Chapter 5. Synthesis

Globally millions of hectares of tropical forests have been cleared and established with commercial plantations or converted to agriculture. Many of these are abandoned or put to alternate use. Abandoned plantations provide opportunities for restoring natural forests that compensate to an extent, forest cover depletion in the tropics. However restoration of such abandoned land to natural forests involves a complex interplay of ecological, socio-economic and legal issues. In the Western Ghats, tea plantations have been established in the rainforest during the colonial rule and these were owned by individuals or large companies. In the post-independence period, especially during globalisation, the tea market receded and many small owners could not maintain their plantations due to labour and other issues which led to the abandonment of many such plantations. In addition plantations established during the British rule are now inside protected areas and they face closure once the lease on the land expires or even otherwise. Not only large number of plantations have been abandoned (Chetana et al. 2012), the available acreage under tea has also been constant for last 5 years (Srinivasan 2012), hinting that no new or abandoned areas are coming under tea.

Apart from ecological issues of colonisation, there are social issues of rehabilitating people once they lose their livelihoods, the legal rights of landowners, economics of abandonment and finally the role of protected areas legislation in abandonment. In areas that come under PA, forest managers are keen that the area under plantations should be annexed with the PA. However, the sometimes large abandoned areas provide a challenge for restoration of native species. This thesis addresses the ecological aspects of colonisation by native tree species in 2, 17 year old abandoned plantations at Chinnamanjolai (CHM) and Netterikal (NTK) within the Kalakad Mundanthurai Tiger Reserve and the social aspects in 15 tea plantations in the Agasthyamalai region. The thesis will help in understanding the ecological and social constraints of native species colonisation and suggests approaches for restoration from an ecological, legal and social perspective that would be helpful for forest and plantation managers.
From an ecological perspective I looked at how seed input and existing vegetation inside the plantations is affected by forest proximity, functional traits of the native species, dispersal modes and frugivore assemblage, exotic species and soil characteristics. Result showed that though 63% of species reach the plantations, the density of seeds in the plantations are not very different from that in the forest. There was a negative distance effect from forest to plantation for both seed and plant density. Species composition of woody plants and seedlings however became less diverse and more homogeneous further away from the forest indicating that only a small subset of the species pool is colonising the interiors of the plantations. This may be due to lack of enough dispersal happening, sapling mortality and also suitable microsite conditions for establishment.

The types of species reaching the plantations are all early-successional species and there is a clear limitation in late-successional species even 17 years after abandonment. These plantations are less than 6 ha and located within the undisturbed forest, but still face seed dispersal limitations even though frugivore assemblages are similar between forests and plantations. Therefore in the case of large plantations with forests patches located far away, seed dispersal may be severely affected and natural succession of forest may be slow and poor in species composition. In such cases as shown by this study one can think of approaches outlined under “Passive or mixed restoration”

The native plant community structure seems to be strongly influenced by the density of invasive species especially in the lower elevation plantation (800-1000 m), but not so in higher elevations. Over grown tea in higher elevation does not seem to have such negative effect on plant communities. On the other hand invasive species do not seem to affect seedling recruitment of native species and mortality appears to be happening at the woody plants stages. However, seedlings of exotic species do better in lower elevation plantation whereas in the wet forest native seedlings do better in plantations.
Passive or mixed restoration

Though many small plantations have been abandoned due to various issues as highlighted earlier, some large plantations that are on lease land can also be abandoned especially those inside PAs. Restoring such large areas is not economically attractive and possible interventions like passive or mixed Ecological Restoration models can be suggested. The ecological intervention needs to be initiated prior to abandonment in managed tea plantations. Since on sensing abandonment tea companies and the labour force attempts to exploit the land as much as possible before leaving. Trees that are either planted shade trees or even native species are usually cut and this is something that needs to be curtailed under ecological restoration. As this study has shown, plantations with varied density of shade trees (*Grevillea robusta*) enhances the arrival of seeds into the plantation from the forest thereby increasing the species richness by 3 times and abundance of native seeds by almost 30 times compared to plantations that had no trees. In addition density of shade trees was important in increasing seed input, altered species composition, and species dominance in the plantations. By having such trees the effect of forest proximity can be reduced as frugivores contribute 30% of the seeds reaching the plantations in *G. robusta* planted areas even away from forests. Whereas in plantations without *G. robusta*, seed dispersal is restricted to 25 m from forest edge (Chetana and Ganesh 2012). In general density of shade trees had a strong influence on seed arrival, which can negate the forest proximity effect and enhance natural forest colonisation especially in areas that are far from forest even if it has a small subset of the frugivore assemblage. This is particularly true in the north east India where tea plantations are far from forests but have adequate shade tree cover (*pers. obs.*).

Even though retaining shade trees may be an option to bring native seeds into the plantation, my research shows that in abandoned tea plantations overgrown with invasive and non-invasive species; even though seeds arrive, microhabitat conditions may curtail germination or enhance mortality at a later stage due to closed canopy as under tea and lantana. The undergrowth clearing experiment conducted in the 17 years old tea plantations showed that cleared plots received higher number of native species compared
to un-cleared control plots. This suggests that minimum clearing in patches need to be made to facilitate establishment of native species and selective planting of early successional species needs to be encouraged (Raman et al. 2009). In short a combination of passive and active such as a mixed restoration efforts are needed to restore areas.

**Future of abandoned plantations**

Though passive or active restoration can be done on abandoned or to be abandoned areas or areas discontinued from tea or plantation activities, the viability of such efforts depends on the land tenure of the ‘to be’ restored area. Plantations are abandoned both inside PAs and outside PAs. The socio-ecological issues that pertain to restorations can be applied in both places. However, the perceptions of plantation managers to abandoned plantations indicates that legal issues such as being inside PAs is making their plantations unviable while the workers feel that if suitable compensations are paid they are willing to move out. As for plantations outside the PAs, most are not properly managed due to labour and union issues apart from economic conditions. In case of plantation outside PAs, where socio-economic conditions such as market fluctuation, labor unions, and tenure rights are strong drivers for plantation abandonments, a more nuanced approach is needed where areas that come under ecologically sensitive zone category, participative ecological restoration model may be applied using tea workers and government incentives to regain biodiversity and also sustain livelihoods.

Markets are dynamic and when writing this synthesis I see tea plantations are recovering from the market slump. The quality of Indian tea has improved to meet both national and international standards and average price of black tea has increased and stabilised (Preetha 2012). However the acreage of tea has remained the same for last 5 years but with the current change in economic status of tea, the area under tea can increase especially outside the PAs and on non EFL lands. Even inside PA, companies holding large areas and having huge labour force even under lease will seek to renew the lease under the guise of livelihood security for its labourer’s along with social and economic benefits for the company and the country in general. Such companies will need to invest
on a more eco-friendly growing practices and give greater impetus to biodiversity conservation for them to sustainably exist in such landscapes. International buyers insist on quality, social equity and environmental friendly practices for them to accept tea from growers in India and elsewhere. The recent rainforest alliance guidelines under sustainable agricultural network (SAN), has emphasised on the importance of eco-friendly agricultural practices and biodiversity conservation priorities for their certification within the tea and coffee plantation in India (Mudappa and Raman 2012; SAN 2012). These will enforce ‘good’ practices of tea production that hopefully will be conducive for a win-win situation for tea growers, forest managers, and biodiversity conservation.

References