The disastrous trajectory of the rain forests: Research imperatives

My experience is in Asia, where rain forests are concentrated in the Far East, and with the taxonomy and ecology of the dipterocarps.

Today, I am presenting a point of view, based on preliminary research, but crying out for testing, by more. That, I suggest, will require a change in research priorities.

- Forest conversion has proceeded further in Asia than in tropical Africa or the Americas.

- It therefore shows what is to come, if the same policies continue.

- Indigenous forests are increasingly confined to land too steep for safe conversion to commodity and other crops, where their importance in minimising erosion remains appreciated. In many regions now, the lowland mixed dipterocarp forest, the rain forest most productive of timber throughout the world, is reduced to patches often less than 10,000 ha.

- Does that matter?

- There are many reasons for the disappearance of the lowland forests. The reason most often given is that they cannot compare, either in productivity or financial return, with commodity crops.

- This reason relies on the low cost of energy in this last century, especially for fertilizer and pesticide manufacture. That may be about to change

- Overwhelmingly in tropical Asia, the indigenous forest estate is owned by governments on behalf of the people. Their policies should therefore be in the long-term economic interest. We all know that that responsibility has been almost universally betrayed (as it was in temperate developing economies in the past)
- What are the costs, and can anything be done?

- 1.

The colonization of the Asian tropics by western powers brought with it a serious attempt at sustainable management, but focussed more or less exclusively for timber, and industry rather than communities and the products and services that are important to them.

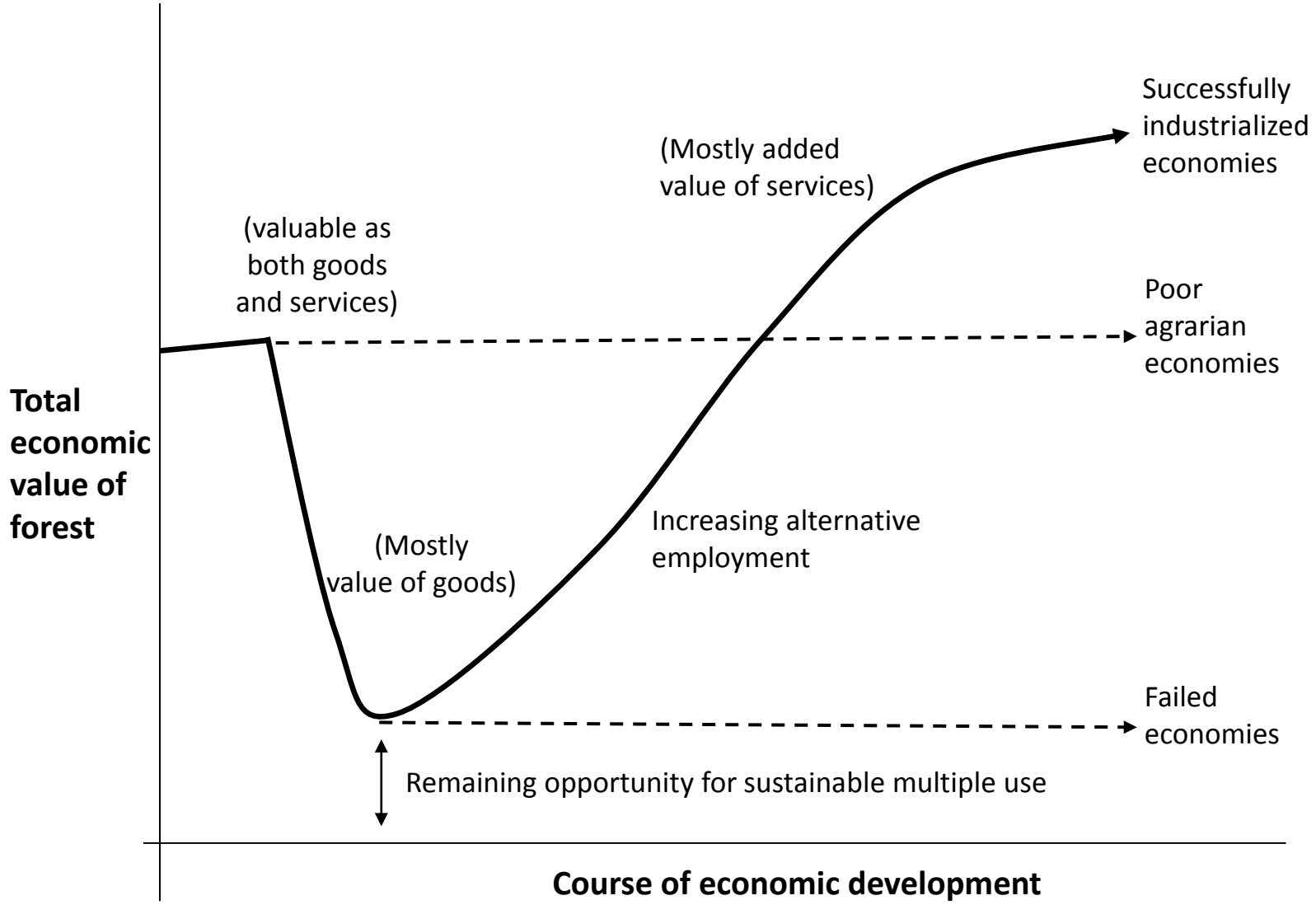
Success in sustainably managing for timber outturn was not easy to achieve in hyperdiverse forest, which had traditionally been valued for a multitude of products as well as services.

- Methods were successfully developed for lowland forests, but not for the hill forests. There, silvicultural ecology is profoundly different, with lower stocking and slower growth.
- In the present era, insufficient research and almost no silvicultural implementation, vital for the continuation of timber production in the forest types that now remain, has been carried out.

Comparison of an unlogged, and a logged area after 12 years, of hill dipterocarp *Shorea curtisii* (seraya) dominated forest: Trees >10 cm dbh

Bukit Lagong, Selangor[1]			**Jengai Forest Reserve, Terengganu[2]**		
Tree family	**No./ha.**	**%**	**Tree family**	**No./ha.**	**%**
Dipterocarpaceae	**57**	**12**	**Myrtaceae**	**156**	**28**
Flacourtiaceae	47	10	Lauraceae	31	6
Euphorbiaceae	36	7	Anacardiaceae(*Swintonia*)	28	5
Rhizophoraceae	26	5	Ebenaceae	28	5
Tiliaceae	22	4.5	Myristicaceae	27	5
Sterculiaceae	21	4	Burseraceae	24	4
Lauraceae	19	4	Sapotaceae	23	4
Anacardiaceae	19	4	Lecythidaceae	21	4
Myristicaceae	18	3.5	Clusiaceae(*Calophyllum*)	16	3
Burseraceae	16	3	**Dipterocarpaceae(*Vatica*)**	**12**	**2**
Other families	213	44		173	32
Total density	494			368	

1. After Manokaran & Swaine 1994
2. After Wan Mohd Shukri & al. 2005



Changes of the economic value of forests during the course of national development.

2. Why worry about the loss of the lowland forests?

Palm oil plantations yield much higher net, pre-tax, profits than forest timber production ever could, US$ 528-790/ hectare in Peninsular Malaysia (Nantha & Tisdell 2009), as opposed to less than $100/ha for a sustainably managed indigenous hardwood timber production forest, in tropical Asia *or* the temperate north .

- The added hydrological service value of indigenous forest over oil palm is small, on evidence from comparing erosion rates.
- Oil palm (in spite of claims to the contrary) is a net contributor to atmospheric carbon – when the carbon released from fertiliser and herbicide manufacture, and transportation – are included. Lowland forest may be a net sink of carbon, and is one of the greatest carbon banks per unit area.
- But who is going to pay, say $350/ha/annum for it?

3.

Temperate forests are under major threat from introduced pests and pathogens, which can only increase as global travel increases. These easily spread in species-poor forests with windy climates.

Species-rich tropical forests, in climates lacking prevailing winds appear less susceptible

- Rain forest biodiversity likely actually owes its existence, and persistence, to the balance of power between the complex chemical defenses of the primary producers – individual tree species – and the equally complex de-activating chemicals of their insect and pathogen enemies.
- There is increasing evidence (Gilbert) that this balance is mediated by the dispersal distance of pathogen spores: Nearby conspecific trees are most liable to infection, leaving space into which other species, resistant to the pathogens of that tree species (but susceptible to others) will invade, thereby building species diversity.

In summary, tree species diversity increases forest stability and decreases risk, especially in the management of long-lived crops. These properties are likely to increase in intensity and the relative economic value of indigenous tropical forest

- This chemical cornucopia has long been recognised as a source of traditional medicinals, and in the search for new pharmaceuticals. In the future, it will be more important – arguably irreplaceable – as a source of chemicals for tree crop protection.

- Rain forests are also therefore libraries of gene sequences vital for genetic modification aimed at protection against pests and deseases.

Conclusion

- Conservation of rain forest biodiversity will vital for the future of tree agriculture (as well as plantation forestry) in the tropics.
- The cost of protecting monocultures is going to rise: How much preparation is going into that?

What is required?

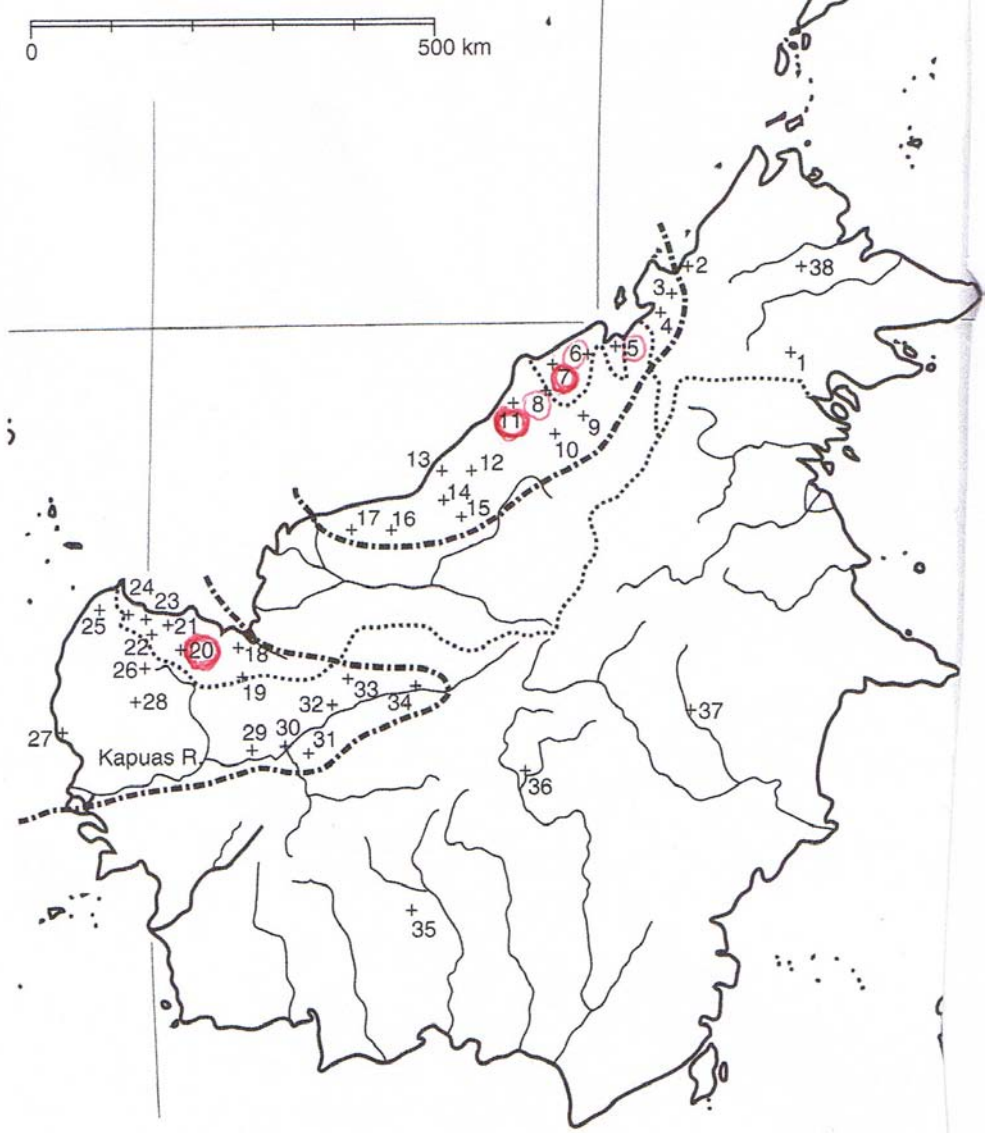
It is still feasable to conserve most of the necessary tree species diversity in Asian tropical forests

The tree species' demography plots of the Smithsonian Tropical Research Institute/ Arnold Arboretum of Harvard University 's Center for Tropical Forest Science. Plots vary in area <50 ha, each large enough to capture >200 individuals >1 cm diameter of half the species within them, and are recensused 5-yearly, using a standard methodology. They provide unique opportunities for monitoring local to global dynamic and demographic change.

- How big a biodiversity reserve is big enough? Cases: Bukit Timah, CTFS 50 ha plots

- How should priority locations be chosen?
- Lowland forests are the richest.
- Rain forests on different geology support different biodiversity

- Are some forest types more endangered than others?
- Yes: Those on the most fertile soils, and those in the most accessible habitats

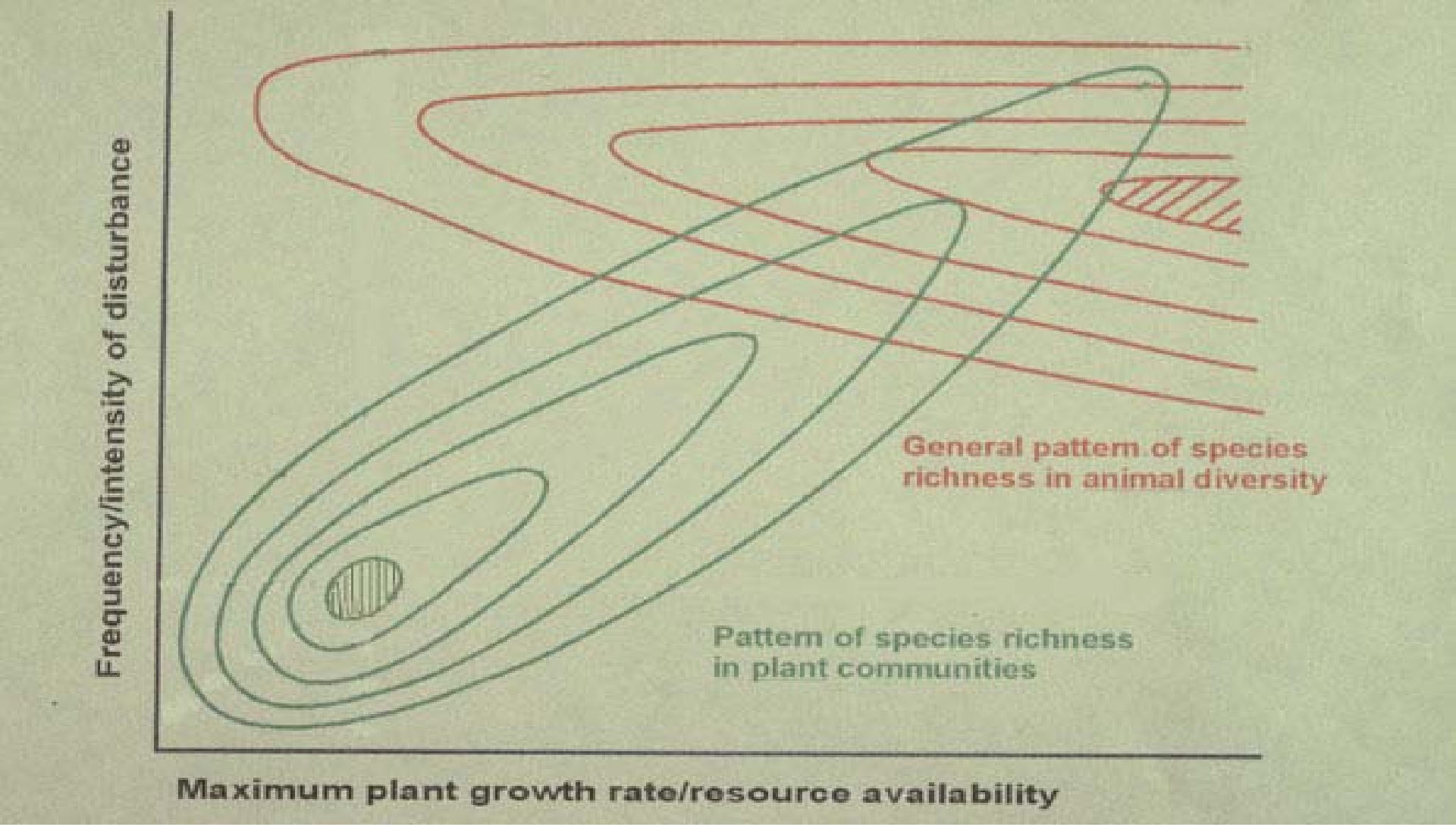


Known locations of the 'Riau Pocket' flora in Borneo. 70% of the 38 dipterocarp sp. occurring within the dot-dash lines are endemic; only 12 occur in locations outside the lines. Locations encircled red are the only intact survivors, of which the thick red circles indicate the richest(28-32 dipterocarp species within each location)

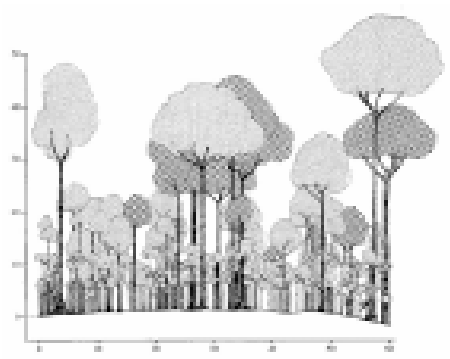
4.

- Can biodiversity reserves be carefully managed for sustained timber production?

- Many vertebrates, including large terrestrial mammals and some birds, actually increase in successional forest, while maturing stands can support the more demanding subcanopy and other species. Strangling figs and other keystone species can be protected



Plants require different conservation strategies from vertebrates. Whereas vertebrate numbers and diversity are greatest in partially disturbed forests on fertile soils, tree species diversity is greatest in less disturbed forests on poorer soils whereas on fertile soils it is repressed by a few fast growing species which dominate the canopy.

Locality	Bako N.P.	Lambir N.P.	Bukit Mersing, Anap
Site characteristics	Drought-prone coastal slope; infertile freely draining sandy soil	Moderately drought-prone moderately infertile andy loam soil; ridge and gentle slope	Mesic lower slopes; deep fertile basaltic clay loam soil
Profile diagram			
Number of species	223	321	143
No. pioneer spp. (%)	18(8)	30(9)	15(10.5)
emergent spp. (%)	10(4.5)	40(12.5)	8(5.5)
main canopy spp. (%)	111(50)	147(46)	43(30)
subcanopy spp. (%)	84(38)	104(32)	77(54)

Tree species richness in Mixed Dipterocarp forest at three sites in Sarawak. Species richness expressed as the number of trees >10cm dbh/1000 individuals. Dipterocarps cross-hatched.

Conclusion: Sadly, no

The full plant species complement is sustained by a canopy gap frequency and average size which is steady and predictable at the time scale of a tree life cycle. Successive harvesting, by changing the gap regime, will cause increasing local and wider extinctions. Besides, the track record for long term careful management is poor.

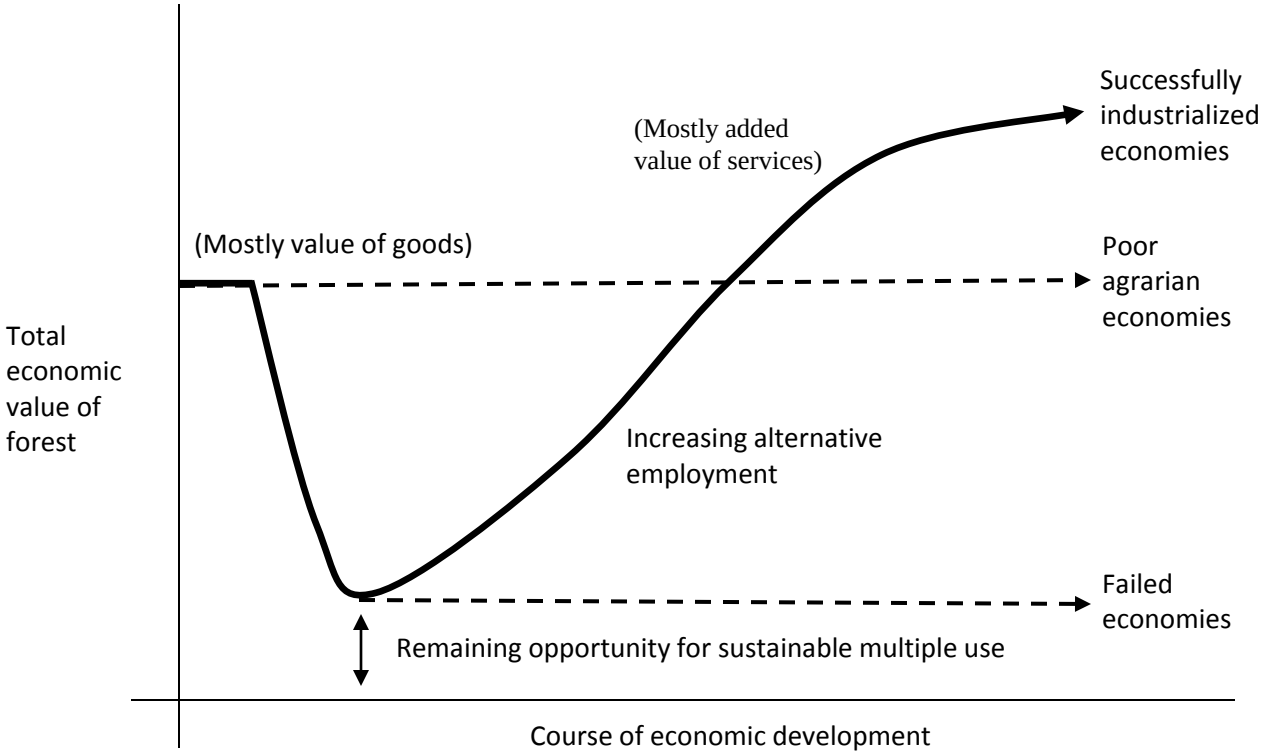
- Plant species can only be augmented by exotic weeds,not by native species which take centuries to spread owing to poor dispersal and demanding establishment requirements.

- Vertebrates, in contrast, can almost all be conserved in the hill production forest estate.

- How much compensation would be necessary to secure 30, 5000 ha strict virgin forest biodiversity reserves?

- Probably $30 x 5000 x ½million = $75,000,000 *per annum*, for Asia alone.

- Who will be willing to pay?
- (Bear in mind that Malaysia netted $14 billion, Indonesia 5.5 billion from oil palm in 2007 (Wall Str. Jour., Asia Jan 18 2008)



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