagar
29-11-2012	Synchron Group	Sriram Sankaran
29-11-2012	Tamil Nadu Agricultural University Department of Bioenergy	P Venkatachalam
30-11-2012	TNAU Centre of Excellence in Biofuels	M Paramathma
02-12-2012	Bannari Amman Sugars Ltd	Manivel Durai
03-12-2012	Tamil Nadu department of agriculture	Arunangai
03-12-2012	Tamil Nadu department of agriculture	R Gnanazhi
03-12-2012	Tamil Nadu Planning Commission	Sugato Dutt

04-12-2012	Tamil Nadu Planning Commission	Jaganmogan
04-12-2012	Tamil Nadu Department of Rural Development	Lakshmipathi
05-12-2012	Southern Railways	C E Sateesh
05-12-2012	Southern Railways	V P Muralidharan
07-12-2012	University of Hyderabad	P Seshagiri Rao
08-12-2012	Anthra	Asha
08-12-2012	Deccan Development Society	Jayasri
10-12-2012	Centre for Sustainable Agriculture	Ramanjaneyulu
10-12-2012	Andhra Pradesh Forest Department	Prasada Reddy
10-12-2012	Andhra Pradesh Department of Rural Development	Purushautam Reddy
11-12-2012	ICRISAT	Suhas P. Wani
11-12-2012	Nandan Biomatrix Ltd	C S Jadhav
12-12-2012	Directorate of Oilseed Research	S L Mehta
12-12-2012	Directorate of Oilseed Research	M Padmaiah
12-12-2012	Southern Online Bio Technologies Ltd	B S Reddy
13-12-2012	University of Hyderabad	Vasuki Belavadi
09-04-2012	Planning Commission in 2003	D N Tiwari
09-10-2013	Environmental Support Group	Leo Saldanha
10-10-2013	ATREE	Sharad Lélé
10-10-2013	University of Agricultural Sciences Bangalore	Balakrishna Gowda
24-10-2013	Hassan Bio-Fuel Park	Haleshi
23-01-2014	Hassan Bio-Fuel Park	Raghu
27-01-2014	Karnataka State Biofuel Development Board	A K Monappa
21-02-2014	University of Agricultural Sciences Bangalore	K T Prasanna

Summary

Biodiesel is a form of diesel which is based on vegetable oil rather than fossil oil. Throughout the world, biodiesel has been proposed as a technology that is renewable, that may contribute towards reducing climate change and that may be economically profitable. These claims are subject to controversy. For example, there are concerns about the extent to which growing feedstock for biodiesel production competes with food production, and about land-grabbing in the name of biodiesel production. In 2009, the Indian government came out with a policy on biodiesel after six years of research, innovation and societal controversy. This period started in 2003, when India's Planning Commission published its National Mission on Bio-Diesel that enabled the allocation of sizeable government funds to research and production of biodiesel. Specific in India's approach was that it claimed to avoid competition with food production by using non-edible crops, particularly *Jatropha curcas*, but also other such as *Pongamia pinnata*, on what were called wastelands, and that biodiesel should be used to replace fossil fuel import while many other countries in the global South aimed to export the biodiesel they produced.

In this thesis, I am concerned with the extent to which knowledge-making on biodiesel, biodiesel innovation processes and policy-making on biodiesel in India can be considered democratic. This concern is fuelled by ongoing controversies on this topic. Furthermore, early on in my research I observed that existing documentation on biodiesel is rather silent on a number of important points. There is especially very little engagement with the practice of growing biodiesel crops in small-scale settings. Yet, such material practice informs the extent to which smallholder farmers consider biodiesel cultivation as beneficial to them, or the extent to which growing biodiesel crops may be considered as environmentally-friendly. This is what I mean with the words 'socio-material entanglements' in the title of this thesis: farmers' voices on the extent to which they consider biodiesel cultivation as

beneficial to them does not come out of the blue. These voices are informed by the way a farmer practices farming and by all the entities to which this farmer is related while doing so. Such (human and non-human) entities may for example include soil, crops, water and rainfall, neighbouring farmers, and sunlight. In this thesis, I consider all of these entities, both human and non-human, as having the ability to act. For example, if a lack of rainfall kills a one-year-old biodiesel seedling, a farmer may regret having planted the seedling. In this case, the lack of rainfall and the seedling's sensitivity to drought play an active role in making the farmer come to regret his earlier decision.

Before I analyse India's contemporary policy-making, knowledge-making and innovation processes on biodiesel, this thesis travels to the past to study the category wasteland and its material voices in relation to policy-making on land in colonial British India. The category wasteland plays an important role in the contemporary legitimization of India's biodiesel activities and has been heavily contested by activists and some researchers. This contestation has been ongoing since the category was introduced to India along with a host of overlapping categories such as jungle and non-revenue yielding land by the British colonizers in the 18th century. In chapter two, I analyse how the diverse lands referred to as wasteland by colonial administrators participated in controversies on categorizing land as wasteland through their associations with entities like people using these lands and the lands' outgrowth. Furthermore, I study to what extent this informed policy-making on those lands. For example, I show how the material diversity among lands classified as wasteland and jungle played a part in the decision of an important colonial administrator, named John Shore, to argue for a slower introduction of a new land-policy that would radically alter land rights and land use patters, called the Permanent Settlement of Bengal. Namely, he argues that more time is needed in order to be able to take into account the enormous diversity of these wastelands and set tax rates that correspond to this diversity. Additionally, I analyse letters between local administrators on land disputes, which show that lands categorized as wasteland and jungle were in fact not waste but used for a wide range of

purposes and inhabited by all sorts of entities such as wild beasts, humans, trees and shrubs. In doing so, I bring to the fore how alternative realities were very much alive during controversies on wastelands, and that the materially diverse lands classified as waste (or jungle and other related categories) and their outgrowth were at times able and allowed to speak by some colonial administrators. These observations are important for the present-day controversy on biodiesel, for they remove some of the category's contemporary power, open up space for contestation not only by humans but also by non-humans such as wastelands and their outgrowth and hence more democratic policy-making.

The third chapter analyses the relationship between the societal controversy on biodiesel in India between 2003 and 2009 and India's 2009 biodiesel policy, and studies to what extent the policy-making process can be considered democratic. To do so, this paper first of all develops a set of criteria based on work by Bruno Latour and Isabelle Stengers. The first criterion is that all interested entities, including entities that were hitherto mute, should be able to speak. Secondly, these entities should be able to play a part in the making of the policy at hand. Thirdly, a democratic policy should register the diversity of entity's voices. Fourthly, such a policy should not be easily transferrable from the socio-ecological situation in which it was created to other socio-ecological situations, which inevitably include entities that have not yet had a chance to raise their voices in relation to the policy at hand. This chapter shows that some voices, such as those of jatropha plants that did not live up to expectations of their yields, indeed got to play a part in the making of the policy at hand. However, there are also many voices, such as those of farmers being reluctant to harvest oilseeds because it is time-consuming and difficult work, which do not get raised at all. Important differences between some entities' voices were removed. For example, CO_2 emissions can be produced in very different amounts depending on the biodiesel production methods used, and may even be higher than when using fossil diesel. Yet, the policy simply ended up stating that the CO_2 emissions of biodiesel are always lower than of fossil diesel. Lastly, the policy proposes that it should contribute towards energy security,

climate change mitigation, employment opportunities and environmentally sustainable development. This clearly delimits the socio-ecological situation in which the policy should apply. For example, large-scale plantations using a lot of inputs and machinery would not contribute very much (or not at all) to climate change mitigation, employment opportunities and may even be environmentally damaging. Yet, the policy does include recommendations for such production practices, which shows that in practice, this proposition does not delimit the socio-ecological situation in which the policy should apply.

The fourth chapter presents a story about a pongamia tree in a biodiesel project called Hassan Bio-Fuel Park in the south Indian state Karnataka. This tree yields oilseeds that can be used for the production of biodiesel. Most biodiesel produced in Hassan Bio-Fuel Park is based on pongamia oil. Hassan Bio-Fuel Park is a research station that aims to study biodiesel production and develop innovations within that field. It also plays an active role in biodiesel policy-making. To enable the production of biodiesel from oilseeds, the project distributes seedlings to farmers free of cost, and engages with farmers in order to convince them to grow these seedlings on parts of their land which they do not use for agricultural purposes and to collect the tree's seeds. The story presented in this chapter follows the life-journey of a pongamia tree that is born out of a seed in the nursery of Hassan Bio-Fuel Park and ends with biodiesel produced from this tree's seeds being burned in the engine of a bus in Bangalore. However, I do not only write about the particular life this tree had, but also about the life that this tree could have had, depending on the many associations it could have built with entities it encounters along its life-trajectory. For example, the seedling could have died early on in its life, it could have been cut by farmers who want to sell the tree's stem and trunk to brick-makers to earn money, or the seeds could have been used for soap production.

Chapter five draws on this story and the idea that action arises not from the inherent capacities of a human or non-human entity but from the way in which this entity is socio-materially entangled, as explained above. It uses

these insights to examine a popular and politically powerful approach to study the effects of a change in practices on the usefulness of environments for humans: the ecosystem services framework. Scientists working with this framework would say they study the impacts of an intervention on the services that an ecosystem can provide to humans. I show how the framework's fixed categories of ecosystem services (provisioning, regulating, supporting and cultural) and aspects of human well-being (rural development, energy security, food security, health, land tenure and gender) make it difficult to document all the changes in ecosystem services and human well-being which I observe in chapter four. For example, one of the benefits which participating farmers gain from participating in the project is broadening of their network. This enables them to gain better access all sorts of benefits, such as government subsidies. To address this, I suggest increasing the flexibility of the framework by including space to document unexpected effects that may be rendered visible through exploratory, qualitative fieldwork that precedes the quantitative methods that are commonly deployed by researchers using the ecosystem services framework. More importantly, I show how using the ecosystem services framework in research has the effect of muting the voices of a wide range of relevant human and non-human entities and argue that this framework cannot be considered very democratic following the democracy criteria proposed in chapter three. Namely, Hassan Bio-Fuel Park barely has any impacts on the framework's pre-defined categories of human well-being and ecosystem services because it fails to actually increase the production of oilseeds by farmers. Yet, the voices of entities that participate in the creation of a lack of impacts, such as the tree's material characteristics that make collecting seeds an arduous and time-consuming task, are not documented in the framework. To address this, I suggest not just documenting a projects' (static) impacts, but documenting what I call 'matters in the making'. A matter in the making is dynamic, and does not focus on an actor's inherent, static characteristics but on how an actor and its actions are created through the relations it has with others. In the specific case of the ecosystem services framework, this would entail documenting how a lack of impacts was

created in Hassan Bio-Fuel Park. Doing so would raise the voices of entities that participated in creating this lack of impacts. And this is important, especially when research results are being used by policy-makers: documenting a lack of impacts alone is not very informative, while understanding the circumstances that created this lack of impacts can tell you something about whether a similar project could be made to be more productive or not.

In chapter 6, I use the insights gained about Hassan Bio-Fuel Park and the concept matters in the making to reflect on a theory called Responsible Innovation (RI), which studies how innovation processes can be made more responsible, leading to environment-friendly, pro-poor and profitable outcomes. Hassan Bio-Fuel Park aims to contribute towards such outcomes with the biodiesel innovations they are developing. Using the concept matters in the making to understand how biodiesel innovation as proposed by the researchers in this project is and is not taking place in farmers' fields as part of this project, I bring a wide range of issues to the fore that make innovating responsibly very difficult in this case. For example, the low availability of water due to disturbed rainfall patterns and the financial and environmental cost of irrigation facilities kills most seedlings within two years after planting them. People's preference to work for daily wages is created by a labour shortage in the area that raised daily wages and the material difficulty of collecting seeds created by, amongst others, the tree's height, the seeds' light weight (due to which many seeds have to be collected) and the thorny shrubs growing under the tree. This raises concerns over the extent to which Hassan Bio-Fuel Park's project will ever be able to do biodiesel innovation democratically, following the democracy criteria proposed in chapter three. Therefore, discontinuing this particular innovation might be more responsible than continuing to try and improve the ongoing innovation. However, the RI literature is surprisingly silent on how such a decision could be taken in a responsible innovation process. This leads to a call to pay more explicit attention in the RI literature towards the way in which decisions on how to continue or discontinue an innovation process can be taken democratically and responsibly.

About the author

Evelien de Hoop was born on 30-05-1987 in Nieuwegein, the Netherlands. She studied at University College Utrecht in the Netherlands between 2005 and 2008, where she obtained a BA focusing on anthropology and economics and a BSc focusing on earth sciences, biology and meteorology. As part of this programme, she studied at Masaryk University in Brno, Czech Republic, taking part in the Central European Studies Program. In 2009, she was awarded the Huygens Scholarship to take part in the Geography and the Environment MPhil programme at the University of Oxford, UK. She graduated with distinction in 2011 with a thesis entitled "Multiple Environments: the environmental subjectivities of rural South Indian students". In October 2011, Evelien started her PhD research at the School of Innovation Sciences at Eindhoven University of Technology, of which the results are presented in this dissertation. She presented her work at various conferences in Europe and India, including EASST/4S, EUGEO, IPA (Interpretive Policy Analysis), ESSHC (European Social Science History Conference) and ICCCR (International Conference on Climate Change Resilience, Pondicherry, India). She also completed the WTMC graduate program. Since the 1st of September 2016, Evelien is employed at the Innovation Studies Group of the Copernicus Institute of Sustainable Development, Utrecht University, where she works on the knowledge politics of experimenting with smart urbanism in the Netherlands.

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