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Commercial Agriculture in Tropical Environments

Peter Goldsmith[1] and Avery Cohn[2]

Abstract

The tropics are a critical nexus of important environmental services and resources, productive lands that are critical to feeding the planet in years to come, and rural economies beset by disease and malnutrition, and in need of economic development. This special issue synthesizes a series of multidisciplinary dialogues aiming to examine the complex challenge of tropical agricultural systems. The work contained five principle themes: (a) The future of tropical agriculture is vital for developing world economies and the global environment in ways that scholars are still working to characterize. (b) The tropics are highly socioeconomically and environmentally heterogeneous. (c) We expect sociocultural and institutional factors to strongly shape the future of tropical agriculture and the environment. (d) Sustainable tropical agriculture means linking smallholders, the vast bulk of farmers, with commercial agriculture, the vast bulk of agribusiness. (d) Scholarship from the environmental sciences can help to navigate many cross-cutting issues facing sustainable agricultural development.

Keywords

tropical, agriculture, commercial, environment, multidisciplinary

Increasingly, the tropics are the site of commercial agricultural expansion (Laurance, Sayer, & Cassman, 2014) supplying food, feed, fiber, and fuel to a global population that continues to expand and increase in affluence (Alexandratos & Bruinsma, 2012). Vital economic and societal benefits are often associated with tropical regions, where agricultural production increases (Dorward, Kydd, Morrison, & Urey, 2004; Richards, Pellegrina, VanWey, & Spera, 2015). Such growth has been found to be closely associated with poverty alleviation and increased prosperity in many of the places on the planet that need these things most. Yet, commercial agricultural growth in tropical landscapes entails a number of risks to the sector, society, and the environment. First, a great deal of tropical commercial agriculture output growth results the conversion of tropical ecosystems (Gibbs et al., 2010)—a pervasive force threatening biodiversity, altering earth system processes, and disrupting rural livelihoods. Second, this land conversion (Perugini et al., 2017) in combination with increased global anthropogenic Greenhouse Gases (GHGs) (Bagley, Desai, Harding, Snyder, & Foley, 2014) can be expected to change the climates of the tropics in ways for which there are no known analogs.

These changes will likely have grave implications for both tropical ecosystems (Williams & Jackson, 2007) and tropical agriculture (Schlenker & Lobell, 2010). They are particularly concerning given the relatively poor state of knowledge on tropical agronomy, ecosystems, earth system patterns, and processes (Wohl et al., 2012), and how tropical biodiversity loss can be expected to feedback on tropical earth system properties. Third, managing agriculture in the tropics involves relatively new and occasionally untested technologies, requires new institutional arrangements (Endres & Endres, 2017), and may require agricultural inputs of little local precedent. From skilled workers, to fertilizer and pesticides, tropical agriculture's demand for inputs has the potential to disrupt and reconfigure tropical economies and environments for better or worse (Goldsmith, 2017). Done well, the technologies, institutions, and inputs of tropical agriculture can promote sustainable growth and prosperity. Done poorly, they can imperil people and ecosystems and

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fray already weak social and institutional fabrics in the places that can least afford such disruptions.

In sum, the tropics are a critical nexus of important environmental services and resources, productive lands that are critical to feeding the planet in years to come, and rural economies beset by disease and malnutrition and in need of growth. These issues are urgent, serious, and interrelated and are therefore complex and difficult to analyze. They have been the focus of decades of previous research (Brando, Coe, DeFries, & Azevedo, 2013; Carter & Barrett, 2006; A. S. Cohn et al., 2017; DeFries & Rosenzweig, 2010; Dorward et al., 2004; Foley et al., 2011; Garnett et al., 2013; Hertel, 2017; Lipper et al., 2014; Mellor, 1966; Tilman, Balzer, Hill, & Befort, 2011; Timmer, 1992; Wheeler & Von Braun, 2013), which taken together suggests an immense and urgent continued research and action agenda. This in turn suggests demand for innovative scholarship, contrasting and combining a host of disciplines.

It was precisely for these reasons that in 2016, The Woods Hole Research Center, The USAID Soybean Innovation Lab, and the University of Illinois initiated a multidisciplinary dialogue on commercial agriculture in tropical environments. The collaboration began with a session at the 2016 annual meeting of the American and Applied Economics Association in Boston, MA. In ensuing months, the team and others produced a globally viewed webcast as part of the 2016 World Food Prize conference in Des Moines, IA. Then in April 2017, researchers came together for a 1-day conference, entitled "Commercial Agriculture in Tropical Environments," on the campus of the University of Illinois at Urbana–Champaign. We have pulled together 12 essays from scholars who presented at the conference to make this special issue.

All told, the papers in the issue were produced by 35 authors representing 14 organizations located across five continents and spanning multiple disciplines in the social sciences, biological sciences, physical sciences, and engineering. These contributions supply a rich cross section of the state of the art of research dedicated to envisioning tropical agricultural systems in the ways the planet so desperately needs. Five central themes emerged:

(1) The future of tropical agriculture is vital for developing world economies and the global environment in ways that scholars are still working to characterize.

Habitat conversion driven by extensification of agriculture in the humid tropics poses grave environmental risks, including, as Brawn (2017) demonstrates, to the biodiversity of some of the world's most biodiverse places. Could intensification limit the damage? The contributions of Neill et al. (2017), Palm, Neill, Lefebvre, and Tully (2017), and Michelson (2017) hint at some ways in which it might. These authors show that respectively: The influence of tropical agriculture on freshwater might be less than would have been expected based on temperate zone evidence, that some tropical soils are well suited for intensification, and that better targeted input distribution could enable sustainable intensification. Spera (2017) urges another solution—arguing that promoting the intensification of agriculture on already cleared lands, such as cattle pastures in Brazil, could readily supply production that might otherwise be expected to come at the cost of future land conversion.

Also in the special issue were articles describing tropical agriculture–environment interactions that have traditionally received less scholarly attention. Many of these themes involve complex feedbacks between agriculture and other human and environmental systems. One example is the contribution by Coe et al. (2017) describing the importance of tropical forest for moderating regional climates. Building on the theme, A. S. Cohn (2017) shows that agricultural expansion can threaten agricultural productivity by disrupting the regional climate. Meanwhile, Wallington and Cai (2017) urge research and action on tropical agriculture cognizant of its role as a fulcrum balancing complex food–energy–water trade-offs. Finally, Trimmer, Bauza, Byrne, Lardizabal, and Guest (2017) makes the case that human health is both closely and complexly connected to agriculture and that this relationship can be expected to exert massive influence on the future the tropics.

(2) The tropics are highly socioeconomically and environmentally heterogeneous. Biodiversity, agricultural potential, ecosystem services, and best management practices all vary greatly spatially. This heterogeneity creates an imperative to delineate "where to put things" (Polasky et al., 2008) and how to connect them. For example, Michelson (2017), Palm et al. (2017), and Goldsmith (2017) show that best management practices depend on various factors as diverse as institutions, soils, and market access. Spera (2017) demonstrates how spatial data can better inform agricultural expansion. Finally, the work of Brawn (2017), Coe et al. (2017), and A. S. Cohn (2017) together suggest that not only the location of agriculture but also where it is situated in the wider landscape will shape how it influences society and the environment.

(3) We expect sociocultural and institutional factors to strongly shape the future of tropical agriculture and the environment. Palm et al. (2017), Endres and Endres (2017), and Goldsmith (2017) all demonstrate the importance of socioculturally sensitive institutional innovations. Such innovations (including contracts, learning networks, etc.) can help to shape agricultural value chains that are transparent, traceable, that promote sustainable practices, and that improve local economies. Access to such markets and institutions for agricultural inputs and outputs can powerfully transform and reconfigure tropical

landscapes. Further work will need to elucidate which approaches work and why.

(4) Sustainable tropical agriculture means linking smallholders, the vast bulk of farmers, with commercial agriculture, the vast bulk of agribusiness. Endres and Endres (2017) and Waldron et al. (2017) direct us to think about the many smallholders populating the agricultural production units in the tropics, especially Africa. Endres and Endres (2017) discuss the prospects for European buyers to explicitly source from small holders, while Waldron et al. (2017) proposes multifunctional crops like agroforestry models that can support livelihoods and supply environmental services. Goldsmith (2017), meanwhile, draws on comparative evidence from Brazil and Ghana to show that engaging smallholders in commercial agriculture can be both the best hope and the worst threat for smallholders.

(5) By confronting complex, cross-cutting issues together, the social sciences, engineering, and the environmental sciences can advance sustainable tropical agriculture. We thank participants and contributors at the events we have organized and the great team of authors and the editorial team at *Tropical Conservation Science* for coming together to produce this important special issue. We hope you enjoy it as much as we enjoyed putting it together. Please feel free to follow up with suggestions, ideas, or comments. The team continues to work in this important space and welcomes your collaboration.

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