Fiche analytique – Mémoire de Master MUSE

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TITRE MEMOIRE*	Water-Food NEXUS in Costa Rica		
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THEMATIQUE* (AFFILIATION)	Climate impacts		
VOLEE MUSE*	2016		
TITRE ACADEMIQUE*	Engineer's degree in Chemical Technology		
DIRECTION* / EVALUATION	Directeur de mémoire* Prof. Anthony Lehmann	Co-directeur de mémoire* Prof. Markus Stoffel	Nom(s) du ou des juré(s)* Prof. Mario Giampietro Dr. Louise Gallagher
STAGE (éventuel)	Organisme d'accueil	Maître de stage	
COLLATION*	Nb de pages* 100	Nb de figures* 24	Nb de tableaux* 39
TERRAIN D'ETUDE OU D'APPLICATION	Multi-Scale Integrated Analysis of Societal and Ecosystem Metabolism as a decision support tool for sustainable land and water use.		
MOTS-CLES* (entre 5 et 10)	MuSIASEM; NEXUS; land resources; water resources; food consumption pattern; agricultural systems; sustainability assessment; Costa Rica.		
RESUME* (max 1500 car)	Traditional studies concerned with the quantitative analysis of sustainability often consider only one dimension and one scale of analysis at a time, hence providing an incomplete outlook on the interconnections between the environment and socio-economic systems. Accounting for these shortcomings, this study illustrates the potentiality of Multi-Scale Integrated Analysis of Societal and Ecosystem Metabolism (MuSIASEM) approach in assessing food, water and land systems interconnections across different scales and dimensions. Applying MuSIASEM in diagnostic mode, this study provides a comprehensive characterization of Costa Rica's existing food metabolic pattern, together with an integrated assessment of the water metabolism of 34 Costa Rican watersheds. One of the most striking findings of our study is that 30% of total nutrient carriers available to the population is absorbed, as feed, by the agricultural sector to produce meat and dairy commodities. Furthermore, the end-use matrix of Costa Rica's agricultural sector reveals that this pattern is responsible for additional virtual water (25%) and land (50%) exploited abroad to sustain Costa Rica's total food consumption. These findings highlight that in the case of future food price volatility, policies geared at reducing food imports' dependency would compromise Costa Rica's reforestation policies. Analyzing Costa Rica's water metabolism, our study does not reveal water scarcity issues at the national level, but watershed-scaled analysis shows that 92% of Bebedero watershed's ecosystem surface water recharge is consumed by society, thus putting the region under threat of surface water scarcity. Our results also uncover that agriculture and hydroelectric power generation through evaporation losses from dam reservoirs, are the largest contributors to Costa Rica's consumptive blue water uses, accounting for 52% and 33%, respectively. In order to accurately estimate Costa Rica's consumptive blue water uses, our study deals with the unreliability of Costa Rica's irrigation withdrawal data, by providing estimates of gross and net irrigation volumes for each Costa Rican crop in each watershed. Moreover, our study considers environmental flow requirements and the process of interception while accounting for watersheds' ecosystem water recharge, underlining that they cannot be neglected when establishing countries' hydrological balances. At last, our paper also gives insights on the potential of MuSIASEM to simulate countries' patterns of future development in the context of climate change, population growth and shifts in population diets.		
REMARQUES	Present master thesis is the result of joint works carried out by two students, Alexander Folz and Igor Chernov. In accordance with directive N°5 of the Guidelines for the Master thesis, the thesis comprises two main individual chapters: the food and water grammars.		