Plant Politics: Forests and Climate Change in Italy and Mexico

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Linking Trees to Climate Change

The biological capacity of plants to incorporate carbon into their tissues has gained increasing attention as climate change has become a topic of international concern. Carbon has increasingly become the metric by which the warming capacity of other green house gases is measured (MacKenzie 2008), and a system of global green house gas accounting has been developed through the UNFCCC (United Nations Framework Convention on Climate Change). In this system, every form of land use is measured in terms of its contribution to green house gas emissions. Burning fields, caring for cows, converting forests to agriculture (or the inverse) are all being reckoned into a moral and political calculus by nation states around the world.

About 12 % of global carbon emissions currently come from land use change. (Corbera and Schroeder 2011), mainly in tropical and developing countries. This analysis has driven a vast array of REDD (**R**educed **E**missions through **D**eforestation and **D**egradation) policies, which address carbon emissions through land use change or agricultural practices, largely by compensating or teaching landowners and land managers to refrain from burning or clearing forest. This family of REDD policies (also known as REDD+ in the most recent formulations) acts we might say, to slow down one part of the carbon cycle, expanding a reservoir of biomass in order to somewhat reduce the portion of the carbon cycle which is resident in the atmosphere as carbon dioxide. In a sense, the carbon cycle is being domesticated as an entity that needs human care if it is to function properly. This domestication takes place through a particular set of government policies, and methods for imagining, measuring and acting upon landcover change. In this paper I will briefly touch on some work that I have been doing on REDD policies in Mexico over the last few years, focusing in particular on the role of the state in attempting to convene rural indigenous communities who own forests into policies which halt or avert the clearance or destruction of forests (Mathews 2013). I will then turn to consider, in much more detail, biomass energy policies in Italy, which curiously, also connect climate change to forests, albeit in very different ways.

Forests have been linked to climate change very differently in developed countries such as Italy, than they have in tropical and developing countries. In developed countries, the transition from biomass to fossil fuel sources of energy during the twentieth century caused an increase in forest area and total forest biomass. In these countries, and especially in the European Union, forests have become valuable to policy makers, because they can be used to address some part of each nation state's burden of reducing green house gas emissions. These policies, like REDD policies, seek to model landcover change and the related location of biomass across the landscape. However, rather than trying to slow down the residence of carbon in biomass stored on the landscape (as in REDD policies), European Union biomass energy policies try to speed up the cycling of carbon through forested landscapes, in order to produce heat and electricity, and replace the burning of fossil fuels in large power plants. I am currently half way through a year of fieldwork in Italy, with the aim of comparing how one European Union country has translated international commitments to reducing green house gas emissions, into actual policies which link forests to the global carbon cycle. In Italy and in Mexico, models of land cover change and of local forest management practices are linked to national carbon accounts in order to justify dramatically different policies.

At first it might seem that measuring forests in the name of abstract tons of carbon could become a kind of authoritative transparency, perhaps imposed upon poor farmers who will be prevented producing food, or perhaps driving land grabs by investors keen to scoop up carbon credits. The emerging literature on REDD policies suggests instead that REDD and biomass energy policies are but one more ingredient in existing political struggles over the state, landscape, and development. The anthropology of the state and of development has, over the last twenty years or so, showed us in some detail how state policies and development projects are renegotiated on the ground. Wonderful (or apparently wonderful) plans are reworked or utterly transformed in the long journey between the apparently simple good idea that inhabits the imaginations of planners, and distant forest landscapes inhabited by people who rarely do what they are told. In my own work in Mexico I have found that state forestry institutions are relatively weak and fragmented, with little ability to impose their will upon trees or upon people, and that forestry officials are notably willing to accommodate the desires of well organized indigenous forest communities and their NGO allies (Mathews 2011).

This paper is part of a larger comparative project in which I am considering how relatively ecologically similar forests have been linked to global climate models and national carbon accounts, in order to produce an apparently diametrically opposite set of policies. In Mexico, rural people, mainly indigenous farmers and forest owning communities, are being encouraged to *decrease* the burning and clearing of forests in order to increase carbon stocks on the landscape. In Italy, rural people are being encouraged to *increase* burning of forest biomass in order to decrease carbon stocks on the landscape and reduce carbon burned in industrial power plants. In both countries, forests are heavily anthropogenic, through long histories of human cultivation and abandonment. These histories have produced particular legacies as to what forests and the people who live and work in them are held to mean, and with regard to the species composition and form of trees and landscapes that have been partially structured by human desires. In both countries, these material and ideological legacies turn out to have a powerful effect upon forest policies, and upon the scale and temporality of the local management models which link particular forests to national carbon accounts and the global carbon cycle. In both Italy and Mexico international policy commitments to reduce national carbon emissions are linked to landcover change models of how forests are likely to change in the future. These models are in turn linked to smaller scale local models, in Mexico of REDD forest protection, and in Italy of biomass energy production. In these local models, hypothetical futures, known as baselines or business as usual scenarios, are used to demonstrate that carbon has been stored or appropriately burned. In both countries, these demonstrations depend critically upon the scale in time and space of the unit of forest that is held to be protected, burned, or otherwise altered. These scales have been notably unsettled, in response to pressure for academics, environmentalists and forest owners, who are attached to trees and landscapes and particular species.

To understand how and why biomass and energy policies take the form that they do, we need to understand the past of forest landscapes. Present day forest politics are profoundly affected by they ways that people have understood and worked in agricultural and forest landscapes. These understandings have, in turn, affected the structure of landscapes, the forms of the trees that remain upon them. In both Mexico and Italy, histories of profoundly human modified landscapes have given rise to present day forest

structures, understandings of forests, configurations of authority over landscapes, and enduring attachments to economically or culturally important species and management systems. As we shall see, both rural land users and actual trees are relevant actors in remaking or resisting national climate/forest policies.

Comparing ecologies, forests, and models

With all of the inevitable differences between tropical montane and temperate Mediterranean ecosystems, there are significant similarities between the ecologies of the montane pine and pine-oak forests of Mexico and the chestnut, oak, and pine dominated montane forests in Italy. These forests are all strongly affected by histories of human use plant species in these forests are well adapted to flourish in the face of human produced disturbances. Dominant tree species are notably well adapted to regenerate and grow in the face of human cutting and burning, and present day forests are the legacy both of heavy human use and of more recent agricultural abandonment. In both countries, forests have expanded and changed in unexpected ways, rather distant from the desires of foresters and people who work in and near forests.

In Mexico, montane pine and pine-oak forests, are dominated by tree species that are adapted to regenerate and grow in the presence of various intensities of natural and anthropogenic fire (Fule and Covington 1998; Rodriguez-Trejo and Fulé 2003). In most cases, the pine trees that dominate the forests of the Sierra Juarez of Oaxaca, where I have worked over the last ten years, can be directly traced to histories of agricultural clearance, agropastoral fire, and subsequent abandonment of forests. When I walk through these forests, old fences with barbed wire show where cattle were pastured only forty years ago. These are forests dominated by *Pinus oaxacana, Pinus patula*, and *Pinus pseudostrobus* which regenerate prolifically after fires, and grow rapidly on the bare mineral soils revealed by fires and logging. In these forests, oak species (*Quercus laurina, Q. rugosa)* are an important component, surviving and resprouting in the face of heavy human cutting for firewood. Over the last century, farmers and pastoralists have withdrawn from more distant fields and pastures, and forest area has increased dramatically, even as indigenous communities have taken control of logging and managing their forests (Mathews 2003), so that about 70% of Mexican forests are owned and managed by indigenous communities. These indigenous communities have mounted fierce pressure upon the climate/forest policies of the Mexican state, causing changes in the scale and temporality of the management models through which carbon storage are demonstrated and rewarded.

In Italy, in the provinces of Lucca and Pisa, montane chestnut and pine forests are the product of millennia of human cultivation. Sweet chestnut (*Castanea sativa)* was sponsored and protected by the republic of Lucca for over five hundred years, and is ideally adapted to flourish if cared for by humans who pollard, coppice, graft, and reshape chestnut groves. Nearby pine forests, dominated by maritime pine (*Pinus pinaster*) have also been planted and sponsored by people who have been concerned to produce timber for ships, and later for furniture and other industrial uses. Over the last century, chestnut orchards have been increasingly abandoned and converted to coppice forests, which are cut on twenty or thirty year cycles in order to produce firewood or poles. Pine and other conifer species continued to be supported by the Italian state until the 1980's, when their disease and fire susceptibility caused them to be largely abandoned. At present, this legacy of state sponsored forestry remains present in diseased

and fire prone pine forests on the Monti Pisani, south of the city of Lucca. Beneath these trees, resprouting stumps of ancient chestnut trees testify to the abiding vitality of peasant managed chestnut groves. Activists and promoters of chestnut cultivation in these forests have mounted a fierce campaign against cutting trees for biomass energy to supply electricity at large power plants. These activists support traditionally acceptable uses of firewood in households and small municipal heating plants dispersed across the countryside, calling into question the large biomass energy plants now sponsored by the Italian state in the name reducing carbon emissions.

Comparing biomass energy in Italy and REDD policies in Mexico reveals the impact of past forest uses upon present day forests and the politics of making forest/climate comparisons. In both Italy and Mexico the impact of tree cutting or protection upon the global carbon cycle is assessed by landscape modeling practices and national carbon accounts. These accounts are in turn linked to national and regional energy policies which link the nation state to the continued existence of forms of property, of energy subsidies, and of credible knowledge about where and of what composition forests are. In Mexico and Italy, different political cultures and imaginations about the future dictate how the state has tried to implement its biomass and REDD policies. In Italy, subsidies to encourage cutting forests for biomass energy production are translated through state mechanisms that seek to address the problem of rural agricultural abandonment, and the rise of agribusiness and industry in valleys and near rivers. In Mexico, REDD policies seek to prevent the destruction of forest by rural people, often (incorrectly) imagined by officials to be the primary cause of forest degradation and clearance. In Mexico, policies that seek to persuade forest owners to refrain from destroying their forests masquerade as a market that compensates landowners for the environmental services produced by their forests. In fact, this supposed market is a subsidy regime supported by World Bank and Mexican state money (Mathews 2013; Shapiro-Garza 2013) because there are neither willing buyers nor sellers for these services.

Mapping Stories REDD, REDD+ in Mexico

For officials and scientists who wish to demonstrate that Mexican forests have grown and absorbed carbon from the atmosphere, complex practices of mapping and imagination are required. Forests have to be mapped in the present, so that their future states may be modeled as a trajectory of plausible futures, in order to sell the difference between a hypothetical scenario and the observed amount of carbon stored in forests and forest soils. This difference is known, as 'additionality' and is the crucial metric which demonstrates that carbon has been stored in living trees across the landscape. Such projects might seem speculative and risky in the extreme, but they are anchored in practices of scenario building which are familiar to the financiers for whom the construction of a 'business as usual scenario' is a routine skill, taught in business schools. Crucially, scenarios are not direct forecasts of probable futures, they are intended not to predict but to assist decision making under uncertainty, to describe not what is likely to happen but what could *plausibly* happen (Cooper 2010). Even as REDD policies are supported by a science of calculation, mapping, and measurement, they also rely upon a science of story telling, of looking to the past to measure several past moments of the world, and then of turning to project this past into a range of plausible and credible futures. Modelers who try to

predict how forests might increase or disappear in the future have to imagine what kinds of policies and events might affect forests, uncertain events whose probability is incalculable, but which must be tamed by practices of principled doubt. Scenarios of land cover change are certified by scientific networks between Mexican and international scientists, and by the technical work of calculating coefficients of carbon storage in trees or of soil and vegetation reflectance. These scenarios also rely upon correlations of land cover change with socioeconomic models, theories about society, social difference, and ethnicity. Modelers must judge the likelihood of socioeconomic changes if they are to come up with a scenario that is credible to their peers, to their employers, and to financial backers[1].

The Vulnerability of Scenario Planning in REDD models

It would be easy to imagine that REDD plans are a kind of authoritative administrative transparency which will hurt poor people, forcing them to abandon their productive practices as some parts of the landscape become unavailable to food production. Certainly, this is a real concern. However, like other state development policies in the past, REDD policies have to be implemented by relatively fragile state institutions that work through local alliances. There are signs that REDD regimes are vulnerable to the imaginations and political organizing of audiences who imagine both the state which administers REDD programs, and the technological knowledge of the land cover change that underpins REDD programs.

The reasons for the shift from REDD to REDD+ are particularly telling in this regard. REDD, in theory, was supposed to compensate *averted deforestation* directly to individual land owners, through the practices of scenario planning that I have outlined above. REDD+, on the other hand, will reward a host of practices including improved forest management, reduced forest degradation, and landscape level carbon storage. The state is, in REDD policies, very much the convener of technical information of land cover change, but money is supposed to flow to the property owner identified by the cadastral map, with relatively little state intervention. In REDD+ policies, which have increasingly come to the fore since the UNFCCC Cancun climate conference in 2010 (Martin and Margaret 2011), the state re-emerges as organizing and supporting sustainable agricultural and forest management practices, including conservation, across the landscape. Organizing and convening landscape level monitoring and measurement of carbon stocks takes place both under REDD and REDD+, but the value of forest carbon is less directly captured by individual landowners in REDD+. In this model, the state acts as a source of subsidies and as an insurer of deforestation risk across the landscape, because it is at a regional or national level that total tons of increased carbon storage will be demonstrated to financial backers should there ever be a market in emissions reductions. The reasons for the shift from REDD to REDD+ illustrate the striking vulnerability of these state making projects to international events. The shift to REDD+ was negotiated at the UNFCCC meetings in Cancun in 2010, partially in response to pressure from forest rich countries. However, the shift to REDD+ in Mexico is also due

[1] It is also of course possible that the possible buyers of carbon credits are simply uninterested in whether actual carbon is removed from the atmosphere, so that the crucial business as usual scenario is no more than a demonstration of due diligence Lohmann, L. (2008). When Markets are Poison Learning about Climate Policy from the Financial Crisis, The Corner House**:** 68..

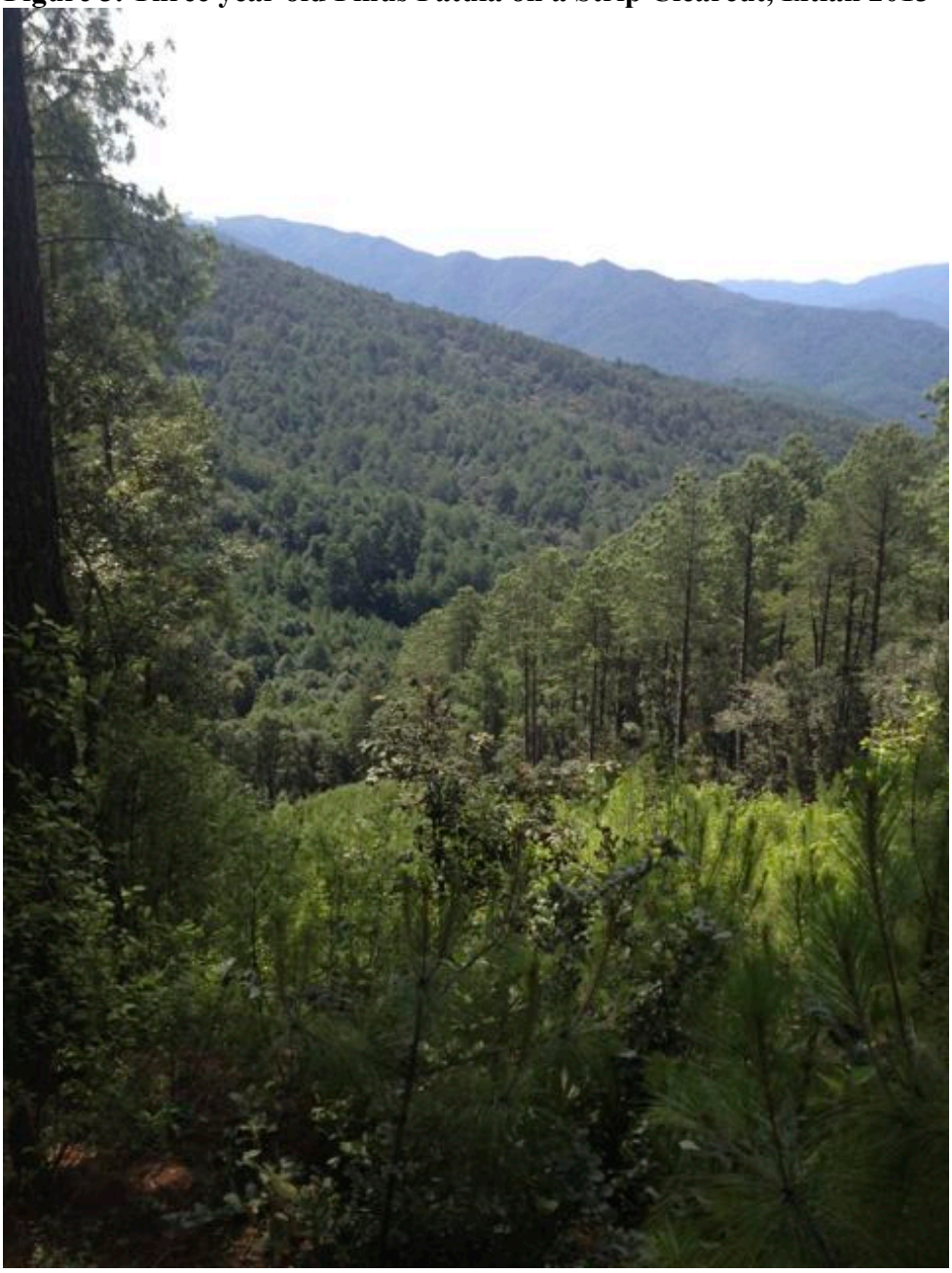
to the vulnerability of state forestry projects to national political pressures and popular imaginations.

Mexican environmental organizations have been skeptical of REDD approaches, partially because of the high administrative costs (much of rural Mexico lacks the kind detailed cadastral property map upon which REDD approaches are premised). Since I began work on REDD in 2008, environmental NGO's supportive of rural communities have heavily criticized the functioning of an existing payments for environmental services program (PSA), forcing forestry officials to modify not only the PSA program, but Mexico's official negotiating position on REDD+. A very active community forestry and environmental NGO sector has pressured the Mexican state to make sure that climate change policy channels funds into forest communities that already protect and manage their forests. These communities are the charismatic clients of state sponsored forestry in Mexico. Indigenous forest communities, among whom I have carried out research, are highly effective forest managers, the poster children for international researchers like myself, and for funding by sympathetic donors such as the World Bank. Through political pressure, occasional protests, and pacific occupation of government offices indigenous forest communities and their NGO allies have greatly modified environmental services programs (McAfee and Shapiro 2010). Through continued pressure on forest service officials, forest communities have pushed for the move from REDD to REDD+, ensuring that forest communities *who were already* protecting their forests would be compensated, if REDD+ should ever get off the ground. These forest communities, far from wishing to protect forests from all transformation, are deeply committed to working in and on forests, and especially, on the pine trees that sustain community logging businesses.

Figure 1. Young Pinus Patula and Pinus oaxacana on a strip clear cut, near Ixtlan de Juarez, Oaxaca, July 2013.

Figure 2. Strip clear cuts and young pine forest, Ixtlan de Juarez, July 2013.

Figure 3. Three year old Pinus Patula on a Strip Clearcut, Ixtlan 2013



Although compensating conservation and forest management practices flies directly in the face of the 'additionality' that REDD programs are supposed to ensure, Mexican forestry officials have rapidly moved to REDD+ formulations which channel resources towards their long term allies and interlocutors, the indigenous communities who care for pine trees in these montane forests. This is in part because of the political weakness of forestry officials, who need the credibility and glamor that the NGO and community forestry sector can provide. This was brought home to me in a striking way in the spring of 2011, at a conference on community forestry in Oaxaca. I had given a presentation on REDD approaches, and explained these might make it difficult to compensate forest communities for the work that they had already been doing in protecting their forests. Almost immediately, a nervous official announced to his audience of community leaders and environmental activists, that REDD+ would compensate the forest community sector. In a word, REDD+ locates the state as an insurer of deforestation risk across the landscape (because it is at a regional or national level that additionality is to be measured and demonstrated), while it allows officials to channel resources to the ecology of NGO's and forest communities who support or criticize the forest service.

Past land uses, present forest structures, and future forest politics in Lucca, Italy.

At present I am half way through a year of fieldwork in heavily forested mountains north and south of the city of Lucca, Italy. I have been reconstructing the past land use practices which have given rise to present day forest structures, and the present day ways that people use and understand forests. These are forests which were formerly heavily used and inhabited, and which have now largely been abandoned. These are not the landscapes which most people think of when I tell them I am working in northern Tuscany. These are landscapes often empty of people, but they are empty in a particular way, because evidence of former human uses is omnipresent. Abandoned houses, sometimes entire abandoned villages, and frequent abandoned chestnut smoking sheds (*metati*) are scattered through dense mountain forests, where the only remaining human visitors are mushroom pickers, hunters, and the occasional mountain biker. Many forests are what is known to foresters as *coppice*, (*ceduo)* an ancient management system which takes advantage of the capacity of some tree species to resprout from a stump. After millennia of human use, tree species (*Tilia, Acer)* which cannot easily be coppiced have largely disappeared from these forests.

In the Monti Pisani, only five kilometers south of Lucca, it is possible to be in a completely different world, only a few kilometers from the tourist sites of the city center, and the industrial sprawl of paper and furniture factories which spreads across the plain that surrounds the city. As in many Mediterranean places, mountains and valleys are near each other, but they are in many ways entirely different worlds. Few tourists visit these forests, and they do not form part of the images most people have of Tuscany or of Italy. I find walking through abandoned chestnut forests a little sad: dense chestnut coppices have relatively little structural or biological diversity and can be monotonous. It is especially the feeling of lack of care that makes these places somewhat melancholy. The forms of remaining large chestnut trees, as of the stools from which coppice shoots grow, are the result of centuries long encounters between farmers, animals, and chestnut trees.

Humans tried to sculpt trees into the particular forms that produced nuts and timber, while also providing sufficient pasture for sheep and goats.

Rising from near sea level to 900 meters above sea level the Monti Pisani were formerly covered with dense forests of sweet chestnut *C. sativa*, with fragments of remaining oak *Q. cerris,* and hornbeam *Ostria carpinifolia* (Regione Toscana Giunta Regionale 1998; Regione Toscana Giunta Regionale 1998). At lower elevations and on the much hotter and drier southern side that faces the city of Pisa, holm oak, *Q. ilex,* is common. In many of the lower elevations, plantations of maritime pine, *Pinus pinaster* have replaced chestnut. These pines were sponsored by the Pisan republic from the middle ages onwards, and then by the Italian nation state after reunification in 1860. As cultivated chestnuts began to be abandoned in the early twentieth century, the Italian state sponsored conifer plantations, and many chestnut orchards were felled and replanted with pine trees. Pines turn out not to have been such a good choice, as they are disease and fire prone. In recent years, diseased pine forests have been cut and chipped for biomass energy. Chestnuts, on the other hand, remain stubbornly present beneath the pines, as sprouts that emerge from ancient stumps, in an understory of bracken (*P. Aquilinum*) and *Erica arborea*. The story of climate change policy and forests around Lucca is entwined with the structure and political associations of these profoundly anthropogenic forests, where people and sweet chestnut came together to produce an agropastoral system that sustained large rural populations over the last 1500 years not only in Lucca (Puccinelli 2010), but across large parts of Italy (Giannini and Gabbrielli 2013).

For most modern day Europeans and Americans, chestnut is a food that is eaten only a few times a year, perhaps for stuffing from vacation Turkey roasts, perhaps roast chestnuts purchased from a street stall, or perhaps (to my taste much too sweet) *marrons glaces* in a holiday gift. It may come as somewhat of a surprise that chestnuts were formerly a staple food crop that sustained millions of people across the Mediterranean. In Italy alone, over 800,000 hectares of cultivated chestnut forest supported hundreds of thousands of smallholder farmers in around 1800, and abundant medieval and early modern documents record legislation, charters, and legal protections encouraging chestnut cultivation (Giannini and Gabbrielli 2013, Squatriti, 2013 #3202).

Chestnuts are originally native only to restricted areas of the high Apennines[2] and to Turkey, but in the late Classical and Antique periods, they were widely planted in mountains across the southern Mediterranean (Squatriti 2013), so that by the year 1000 they had become a prominent feature of the landscape, including particularly in the Apennine mountains that stretch from central to Southern Italy. Chestnut is not particularly effective at spreading across the landscape on its own accord. Too many animals like to eat chestnuts and they are too heavy to fall far from their parent tree. Humans however, like chestnuts a great deal, and have been willing to cultivate them far outside of the high elevation valleys to which they are best adapted. Chestnuts were desirable for early medieval farmers because of their multi-functionality and flexibility,

[2] There is considerable learned dispute as to whether chestnuts were introduced from wild sources in Turkey during the classical period, or whether it is also native to restricted areas in the high Appenine mountains of Liguria Mattioni, C., M. A. Martin, et al. (2013). "Microsatellite markers reveal a strong geographical structure in European populations of Castanea sativa (Fagaceae): Evidence for multiple glacial refugia." American Journal of Botany **100**(5): 951-961..

and because they provided a relatively reliable supply of food, as well timber and firewood, depending upon how they were cultivated.

As fruit chestnuts came to have increasing economic importance, numerous varieties were grafted onto the 'wild' rootstock. Particular varieties were chosen for their adaptation to local environmental conditions, or for their particular fruit characteristics. In any given chestnut grove in Lucca today there are typically four to six varieties planted in any given chestnut orchard, with perhaps 80 varieties in the province of Lucca as a whole (Paglietta and Bounous 1979). Some chestnut varieties were best boiled, some could be roasted or candied (*marroni*), others were dried, smoked and ground into a flour which would keep for two years. Overall, chestnut cultivation was not very labor intensive, requiring a few weeks of gathering and smoking in the fall, as well as pruning suckers every few years, and annual burning of leaves and burs. A managed chestnut orchard (known as a *selva*) had a grassy understory, and could be easily combined with pasture by goats or sheep (once the seedlings were well established), providing a source of protein to complement the carbohydrates provided by the chestnuts themselves.

During the late nineteenth century, migration to cities and to emerging industries in valleys began to draw people out of the mountains where chestnut cultivation took place. Water powered mills offered employment opportunities in mountain valleys across Italy in the second half of the nineteenth century (Barca 2007). During the twentieth century, but especially after World War II, these processes of rural abandonment accelerated. In the province of Lucca chestnut orchards were increasingly abandoned and in many cases mature trees were cut down to be converted to tannin factories across Italy, including one at Bagni di Lucca about 30 kilometers from the city of Lucca (Calleri 1989). In other cases and in more remote spots, fruit chestnuts were simply abandoned. Such fruit trees rapidly become wild without human tending. As a grafted tree, the portion of the tree above the graft is never as well connected with the tree roots as are the dormant buds in the cambium layer below the graft. Chestnut farmers know this and lop off the suckers that sprout from the very base of the tree. If trees are abandoned, suckers preferentially absorb nutrients, resulting in the eventual death of the main stem. On the other hand, the ability of chestnut to sprout prolifically provides guaranteed reproduction, so that trees can be cultivated for poles or larger diameter timbers through coppicing (*ceduo*). When a chestnut orchard is abandoned, large cultivated stems gradually die, and coppice forests take over, producing a dense and often nearly monospecific stand of chestnut, that gradually gives way to other tree species depending upon local conditions.

This abandoned landscape is the subject of present day forest politics in Lucca, and elsewhere across Italy, whether as chestnut coppices, or as coppices of oak and other species. The history of chestnut cultivation and associated pastoralism has produced a pattern of very small parcels of forest ownerships. This size of forest property emerged from the friction between chestnut trees, flocks of goats and sheep which grazed in chestnut groves, and the political institutions which extracted taxes from peasant landscapes over the last centuries. With the decline of smallholder tree cultivation in the twentieth century, forest structures changed to larger relatively uniform areas of coppice forest of chestnut and other species (Agnoletti 2007). Abandonment and outmigration have produced an ownership landscape that is particularly illegible to the state, as for many areas of forest there is either no known owner, or no effective ownership. Inheritance laws dictate that all the heirs own a property in common and must agree upon

what to do with it. After two or three generations a given piece of land may have ten or twenty owners spread across Italy, the United States, and South America, making the forest effectively impossible to purchase or tend. As the contact between landowners and forests decreased in intensity, the infrastructure of terraces, mature fruit chestnuts, and well cared for coppice forests, linked to towns by mule or donkey trails, has gradually disappeared. The area of fruit chestnut cultivation has declined precipitously, and forests have become increasingly illegible to the state because owners have little reason to be attracted to state forms of documentation, including land titles and boundary marking.

Figure 4. Chestnut orchard near Fosciandora, Lucca, December 2013

Figure 5. Chestnut Coppice near San Andrea del Compito, November 2013

Figure 6. Holm oak and hornbeam coppice near Volterra, December 2013

Figure 7. Chestnut coppice *matricine* on Santallago, Lucca, November 2013

The cultural history of this landscape has resulted in a small remaining area of fruit chestnut of about 7000 hectares in all of Tuscany (out of about 150,000 hectares of chestnut coppice) (Ministero Delle Politiche Agricole Alimentari e Forestali 2009). These chestnut orchards are cultivated farmers who own an average of 1 hectare of fruit chestnuts each, with additional areas of coppice of chestnut or other forests. Such small farms are difficult for the state to read or make sense of. Small farmers sell firewood either directly or through firewood cutters who in turn sell wood to people in the countryside and small towns[3]. Firewood cutters have a particular advantage with regard to the Italian state, because as primary producers they are hard to monitor, and can systematically underestimate the volume of firewood that they sell. In Tuscany, many firewood cutters are Albanian or Romanian immigrants, who are (somewhat ambiguously) admired for their hard work and for their skill as woodcutters, even as they are criticized for being possibly illegal immigrants. There is an interesting symmetry here between the illegal immigrants who cut firewood, and the marginally legal firewood that they produce.

The trees that are cut in small patches of oak, chestnut, and beech coppice across the more accessible parts of the Apennines end up in domestic fires in villages and small towns, but this production and consumption are only partially taxed or recorded by the state. A vast number of cutting operations below 0.1 hectares do not require any official documentation, and cuts of up to 5 hectares require only a simple notification, so much firewood cutting is simply unknown to the state. Even when firewood cutting is reported, it is systematically underestimated, in order to avoid taxes, due to the extremely limited ability of the Italian state to collect taxes from primary producers and small business owners. In addition, the physical structure and location of forests and the even smaller size of an average logging operation make the vast majority of firewood production and consumption statistically invisible. This invisibility has consequences for the way that the Italian state has chosen to incorporate forest based biomass energy into climate change policy.

Critically, firewood cutting is not reflected in national estimates of forest uses and only partially appears in national energy accounts. Biomass energy from forests, including domestic heating *and* electricity production are expected to be the primary source of renewable energy in Italy's national biomass energy plan (Ministero Dello Sviluppo Economico 2010), but over 5 Mtoe (megatons of oil equivalent) of domestic firewood consumption (out of about 7 Mtoe) per year is invisible in the national biomass energy plan (Tomasetti 2010). Other consumption surveys of wood used for domestic heating suggest a total national consumption of 20 million tons of firewood, i.e. about 9 Mtoe (megatons of oil equivalent)(Caserini, Fraccaroli et al. 2008). The national bioenergy plan using official statistics of firewood production, tells a very different story, of only about 2.2 Mtoe of energy production from home heating with firewood. As in many countries, including Mexico, firewood is dispersed, geographically hard to inspect, and often takes place on steep and marginal lands far from the gaze of forestry officials or forest guards. In a real sense, the historical engagement of peasants with tree crops such as chestnut has produced the very small land holdings which divide the mountain landscape. These are forests that made sense to traditional smallholder production of

[3] Burning firewood in crowded cities is more complicated because of the inconvenience of carrying logs up and down stairs, but some people do it.

chestnuts, firewood, or construction timber, but never to the Italian state, which struggled valiantly to impose plantation forestry until the early 1980's, before deciding that abandoned forests in hills and mountains were best managed through various forms of protected areas.

Even as it is only partially visible to the Italian state, firewood is widely used and highly valued. Whether burned as logs, woodchips or pellets, firewood is widely considered the cheapest form of winter heating, and many people in the countryside or in small towns use modern wood fired heating systems for water and central heating (Bertacchi, Sani et al. 2004). Elegant advertising brochures offer high efficiency heating systems that can heat water for radiators and baths. Firewood costs for domestic users are around 100/130 Euros in forest rich areas such as Tuscany, and rather more in more distant and forest poor areas such as Naples or Sardinia. Faced with the high cost of natural gas (over three times US prices), many people try to use wood/fired stoves for home heating. In fact, firewood powered stoves are so popular, that firewood cutting has become one of the few profitable businesses for farmers across southern Tuscany.

An increasing number of municipal or school buildings near Lucca are heated by woodchip or wood pellet heating systems, in some cases through '*teleriscaldamento*', where a cluster of buildings are heated together (Fagarazzi, Nibbi et al. 2011). Firewood, in its various forms then, is in widespread use, but it is almost impossible for the Italian state to know where firewood is produced or by exactly by whom. This should be familiar to many people who work in rural landscapes around the world, and is eerily similar to what I found in Mexico in earlier work(Mathews 2005; Mathews 2006). As a direct result of the official invisibility of firewood production and consumption, the national energy plan does not count already existing forms of biomass energy production, making Italy's increasing total forest area and timber volume appear like an easy opportunity for sustainable energy production. Large scale biomass energy plants, either in former coal fired power stations, or in new biomass energy plants are the means by which national renewable energy goals are supposed to be fulfilled.

National carbon accounts and biomass energy

In 2008 the European Union established binding national goals for renewable energy production by member states, which were collectively expected to reduce green house gas emissions by 20%, to increase energy efficiency by 20%, and to make 20% or energy come from renewable energy sources, by the year 2020 (Giachi 2011). This is known as the 20/20/20 goal, and member states have been pressed fairly strongly to take concrete steps towards these goals, because they are in theory enforceable with fines or other sanctions (Johnson, Pacini et al. 2012). Italy has undergone a rapid increase in forest area and in total biomass on the landscape (Agnoletti 2013; Agnoletti, Santoro et al. 2013) as trees colonize abandoned farms and pastures. This increase in apparently available biomass, expressed in national forestry statistics, seems to present a simple solution to Italy's renewable energy needs. Statistical sampling of present day forests, and modeled scenarios of future forests, are used to establish baselines of forest cover and density in the future. These baselines are then incorporated into other baselines to demonstrate the required increase in energy efficiency and renewable energy use. National total figures of forest area and of total biomass on the landscape are the raw materials for producing energy policies that allow Italy to minimize changes in other sectors. It is one thing, however, to calculate a national total for biomass, and another to

actually persuade rural people to cut trees in steep and remote mountains, and then to decide to turn these trees into woodchips that will fuel boilers in electricity power plants.

Over the last few months, I have talked to firewood cutters, environmental officials, and environmental activists. For related reasons, all of these people have been deeply skeptical, and often scathing, about the prospects of cutting trees, chipping them, and shipping them to biomass energy plants which will produce electricity.

Cutting trees for firewood is hard work. In Tuscany, oak, chestnut, or beech forests are cut in the winter, before the sap rises, with the aim of maintaining the health of the tree. Every 30 years or so[4] firewood cutters venture into the forest, carefully cutting 4 to 6" diameter stems on a coppice stool. The stems are only thirty years old perhaps, but the stool may be tens or hundreds of years old, and its roots stabilize steep slopes, preventing landslips and erosion. To the untrained eye, a coppice forest may look like a grove of healthy young saplings, but the tell tale cluster of stems with curved bases, emerging from large and ancient stumps, reveals that this is a much older coppice forest. Cutting coppice forest for firewood is a highly developed skill: loggers[5] cut down stems, and remove limbs and branches, and then carefully cut poles to the required 1 meter length for firewood. A forest after a cutting operation is (unlike many of the forests I have visited in Mexico or the United States), a tidy place, with neatly stacked piles of logs, and with leaves and branches neatly cut down into short lengths. For these loggers, and for the landowners who employ them, the possibility of cutting trees for woodchips seems ridiculous and unprofitable. Cutting up good firewood seems like a waste of time, not to mention unprofitable: firewood currently costs 130E/ton, and is worth shipping to Naples or Sardinia, where it costs 160 or 170E/ton to the end user. In contrast, firewood is only worth 60-70 Euros/ton as woodchips. This means that for most landowners and loggers, the heavy work of dragging piles of branches up steep hills to a wood chipper is simply not worth the trouble.

Firewood cutting then is both profitable and widely legitimate. With energy costs very high, some retired people have returned to cutting small 10 and 20 cubic meter loads in order to supply themselves with their own heating costs, and perhaps earn a few hundred euros. All of this amounts to a thriving supply chain for firewood, both through local and more long distance networks, but these are not networks which are willing to supply large quantities of woodchips at the low prices that biomass energy plants are willing to pay. In practice, as one long time supporter of traditional chestnut agriculture pointed out, a large biomass energy plant is likely to have to import woodchips from far away, perhaps even from Eastern Europe. The legitimacy of firewood cutting for heating, has led one environmental NGO to frame its criticism of a proposed 13MW biomass electricity plant at Bagni di Lucca, on the question of wasted heat. NGO leaders argue that small biomass heating plants spread throughout mountain areas are preferable to an enormous energy plant that will waste heat and ship electricity to distant cities (Legambiente Lucca 2013). For other critics, such energy plants are considered to be so implausible in terms of their long term biomass supply, that they are seen as either a scam to attract state subsidies, or a foot in the door to convert legitimate forest biomass energy

[4] The decision to cut depends less upon age than upon the diameter of the coppice stems. A dry or poor site will take longer to grow to the required diameter, a productive site on deep and well watered soil much less.

[5] The two farmers that I visited in the province of Siena employed Serbian and Albanian loggers. These subcontracting firms likely employ illegal immigrants.

to illegitimate burning of food and industrial wastes. Such suspicions have all the more weight because of the lack of legitimacy of the Italian state.

The Italian state has limited credibility among ordinary people. This partly because of the famous informal/black economy, which is a relatively large part of economic life, and partly because of the mundane practices through which people negotiate with an oppressively complex and fragmented set of government bureaucracies (Herzfeld 2009). In addition, however, the current economic crisis is widely felt to be the caused by a predatory state and corrupt politicians. I cannot overemphasize this point. Not one single interview that I have conducted this year has failed to end without a bitter denunciation of the Italian state and of Italian society. Populist movements denouncing the state spring up almost every month it seems, from the Five Star movement of Beppe Grillo (which captured a large share of the parliamentary vote in the most recent election), to recent protests by enraged farmers, called *forconi* after the pitchforks that they brandish. Daily conversations about the motivation for government actions typically assume that state policies and resources are largely captured by well connected business interests. The biomass energy plants that have been set up across Italy in the last few years, have been opposed by systematic accusations of corruption, of possible connection with organized crime, and of overexploiting the forests in their catchment areas (RAI 3 2010; Legambiente Lucca 2013), and there have been numerous protest movements against the establishment biomass electricity plants (for a partial list of plants and opposition movements see (Anonymous 2013)).

The reasons given by these local movements against biomass plants are varied, ranging from concern over local air and water pollution, to overuse of local forest resources, and critically, that they produce electricity for national markets (wasting heat) rather than heat for local use, as in the opposition to the proposed biomass/electricity plant at Bagni di Lucca. A second feature of opposition to biomass energy plants in Italy has to do with the variety of possible meanings of the term biomass itself. 'Biomass' is used to describe a range of fuels, from firewood and woodchips, to agricultural residues, to food residues from domestic or industrial uses. This lack of specificity makes it easy to imagine that once a biomass energy plant is established, it will be used to burn domestic garbage or toxic wastes. In some areas in the south of Italy garbage collection and disposal, as well as toxic waste dumping, have been firmly controlled by organized crime groups for many years, so this fear is entirely credible. In Italy, conspiracy stories often turn out to be true. Alternative conspiracy theories as to the 'true' motivation for biomass energy projects are that they provide a way for the national Energy company ENEL to avoid mothballing large coal or oil burning power plants. The net effect of the weakness and lack of credibility of the Italian state, and the power of conspiracy theories to mobilize opposition, has been to make siting and building new biomass energy plants relatively difficult. In the province of Lucca, one large plant has been successfully blocked, another one has been delayed for several years.

Modeling Biomass Energy Production

Biomass energy production in Italy is justified by several kinds of models that are conceptually and politically linked. Most obviously, Global Circulation Models (GCM) which model the impact of green house gas emissions on climate, have driven policy decisions by European Union member states to reduce or mitigate green house gas emissions. At a national level, the Italian state models landcover change and carbon

stored on the landscape (Giordano and Scarascia Mugnozza 2010) producing various scenarios which emphasize that an increase in carbon stored on the landscape in the form of forests could be used for biomass energy (Ministero Dello Sviluppo Economico 2010; Rautiainen, Saikku et al. 2010), making biomass energy production an attractive way for Italy to meet its European Union renewable energy goals. Once the national baseline of energy production and carbon emissions has been agreed upon in negotiation with the European commission (European Commission 2013), all policy interventions taken by nation states are assessed as either increasing or reducing green house gas emissions by comparison with this baseline. Biomass energy is assumed to substitute for fossil fuel emissions and counts towards the renewable energy commitment. The more biomass energy is produced, the less other measures nation states (such as Italy) have to take to increase efficiency or reduce emissions in other sectors. Biomass energy is valuable then, because it allows other costly steps to be avoided.

Biomass energy is, however, only carbon neutral if another set of somewhat heroic modeling assumptions are made. At any given moment, an energy plant burning woodchips is clearly emitting carbon dioxide. The key question then is not how much carbon is being emitted at any given moment, but how much carbon is being emitted over the life cycle of the forest that supplies the energy plant. If the forest that supplies the plant is stable or increasing in total mass over the biological cycle of forest growth, then the energy produced by the plant is said to be either carbon neutral or carbon negative (Cherubini, Bright et al. 2013). Particular boundaries in time and space therefore become necessary to calculate carbon neutrality. The spatial scale of the forest used to supply an energy plant must be defined in order to assess whether the supply chain that brings woodchips to the power plant is not so long as to emit more carbon than is saved by burning the wood chips. The scale in time must be defined in order to assess the total carbon stored over the lifecycle of the forest supplying the power plant. Clearly then, biomass energy plants are only net carbon negative for nation states that can successfully model large scale carbon sequestration across the landscape at national, regional, and local scales.

It is precisely on the question of local energy uses that opponents to biomass energy have focused their attention, pointing out that shipping woodchips hundreds of miles to giant electricity power plants is unlikely to reduce carbon emissions and will deprive local firewood users of their already existing heating. Proponents of biomass energy on the other hand produce models to show how biomass energy will not compete with local firewood markets,(Fagarazzi, Nibbi et al. 2011; Fagarazzi, Tirinanzi et al. 2011). Out of these contests over scales in time and space comes a politics of defining the proper length of supply chains through an official support for ‘filiera corta’- short supply chains. A short supply chain for biomass energy will, it is hoped, consume less fossil fuel, and it will be easier to demonstrate a net increase in forest biomass across the landscape and carbon neutrality. This short supply chain is currently defined as 70km for Italian biomass energy projects. Activists and critics argue that this is too large, that the supply chain would be better if it was shorter.

Chestnuts in Lucca, and in Italy, have their own sets of institutional allies, including an organization called City of the Chestnut (Associazione Nazionale Città del Castagno (Associazione Nazionale Citta del Castagno 2013)) with transnational alliances with chestnut growers across the European Union. City of the Chestnut had major

influence upon the crafting of the national chestnut plan, which addresses the concerns of chestnut growers (Ministero Delle Politiche Agricole Alimentari e Forestali 2009). Firewood and biomass are less important to chestnut growers and their allies than are efforts to combat an invasive gall wasp *Torymus sinensis*, through a biological control program. For leaders in this chestnut network, biomass energy is only conditionally and very cautiously welcomed, to the extent that chestnut coppice could provide an additional source of income for hard pressed chestnut farmers. Ivo Polli, a leading actor within City of the Chestnut, told me that while he was in no way opposed to bringing abandoned chestnut coppice back into production, he doubted that the low prices for biomass (i.e. woodchips) would actually convince small chestnut cultivators to sell their wood (interview, 11/27/13). In any case, he told me, the impossibly steep forests of the Apennines, where abandoned chestnut and other coppice forests are so often found, would be economically and practically inaccessible.

Biomass energy proponents working on a regionally sponsored project based in Lucca are similarly cautious about the proposed Bagni di Lucca power station. For them, the goal of making forests improve local economies is at odds with the national and regional goals of building a vast supply chain to supply wood chips across a large (70 km radius) supply chain. They are much more deeply concerned with the difficulties of connecting fragmented forests ownerships with local firewood and energy markets. For them the reality of small forest properties, and the large areas of forest with unclear or divided ownership, are the critical limitation to efforts to tame abandoned or remote forests through renewed cutting. They talk about the desirability of consolidating landholdings so as to bring forests into production. This is as yet only a speculative desire: actually consolidating the myriad tiny properties across the mountainous landscapes of Italy would require a great deal of political willpower and institutional support, not to mention bureaucratic resources. Even a heavily bureaucratized state such as Italy might quail at the burden of legal procedures required to produce large, and legible units of forest ownership.

Property ownerships emerge then, not only from the desire of the state to produce clear and legible forms of tenure, but from the ability of the state to attract people and forests into state forms of classification. People and forest landscapes have to be in a sufficiently intense relationship for property to come into being. The desires of biomass energy promoters for a consolidation in forest properties suggest that a new form of engagement between people and trees, this time around firewood cutting for energy production, might cause a mutual pulling between areas of forest and property boundaries. Just as chestnut cultivation produced the small forest holdings linked by a system of donkey and mule trails, and just as the abandonment of chestnut cultivation produced un-owned or abandoned chestnut orchards and aged coppice forests, the new system of biomass energy production could, just possibly, produce a new set of larger properties which harness chestnut coppices into relatively legible landscapes. Whether this does, end up happening, depends upon on the scale of biomass energy supply chains, and upon the legitimacy of the institutions that are linked to them. For both local biomass energy promoters and chestnut activists, small scale (i.e. local) fuelwood supply chains which reconnect forests with villages and towns are legitimate, while networks which discard heat and produce electricity are questionable or illegitimate.

Conclusions

Models of biomass catchment areas in Italy, or of baseline forest futures in REDD projects in Mexico, define the spatial and temporal scale of the forests that are to be protected or logged. These scales connect particular forests with particular institutions (such as short supply chains for Italian biomass energy plants or indigenous forest communities in Mexico with their own sawmills or carbon credit purchasers). These management models are produced for particular audiences, who may assent, or otherwise, to the ecological, economic, or political implications of proposed policies. Calculations that sustain models of these kinds can only take place once incalculable questions as to the legitimacy of the state, and the credibility of its policies have been settled. In Italy for example, the definition of the 70km catchment area radius has emerged in response to academic and environmentalist critics who point out that Italy already imports woodchips from Eastern Europe, and that such long supply chains are unlikely to reduce green house gas emissions[6].

In Mexico, REDD+ policies link baselines either with local property ownerships (in the REDD formulation) or with regional baselines through the mediating presence of the Mexican state, which comes to act as an insurer of deforestation risk, through its ability to link different forest landscapes into a risk pool (in the REDD+ versions). As yet, there have been relatively few skeptical voices as to the credibility of models themselves, but rather more criticism of the ways in which REDD+ subsidies might be distributed to landowners, whether through subsidies for sustainable forestry activities at a community scale, or through payments to individual landowners to simply refrain from cutting their forests. Across both Italian and Mexican cases, model baselines have largely followed the imaginations of dominant political actors about plausible social and environmental futures. In Mexico REDD model baselines reflect official fears that forests are disappearing at the hands of poor subsistence farmers, even though in many areas agricultural abandonment has caused afforestation. In Italy, over the last fifty years, forestry officials have struggled to convert formerly peasant cultivated chestnut orchards and coppice forests to something more desirable, such as high forest or conifer plantations. Biomass energy policies, are but the latest version of this official desire to prevent the 'underuse' of forests by making abandoned coppices productive once again.

In both countries, national carbon accounts provide an overarching justification for forest/climate change policies, and are negotiated in relation to international carbon accounting standards. For Mexico this takes place as part of the UNFCCC reporting process, and in Italy through its participation in the UNFCCC but more directly through negotiations with the European Union. These overall national carbon accounts, including emissions from forest, allow officials in each country to choose forests to bear the burden of national emissions reductions, though various biomass energy production (Italy) or REDD projects (Mexico). Across these cases, officials are careful to avoid offending powerful local actors and audiences, and work to implement projects through existing

[6] There is also a longer distance, Indonesian connection, which is concerned with the debacle of the European Union biofuel energy policy, which supported the proliferation of palm oil production in South East Asia. EU biomass energy policies are therefore also concerned to *prevent* certain connections by defining catchment areas, as with establishing methods for measuring and auditing the sustainability of supply chains within catchment areas. I am currently engaged in ethnographic research on this question, so these are early and incomplete observations.

relationships. In Mexico, officials have been anxious to make it clear that REDD+ policies will continue to support successful indigenous forest communities, and that they will support productive activities in forests. In Italy, biomass policies have faced heavy local opposition, and subsidies to biomass energy plants have been reduced, even if not completely eliminated. Local opposition movements can draw on collective understandings of the Italian state as corrupt and bureaucratically inept to slow down or prevent new power plants from being built.

Comparing the ways in which Italian and Mexican forests are connected with global climate change reveals the power of national epistemic cultures in affecting how credible knowledge about forests is produced in Mexico and in Italy. In both countries, for different reasons, the state is widely felt to be illegitimate. Popular understandings of what the state is, and of why officials act as they do, empowers opposition to state environmental policies and official forms of knowledge. Forestry officials in Mexico, in particular, are well aware of this, and are careful to avoid offending powerful forest communities and vociferous environmental NGO's. In Italy, the state is a much more powerful infrastructural presence than in Mexico, and officials appear better buffered from public opinion. There are more officials, more offices, more levels of government, and more forest guards. Nevertheless, it is clear that here too, forestry officials are careful to pay attention to public opinion, which largely wishes forests to be protected from harm, and is willing to believe that biomass energy projects might be degrading or motivated by corrupt deals. Biomass energy plants have run into powerful local opposition, and are likely to run into more.

Comparison

One impulse for this project was to ask how the textures of encounters between officials and their audiences, or between people and plants, can come to have an impact upon 'larger' kinds of things, such as the legitimacy of the state or the credibility of climate change. The anthropology of climate change has been largely willing to accept that our job is to look at the impact of climate change upon 'local' populations. A comparative project allows me to look instead at how the scales and temporalities at which climate change is addressed are renegotiated in response to local understandings of forests, of the proper uses of firewood, and of what the state is. Comparison also reveals how the particular forms of human modified forests can limit the ability of the state to make landscapes legible, through cadastral maps or management plans. As we have seen, the material landscapes produced by peasant chestnut cultivators have become impenetrable to the Italian state. A particular infrastructure of trees, trails and property rights has become illegible to the state, not only because of the inability of the state to elicit proper behavior from landowners, but because of changing relations between people and chestnut trees. Comparison is also interesting for other reasons entirely: in comparing these two different forests, I am not simply itemizing fascinating similarities and differences which pre-exist comparison. I am also creating a new thing in the world, the category that links these distant places with one another. It was only when I began to compare REDD policies in Mexico with biomass energy policies in Italy that I began to think of all of these policies as efforts to speed up or slow down the cycling of carbon into forests. These policies both seek, in different ways, to link the temporalities and scales of forests with the global biogeochemical carbon cycle, by speeding up or slowing

down the residence of carbon in forests, fields, and soils. We can understand climate change better if we pay attention to how forests are linked to this global carbon cycle, through particular engagements between people and plants.

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biomass project helped 10 biomass plants in provincia di lucca, lssted, pg. 54, most run 200-700 kw, consume 240-700 tons per year,

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