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Forest Transitions across Ages and Continents: Implications for REDD

by

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Abstract

A host of economic, political, social, ecological, religious and aesthetic reasons have anchored forest transitions across the world. Transition results from the relative strengths of causes favoring forest losses and gains and is very context specific. Buddhist emphasis on sacredness of all life forms provided the early emphasis on protection of forests in India. Plague caused the first transition in France wiping out more than one third of its population. The colonization of Americas, and destruction of its forests, provided the second large phase of transition in Europe. Building on earlier works the authors propose that the transitions are led by a combination of one or more of the following factors, namely, acute crisis of availability of forest goods and services, incentives for abandonment of marginal croplands, enhanced agricultural productivity, massive urbanization, globalization, demand displacement, agroforestry intensification, appropriate forest policies, aesthetics, enhanced public awareness and legal imperatives. Popular discourse on REDD places high emphasis on poverty eradication, good governance, low corruption, restoration of land and human rights of indigenous people. These are goals of highest values worthy of being pursued vigorously but there is not much evidence that their successful pursuit would result in reducing emissions from deforestation and forest degradation.

Key words

Forest transition, REDD, good governance, corruption, plague

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Introduction

The evolving importance of Reducing Emissions from Deforestation and Degradation of Forests (REDD) in mitigating climate change has brought destruction of forests into sharp focus over the past few years but the problem is as old as the social evolution of man from nomadic hunter gathering to settled agriculture. Human ability to control his environment led to sharp increase in population resulting in fast paced conversion of forest lands to crop lands for food and degradation of forests in the neighborhood of habitations to meet their energy need. As far back as the 5th Century BC Plato had noted that the denudation of hills surrounding Athens had caused loss of soil and fertility and observant people in other civilizations had reached similar conclusions even earlier.

At its peak Rome had a population close to a million people, a level reached by London only two thousand years later. As the size of Rome increased the ruling class did not take long to understand that the real risk to their great empire lay within and that food supply to such a vast population had to be ensured at any cost to prevent devastating rebellion by hungry people. The realization made the Romans conquer new areas and bring more land under cultivation for growing wheat to feed the population back in the capital Rome. Agriculture became the economic base for the Roman Empire and with its increasing population, and rapid increase in the number of slaves from conquered territories, the clearing of forest for crop cultivation was officially encouraged. The Roman law allowed anyone who occupied public land of up to 8 hectares to own it provided the land was used for crop cultivation. This policy led to widespread felling of forests even as it created an extended affluence and new landed gentry, prime among the loyalist of the Roman Emperors. Military strategists also created large forest clearings around forts and important towns to enhance visibility for the defending armies and ensure advancing enemies are not able to use them as cover.

Affluence also led to construction of larger buildings that required more timber and even more energy to keep them warm. Wood was also used extensively in industry, mining, smelting and ceramic manufacture. The unique Roman institution of public bath also demanded a large amount of wood for heating. One of the earliest industry caused deforestation occurred in the Levant region of the Mediterranean, the modern Lebanon, from where the Levantine iron had long been exported to Babylon. The Lebanon Mountains contain iron ore as also limestone for both of which there was a large scale degradation of forest. Similar devastation of forest for iron also occurred in the Shantung region of North East China during the northern Sung period at the beginning of second millennia in the Christian era (1).

The pre-industrial loss of forests, however, was nothing compared to what was to follow in the period of industrialization. The sporadic small scale changes were replaced by large scale organized clearing of forests across the world once industrialization began in the 18th century. Over the last 250 years land for growing food has increased by almost five times with over one fifth of forest and woodlands and 1% of grasslands giving way to crop lands. Today over 4.9 billion ha of land are used for producing food, meat and milk as against just about 4 billion hectares of forest area (2) that must not only provide ecological stability that sustains agriculture production but also forest goods for energy, paper, construction, furniture, local medicines and myriad other needs of the people.

Forest transition

The concept of 'forest transition' was first developed by Professor Alexander Mather of the Department of Geography in Aberdeen University, who began his research work on historical changes in Scottish landscape over the past half millennia and spent a lifetime studying the economic, political, social, ecological, religious and aesthetic reasons behind the changes in forest cover in Scotland and across many continents. He discovered how the Scots cleared most forests by the end of sixteenth century and then reforested them in the twentieth century with active state support (3). A society on the path of economic growth through agriculture in the preindustrial age, and through industrialization, and consequential urbanization, in modern times, first clears the forests at a rapid pace and, as it reaches a certain level of prosperity, deforestation slows down till a point of inflection is reached when reforestation begins replacing loss of forest cover.

Mather noticed similar trends in a number of other places across the globe and found that a very large number of causative factors lay behind such transitions. One of his initial observations, in the case of Scotland, was the gradually increasing knowledge of low productivity agriculture lands among the farmers and resulting prioritization in sowing better lands first. Sometimes, a farmer would learn that leaving lands of very low fertility altogether, and using his labor and other resources for alternate economic activities, would not only allow him more leisure time but even more income. Farmers would then concentrate their efforts more and more on better soils abandoning poorer soils which would be reoccupied by forests over time. As forests increased in the neighborhood of habitations, fuel became easier of access and hunting success increased too, and so did the soil conservation along with a number of other goods and services, none of which would go unnoticed.

Elsewhere, where wood was the only source of fuel, the change over from wood to coal led to the slowing down of deforestation. In many other places it was the high cost of agricultural labor that made cropping economically unviable and forests occupied the untended fields quickly. These and a number

of other causative factors have been examined in details by a number of researchers, foremost among them being Mather himself, in attempts to understand the larger macroeconomic environment in which these many causative factors interacted among themselves to produce the resultant effect.

The theory of forest transition, at its most fundamental, is that the trend of loss of forests slows down at some point of time and then reverses itself towards recovery. While this raises hopes that REDD would ultimately succeed it provides no clue as to where the loss would stop and how long would it take to reverse the downslide. Nor does it give an inkling into the extent and nature of the forests that recovery would lead to, that is, whether the old natural forests, rich of biodiversity, would return to occupy the vacated lands or commercial plantations would take their place and the extent of land that would come under recovery relative to that before the deforestation began.

The interesting case of France

Technological advances in agriculture and the resulting intensified agriculture has driven the increased limiting of agriculture to better quality lands since there are larger returns on such lands (4). One example is the case of France where there was rapid deforestation till the fourteenth century on account of increasing population and demand for food and fuel and grazing pressure due to increased livestock. There was relative peace in France between 1000 AD to 1300 AD which saw the population double and forests reduced to half as they gave way to agriculture and grazing. While families cleared small extents for their use the aristocracy cleared vast sized forests to settle large number of people who would then provide their armies both soldiers from among their sons, and money from taxes. Church also helped clear forests for increasing its own influence and wealth. Larger clearings that that required for agriculture and pasture also afforded greater security to habitations against raiders from outside due to enhanced visibility (5).

Plague brought the first transition in France

The first forest transition took place in France in the 14th century and two major reasons have been cited (5) for this transition. First was the toll that forest clearing has taken on the hunting grounds of the aristocracy and on timber supply which led to the issuance of a series of royal forest protection notifications in the thirteenth century. But from the manner in which the notifications had to be issued repeatedly it would appear that they had little effect in preventing deforestation. It was more likely the plague which rampaged through Europe in cycles after cycles in the 14th and 15th centuries. The first cycle of this magna pestilencia, that began in Italy in the autumn of 1347 and travelled clockwise

through Europe till its end in the frozen plains of Russia in 1353, brought death on a scale unknown to humanity till the Nazi Holocaust. Many more cycles followed reducing the population of France by one third, and large scale abandoning of agricultural lands across the countryside, which may have played a more crucial role in reversing the trend of deforestation.

Colbertian Ordinance ineffective in protecting French forest resources

By the second half of 16th century plague had been controlled throughout the continent and the population build up in France to the levels of 1300 AD was quick. The demand for food, fuel and timber rose again leading to fast paced deforestation. And this time the demand for timber was not merely for domestic consumption but also for huge jump in ship building as France became a major colonial power with territories to conquer and defend against other competing powers. Timber became a strategic resource, something similar to oil in the twentieth century. The government made several efforts to halt the severe decline in forests but the forest management was both inefficient and corrupt and royal notifications had, at best, a marginal effect. The situation was so desperate that in 1661 Jean Baptiste Colbert, a Minister in the Court of Louis XIV, who issued the Colbertian Ordinance making forests a national resource giving the King many rights over the forests for their protection (6) claimed that the very future of France was at stake if the scarcity of timber were to continue.

But as the population grew fast providing food was the priority and clearing of forests to grow more food was encouraged once again by the state ignoring the Colbertian Ordinance. And as industrialization began in 1750s and energy consumption increased vastly for feeding engines and making iron, the deforestation rate became even higher. In the aftermath of the French Revolution the hunting reserves of the aristocrats became a particular target of the poorer classes, long resentful of the aristocratic privilege of killing any goat that strayed into their woodlands, who now felt free to rear goats in these forests hastening their demise. It has been estimated that forests occupied a quarter of France in 1750, one-seventh in 1788, one-eighth in 1792, one-tenth in 1804 and one twelfth in 1825 when it came down to as low as 7.6 million ha (5), just about half of its forest cover now.

Modern forest transition in France

By 1830 the deforestation trend slowed somewhat with stabilization of forests and thereafter forests began to increase in extent caused by a variety of socio-economic and technical factors that combined to reduce the demand for more lands and agriculture was increasingly restricted to more fertile lands with higher insistence on use of technology and management, first at local scale and then at national

scale. Mountain grazing of sheep and goats in the Alps became less attractive compared to rearing of cattle on cultivated grasses in the valleys. Self-sufficiency in food acquired a different meaning with increasing transportation network of railways and availability of food at local levels was assured through expanding market networks. Urbanization was also proceeding apace and it resulted in large migration of poorer sections of people living on marginal lands leading to the abandonment of such lands (4).

With increasing prosperity the population of France also increased and today it is roughly four times of the population of 21 million in 1825 when the forests had declined to its lowest ever level. And yet the forests cover is twice that of 1825. This transition thus appears to negate Malthusian projections which could explain so well the decline, rise, and again decline, of forest cover between the years 1000 to 1825. Its drivers are a complex combination of several factors each operating at different levels and different times and have been discussed later in this paper.

Forest Transition in South Korea

In a parallel study on forest transition Dr Jae Soo Bae of Korea Forest Research Institute and team examined the forest transition in South Korea after the devastating Korean war during 1950-1953 at the end of which forests covered only about a third of the geographical area and were also highly degraded to the present status when two third of its land is covered with forests of high growing stock (7). While fast paced development of the Korean economy was important the transition could not be ascribed to economic development alone and was primarily, atleast in the initial years, led by the reforestation policy of the government that provided attractive incentives to people for planting and protecting forest and replacing firewood with fossil fuels. The average stock volume of the Korean forests declined in the period 1927 to 1952 with per hectare growing stock and per capita growing stock both decreasing continuously. Towards the end of this phase of reduction, the per capita growing stock decreased even more sharply after the Second World War when the population of South Korea increased quickly. This was followed by a stagnation period between 1953 and 1972, when there was no decrease in these two parameters but no increase either. During the expansion period 1973 – 2007 that followed both per hectare and per capita growing stock increased by 20% and 14.4% reversing the previous trend. It is worth noting that per capita growing stock increased 7.9 times between the years 1952 to 2007 even though this period also saw a considerable increase in the population of Korea (7).

Between 1970 and 1990, urbanisation was very fast and the rural population decreased from 44.7 % to a mere 15.4 %. This urbanization had a sharp reducing effect on the consumption of the fuelwood as urban areas had a much better organized access to fossil fuels which was also far more convenient to use. And since large scale uncontrolled felling for fuel was a major reason for decline in the forest cover

this move away from firewood to fossil fuel had a very significant effect on the extent and quality of forest cover (7).

In the 1970s the then President Park Chung Hee, took personal interest in reforestation which ensured the wholesome cooperation of all related wings of the Government and the reforestation efforts became national efforts instead of a mere departmental endeavour. Adequate administrative and enforcement powers were also devolved on local authorities involved in reforestation who were given access to the latest technology available at that time. A large number of local forestry associations and cooperatives were organized in each village which became a new model for public private partnership in forestry focusing on extension services. This strong political support was crucial to the early success of forest expansion efforts in Korea (7).

The nineteenth century transition in Switzerland

Continuing with their series of work in forest transition in countries across the world Professor Mather and his co-workers also analysed the nineteenth century forest transition in Switzerland apparently caused by the floods (8). By the middle of 19th century the forest cover in Swiss Alps had shrunk to barely fifteen percent, a decline which had taken several centuries of population growth and cattle rearing. Today the forest cover stands at about 30% and this transition occurred in the latter half of the nineteenth century. There appears to be several causes of these changes, some active and many more passive that created the general environment in which the more active causes could bear fruit. The most active and critical factor appears to be the floods of 1830 and 1868 both of which caused considerable economic damage and many deaths. This also happened to be a period when it had become accepted wisdom in Europe to view deforestation of hill slopes as the primary cause of floods (8).

Beside the recurring floods firewood was also becoming scarce in the hills. The Cantons had provisions for supply of wood to the communities from the forests but such a management works well only when the resources are adequate. With severely depleted forests the principles of management that were working satisfactorily earlier failed to deliver and there was little that Cantons could do to ensure supply of firewood to the inhabitants.

Mather and Fairbairn have suggested that some form of forest resource crisis has to be experienced by the society before it can be nudged into managing its forests more sustainably. It was under these circumstances that the head of the Swiss forestry, Professor Landolt, wrote a detailed report arguing the direct link between the continuing deforestation in the hills and the damage by floods. The government

appointed him as the head of a Committee to suggest ways of addressing this grave situation and the Committee submitted a report giving their assessment of the causes and suggested extensive reforestation measures combined with protection of the existing forest resources through enactment of a federal law. Under the Swiss Constitution the subject of forest was devolved on the Cantons, but in the immediate aftermath of the devastating flood and serious deficiency of firewood for energy it became politically feasible to agree to a federal law on forest protection even though its implementation was to remain with the Cantons (8).

In 1876 the Federal Forest Law was enacted. By this time the increase in forest cover had already begun to be noticed even though very little reforestation work had actually been undertaken. This was due to several passive factors at work, foremost being economic development which was already on the rise all over Europe and the expansion of the Railway services across the country which made it possible for coal to be carried to even remote areas reducing the need for firewood thus helping forests to regenerate. Besides, in many Cantons there was net import of good from outside providing relief to the forests which were bearing heavy pressure of demand. Agricultural land adjustment preferring more fertile lands for cropping over marginal lands, which was already going apace, became an increasing necessity as rural migration to urban areas due to industrialization gathered speed and farmers had difficulty finding suitable workers to work on their agriculture fields, thus encouraging them to confine to better quality lands (8).

The Great Colonial Drive

Another period of conversion of forests to agriculture, as also a changed pattern of use of forests from local sustenance to large scale commercial usage, began with the European conquest of colonies in Asia, Americas, Africa and Oceania in the sixteenth century and peaked in the eighteenth century. The experiences of different colonies were however different as colonisations had different drivers in different destinations. The Americas and Oceania saw waves after waves of mass migration from Europe who cleared millions of hectares of forest lands for agriculture and pasture but in Asia and Africa migration was limited and trade was the driving reason for control over colonies which also brought in fundamental changes in the use pattern of forest resources.

One of the largest colonies, the Indian Subcontinent, had actually been loosing its forest cover for centuries even before the arrival of British on account of extension of agriculture and of unregulated grazing. The problem should have been serious enough as long back as 300 BCE for the famed Sanskrit governance treatise Arthashastra to include Guidelines for the management of forests that prescribed

placing forest divisions under the control of a Superintendent responsible for both forest protection and production, regulating felling and deliberately caused forest fires as well as unauthorized hunting through stiff fines. The measures were reasonably successful, given the generally law abiding nature of the people and the deep influence of Buddha on the people with his emphasis on non-violence and love of nature. When the Chinese scholar Huen Tsang travelled through India between 629 to 645 CE he found wildlife in abundance everywhere and noted that its protection was affected through both law and religious and cultural practices of the Indian people.

In this India under the strong influence of Buddha governance was more through consensus rooted in religious practices than by force of law, and armies were small. The King, therefore, did not burden people with too many taxes and agriculture was largely to feed the local people with marginal increases in lands under cultivation as the population rose. Agriculture became the thrust of political economy only under the Islamic rule that followed when the need for large armies forced the rulers to think of ways to increase their revenues. Feudal land lordships were established and forests were cleared for agriculture as a state policy and the resulting revenues from land taxes as well as tax on agricultural produce across the fertile lands of the Indo-Gangetic plains enabled the rulers to keep large armies even as agriculture production soared and economy boomed on the cheap labour of the serf.

As the British East India Company established its control over increasingly larger parts of India between the mid eighteenth to the mid nineteenth century, exploitation of valuable timber like teak in the south and Deodar (Cedrus deodara), Sheesham (Dalbergia sissoo) and Sal (Shorea robusta) in the north increased many fold. In most places the exploitation was indiscriminate and depended solely on the need and ease. In some places, however, local administrators of the East India Company showed consideration and wisdom, such as in Malabar in southern India, and established plantations of lasting worth.

But major changes in approach to forest management and administration in India came only after 1865 when the British Empire took over the reigns of administration from the British East India Company and appointed Dietrich Brandis, a celebrated German forester, as the first Inspector General of Forests of a revamped administration with a clear shift from the previous Company goals of profit making to a rule based governance. Brandis introduced science based forest management which has largely served to limit deforestation and forest degradation in India over the last one and half century in spite of the multifold rise in population and the pressures created by rising demands.

European colonialism had little effect on the Chinese forests but much to do with the condition of forests in the archipelagos of Indonesia and Malaysia with extensive rubber and oil palm plantations

established after deforestation and introduction of the system of thousands of hectares of prime forests being leased to timber companies for forest working with minimal state supervision leading to severe degradation of these rain forests. But to blame colonialism alone for it might be seeking an easy target because the situation has only worsened in more than half a century that has elapsed since the foreign rulers were packed home. Clearly, lands on which forests stand remain more useful than the forests themselves for the ruling elite whether indigenous or foreign.

A factor which has not attracted much academic scrutiny is the contribution of colonization to forest transition in Europe. The occupation of Asia and Africa by the European powers offered employment opportunities to the European poor subsisting on marginal lands in their armies and navies and in civil bureaucracy in the colonies leading to return of forest cover on these marginal lands. This was happening at the same time as mass migration of the poor to the Americas for permanent settlement by clearing forests there. It was thus a European forest transition that came at the cost of colossus loss of forest cover in the Americas.

Transition in China, Vietnam and India

After Japan in the late nineteenth century and South Korea in the 1970s three more major Asian countries, China, Vietnam and India, have crossed the forest transition threshold between 1980 to 2000 and it took place, compared to the European countries, with larger percentages of forests still remaining intact (9).

Table: Long tern forest cover trends in India, Vietnam and China

Year/country	India Mha	Vietnam Mha	China Mha
1880	102.7	25.0	
1920	94.8	20.7	
1950 (1949 for China)	82.5	18.9	102.3
1970 (1977-81 for China)	74.3	16.4	95.6
1980 (1989-93 for China)	64.6	14.8	108.6

Source: Mather (2007)

As discussed above the transition in European countries appears to relate to economic development that took place in that continent in the second half of the nineteenth century. But in the case of these three countries the transition has taken place at a much earlier phase of their own economic development even though they were on a rapid growth trajectory. But neither the growth trajectory nor the achieved levels of growth would explain as to why neighbouring countries like Malaysia and Thailand, both of which have enjoyed a fast growth trajectory for a prolonged period, still have not reached the transition phase.

Governance and forest transition

The conventional wisdom is that quality governance plays a core role in forest transition. Mather has examined relationship of transition with governance but found little evidence to substantiate the links (9). On the issue of government effectiveness, control over corruption and adherence to the rule of law Malaysia and Thailand score higher than China, Vietnam and India. All the three countries had reached self sufficiency in food production before they reached transition and there was considerable and sustained increase in agricultural productivity but still it could not have been a dominant underlying cause as this would also fail the Malaysia and Thailand test. One factor which could have played a very important role is the consistently strong legal and policy backing to forest conservation and expansion in all these three countries which implies that, on balance, the political economy of these countries favoured forest expansion, something which clearly was not the case in Thailand and Malaysia.

A delicate balance of factors favouring deforestation and reforestation

Forest transition results from the relative strengths of factors favouring reforestation and the factors favouring deforestation and when they balance each other a natural forest transition is said to occur (8). Factors favouring reforestation often begin with a small but influential section of the population represented in civil society and slowly gather momentum as the effects of deforestation become more pronounced and visible and a stage is reached when the country's political economy can not fail to take notice of it resulting in larger budget allocations and policy support for forestry. Since slowing deforestation and bringing former deforested lands back under forest cover expectedly faces severe resistance from the entrenched lobbies that have big stakes in deforested lands it is politically expedient to channelize this increased popular support against forest loss into financial and policy support towards afforesting new lands. That is why in the early stages of forest transition forest plantations over new and marginal lands play a major role (8, 10).

Socio-ecological feedback to socio-economic changes

In a work of high significance, Eric Lambin and Patrick Meyfroidt have attempted to juxtapose land use transitions between socio-ecological feedback on one side and socio-economic changes on the other side and propose that the transition occurs when the socio-economic changes respond positively to the socio-ecological feedback rather than aggravate them as they normally do in pre-transition phase. They have defined the socio-ecological feedback as signals that severe degradation in ecosystem services sends to the society compelling change in its land use behaviour. This process is endogenous to the ecosystem in contrast to the socio-economic changes that take place exogenous to the ecosystem either due to nationalization or global changes occurring which are either beyond the control of the society or are only nominally under their control with very little autonomy. They then raise a core question as to whether the transitions occur due to mostly endogenous sociological factors or exogenous socio economic factors and also whether the land use transitions are merely unintended side effects of technological innovations, economic development and social preferences.

Jared Diamond in his celebrated work "Collapse: How Societies Choose to Fail or Succeed" has suggested that only those cultures which profoundly modified their land use practices in response to depleting natural resources and ecosystem services survived. History is replete with instances of civilizations that rose to their glory achieving successes over centuries but failed to notice the grave injuries they were causing not only to their environment but also to their social fabric within and often their end would come with just a minor push from a few hundred enemy soldiers commanded by leaders who could see the fissures which the invaded civilization failed to notice as in the Maya and Inca civilizations of Americas. Here invasions formed the crisis but by the time the crisis occurred the society had already been weakened to such an extent that it had no strength left to correct its course and survive. Invading armies, often cited as the primary reason for the demise of these civilizations would, on closer analysis, turn out to be no more than the final push with the real damage having happened endogenously over long time.

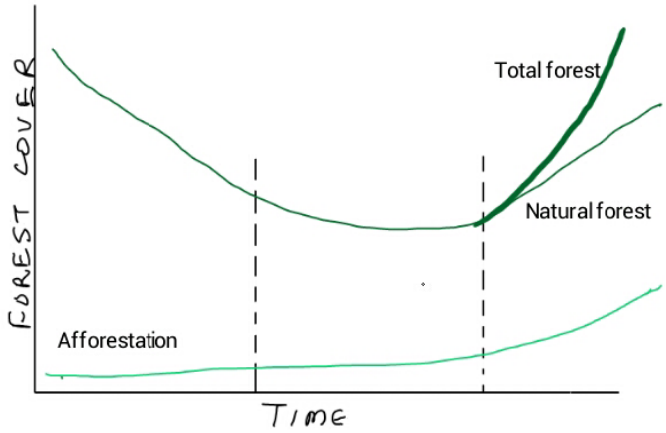

Figure : Forest transition in which plantations play important role

Implications for REDD

The causes for forest transitions across the continents, and over the long human history, are thus varied. Increasing population is an obvious cause of deforestation and forest degradation but there are instances, as in the 19th century transitions in Western Europe, and more recently in Korea, where sharp increases in population, and increase in forest cover and its quality, have occurred together.

High quality governance and low corruption levels in public life are similarly seen as critical to the success of REDD but the contrast between Malaysia and Thailand where transition is yet to take place inspite of their better governance and lower corruption levels compared to India, Vietnam and China, where transition has already occurred, suggests that governance, while important in itself, may not always have deciding influence on the outcome of REDD efforts.

Similarly, extent and the depth of poverty in a country do affect the status of forests but it is not necessary to become rich before forest transition can occur as the example of India has shown conclusively. This raises hopes that it should be possible for the Least Developed Countries also to do well in their REDD activities.

On the question of the type of political model more suitable for implementing REDD in poorer countries also there are examples of both highly authoritative top down models in China and Vietnam and very liberal bottom up political model of India having achieved reasonable success at relatively low economic costs and it would be difficult to ascribe success to either of the models.

Enhancing equity and restoring the land rights and human rights of indigenous people need to be pursued vigorously because of their high importance in themselves in creating a just world order but there is no need to link these very worthy goals with REDD because there is little evidence so far of these factors having led to forest transition anywhere.

Lambin and Meyfroidt have identified five forest transition pathways, namely, Forest product and services scarcity, State Forest Policies, Economic Development, Globalization and Small holder tree based land use intensification pathways (11) expanding on the work done earlier by Rudel and others. Below we have made an attempt at further refinement of these transition pathways discussed below.

1. Crisis led transition

Quite often products and services associated with forest become a trigger for causing forest transition. In the times when fossil fuels were not easily accessible the demand for firewood was often a contributory factor for state intervention for reforestation on a massive scale leading to transition over a period of time. Also frequent landslides and floods, as in the case of Switzerland discussed above, when backed by an active media and effective civil society can prepare the ground for the requisite political support for conserving and reforesting forest lands. China and Vietnam are also examples of countries where transition occurred in part due to enormous scarcity of forest products due to continued destruction of forest resources in both these countries over many centuries in the past.

Since a crisis can neither be timed nor planned but depends upon a large number of factors that precede the building up of storm it would be difficult to predict when the society would ultimately begin to act right. It would also need institutions which can pick up the distress signals in time, give them voice and rational backing to gather forceful political support. A powerful media and active civil society, and linkages with the world outside, are often critical in gathering such support.

2. Marginal cropland abandonment led transition

Mather noticed that transition in Scotland occurred when farmers learned to abandon croplands of lower productivity as they realized they earn more by concentrating on smaller extents of good quality lands and the abandoned lands quickly regenerated with native forest species. In recent years China has provided financial incentives to encourage farmers cultivating mountain slopes into other economic activities with the goal of reducing ecological pressures and degradation on these lands bringing forests back.

3. Enhanced agriculture productivity led transition

Technological advancements in agriculture, higher yielding varieties and expansion of irrigation and disease control has led to a high increase in agricultural productivity relaxing pressure on new lands for agriculture. This has been one of the major reasons for reduced deforestation in many territories and will continue to be important in future in view of the increasing food demand because of still increasing global population.

4. Forest Policies led transition

National forest policies sometimes play crucial role in forest transition, the prime example of which is India. There was a sustained decline of forest resources in the country after independence which reached a peak of loss of about 125000 ha of forest cover annually by the late 1970s. Concerned about this, the then Prime Minister Indira Gandhi caused constitutional changes bringing forests in the Concurrent List of the Constitution of India from the previous State List thus enabling Central Parliament also to legislate in forestry matters and made conservation a national duty. Prior to this the Indian Constitution had only listed people's rights but not duties and this was a fundamental change. Following this, the Forest Conservation Act of 1980 was enacted which brought down the annual deforestation immediately by about 80 percent. Subsequently, with prolonged reforestation, transition was achieved in the late 1990s.

Other example of this pathway is Korea where the strong proactive national policies and continuous support by President Park Chung Hee caused a relatively quick turnaround in forest cover. Bhutan also presents another important case where the forest policy of Bhutan of 1991 and the subsequent Bhutan Forest and Nature Conservation Act of 1995 making sustainable forest management as the founding principle of forest management in the country has succeeded in bringing about the transition. China is, of course, one of the prime examples of this pathway where a supportive policy environment sustained over last four decades has led to an incomparable level of reforestation at an average of 4 million hectare per year.

5. Court directed transitions

In India there is a very active civil society working in the field of environment which has used the unique tool of Public Interest Litigation filing cases in the Supreme Court and various High Courts asking for forest conservation as a public good greatly needed for the ecological security of the country and the courts have tended to be sympathetic to their demands. These Court rulings have tended to protect many important forest lands against vested interests but the changes they bring remain largely superficial limited to specific cases and rarely serve to bring country level changes that could lead to forest transition. Also many Court decisions have tended to rely excessively on ecological principles and lack both the depth and the flexibility that political systems bring to their decision making process by combining ecology with political economy thus restricting their wider application. The Court ruling also tend to be irreversible and may last for too long even when they no longer serve the purpose for which they were initially issued.

6. Urbanization led transition

In a large number of developed countries economic development has led to migration of rural population to urban areas leaving the marginally fertile lands previously cultivated by them fallow that are subsequently taken over by natural tree vegetation or are planted up with trees by the landowners in countries that have proactive agroforestry and farm forestry support systems including well developed markets for short rotation timber. Lack of labor in rural areas due to their migration and resulting high cost of manual labor also leads to mechanization which disfavors small holdings under agriculture pushing such lands to alternative uses like forestry. Lands under forest require labor only intermittently as against agriculture which are highly labor intensive and the rural labor scarcity works in the favor of having an increased forest cover. In many societies the younger generation sees the agriculture work as unattractive leading to abandonment of farming as parents grow old. Trees are preferred crops on such lands as they protect ownership of land while giving good income over a longer time frame.

In countries where the dominant source of household energy in rural areas is firewood rural migration reduces demand for wood and allows forests in the neighborhood to regenerate. While this may not be the dominant pathway but is an important route to forest transition in almost all countries where transition has taken place or is on the way.

Mass urbanization, which is a major passive factor in the transition, can come at high cost to the social fabric of a people. But it can also heal a society wounded by extreme inequity in rural areas. The mass migration of Dalits, at the bottom of the caste hierarchy in the traditional Indian society, out of rural hinterland to anonymous urban settings may have contributed only marginally to the forest transition in India but it has certainly been a major factor in breaking the stranglehold of caste in keeping the poorest section of the Indian society humiliated and subdued. The great buoyancy in the Indian economy in the past decade or so is, at least in part, the result of entrepreneurial creativity, and increased purchasing power, of this large section of Indian people finally coming out on their own. With the ‘hewers of wood’ now having many more opportunities the rural forests have more time to regenerate and deepen the transition and make it socially more meaningful.

7. Globalization led transition

This is essentially an economic development pathway but is different in the sense that it depends more on the global cues. When the forest transition took place in the West in the nineteenth century,

globalization was an important factor even though it was of a colonial kind and not the modern WTO facilitated globalization which is based in equity and fairplay rather than power and cunning. In the emerging economies globalization has helped bring greater prosperity and increased jobs in the non agricultural sector in some of the poorest countries that were till recently almost entirely dependent upon agriculture for providing economic opportunities to their people. This has helped increase migration away from rural areas and urbanization leading to beginning of changes in forest protection.

Globalization has also tended to spread new notions of conservation that first evolved in richer Western societies which has helped in gaining political support for forest conservation. This is an increasingly important pathway across the developing world.

8. Agroforestry led transition

Increasing support for agroforestry and horticulture on relatively poorer and smaller land holdings have become increasingly popular with in the infusion of technology and better quality extension services offered by many Governments across the world in production, storage, better and cheaper transportation to consumers. In India and China, as also in several countries across Asia Africa and Latin America, agroforestry is becoming a good additional income option for small farmers even as it relieves the pressure on natural forests by meeting part of the demand. In India some parts like the province of Haryana and western part of Uttar Pradesh have become surplus in wood supply.

9. Demand displacement led transition

Forest transition in one national territory may not always mean conservation of global forests since forest transition often accompanies displacement of related activity like sourcing timber and meeting agricultural demands overseas. China and Vietnam, both of whom have experienced forest transition in recent past are now major importers of both food and timber thus displacing some of their own demand for land use for agriculture and timber overseas. It has to be noted, though, that part of the displacement is not due to the existing demand at the time of forest transition but increased national demand resulting from fast economic growth. But some countries behave differently, notable among them is India where reforestation, though modest compared to China, has happened at a time when it also became food surplus from food deficient and was able to export food thus absorbing land-use demand from agriculture from abroad.

10. Aesthetics led transition

In countries more dependent upon tourism a sustained drop in tourist arrivals seemingly caused by poor aesthetic environment can also become a factor for forest transition. This however, is more likely to happen in very small territories. In larger countries aesthetic reasons can sometimes act as effective supplements to a range of other factors for forest enhancements.

11. Public awareness led transition

Increased public awareness now plays a high role in strengthening forest transition by preparing the society for it and motivating it to cause internal changes in behaviour. It is a big force in the developed world and is gaining momentum in emerging economies like India and China. Creative ways of using social media in support of forest transition has the potential of reducing costs of implementing REDD and ensuring permanency of its outcome.

The ecological quality, impacts, and social, environmental and economic costs of these forest transitions pathways differ due to their own contents and also the context in which they exist and manifest. Some forest transition pathways are more likely to lead to faster achievement of transition through a larger share of man made plantations while other might lay greater emphasis on the natural quality of the recovery. Yet others may lead to high environmental costs like the ones that have depended more on conservation of forests through shift from firewood to fossil fuels.

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