Farming the Chaco: Tales from both sides of the fence

ARTICLE *in* JOURNAL OF ARID ENVIRONMENTS · DECEMBER 2015

Impact Factor: 1.64 · DOI: 10.1016/j.jaridenv.2015.07.011

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Journal of Arid Environments 123 (2015) 1–2

Contents lists available at ScienceDirect

Journal of Arid Environments

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Editorial

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The Chaco plains of Argentina, Bolivia and Paraguay host one the last large global reserves of fertile soils that are still uncultivated (Lambin et al., 2013). Most of this non farmed land is home for the most important tract of native dry forests of the world. Social, economic and technological changes are driving a fast expansion of agriculture over the whole region; challenging indigenous communities, rural settlers, farmers, conservationists, and policy makers alike (Grau et al., 2005). This special issue describes this process from multiple perspectives and explores its associated productive benefits and constrains as well as some of its major environmental impacts. Combining creative remote sensing approaches, field observations, and national statistics; a collective synthesis effort embodied in ten articles pushes available information and concepts a step further. While these contributions respond to an urgent regional demand, they provide at the same time useful knowledge for other active agricultural frontiers on dry regions like the Cerrados and Caatinga in Brazil and the Miombo and Mopane in Sub-Saharan Africa (Baldi and Jobbágy, 2012; Gasparri et al., 2015a,b).

A painstaking compilation and interpretation of remote sensing data provided the first unified characterization of land use changes for the whole region since the onset of the expansion of market agriculture, back in the seventies (Vallejos et al., 2015). Although we know that by the time this special issue is being published, more than three fourths of the region are still covered by natural vegetation, forest clearing is growing rapidly across most of the territory. The Paraguayan Chaco displays some of the highest deforestation rates ever seen in the planet. As this process unfolds, agricultural paddocks grow in size and forest relicts become smaller and less connected. An accompanying methodological contribution warns that while traditional "flat" remote sensing descriptions of the vegetation may be fundamental to monitor and control deforestation, they run short to characterize the integrity of forests, including their canopy structure and species composition (Monmany et al., 2015). Better remote sensing approaches that take full advantage of high resolution imagery, including 3D approaches and the use of non-radiometric products such as passive microwave products will find fertile ground in the Chaco plains.

The key driver of deforestation has been the connection of the Chaco territory to the ever growing international market of livestock feed, particularly soybean, yet, its actual expansion appears conditioned by infrastructure, suggesting that logistical improvements in towns and transport networks will fuel agricultural expansion even further (Gasparri et al., 2015a,b). Under this context, the Chaco is skipping an expected reversal of forest loss that has been coined as "Forest Transition" in northern countries: Forests may come back in marginal lands when other territories can provide food at lower costs. Since modern agriculture expands its range of suitability, there seems to be little support for this possibility in the Chaco plains according to another of the contributions of this special issue (Volante and Paruelo, 2015).

While simplified perceptions of the region would characterize it as a mosaic of two major categories (forests and modern agriculture fields), reality proves much more complex. A remote sensing-based characterization of the farming systems of the Chaco shows eleven groups of land users that have cleared the land for different purposes, ranging from very small holders like local indigenous groups to transnational agents such as large Brazilian ranchers or Argentinean farming corporations cultivating in Paraguay and Bolivia (Baldi et al., 2015). Interestingly, large capitalized farming systems in the Chaco appear to have more interannual variability in the primary production rates (likely mirrored by other ecosystem process) than "campesino" systems, suggesting different ways to cope with climatic fluctuations. From the other side of the fence diversity and heterogeneity are also emerging and valuable natural vegetation is not just forests. While tree and shrub dominated vegetation covers most uncultivated territories today, grasslands which host a unique array of wildlife, may have been much more abundant just a century ago (Grau et al., 2015). Paradoxically, under their current management, national parks seem to restrict rather than foster the preservation of this type of natural systems in the region as agriculture and planted pastures expansion rapidly replace natural grasslands outside protected areas. Also eye-opening is the fact that the diversity of land users within natural systems appears to be relevant explaining both plant and animal diversity (Marinaro et al., 2015).

Water supply to livestock and crops in a subtropical region with highly seasonal summer-rainfall has been a perennial challenge in the Chaco plains. In the case of farmers, reducing the cultivated area during dry years used to be the prevailing strategy before the seventies. However, technological breakthroughs over the last decades, which included new maize hybrids and the arrival of soybean together with the adoption of no-tillage practices; had decoupled the cultivated area from climate fluctuations in the region, as seen in the Southern US plains thirty years before (Ricard et al., 2015). Today, conservative agricultural practices that cut drought risks, such as the late sowing of summer crops, make farming suitable in most of the Chaco territory (Gimenez et al., 2015). While this is good news for farmers in the short term, it may not be so in the longer run. The plains of the Chaco appear

http://dx.doi.org/10.1016/j.jaridenv.2015.07.011
0140-1963/

to be vulnerable to “dryland salting”, an environmental tragedy that expands in cultivated areas formerly occupied by dry forests in Australia, that is showing some of its foundations in our focus region (Amdan et al., 2013). Leaching of deeply stored soil salts, which represent a large pool in the Chaco soils, and their transport to the surface by raising water tables has been already documented and will be exacerbated by conservative water use strategies focused on lowering drought risks (Gimenez et al., 2015).

The natural abundance of salts in aquifers and the lack of permanent surface water bodies in the Chaco region made water provision to livestock and settlers extremely challenging, preventing the colonization of many tracts of forests until recent times. One of the first responses to this limitation has been the development of rainfall water harvesting structures, many of which are still the only available water source. For the first time to our knowledge, this special issue describes the different types and regional distribution of water harvesting structures (Magliano et al., 2015). Being a key component of all grazing systems, water harvesting structures are following two contrasting fates in the Chaco now days: to disappear if grain production displaces ranching, as in many areas of the Argentine Chaco; or to evolve into more complex and efficient systems, which include dedicated run-on generation areas and pumping and storing facilities, if intensive beef and dairy producing systems take off as seen among the Mennonite settlements of the Paraguayan Chaco (Magliano et al., 2015).

Claims for natural and cultural conservation together with the awareness on ecosystem services provision are intensifying worldwide and the urban societies of the countries that share the Chaco territory are no exception to this. As conflicts and debate percolate into the political system, the need for land planning actions will likely grow, demanding what is known in the continent as land use policies (“políticas de ordenamiento territorial”). Some of the first attempts are already in their way, not without turmoil, through forest conservation laws (Collazo et al., 2013). Simultaneously, the remote demand of agricultural products will continue to be a pressing factor on the Chaco land and its stakeholders in the coming decades. Regulation initiatives based not only on land use polices but also on product flow-chains including their final overseas markets are likely to grow. We hope that this special issue becomes a cornerstone for the evolution of such efforts in the future. For the broader international scientific community focused on dryland farming, ranching and conservation; this special issue opens a window to one of the most active agricultural frontiers of the world, illustrating how it has motivated local researchers to understand the dialog between people and nature from both sides of the fence.

Acknowledgments

The development and convergence of most of the research lines presented in this special issue were made possible by the financial support of the International Development Research Center (IDRC, Canada – Grant 106601), the Global Land Project through its South American Nodal Office, and the Inter-American Institute for Global Change Research (IAI) CRN3095 which is supported by the US National Science Foundation (Grant GEO-1128040). Support from CONICET and MINCYT (Argentina) is acknowledged.

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