What causes tropical deforestation?

A complex picture

No simple generalisations

Tropical forests are lost due to a large number of factors acting together

Useful conceptual framework divides factors into

- Proximate causes
- Underlying causes

Results of meta-analysis

Geist and Lambin analysed case studies from Asia, Latin America and Africa
Found large number factors that led to deforestation
Drivers differ in importance between regions

I. Geist, Helmut II. Lambin, Eric III (2001)Land-Use and Land-Cover Change (LUCC)Project IV. International Human Dimensions Programme on Global Environmental Change (IHDP) V. International Geosphere-Biosphere Programme (IGBP) VI. TitleVII. Collection: LUCC Report Series

Underlying causes

Economic factors (economic growth, change or development, commercialisation)	Market growth & commercialisation	Unspecified: rapid market growth (especially of the export-oriented sector), rise of cash economy, increasing commercialisation, incorporation into (world) economy
		Increased market accessibility (esp. of semi-urban and urban markets)
		Growth of sectoral industries (wood-related, agriculture-related, mineral-related, others)
		Lucrative foreign exchange earnings
		Growth of demand for consumer goods and services procured with cash due to a rise in well-being (unspecified, wood-related, agriculture-related, housing & transport)
	Specific economic structures	Unspecified
		Large individual (mostly) speculative gains
		Poverty & related factors (lack of income opportunities, joblessness, resource poverty, low living standard, etc.)
		Economic downturn, crisis conditions
		Indebtedness, heavy foreign debt
	Urbanization & industrialization	Urbanization: growth of urban markets
		Industrialization: rapid built-up of new basic, heavy and forest-based or –related industries
	Special economic parameters	Comparative advantages due to cheap, abundant production factors in resource extraction & use
		Special, mainly artificially low kept production conditions
		Price (value) increases (of fuel, land, cash crops)
		Price decreases (of cash crops)

Underlying causes

Policy and institutional factors (change of political economy institutions)	Formal policies	On taxation, charges, tariffs, prices
		On credits, subsidies, licenses, concessions, (logging) bans
		On economic development (agriculture, infrastructure)
		On finance, legislation, investment, trade
		On population (migration)
		On land
		Other pro-deforestation policy (unspecified)
	Informal policies (policy climate)	Corruption, lawlessness
		Growth or development coalitions at work
		Poor performance, mismanagement
		Clientelism, vested (private) interests
		Redefinition of (forestry) policy goals
	Property rights regimes	Insecure ownership, land tenure insecurity (unspec.)
		Land race, race for property rights
		Titling, legalization, consolidation (of individual titles)
		Malfunct customary rights
		Low empowerment, deprivation, marginality
		Open access conditions

Underlying causes

Technological factors (technological change or progress)	Agro-technological change	Land-use intensification
		Land-use extensification
		Agricultural involution
		Other changes (landholding, production orientation, etc.)
	Technological applications in the wood sector	Damage & wastage due to poor logging performance
		Wastage in wood processing, poor industry performance
		Lack of cheap, technological alternatives to woodfuel; poor domestic & industrial furnace performance
	Other production factors in agriculture	Low level of technological inputs (unspecified)
		Land-related factors (landlessness, land scarcity)
		Labour –related factors (limited labour availability)
		Capital-related factors (no credits, limited irrigation)

Underlying causes

Cultural (or socio-political) factors	Public attitudes, values, beliefs	Public unconcern or lack of (public, political) support for forest protection and sustainable use: low morale or education, frontier mentality, and dominance of other public attitudes (modernization, development, nation-building, etc.)
		Unconcern about the welfare of others and future generations, or disregard of the "sacredness of nature"
		Beliefs about how environmental conditions affect those things which individual values
	Individual and household behaviour	Unconcern by individuals about the environment as reflected in increasing levels of demands, aspirations, materials and energy consumption, commonly associated with commercialisation and increased income
		Situation-specific behaviour of actors: rent-seeking, non-profit orientation, tradition/imitation/continuation of inherited modes of resource use

Proximate causes

Proximate causes		
Agricultural expansion (AGRO)	Shifting cultivation	Traditional shifting cultivation
		Colonist shifting cultivation
	Permanent cultivation	Subsistence (food, smallholder) agriculture
		Commercial agriculture (large-scale, smallholder)
		Agricultural (Integr. Rural) Development Projects
	Cattle ranching	Smallholder cattle ranching (pasture creation)
		Large-scale cattle ranching (pasture creation)
		Unspecified
	Colonization, transmigration, resettlement	Spontaneous transmigration
		Local transmigration (resettlement)
		Military transmigration (penal settlements)
		Estate settlement (agricultural, nucleus)
		Industrial forestry plantation settlement
		Unspecified

Proximate causes

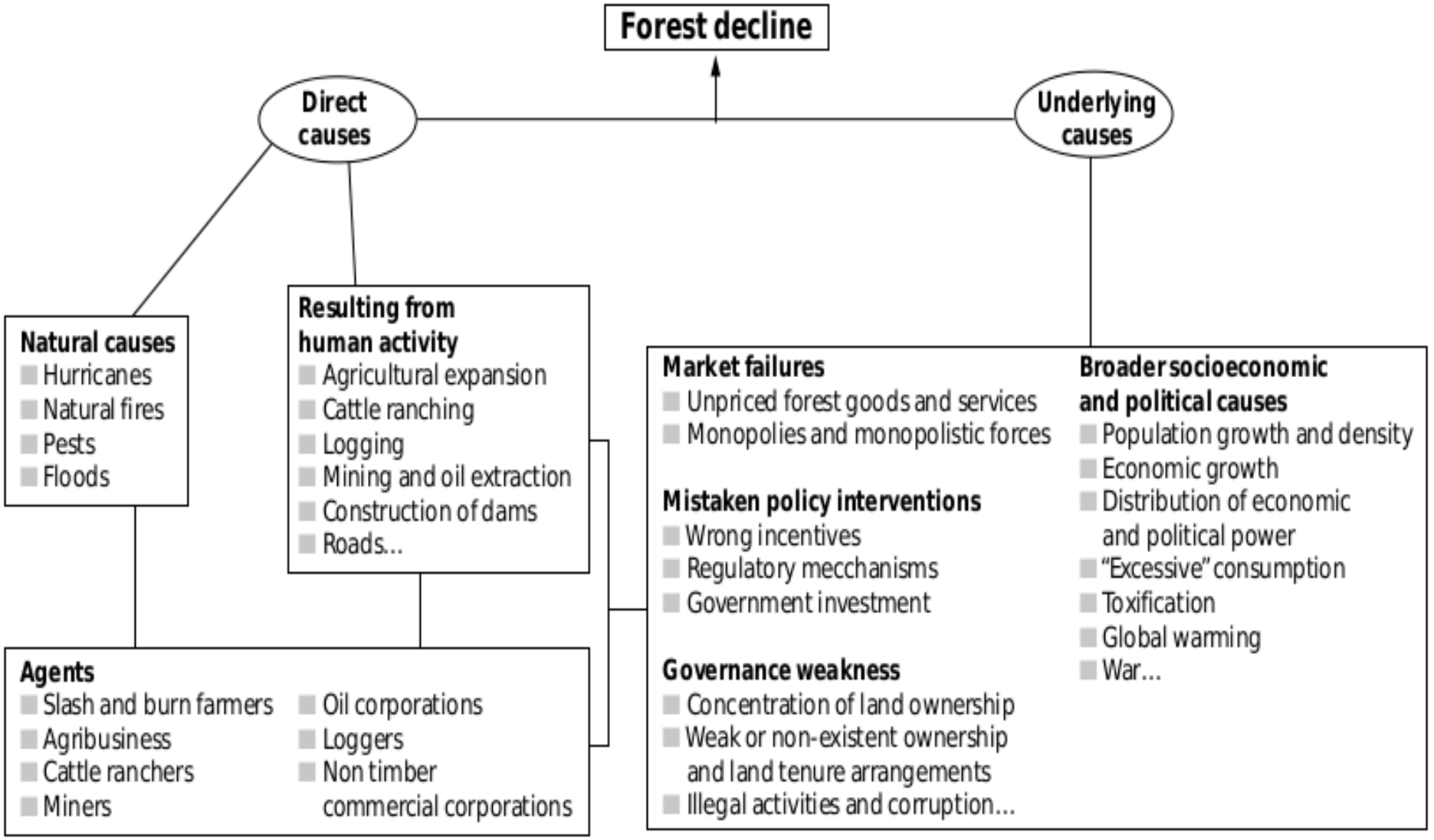
Wood extraction (WOOD)	Commercial wood extraction (clear-cutting, selective harvesting)	State-run logging (selective, clear-cutting)
		Private company logging (selective, clear-cutting)
		"Growth coalition"-led logging
		Illegal (illicit, undeclared) logging
		Unspecified
	Fuelwood extraction	Domestic uses (rural, urban)
		Industrial uses (rural, urban)
		Unspecified
	Polewood extraction	Domestic uses (rural, urban)
		Industrial uses (rural, urban)
		Unspecified
	Charcoal production	Domestic uses (rural, urban)
		Industrial uses (rural, urban)
		Unspecified

Proximate causes

Infrastructure extension (INFRA)	Transport infrastructure	Roads (public, military, logging, mining, etc.)
		Railroads
		Rivers & tributaries
	Market infrastructure	Public infrastructure (food markets, storage, etc.)
		Private infrastructure (sawmills, food markets, etc.)
	Public services	Water & sanitation facilities, electrical grids, etc.
		Unspecified
	Settlement expansion	(Semi-)urban settlements
		Rural settlements
		Military defense villages
		Unspecified
	Private entreprise infrastructure	Hydropower development
		Oil exploration
		Mining (gold, coal, tin ore, etc.)

Other factors (facilitators)

Other factors		
Land characteristics (biophysical environment)	Soil-related	Good/bad soil quality
	Slope & topography-related	Flat areas
		Gently sloping areas
		Lowlying areas
	Water-related	Location next to water resources
	Vegetation-related	Forest size & fragmentation
		Vegetation density (high, of marketable woods)
Biophysical drivers (triggers)	Soil-related	Soil compaction
		Soil fertility decline
		Land degradation (unspecified)
	Water-related	Drought conditions (aridity)
		Wet conditions (high humidity)
		Floods
	Vegetation-related	Weed intrusion
		Forest fires
Social trigger events	(Civil) war, rebellion, revolution, social unrest & disorder	
	Health & economic crisis conditions (e.g., epidemics, economic collapse)	
	Abrupt (& violent) population displacements (refugee movements)	
	Government policy failures (e.g., abrupt shifts in macro-policies)	



Source: After Contreras-Hermosilla (2000), Underlying causes, CIFOR, p. 5.

Table 7: Frequency of specific agricultural activities causing deforestation*

	All cases (N=152)		Asia (n=55)		Africa (n=19)		L. America (n=78)	
	abs	rel	abs	rel	abs	rel	abs	rel
Permanent cultivation								
Total	**73**	**48%**	**24**	**44%**	**10**	**53%**	**39**	**50%**
• subsistence agriculture[1]	61	40%	20	36%	10	53%	31	40%
• commercial agriculture	22	15%	5	9%	4	21%	13	17%
(smallholder)	(17)	(11%)	(3)	(6%)	(4)	(21%)	(10)	(13%)
(large-scale)	(9)	(6%)	(4)	(7%)	(1)	(5%)	(4)	(5%)
• agricultural projects[2]	6	4%	1	2%	3	16%	2	3%
Cattle ranching (pasture creation)								
Total	**70**	**46%**	**3**	**6%**	**3**	**16%**	**64**	**82%**
• unspecified	38	25%	1	2%	2	11%	35	45%
• smallholder	28	18%	2	4%	1	5%	25	32%
• large-scale	15	10%	0	-	0	-	15	19%
Shifting cultivation								
Total	**63**	**41%**	**24**	**44%**	**8**	**42%**	**31**	**40%**
• traditional shifting cultivation	46	30%	24	44%	7	37%	15	19%
• colonist shifting cultivation	26	17%	5	9%	3	16%	18	23%
Colonization, transmigration, (re)settlement								
Total	**61**	**40%**	**23**	**42%**	**4**	**21%**	**34**	**44%**
• unspecified	51	34%	21	38%	1	5%	29	37%
• "spontaneous"	21	14%	8	15%	2	11%	11	14%
• local transmigration[3]	8	5%	4	7%	2	11%	2	3%
• military transmigration[4]	5	3%	5	9%	0	-	0	-
• estate settlement[5]	6	4%	6	11%	0	-	0	-
• forestry settlement[6]	2	1%	2	4%	0	-	0	-
Agricultural expansion (unspecified)								

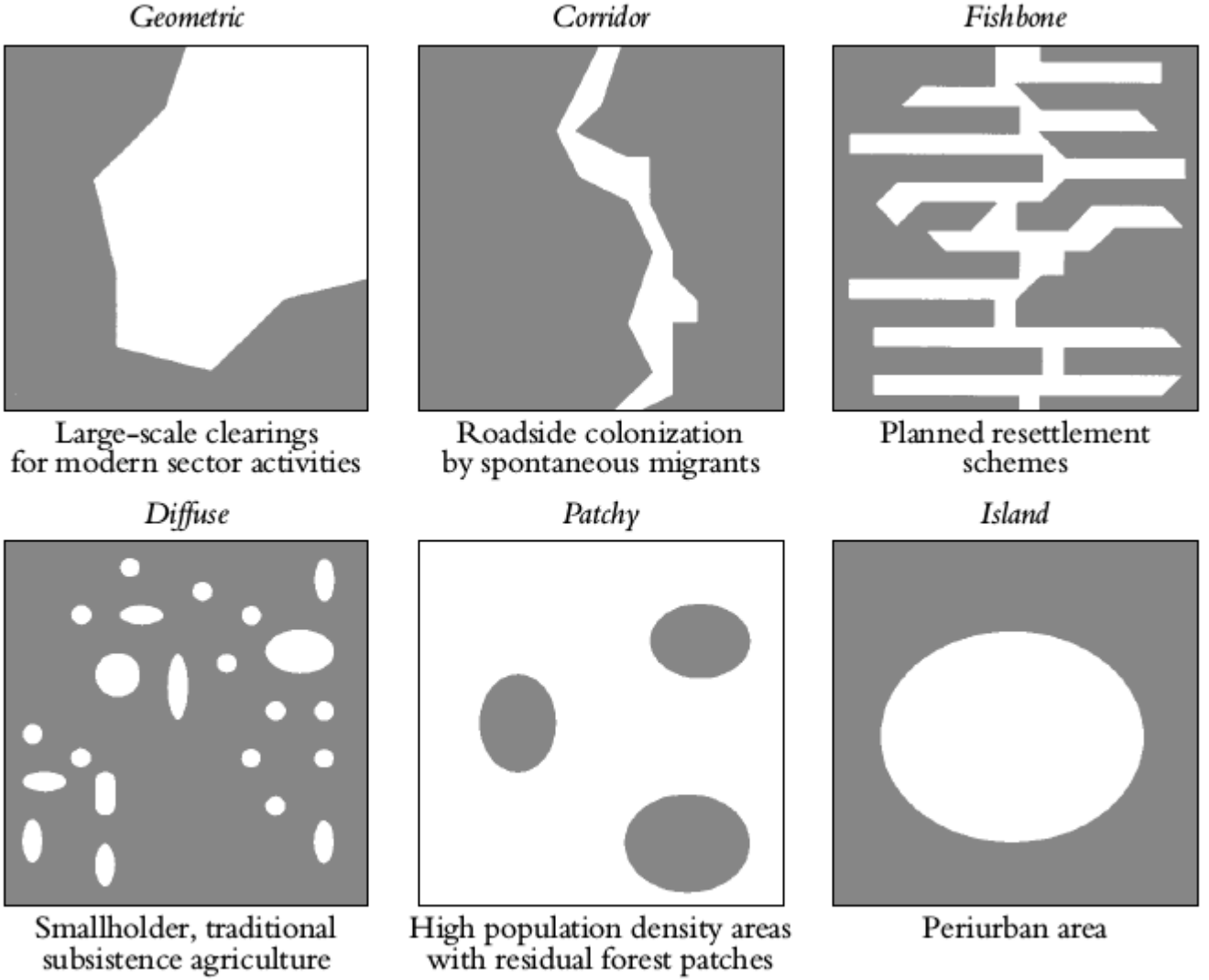
Table 9: Frequency of wood extraction causing tropical deforestation*

	All cases (N=152)		Asia (n=55)		Africa (n=19)		L. America (n=78)	
	abs	rel	abs	rel	abs	rel	abs	rel
Commercial wood extraction[1]								
Total	**79**	**52%**	**43**	**78%**	**5**	**26%**	**31**	**40%**
• unspecified	48	32%	22	40%	4	21%	22	28%
• illegal (illicit, undeclared)	18	12%	12	22%	0	-	6	8%
• state-run	17	11%	15	27%	1	5%	1	1%
• private-run	9	6%	6	11%	1	5%	2	3%
• growth coalition-led	5	3%	0	-	1	5%	4	5%
Fuelwood extraction								
Total	**42**	**28%**	**18**	**33%**	**10**	**53%**	**14**	**18%**
• for domestic uses[2]	33	22%	14	26%	7	37%	12	15%
• for industrial uses[2,3]	17	11%	6	11%	7	37%	4	5%
Polewood extraction								
Total	**31**	**20%**	**15**	**27%**	**8**	**42%**	**8**	**10%**
• for domestic uses[2]	21	14%	11	20%	4	21%	6	8%
• for industrial uses[2,3]	16	11%	6	11%	6	32%	4	5%
Charcoal production								
Total	15	10%	8	15%	4	21%	3	4%

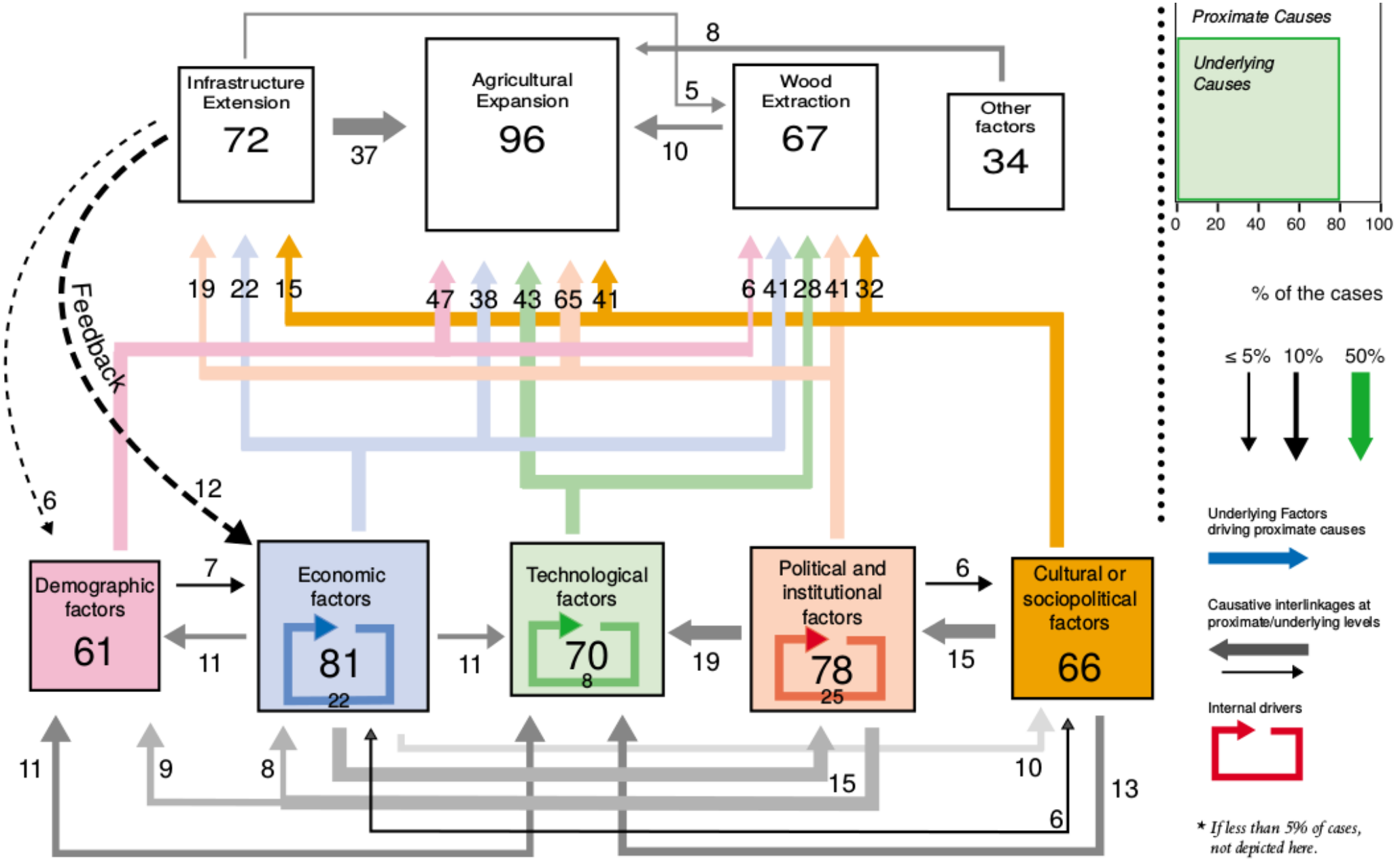
Underlying causes

Demographic factors (human population dynamics)	"Population pressure" (unspecified)
	Population growth (unspecified)
	Natural increment (fertility, mortality)
	In-migration
	Population density
	(uneven) spatial population distribution
	Life cycle features

Patterns



Source: Mertens and Lambin (1997), Spatial modelling of deforestation, p. 149.


Infrastructure Extension
72
Agricultural Expansion
96
Wood Extraction
67
Other factors
34
37
8
5
10
Feedback
6
12
19 22 15
47 38 43 65 41
6 41 28 41 32
Demographic factors
61
Economic factors
81
22
Technological factors
70
8
Political and institutional factors
78
25
Cultural or sociopolitical factors
66
7
11
11
19
6
15
11
9
8
15
10
6
13
Proximate Causes
Underlying Causes
0 20 40 60 80 100
% of the cases
≤ 5% 10% 50%
Underlying Factors driving proximate causes
Causative interlinkages at proximate/underlying levels
Internal drivers
* If less than 5% of cases, not depicted here.

Conclusions

Causes and drivers of tropical deforestation cannot be reduced to a single variable. The interplay of several proximate and underlying factors drive deforestation in a synergetic way. The expansion of cropped land and pasture is clearly the most important proximate cause of tropical deforestation

Conclusions

Shifting cultivators are not always the key agents of deforestation

Chain-logical causation in the form of 2-factor chains underlies about two thirds of the proximate as well as underlying causes

Population pressure in the form of natural increases in number of population is not a major underlying driving force alone, without migration.

The explanatory power of PAT variables (population, affluence, technology, thought to work together in the seventies) is poor.

Economic growth and technology may slow or