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Forest and agroforest dynamics on Malagasy Highlands

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Background and objectives

Post-forest landscapes of Madagascar result generally from combined processes: forest fires due to pasture fires, forest conversion to agriculture (Serpantié and Girres, 2018), ecologically regressive dynamics (Randriamalala et al, 2007) , and also regeneration thanks to practices that favor the protection or regeneration of local or exotic trees. These are distinguished between "agri-forestry" practices (when agriculture and trees are on different plots) and agroforestry ones (combined crops and trees on a same plot).

These processes give a new landscape called "biodiversity melting pot" (Kull et al, 2013).

Post-forest landscapes in a "geranium belt" of Malagasy Highlands have to be characterized in their drivers, structure, composition and relatively to their ecosystems services in order to identify the possible levers for a landscape transition towards more or maintained watershed regulating ecosystem services expected by an hydro-electric plant in project (GRET Rhyvière project) for sustained water quality

Small geranium agroforestry peasant field with terraces and forest trees regrowth maintained « for the beauty », regrowth fallowland in the back

Agri/agroforestry farm precursor in nineties.
Many australian wood species around fields and many fruits trees and cover crops on terraced fields
(Jean-Marie, Camp-Robin)

Methodological approach

Ifanindrona watershed on the middle Highlands of Madagascar. (Ambatofitorahana/Fiadanana, Amoron'i Mania / Upper Matsiatra,)

- 1. Spatial dynamics of land cover in a post-forest zone by archiving, photo-interpretation of 1/50000 photo archives and Google-earth high resolution products
- 2. Inventory of habitats on representative ground transects, ecological inventory of representative stations
- 3. Study of the drivers : practices (study practices by survey on 20 households, maps of fire, population change, climate change
- 4. The ecosystem services though quantitative survey and open interviews: evaluation of providing services per area unit, hydrological surveys, ground monitoring and map of erosion, services expectation by stakeholders
- 5. Development of adapted options and participatory tools for regulation ecosystem services management

Ecological regional diagnosis (maps, inventory)

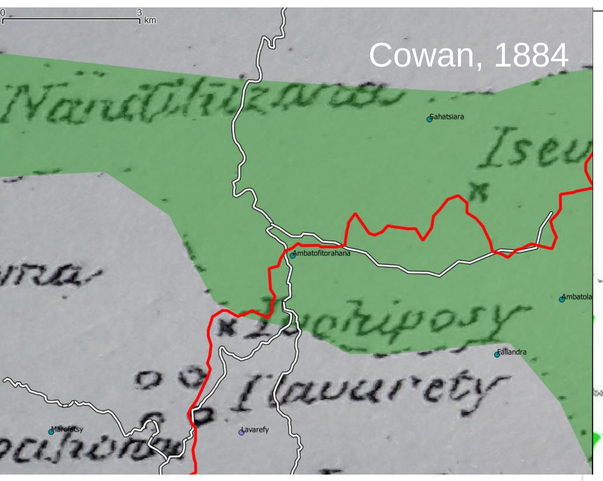
Drivers monitoring (practices and production of agriculture, forestry, cattle, fire) by survey (household, community) and remote sensing (fire)

Ecosystem services inventory and value
Scientific evidence
Local and expert knowledges

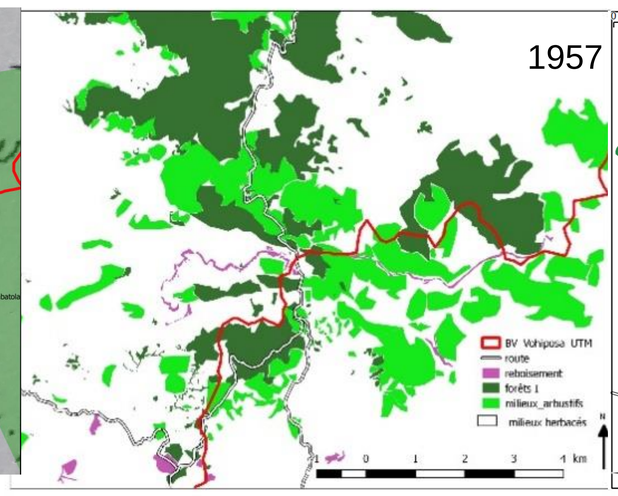
Development of adapted options and participatory tools for ecosystem services management

Results

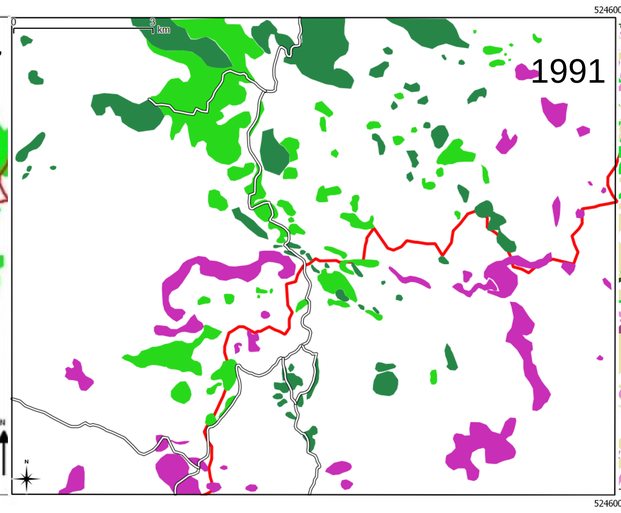
1. A natural forest and rangeland destruction and agro-sylvo-pastoral landscape construction



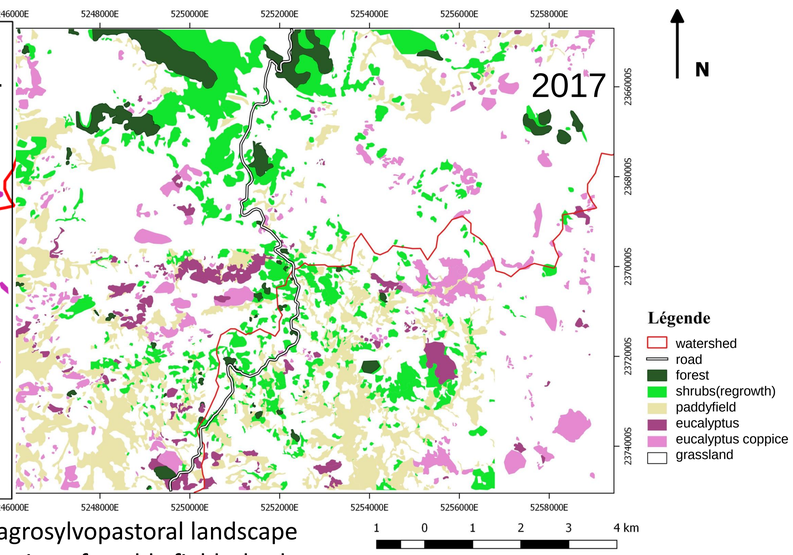
A low populated natural forest/rangeland landscape in a high altitude zone (1600m)



Reduction, fragmentation, secondarization of forest habitats; increasing grass and shrubs initiation Eucalyptus in 1957 along tracks



Expansion of exotic fire-tolerant trees, expansion of grass and fires; construction of an agrosylvopastoral landscape

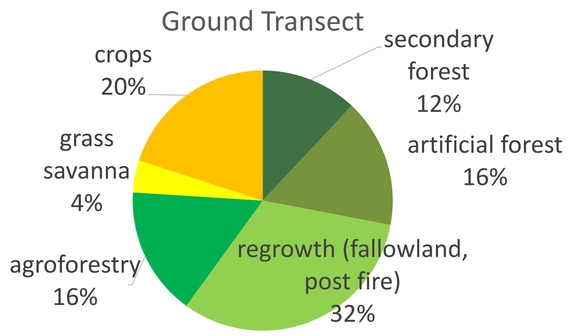


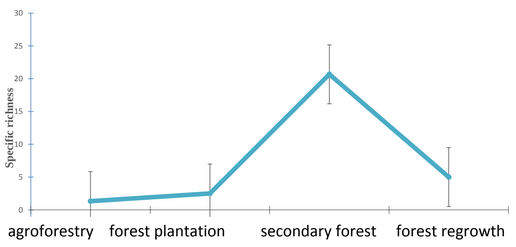
A scattered agrosylvopastoral landscape
South : expansion of paddy field, shrubs (fallows) and charcoal tree coppice (agri-forestry) but rare forests, timber, rangelands and fires; North, West: rangelands and fires

%	natural forest	re-growth shrubs	timber plantation coppice	crops and grass	Total
1957	15	15	1	69	100
1991	5	6	4	85	100
2017	2	10	7	81	100

2 . Diversified ecotopes rich in lignous

(76% lignous, 16% agroforestry on transect)

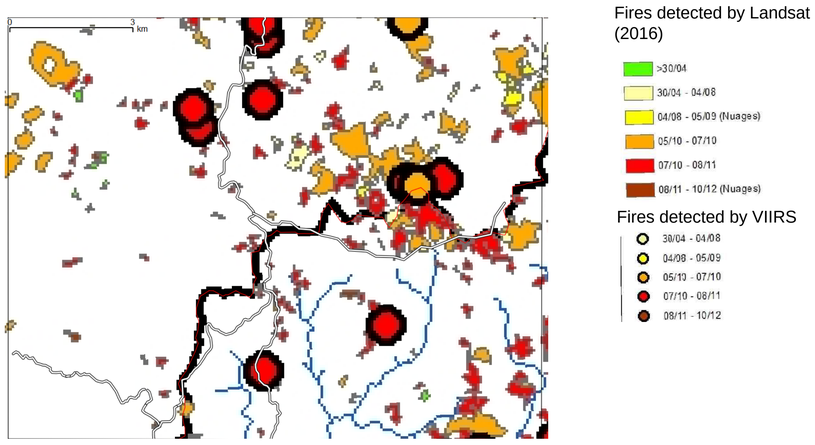




But biodiversity is globally lost, except in secondary forests !!

3 . Drivers

North, East ; fires oct-nov on rangeland (pasture management) and around forest remnants (slash and burn for geranium);
South, West : less fire, rare scattered fires (new carbonisation practices firing coppice)



And also :
Climate change : less water at the begining of rainy season,
Population increase; Diversifying under a climate opportune for wood. Forestry et and agroforestry practices in each farm

4 . Agrosylvopastoral landscape =

- More providing services
- but uncertain durability of charcoal and wood
- low biodiversity
- threats on watershed regulating services

Many geranium fields in fallowland currently
Next cycle will be on greater fields, more erosion-susceptible

Great nude geranium field of investors on post-forest regrowth and rangeland

Conclusion

Agri-forestry and agro-forestry replace forest and rangeland in post-forest landscapes of Highlands, providing food, charcoal, less fires but also less and less wood. Biodiversity (and habitat) is the principal service missing, but may be maintained on small secondary forests by each after a sensibilisation to the importance for this. Watershed regulation is good (terraces, coppice) but threatened by a comeback of geranium investors. This sector has to take his responsability to reduce erosion risk. By promoting regulating ecosystem services (like watershed regulation or carbon sequestration), conservation, forestry and agroforestry initiatives should be federated and supported by water, wood, energy, geranium or carbon sectors, and adapted to the main limiting factors, at first fire risk.

References

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