

**Land-use change, tropical biodiversity, and ecosystem services –
Southeast Asian amphibians and reptiles in focus**

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To my parents.

“The fire had been violent, and now only smouldering black stumps remained. The aspect of the land was desolate. The great trees had toppled down, tearing up the soil and making deep pits. All the landscape was soiled with ash and soot. Smouldering trunks lay everywhere.”

Madelon H. Lulofs – *Rubber*. 1931

“Sometimes all it takes is a tiny shift of perspective to see something familiar in a totally new light”

Dan Brown – *The Lost Symbol*. 2009

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Summary

In the tropics, global food demand and population growth have already led to conversion of more than 50 % of formerly forested areas into agricultural landscapes. Across all tropical regions, Southeast Asia suffers from the highest deforestation rates, where land-use change is mainly driven by rapid expansion of biofuel and cash crops such as cacao. The ecological effects of agricultural expansion on biodiversity and ecosystem services are little known, in particular, in chronically understudied areas like Sulawesi (Indonesia), the third largest cacao producer globally. Moreover, certain taxonomic groups such as amphibians and reptiles remain particularly poorly studied, yet are the most threatened vertebrate groups on the planet. My thesis targets the impact of land-use change on Southeast Asian amphibian and reptile diversity as well as their ecosystem services provided.

After an introduction to the research context, the first chapter shows how land use change from pristine forest to open areas impacts amphibians and reptiles. I use Bayesian modelling to examine environmental predictors of diversity patterns to then derive the first assessment of how amphibians and reptiles are affected by cacao farming in Sulawesi. In the second chapter, I assess the conservation value of cacao agroforest based on a two-step approach: (i) multi model inference is used to identify environmental predictors of herpetological diversity patterns in cacao agroforests; then (ii) a large scale experimental approach is used to test whether these predictors can realistically be implemented on a large scale by local farmers. In the third chapter, I compiled, for the first time, an extant species list, to make best use of the information on amphibians and reptiles in the region. I discuss how such species lists can be used by National Park authorities and local researchers to facilitate ecotourism and research activities. In the fourth chapter I show how endemic toads can control highly invasive “yellow crazy ants” and the likely implications this interaction may have for cacao yield. In the final chapter, I argue that pesticide use is a major driver of tropical biodiversity loss that currently has not received the attention it deserves.

In conclusion, this thesis revealed that there is still much to be learned about the impact of land-use change on amphibians and reptiles in Southeast Asia, their conservation, and the ecosystem services they can provide. Future research efforts need to incorporate pesticide impacts on amphibians and reptiles, to give realistic management recommendations for sustainable agricultural landscapes. In addition, the monetary value of herpetological ecosystem services must be identified in these secondary habitats. Only then, local small-scale farmers may be supportive of biodiversity conservation.

Originality statement

This work contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution to Thomas Cherico Wanger and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text.

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