DOSSIER

Abstracts of scientific research on the effects of tree monocultures and associated cellulose production in grassland ecosystems in South America.

A. Monocultures of eucalyptus for cellulose production are worse carbon sinks than grasslands originating in South America. In addition, most of the carbon captured by these trees is released by harvesting them and transforming them into cellulose. As part of its process, biomass is burned and other gases are released into the atmosphere, with the consequent effects on the climate.

A1. **Preliminary study of prairies forested with Eucalyptus sp. at the northwestern Uruguayan soils.** Carrasco-Letelier, L., Eguren, G., Castiñeira, C., Parra, O., & Panario, D. (2003). https://www.researchgate.net/publication/9054561_Preliminary_study_of_prairies_forested_with_Eucalyptus_sp_at_the_northwestern_Uruguayan_soils/link/5a6b8e48a6fdcc317b159a21/download

* The forestation of Uruguayan natural prairie soil does not always ensure an increase of soil carbon sink. Five fields forested and six natural prairies were compared. The results not only show a statistical significant soil acidification, diminution of soil organic carbon, increase of aliphaticity degree of humic substances, and increase of affinity and capacity of hydrolytic activity from soil microbial communities for forested sites with Eucalyptus sp. but also, a tendency of podzolization and/or mineralization by this kind of land cover changes, with a net soil organic lost of 16.6 tons ha_1 in the horizon Au1 of soil under Eucalyptus sp. plantation compared with prairie. Besides, these results point out the necessity of correction of the methodology used by assigned Uruguayan commission to assess the national net emission of greenhouse gases, since the mineralization and/or podzolization process detected in forested soil imply a overestimation of soil organic carbon.

Institutions: Environmental Sciences Center EULA-CHILE, University of Concepción, Chile; Faculty of Sciences, University of Republic, Uruguay; National Commission of Archeology, Ministery of Education and Culture, Uruguay.

This work is part of a PhD Environmental Sciences thesis of first author at Environmental Sciences Center EULA-CHILE (University of Concepción, Chile).

Funding: This work was supported by a grant from the Inter-American Institute (IAI) for Global Change Research.

A2. **Soil organic carbon vs. bulk density following temperate grassland afforestation.** Céspedes-Payret, C., Bazzoni, B., Gutiérrez, O., & Panario, D. (2017). *Environmental Processes*, *4*(1), 75–92. https://doi.org/10.1007/s40710-016-0197-4

* By promoting the loss of native carbon, afforestation in grassland soils may have the opposite effect to the mitigation of CO2 emissions attributed to it. Afforestation is part of a worldwide strategy to mitigate CO_2 emissions. However, afforestation in grassland soils may have the opposite effect by promoting the loss of native carbon. Potential effects of this land use change on the flow of organic carbon to and from the soil can be described through bulk density (Db). Nowadays the suitability of Db for this purpose is being questioned. In order to bring new elements to the discussion, we carried out a comparative study of soil in the western region of Uruguay. Based on the background information and our own data, collected for over a decade, we evaluated the fitness of Db as proxy soil organic carbon (SOC) stocks in grassland converted to tree afforestation. These data were also related to soil pH values. The high acidity generated in soils following afforestation, is enough to affect the interaction between mineral and organic fractions and, with them, the original Db values. According to a previous study in the same location, there is a change in the predominance of different clay minerals in the topsoil (0–20 cm). This qualitative change in the mineral fraction can affect the ability of the soil to retain organic carbon, and not be reflected in the recorded Db values. The non-reciprocity recorded between Db and SOC values warns about the need for restriction of the generic use of Db in calculation of SOC stocks estimation. In view of these results, we present a discussion of possible causes that explain the disparity between Db values and SOC measurements.

Institutions: UNCIEP (Unidad de Ciencias de Epigénesis) e Instituto de Ecología y Ciencias Ambientales (IECA), Facultad de Ciencias, Universidad de la República, Uruguay.

B. Tree monoculture plantations irreversibly extract nutrients and minerals from this original ecosystem that took thousands of years to settle. Among its rows of thousands of cloned trees, species of exotic fauna proliferate, such as wild boar, which are a plague local livestock and agriculture.

B1. **Patterns and mechanisms of soil acidification in the conversion of grasslands to forests.** Jobbágy, E. G., & Jackson, R. B. (2003). *Biogeochemistry*, *64*(2), 205-229. https://www.researchgate.net/publication/228481637_Patterns_and_mechanisms_of_soil_acidification_in_the_conversion_of_grasslands_to_forests

* Grassland to forest conversions currently affect some of the world's most productive regions and have the potential to modify many soil properties. We used afforestation of native temperate humid grassland in the Pampas with eucalypts as an experimental system to 1) isolate forest and grassland imprints on soil acidity and base cation cycling and 2) evaluate the mechanisms of soil acidification. We characterized soil changes with afforestation using ten paired stands of native grasslands and *Eucalyptus* plantations (10–100 years of age). Compared to grasslands, afforested stands had lower soil pH (4.6 vs.5.6, $p < 0.0001$) and _40% lower exchangeable Ca ($p < 0.001$) in the top 20 cm of the soil. At three afforested stands where we further characterized soil changes to one meter depth, soil became increasingly acidic from 5 to 35 cm depth but more alkaline below _60 cm compared to adjacent grasslands, with few differences observed between 35 and 60 cm. These changes corresponded with gains of exchangeable acidity and Na in intermediate and deeper soil layers. Inferred ecosystem cation balances (biomass + forest floor + first meter of mineral soil) revealed substantial vertical redistributions of Ca and Mn and a tripling of Na pools within the mineral soil after afforestation. Soil exchangeable acidity increased 0.5–1.2 kmolc.Ha−1.yr−1 across afforested stands, although no aboveground acidic inputs were detected in wet + dry deposition, throughfall and forest floor leachates. Our results suggest that cation cycling and redistribution by trees, rather than cation leaching by organic acids or enhanced carbonic acid production in the soil, is the dominant mechanism of acidification in this system. The magnitude of soil changes that we observed within half a century of tree establishment in the Pampas emphasizes the rapid influence of vegetation on soil formation and suggests that massive afforestation of grasslands for carbon sequestration could have important consequences for soil fertility and base cation cycles.

Institutions: Department of Biology, Duke University and Nicholas School of the Environment and Earth Sciences, Duke University, USA; Facultad de Agronomía, Universidad de Buenos Aires, Argentina.

Funding: EGJ was supported by Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET, Argentina – Beca Externa), the Forest History Society of America, and grants from NSF (Dissertation Enhancement INT 0089494) and Inter American Institute for Global Change (SGP 004). RBJ was supported by a NSF CAREER grant (DEB 97-33333), the Inter American Institute for Global Change Research, and the Andrew W. Mellon Foundation. This research contributes to the Global Change and Terrestrial Ecosystems (GCTE) core project of the International Geosphere Biosphere Programme (IGBP).

B2. **The irruption of new agro-industrial technologies in Uruguay and their environmental impacts on soil, water supply and biodiversity: a review.** Céspedes-Payret, C., Piñeiro, G., Achkar, M., Gutiérrez, O., & Panario, D. (2009). *International Journal of Environment and Health*, *3*(2), 175-197. https://doi.org/10.1504/IJENVH.2009.024877

* Research on eucalyptus afforestation shows depletion of the ecosystem services associated with grassland and loss of the resilience capacity of the system. In recent years, economic growth has produced a global change in the demand for food, fibre and energy supply. This has gone together with the globalisation of the agro-industrial production systems, leading to a qualitative change in land use because of intensive use of technological inputs. Uruguay, just as the other countries of the region, is part of this phenomenon. The massive introduction of forest crops has been made over native grassland ecosystems, replacing traditional productive activities of the post-colonial period. Research on eucalyptus afforestation shows depletion of the ecosystem services associated with grassland and loss of the resilience capacity of the system. Impacts on soil organic matter, soil physicochemical properties, the hydrological cycle and on biodiversity are analysed. This review (with emphasis on Uruguay and the River Plata Basin) tries to contribute to an integrated vision of the environmental consequences of current land-use change.

Institutions: UNCIEP (Unidad de Ciencias de Epigénesis), Instituto de Ciencias Geológicas y Lab. de Desarrollo Sustentable y Gestión Ambiental del Territorio del Departamento de Geografía, Facultad de Ciencias, Universidad de la Republica, Uruguay.

Funding: Inter-American Institute for Global Change Research (IAI) (CRN II 2031), which is supported by the US National Science Foundation (Grant GEO-0452325).

B3. **Land use change in a temperate grassland soil: afforestation effects on chemical properties and their ecological and mineralogical implications.** Céspedes-Payret, C., Piñeiro, G., Gutiérrez, O., & Panario, D. (2012). *Science of the Total Environment*, *438*, 549-557. https://doi.org/10.1016/j.scitotenv.2012.08.075

* Eucalyptus afforestation in a grassland soil causes a loss in fertility. Potassium capture by trees irreversibly affects the mineral structure of illites. Other physicochemical variables are also affected by these changes associated with the mineralogy. The set of processes that occur under afforestation redirects pedogenesis. The current change in land use of grassland in the temperate region of South America is a process associated with the worldwide expansion of annual crops and afforestation with fast growing exotic species. This last cultivation has particularly been the subject of numerous studies showing its negative effects on soil (acidification, loss of organic matter and base cations, among others). However its effects on the mineral fraction are not yet known, as it is generally considered as one of the slowest responses to changes. This stimulated the present study in order to assess whether the composition of clay minerals could be altered together with some of the physicochemical parameters affected by afforestation. Our results show that the exportation of some nutrients is not compensated due to the turnover of organic forestry debris; the process of soil acidification was not directly associated with the redistribution of cations, but with an incipient podzolization process; the loss of potassium together with soil acidification, leads to a drastic change in clay mineralogy, which would be irreversible.

Institutions: UNCIEP, Instituto de Ecología y Ciencias Ambientales (IECA) y Departamento de Evolución de Cuencas, Instituto de Ciencias Geológicas, Facultad de Ciencias, Universidad de la República, Uruguay.

B4. **The political economy of global tree plantation expansion: a review,** Markus Kröger, The Journal of Peasant Studies (2014) (https://www.tandfonline.com/doi/abs/10.1080/03066150.2014.890596)

* This contribution analyses the political and spatial causalities explaining varieties and commonalities in expansion style and pace, with elaboration on the applied and empirical significance of these findings for peasant studies. The literature on environmental and developmental impacts of tree plantation expansion is also surveyed.

Institution: Department of Political and Economic Studies, University of Helsinki, Helsinki, Finland.

B5. **Afforestation of savannas: an impending ecological disaster.** Fernandes, G. W., Coelho, M. S., Machado, R. B., Ferreira, M. E., Aguiar, L. M. de S., Dirzo, R., Scariot, A., Lopes, C. R. (2016). *Natureza & Conservação*, *14*(2), 146-151. https://doi.org/10.1016/j.ncon.2016.08.002

* Failure to understand or misinterpreting the concepts of revegetation and afforestation can conceal, and indeed favor, the short-term economic interests of a few to the detriment of the global conservation targetsadvocated by the CBD (Convention on Biological Diversity) and defended by the majority of Brazilian society. Many of the 13,140 angiosperm species native to the cerrado,and their above- and below-ground carbon storage, would continue to contribute significantly to carbon sequestration andwould help in the restoration of degraded areas of the sec-ond largest South American ecosystem.

Institutions: Ecologia Evolutiva & Biodiversidade/DBG, ICB/Universidade Federal de Minas Gerais; Department of Zoology, Institute of Biological Sciences, Brasília; Laboratory of Image Processing and Geoprocessing, Institute of Socio-Environmental Studies, Universidade Federal de Goiás, Goiânia; and Laboratory of Ecology and Conservation, Embrapa Recursos Genéticos e Biotecnologia, Brasília, DF, Brazil; Department of Biology, Stanford University, Stanford, USA.

C. Monocultures of eucalyptus and associated cellulose plants seriously reduce and contaminate the main sources of water in the region.

C1. **Hydrological consequences of Eucalyptus afforestation in the Argentine Pampas.** Engel, V., Jobbágy, E. G., Stieglitz, M., Williams, M., & Jackson, R. B. (2005). *Water Resources Research*, *41*(10), W10409. https://doi.org/10.1029/2004WR003761

* The impacts of a 40 ha stand of *Eucalyptus camaldulensis* in the Pampas grasslands of Argentina were explored for 2 years using a novel combination of sap flow, groundwater data, soil moisture measurements, and modeling. Sap flow measurements showed transpiration rates of 2–3.7 mm d^{-1}, lowering groundwater levels by more than 0.5 m with respect to the surrounding grassland. This hydraulic gradient induced flow from the grassland areas into the plantation and resulted in a rising of the plantation water table at night. Groundwater use estimated from diurnal water table fluctuations correlated well with sap flow ($p < 0.001$, $r^2 = 0.78$). Differences between daily sap flow and the estimates of groundwater use were proportional to changes in surface soil moisture content ($p < 0.001$, $r^2 = 0.75$). *E. camaldulensis* therefore used both groundwater and vadose zone moisture sources, depending on soil water availability. Model results suggest that groundwater sources represented ~67% of total annual water use.

Institutions: National Park Service, Everglades National Park, Homestead, Florida; School of Civil and Environmental Engineering and School of Earth and Atmospheric Sciences, Georgia Institute of Technology, Georgia; and Nicholas School of the Environment and Earth Sciences, Duke University, North Carolina, USA; Grupo de Estudios Ambientales, Instituto de Matemática Aplicada San Luis, Universidad de Nacional de San Luis y Consejo Nacional de Investigaciones Científicas y Técnicas, Instituto Nacional de Tecnologia Agropecuaria San Luis, San Luis, Argentina; Institute of Atmospheric and Environmental Sciences, University of Edinburgh, Edinburgh, UK;

Funding: This research was supported by grants from the InterAmerican Institute for Global Change (SGP 004 and CRN 012), the Fundación Antorchas, NSF, and the Andrew W. Mellon foundation. EGJ has a career fellowship from CONICET, Argentina.

C2. **Effects of afforestation on water yield: a global synthesis with implications for policy.** Farley, K. A., Jobbágy, E. G., & Jackson, R. B. (2005). *Global Change Biology*, *11*(10), 1565-1576. https://www.researchgate.net/publication/227862602_Effects_of_Afforestation_on_Water_Yield_A_Global_Synthesis_With_Implications_for_Policy

* Carbon sequestration programs, including afforestation and reforestation, are gaining attention globally and will alter many ecosystem processes, including water yield. The possibility that afforestation could cause or intensify water shortages in many locations is a tradeoff that should be explicitly addressed in carbon sequestration programs. To assess and predict these effects globally, we analyzed 26 catchment data sets with 504 observations, including annual runoff and low flow. We examined changes in the context of several variables, including original vegetation type, plantation species, plantation age, and mean annual precipitation (MAP). All of these variables should be useful for understanding and modeling the effects of afforestation on water yield. We found that annual runoff was reduced on average by 44% (_ 3%) and 31% (_ 2%) when grasslands and shrublands were afforested, respectively. Eucalypts had a larger impact than other tree species in afforested grasslands (P50.002), reducing runoff (90) by 75% (_ 10%), compared with a 40% (_ 3%) average decrease with pines. Runoff losses increased significantly with plantation age for at least 20 years after planting, whether expressed as absolute changes (mm) or as a proportion of predicted runoff (%) (Po0.001). For grasslands, absolute reductions in annual runoff were greatest at wetter sites, but proportional reductions were significantly larger in drier sites (Po0.01 and Po0.001, respectively). Afforestation effects on low flow were similar to those on total annual flow, but proportional reductions were even larger for low flow (Po0.001). These results clearly demonstrate that reductions in runoff can be expected following afforestation of grasslands and shrublands and may be most severe in drier regions. Our results suggest that, in a region where natural runoff is less than 10% of MAP, afforestation should result in a complete loss of runoff; where natural runoff is 30% of precipitation, it will likely be cut by half or more when trees are planted.

Institutions: Center on Global Change, Duke University and Department of Biology and Nicholas School of the Environment and Earth Sciences, Duke University, Durham, USA; Grupo de Estudios Ambientales – IMASL,
Universidad Nacional de San Luis & CONICET, San Luis, Argentina

Funding: Center on Global Change at Duke University, NSF, and the Biological and Environmental Research (BER) Program, US Department of Energy, through the Southcentral Regional Center of NIGEC.

C3. **Trading water for carbon with biological carbon sequestration.** Jackson, R. B., Jobbágy, E. G., Avissar, R., Roy, S. B., Barrett, D. J., Cook, C. W., Farley, K.A., le Maitre, D.C., Mc Carl, B.A., Murray, B. C. (2005). *Science*, *310*(5756), 1944-1947. https://doi.org/10.1126/science.1119282

* Carbon sequestration strategies highlight tree plantations without considering their full environmental consequences. We combined field research, synthesis of more than 600 observations, and climate and economic modeling to document substantial losses in stream flow, and increased soil salinization and acidification, with afforestation. Plantations decreased stream flow by 227 millimeters per year globally (52%), with 13% of streams drying completely for at least 1 year. Regional modeling of U.S. plantation scenarios suggests that climate feedbacks are unlikely to offset such water losses and could exacerbate them. Plantations can help control groundwater recharge and upwelling but reduce stream flow and salinize and acidify some soils.

> **Institutions**: Department of Biology, Nicholas School of the Environment and Earth Sciences, and Center on Global Change, Duke University; Department of Civil and Environmental Engineering, Duke University, Department of Agricultural Economics, Texas A&M University; and Center for Regulatory Economics and Policy Research, Research Triangle Institute, USA.; Grupo de Estudios Ambientales–Instituto de Matemática Aplicada de San Luis (IMASL), Universidad Nacional de San Luis and Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), San Luis, Argentina; Commonwealth Scientific and Industrial Research Organisation (CSIRO) Land and Water, Australia; and Natural Resources and Environment CSIR, South Africa.

C4. **Land-use change and water losses: the case of grassland afforestation across a soil textural gradient in central Argentina.** Nosetto, M. D., Jobbágy, E. G., & Paruelo, J. M. (2005). *Global Change Biology*, *11*(7), 1101-1117. https://doi.org/10.1111/j.1365-2486.2005.00975.x

* Vegetation changes, particularly those involving transitions between tree- and grassdominated covers, often modify evaporative water losses as a result of plant-mediated shifts in moisture access and demand. Massive afforestation of native grasslands, particularly important in the Southern Hemisphere, may have strong yet poorly quantified effects on the hydrological cycle. We explored water use patterns in Eucalyptus grandis plantations and the native humid grasslands that they replace in Central Argentina. In order to uncover the interactive effects that land cover type, soil texture and climate variability may have on evaporative water losses and water use efficiency, we estimated daily evapotranspiration (ET) in 117 tree plantations and grasslands plots across a soil textural gradient (clay-textured Vertisols to sandy-textured Entisols) using radiometric information from seven Landsat scenes, existing timber productions records, and 13C measurements in tree stems. Tree plantations had cooler surface temperatures (_5 1C on average) and evaporated more water (180% on average) than grasslands at all times and across all sites. Our study highlighted the key role that vegetation type plays on evapotranspiration and, therefore, in the hydrological cycle. Considering that tree plantations may continue their expansion over grasslands, problematic changes in water management and, perhaps, in local climate can develop from the higher evaporative water losses of tree plantations.

> **Institutions**: Grupo de Estudios Ambientales – IMASL, Universidad Nacional de San Luis & CONICET (D5700HHW), San Luis, Argentina, Facultad de Ciencias Agropecuarias, Universidad Nacional de Entre Ríos (E3100XAD) Entre Ríos, Argentina; IFEVA – Facultad de Agronomía, Universidad de Buenos Aires & CONICET, Argentina.
>
> **Funding**: This work was funded by Fundación Antorchas (Career Start up) and Inter-American Institute for Global Change Research (IAI-SGP 004). MN was supported by CONICET (Argentina–Beca Doctoral Interna) and a fellowship from IAI.

C5. **Las forestaciones rioplatenses y el agua.** Jobbágy, E. G., Nosetto, M. D., Paruelo, J. M., & Piñeiro, G. (2006). *Ciencia hoy*, *17*(95), 12-21. https://www.researchgate.net/publication/265376623_Las_forestaciones_rio-platenses_y_el_agua

* A large part of the forestry expansion of the last decades in the Rio de Janeiro nations has concentrated in grassland areas. This implies impacts of afforestation on some ecosystem properties, different from those that might be expected in naturally forested or jungle regions that are reforested. The synthesis of hydrological information confirms that afforestation channels most of the rainfall to evaporative outlets. Increases in

transpiration that accompany the exceptional primary productivity of afforestation are the main cause of this change and can pose significant local and regional water costs when the area of grassland that is forested covers a large portion of the paired basins.

Institutions: Grupo de Estudios Ambientales - Universidad Nacional de San Luis; IFEVA - Facultad de Agronomía, UBA, y CONICET, Argentina.

Funding: With support of Inter-American Institute for Global Change Research (IAI – CRN 2031, NSF – GEO 0452325), Fundación Antorchas and CONICET, Argentine.

C6. **Síntesis de los efectos ambientales de las plantas de celulosa y del modelo forestal en Uruguay.** Panario, D., Mazzeo, N., Eguren, G., Rodríguez, C., Altesor, A., Cayssials, R., & Achkar, M. (2006). https://doi.org/10.13140/RG.2.1.2929.0483

* In this report, carried out by researchers from the Faculty of Sciences University of the Republic, Uruguay, appointed by the Faculty Council, the available scientific evidence about the possible environmental impacts of the installation of cellulose plants and the associated forest model is synthesized.

Institution: Facultad de Ciencias, Universidad de la República, Uruguay.

C7. **Stream acidification and base cation losses with grassland afforestation.** Farley, K. A., Piñeiro, G., Palmer, S. M., Jobbágy, E. G., & Jackson, R. B. (2008). *Water Resources Research*, *44*(7), W00A03. https://doi.org/10.1029/2007WR006659

* Afforestation of natural grasslands with fast-growing pine and eucalyptus species is increasing globally, but little is known about its effect on ecosystems and watersheds and, ultimately, the quality of water resources. Overall, our data suggest that repeated harvesting cycles at some locations could negatively impact the soil store of base cations and reduce downstream water quality. To investigate the biogeochemical and hydrological consequences of this land use change, we sampled stream water in paired watersheds in Uruguay and Argentina. In watersheds planted with pine, we found no change in stream pH following afforestation, while in watersheds planted with eucalyptus, pH was 0.7 units lower on average than in streams draining grasslands. To further investigate the mechanism behind the decrease in pH, we sampled soils and streams of eucalypt catchments in Uruguay and analyzed exchangeable base cation concentrations, alkalinity, and dissolved inorganic carbon (DIC). At these sites, Ca, Mg, and Na concentrations were >30% lower in afforested soils than in grassland soils, and pH was significantly lower below 10 cm depth. Stream measurements taken over three years illustrate that these soil changes were also manifested in stream water chemistry. In the eucalypt watersheds, base cation concentrations were >40% lower, and alkalinity and DIC were halved in stream water. A test with data from additional sites where both pines and eucalypts were planted nearby showed that eucalyptus has a stronger acidifying effect than pine.

Institutions: Department of Geography, San Diego State University, San Diego, California and Department of Biology and Nicholas School of the Environment and Earth Sciences, Duke University, Durham, North Carolina, USA; Facultad de Agronomía, Universidad de Buenos Aires, Buenos Aires; Grupo de Estudios Ambientales, IMASL, Universidad Nacional de San Luis, San Luis; y CONICET, San Luis, Argentina; School of Geography, University of Leeds, West Yorkshire, UK.

Funding: National Science Foundation (Biological Sciences grant 0717191), the Inter-American Institute for Global Change Research (IAI) (CRN II 2031), which is supported by the U.S. National Science Foundation (grant GEO-0452325), and the project "SENSOR TTC".

D. The installation of pulp agribusiness in the Southern Cone of America generates conflicting social and political transformations in the region.

D1. **Ecosystem services and tree plantations in Uruguay: A reply to Vihervaara et al.** Paruelo, J. M. (2012). (2012). *Forest Policy and Economics*, *22*, 85-88. https://doi.org/10.1016/j.forpol.2012.04.005

* The expansion of industrial tree plantations in South America is a case of land transformation that has already generated conflicts at the local, national and international levels. In a recent article, Vihervaara et al. (2012) present a controversial analysis, mainly for the potential use of some of their results; they suggest that the general attitude

among the local people toward an increment in tree plantations and toward the forest indus- try is positive. In this article I discuss the results and conclusions of the Vihervaara et al. article, particularly those related to the definition of the ecosystem services concept, the definition of stakeholders and the approaches to deriving their perception, and the available evidence on the impacts of grassland afforestation in Uruguay.

Institution: IFEVA-Facultad de Agronomía, Universidad de Buenos Aires, CONICET, Argentina

Funding: JMP's research on grassland afforestation has been funded by a grant from the Inter-American Institute for Global Change Research (IAI, CRN II 2031),which is supported by the US National Science Foundation (Grant GEO-0452325).

D2. **In the shadows of social licence to operate: Untold investment grievances in Latin America,** Maria Ehrnström-Fuentes and Markus Kröger, Journal of Cleaner Production (2016) (https://www.sciencedirect.com/science/article/pii/S0959652616314536)

* We identify four potential problems (risks of co-optation, structural power imbalances, conflicting worldviews, and the silencing effects of global certification schemes) that emerge when the current practice and literature on Social License to Operate (SLO) is implemented in forestry operations in Global South's rural areas, commonly marked by dynamic and contentious corporate-community relations. The findings illustrate that caution is necessary prior to claiming that a company, investment, or industry has achieved an all-encompassing SLO at the local level. Instead, to understand the dynamic and contentious corporate-community relations we argue for a more nuanced approach to how locals engage with different economic alternatives based on their own place-based capacity to sustain and reproduce life in community.

Institution: Department of Management and Organisation, Hanken School of Economics, Vaasa, Finland.

D3. **Birthing extractivism: The role of the state in forestry politics and development in Uruguay,** Maria Ehrnström-Fuentes and MarkusKröger, Journal of Rural Studies (2017) (https://www.sciencedirect.com/science/article/abs/pii/S0743016717305272)

* This study examines the role of states in developing contemporary extractivism based on recent investments and project plans in industrial forestry in Uruguay. This sheds light on several unanswered questions related to the role of the state and civil society in the governance, politics, and political economy of extractivism. Our analysis indicates severe and negative developmental and socio-economic outcomes of pulp investments in Uruguay, which are hard if not impossible to transform as corporations can now use the investment protection laws – created by the government to regulate the state conduct – to restrict the possibilities of civil society and state actions.

Institutions: Department of Management and Organisation, Hanken School of Economics, Vaasa, and Department of Political and Economic Studies, University of Helsinki, Helsinki, Finland.

D4. **Confronting extractivism – the role of local struggles in the (un)making of place**, Maria Ehrnström-Fuentes, Emerald Insight (2019) (https://www.emerald.com/insight/search?q=confronting+extractivism&showAll=true)

* The purpose of this paper is to examine the politics involved in local struggles against forestry extractivism. The forestry sector is dependent on vast areas of land for tree plantations. This creates deep-rooted conflicts between global corporations that seek access to natural resources and locals whose way of life requires the use of the same land. One of the testimonies reveals how the farmers engage in a form of “politics of place” (Escobar, 2001, 2008) to counter the power of the proponents of forestry and the further expansion of plantations. This form of politics strengthens and politicises the ontological difference between extractive and non-extractive worlds.

Institution: Department of Management and Organisation, Hanken School of Economics, Vaasa, Finland

---