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Bringing Science and Technology Studies into Agricultural Anthropology: Technology Development as Cultural Encounter between Farmers and Researchers

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Abstract

The "farmer-back-to-farmer" model of agricultural development, pioneered by Robert Rhoades and Robert Booth, urged technologists to use farmers' knowledge and practices as both the starting point for technological innovations as well as the ultimate measure of the value of innovation. This approach was premised upon close ethnographic study of farmers' livelihoods, especially how technical agricultural practices interacted with household dynamics, community structures, and cultural values. However, the original "farmer-back-to-farmer" approach left the "expert" practice of science and technology as an implicitly practical and apolitical space rather than as a subject of ethnographic study. The increasing and diverse articulation of farmers' livelihood practices with the professional practices of agricultural scientists demands theoretical tools that bring them all into the same frame of analysis. This article proposes that the integration of agricultural anthropology and science and technology studies provides a well-balanced toolkit for analyzing participatory technology development as a space of cultural encounter. [participation, technology, development, science and technology studies, Mali]

Introduction

In 1982, Robert Rhoades and Robert Booth outlined a proposal for how to more effectively develop agricultural technologies. The idea was simultaneously modest and far-reaching, which is to say that it was radically sensible: research scientists' development of agricultural technologies should both start and end with farmers. The "farmer-back-to-farmer" (FB2F) approach (Figure 1) is a painfully obvious idea to many young scholars today, who have come of age with the "participatory paradigm." During the Green Revolution, however, when agricultural development strategies were driven by high-modernist science and policy, this was a deeply radical idea, perhaps even subversive. Maybe it still is. Not only was it implicitly critical of the prevailing paradigm in agricultural development, but it effectively called for a substantial transformation of how to do applied science itself, both in terms of individual and team level practices, and also the institutional practices of science and development writ large.

The premise is simple. Research on technical problems should start with an analysis of farmers' multiple considerations and perspectives, including: problem identification; existing technical practices and material conditions; economic circumstances; organization and processes of social institutions; cultural values; and ecological contexts. In short, technical problems always need to be socially situated. All of this should then be incorporated into scientific research on technologies for addressing the identified problem. As an iterative process, the scope of applied agricultural research ends with farmers' evaluation, adaptation, and integration of particular technological practices. Rather than abstracting and disembedding technical problems from their social realities, the FB2F approach in essence asks technical scientists to understand, respect, anticipate, and respond to rural realities in order to develop technologies and practices that are suited to farmers' conditions. Along with the writings of many other contemporaries, such as

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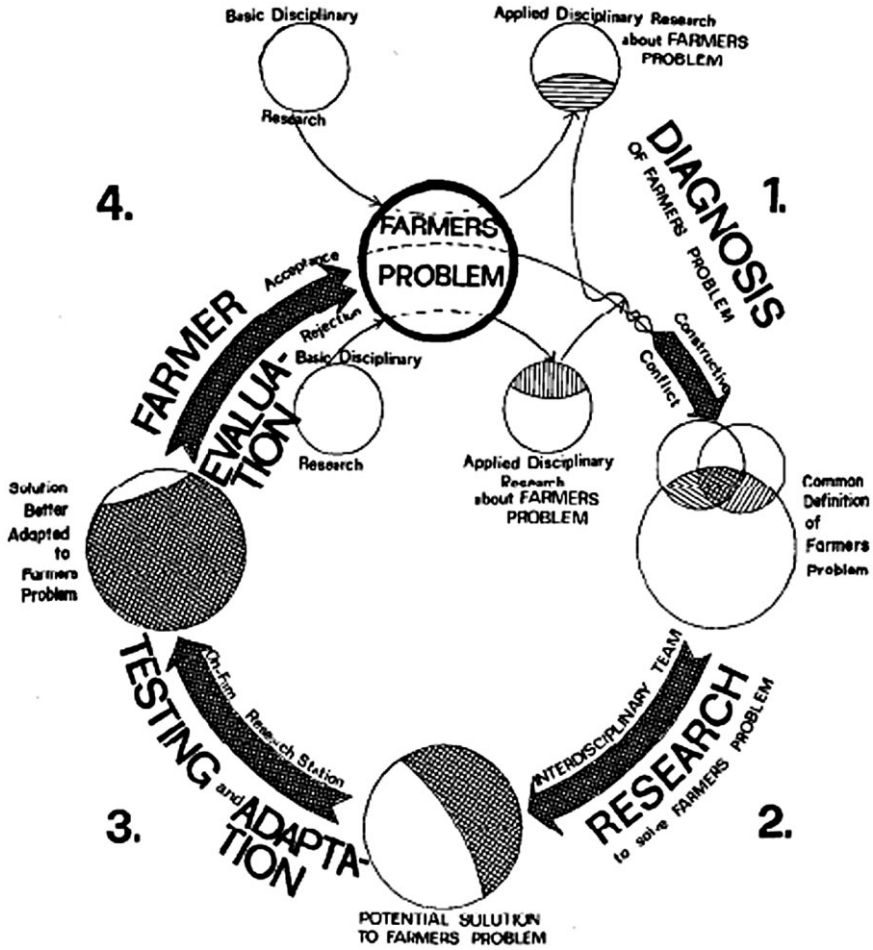
Figure 1.
The farmer-back-to-farmer model for generating acceptable technologies (from Rhoades and Booth 1982). Shading in the circles is meant to indicate the degree of overlap between farmers' and scientists' perspectives regarding the goals and activities in the coproductive process.



Richards (1985, 1986, 1989), Ashby (1986, 1987), Röling (1992), and Chambers et al. (1989), Booth and Rhoades's "farmer-back-to-farmer" concept has formed a pillar of applied research into local knowledge in agriculture and in participatory development.

"Local knowledge" is a topic that has been richly theorized in ethnoecology (Berlin et al. 1973; Brown 1976; Conklin 1972; Hunn 1982), and applying the approach to agricultural development was a natural step (Bentley 1989; DeWalt 1994; Moock and Rhoades 1992; Purcell 1998; Sillitoe 1998). However, with all the emphasis on researching farmers' knowledge, practices, and culture, applied anthropological research in agriculture has left an important theoretical blind spot. Having rarely been explicit focal points of research, the institutions of agricultural science itself have been substantially under-theorized as cultural spaces within agricultural anthropology.[1] In terms of the FB2F approach, there has been a strong tendency to focus our analytical energies on the "Fs" at the beginning and end of the equation, but we have not often sought to explicitly analyze the "back-to" part in the middle. The institutions and practices of biophysical sciences, as cultural spaces, have often been either left invisible or assumed to be purely technical. At best, they have been reflexively analyzed by practitioners in an ad hoc fashion (see Cernea and Kassam 2006; Rhoades 2005; Rhoades et al. 1986).

Around the same time that Rhoades was advancing the practice of applied agricultural anthropology, another groundbreaking anthropologist was laying the foundations for a different theoretical breakthrough. Like Rhoades, Bruno Latour, a godfather of the field of Science and Technology Studies (STS), also started his career looking at knowledge and technology at a cultural interface, in his case researching the cultural politics of transferring technical expertise from French to Ivorian industrial managers in postcolonial Ivory Coast (Latour 1974). Ultimately, Latour returned to France and turned his ethnographic lens on the production of scientific knowledge in a chemistry laboratory, resulting in the classic "Laboratory Life: The Construction of Scientific Facts" (1986), coauthored with Stephen Woolgar. One fundamental theoretical contribution of STS, via Latour and others who have built on his work, is again perhaps obvious to those who have grown up in its time: beyond revealing insights into the nature of the world, science is itself a socially embedded spectrum of actors and institutions that have cultures of practice. Just like local knowledge, scientific knowledge is the product of social processes that occur in particular cultural contexts (Agrawal 1995). More specifically, the Latourian stream of STS has developed Actor-Network Theory as a means of analyzing sociotechnical change without privileging either social or biophysical elements, as well as dispensing with preconceived categories or dichotomies that necessarily bias analyses (Murdoch 1997), including local *versus* scientific knowledge. Latour has influenced anthropology in several streams of thought, including studying up chains of power (Nader 1996), poststructural political ecology (Escobar 1999), and multisited ethnography (Marcus 1995) but rarely integrated into applied agricultural anthropology.

As with any cultural space, the social institutions of science shape and are shaped by intersecting interests, actors, and values. Thus, the boundaries of "proper science" are constantly renegotiated and contested by actors from within and without. Furthermore, rather than operating independently of one another, science and policy coproduce each other (Jasanoff 2004a, 2004b). Consequently, we can look at different forms of scientific knowledge production as (1) resulting from particular policy positions, but also (2) creating results that, due to the framing of the research problem and question, point toward particular forms of policy response, implicitly eliding other potential alternatives (see Crane 2009). These tend to become mutually reinforcing over time, as networks of knowledge and practice tighten between policy making and research.

To summarize, just as anthropologists research how "local knowledge" emerges from social processes of technical practice in particular cultural and environmental contexts, we can also research "scientific knowledge" within the same analytical frame. Following on this observation, the purpose of this paper is to outline an argument for the integration of science and technology studies perspectives into applied agricultural research, giving an "STS turn" to the FB2F approach. Conducting empirical social research on scientists' technical practices, social organization, and institutional norms—alongside the same research done with farmers—will enable a better theorization of how and why certain forms of applied agricultural research work (or do not work), which should in turn enable applied research strategies to become more effective. Furthermore, by including both farmers and research scientists in the analytical lens, we can also better understand the "hows" and "whys" of cultural encounters that occur when farmers and scientists work together. This approach should be particularly appropriate in the context of participatory research and development projects, the key spaces where such encounters between farmers and scientists occur. However, it should also be useful as a means of comparing the different approaches that farmers and researchers take to problem solving and their social institutional implications.

Research Context

In order to illustrate the widening of the analytical lens to include research scientists, I will draw on experience in the Sustainable Agriculture and Natural Resource Management (SANREM) program, one of the Collaborative Research Support Programs funded by the United States Agency for International Development (USAID). SANREM was a program guided by four principles: interdisciplinary integration, institutional collaboration, farmer participation, and a landscape approach. The SANREM approach was applied in a variety of different sites in Africa, Asia, and Latin America, including Mali, where the work presented here was done, and Ecuador, where Robert Rhoades was deeply involved. Initiated in response to the Brundtland report (World Commission on

Environment and Development 1987), which effectively codified sustainable development as a global policy agenda, the overarching goal of SANREM was to

> advance the principles, methods, research, and collaborative breakthroughs for a new paradigm which would rise to the challenges outlined in the Brundtland Report. SANREM was designed to carry out basic and applied research on sustainable agriculture and natural resource management across multiple scales involving local people, NGOs and government agencies and universities. [Rhoades 2001:4]

In the context of SANREM-Mali, my role was to research local knowledge of soils and soil fertility management, both in terms of technical practices as well as the cultural politics between farmers and herders (see Crane and Traoré 2005). As a PhD student, I spent two full agricultural seasons (2003–2005) in the Commune of Madiama, plus a half season of preliminary research in 2001. As such, I had the pleasure of working alongside many colleagues—from both Mali and the United States but nearly all biophysical scientists—witnessing the various participatory technical experiments that were implemented through the course of the project. While I never missed an opportunity to visit the research experiments with my colleagues, analysis of the interaction between researchers and farmers was not explicitly on my research agenda. I was there to study farmers. It was only toward the end of my research that I fully realized that when it came to understanding SANREM as an intervention for improving farmers' livelihoods, focusing exclusively on farmers was giving me only half of the picture. Just as the farmers' cultures shape the parameters within which people pursue agrarian livelihoods, the culture of scientific institutions likewise shapes the ways its members undertake their livelihoods as scientists. Following on this observation, this article reflects upon some observations about the ways that agrarian culture and research culture interacted in the context of participatory soil fertility management experiments.

Case Study

A Participatory Landscape/Lifescape Appraisal (PLLA) was conducted at the beginning of the SANREM project, as a key mechanism for ensuring the participatory element of the project. During the PLLA, the people of Madiama ranked soil fertility maintenance as the most significant challenge that they were facing in their livelihoods, followed by pasture degradation and farmer-herder conflicts (Earl and Kodio 2005). This paper will focus on the issue of soil fertility. Within the SANREM project, the response was to develop participatory experiments testing various treatments aimed at the improvement of soil fertility. The experimental treatments combined variations of four general approaches: (1) the applications of cattle manure in various quantities and frequencies, (2) micro-dosing of various chemical fertilizers, (3) intercropping of grains and legumes, and (4) rotation of grains and legumes. The experiments were designed to continue over the course of three years with the objective of identifying management strategies that would simultaneously improve soil fertility and maintain productivity while using scarce resources (especially manure, labor, and money) in efficient and effective manners. For a more thorough elaboration of treatments, findings, and valuations, see Wyeth et al. (2005) and Badini et al. (2005).

My preliminary research trip was conducted during 2001, the first year that the soil fertility experiments were being installed in local fields. Coming from an ethnoecology background, my research focused on farmers' soil typologies and fertility management practices. As in much smallholder agriculture in West Africa, the primary means of managing soil fertility in the area is the addition of animal manure.

In the sphere of farmers' soil fertility management practices, one of the most prominent findings of my preliminary research was that farmers had an overwhelming preference for goat and sheep manure as a fertilizer. One hundred percent of the sampled 40 farmers claim that goat and sheep manure is the best fertilizer they have available to them because it endures in the soil for 5–7 years after application, whereas farmers characterize the effects of cow manure as lasting for only one season.

Farmers' valuation of small ruminant manure, however, was not purely due to its advantageous physical qualities. It was also due to its accessibility, which proved to be a function of the social context of its production. Across West Africa, farmers have for decades been investing in small ruminants as means of livelihood diversification and buffering against eco-

nomic shocks (Mortimore and Adams 2001). As such, the vast majority of households in Madiama had at least a few goats and/or sheep that are grazed in small pastures near the village during the day and penned inside the household compounds at night. The practice of penning small ruminants inside the family compounds means that the manure they drop overnight is easily collected and composted. This is then carted to the fields and applied just prior to the first plowing at the beginning of the rainy season. Cows, on the other hand, are mostly used for traction, and being much more expensive, are not as widely owned by every household. Because of their high fodder requirements, traction bulls are herded in more remote locations by hired Fulani pastoralists for a large part of the year, meaning that they are not as frequently penned in the household compounds, thus their manure is not as readily available as a resource within household production.

Being inspired by the FB2F approach, these analyses were driven by the importance of understanding the cultural logics of farmer technical practices. My finding that small ruminant manure was overwhelmingly farmers' most valued and favored approach to soil fertility management was greeted with great interest by my colleagues in the SANREM program. However, it also raised a difficult question: why were none of the soil fertility trials testing the efficacy of small ruminant manure? At the time, it seemed a minor and correctible oversight. My colleagues overseeing the soil fertility experiments enthusiastically integrated treatments aimed at testing small ruminant manure into the research program in subsequent years because they recognized the importance of the question in terms of its potential impact on livelihoods, as well as its scientific significance. As a beginning applied anthropologist, I patted myself on the back for having successfully taken on the classic role of anthropologist as knowledge broker between farmers and biophysical scientists, but the seed of a niggling question was planted through that experience.

While my PhD research itself was focused on the local knowledge, cultural logics, and land politics of farmers and herders in the area (see Crane 2009, 2010; Crane and Traoré 2005; Crane et al. 2011), over the course of the rest of my research in Madiama, I eventually came to question how a basic reality of farmer practice was overlooked in a project about participatory technology development. What were the cultural logics of scientific technical practice that led to soil fertility trials that only drew on cow manure? My inquiries and analyses found that there was a suite of factors involved that reveal important contours of the culture of science. Understanding these contours is relevant to unpacking the black box of the "back-to" stage of "farmer-back-to-farmer." It is important to emphasize that the analysis of cultural drivers of scientific practice is not meant as a grand narrative, blanket critique of "Science," nor as a critique of the individual scientists involved, but as a means of understanding some of the institutional barriers to more effective joint production of technology through participatory research.

Unpacking the "back-to" part of "farmer-back-to-farmer" means acknowledging researchers as stakeholders in the process, just as much as farmers are. Consequently, we must see the soil fertility trials as serving multiple purposes. In this case, not only were they designed as a means of generating robust analyses of various management techniques that could inform local practices, but they were also a PhD project for the researcher leading them. So, in addition to generating knowledge that is relevant to the conditions of local practice, the experiments needed to live up to the standards of scientific rigor imposed by degree-granting institutions. This pressure for rigor and comparability played into the initial choice to use cow manure, which was drawn from a standardized supply from the regional research center. Using a standardized supply of manure helped ensure high scientific quality because the manure was well-composted and free of weed seeds, especially *Striga* spp.[2] Having a manure supply that was infested with weed seeds, or worse yet partly infested with weed seeds, could compromise the quality of the experiments from both a scientific point of view, but also in terms of farmers' ability to evaluate the techniques being tested.

As previously mentioned, one of the top problems identified in the PLLA was farmer-herder conflicts. Conflicts over agricultural encroachment into pastures, enclosure of water sources, and crop damage by loose cattle are rife throughout the region, particularly in areas immediately surrounding the Niger River Inland Delta (NRID), which is a significant water and pasture resource for all of Sahelian West Africa. A nationally designated cattle trail runs through the commune of Madiama, along which tens of thousands of cattle pass twice every year: once as they descend from the wet season highland pastures to the east of

Madiama into the dry season pastures in the Niger River inland delta, and again as the herds leave the NRID at the onset of the rainy season. The descent of cattle at the end of the rainy season coincides with lowland farmers' harvest season, meaning there is always potential for conflict between farmers and herders as they pursue their respective livelihood objectives. This leads to the subject of politics.

The political context in which SANREM's scientific research was framed contributed substantially to the initial emphasis on running soil fertility trials based exclusively on cattle manure. In addition to its agroecological goals, better coordinating farmers' and herders' production practices is also a political aim throughout the region, though perspectives on exactly how to do this vary widely between different actors, both locally and nationally. In the years prior to SANREM, the Commune of Madiama had become a hotspot for farmer-herder conflicts, which was part of the motivation to locate the SANREM project there. Consequently, SANREM and the regional government had predefined the integration of agrarian and pastoral livelihoods as a programmatic objective. From an agroecological perspective, this points toward identifying practices whereby farmers can benefit from the manure of the transhumant cattle, both in terms of technical application as well as the socio-institutional arrangements for its delivery.

While synergistic relationships between farmers and herders have been institutionalized in other areas of West Africa (Dafinger and Pelican 2006; Moritz 2006), the norm for the Madiama area had become an "each to themselves" approach during the rise of cattle keeping among farmers over the last few decades. As such, the political and research stakeholders in the project had a substantial role in problem definition at the program level and were important facilitators in locating the program in Madiama. They legitimately framed the problem from an agroecological systems perspective, which makes sense given their social location and the responsibilities of their positions. Increased complementarity between farmers and herders is indeed a laudable goal and could potentially solve many problems at once. However, the wider systems frame is not often shared by farmers' problem frames, which are primarily oriented toward their immediate subjective livelihood objectives. Because small ruminant herding is not the center of substantial conflicts, it is not on the political radar in the same way as cattle herding. Consequently, the testing of small ruminant manure for soil fertility trials did not initially arrive on the scientific agenda.

Examining this case from an FB2F perspective with an STS twist requires viewing policy makers, farmers, and researchers all as legitimate stakeholders who relate to each other through the creation of networks to which each actor brings their own knowledge, values, and agendas. Viewed from this angle, this case emphasizes that there are numerous livelihood-enhancing technologies being pursued in this scenario: soil fertility maintenance techniques, scientific publications, higher degrees for career advancement (including the author's), reduction of farmer-herder conflicts through pursuit of greater synergy, etc. The original FB2F concept elides researchers' and policy makers' agendas and institutional considerations, effectively proposing that they should build their own interests solely around farmers' interests. From a normative point of view, I sympathize. However, from an empirical point of view, all researchers and policy makers (even those who engage in participatory work) act from within institutional and political settings that influence the decisions they make vis-à-vis the creation of technology, settings which are not driven by farmers' goals. Explicitly analyzing researchers' and policy makers' actions and drivers, alongside those of farmers, enables us to get a more accurate, complete, and precise picture of what makes participatory research reach its goals.

Discussion

The case study presented above is meant to illustrate the relevance of analyzing scientific practice both in terms of the micro-social details and the macro-social political context. In this case, starting from a conventional FB2F approach, farmer practices are contextualized in a cultural history that bears upon their location in the physical landscape, their ethnic identity in a mixed social landscape, and a political history of development that has encouraged particular forms of technical practice (for greater elaboration of these aspects, see Crane 2010). Analyzing all of this in traditional anthropological fashion rendered useful insights into the drivers of farmers' soil fertility management strategies. The centrality of small ruminant keeping in soil fertility management opened up a new set of experiments, which in the end confirmed the

greater potency of small ruminant manure (Badini et al. 2005). From an applied perspective, this experience reaffirms the importance and value of beginning and ending with farmers' perspectives, and the utility of anthropologists in the role of cultural mediator. From a more theoretical perspective, it highlights that understanding socio-technical contexts of farmers' livelihood practices helps identify opportunities and constraints for innovation, as well as how cultural variables might shape farmers' pursuit, interpretation, and evaluation of new technological options.

Adding an "STS turn" to FB2F—analyzing the technical, institutional, and political factors that affect scientists' practice of soil fertility management research—likewise renders important findings in terms of understanding the culture of science. The logic of the initial focus on cattle manure was shaped by a variety of social factors: institutionally imposed standards of rigor and evaluation metrics, individual positions and aspirations within those institutions, and an overarching political objective that favored particular logics within the program. The remedial integration of small ruminant manure as another treatment in the soil fertility trials is testimony to the open-mindedness and flexibility within the program and the commitment to serving farmers' interests.

Traditional agrarian and ethnoecological anthropology has theoretical strengths in understanding farmers' knowledge, technical practice, and social organization. Integrating biophysical materiality, social structure, and socially constructed meaning into one analytical frame enables a valuable analysis of agrarian culture in a holistic perspective (Crane 2010). While anthropologists have long been exhorted to "study up" chains of power (Nader 1996), in agricultural anthropology this has most often been directed at the political economy of industrial agricultural (Bonanno and Constance 2001; Broadway 1996; Constance 2008; Durrenberger 1996; Snell 1996; Thu 2009), agricultural policy (McDonald 1995), or encounters with nongovernmental organizations in the development sector (Markowitz 2001; Shepard 2005). Anthropological research has rarely been conducted on the institutional contexts of agricultural research scientists themselves, with a few notable exceptions (DeLind and Bingen 2005; Gupta 1989; Nazarea-Sandoval and Rhoades 1994; Soleri and Smith 1999).

Science and technology studies, on the other hand, bring a rich theorization of social processes in "expert" production of science and technology, as well as the social construction of scientific "expertise" itself. Moving beyond ethnographic approaches to scientific practice, STS also brings strong theorization of the coproduction of science and policy, highlighting the powerful and often invisible forces of agenda setting and problem framing at macro-scale (Jasanoff 2004a, 2004b). However, STS as a field very rarely addresses agricultural issues in the global South, especially farmers' own production of ("folk") science and technology (Shrum 2000). Furthermore, STS, as a scientific culture, tends toward a very theoretical emphasis, with little tradition of the kind of applied work that is so strong in agricultural anthropology.

The ongoing evolution of participatory agricultural research exemplifies the dynamic boundaries and contested principles of the institutions of science. As with any process of cultural change, it is not without its growing pains or detractors. While many studies have shown that participatory technology development can work in practice (see Almekinders and Elings 2001; Almekinders and Hardon 2006), the institutional mechanisms that shape scientific researchers' engagement with participatory research remain under-documented and under-theorized (Almekinders 2011). Combining agricultural anthropology with STS implies analyzing equally both farmers' and scientists' cultural contexts as they come together. Empirically focusing on situated practices (Almekinders 2011; Jansen and Vellema 2011), rather than reified conceptual categories of "local" and "scientific," will contribute to the generation of new insights into the factors that enable and constrain effective, participatory technology production. Furthermore, while this paper focuses on agricultural research, these same premises and benefits should apply to diverse fields such as fisheries management, environmental conservation, public health, climate change adaptation, and others.

While Robert Rhoades's research always had a compelling applied component, he maintained a strong, and I believe accurate, insistence that there is no necessary boundary between applied and theoretical research. Taking FB2F forward, ethnographic analysis that explicitly examines research science as a culture of practice will enable a better theorization of participatory technology production. Over the long run, richer theorization and empirical analysis of FB2F (and related participatory approaches) as socio-technical processes should improve our understand-

ing of the barriers to transformations in research institutions as well as in agricultural livelihoods.

Conclusion

While applied research in agricultural anthropology often focuses on positive transformation of rural people's livelihoods, I propose that one important step toward achieving this goal lies well outside of rural society (see Röling et al. 2012). The starting assumption and applied challenge of the "farmer-back-to-farmer" approach is to stimulate a cultural transformation of how formal science and technology production are done, particularly how they articulate with the socio-technical world of farmers' livelihood practices. As such, an updated FB2F must analyze scientists just as it analyzes farmers in order to make a complete picture of the process of coproduction of technologies.

There is a strong tradition in anthropology of taking critical perspectives vis-à-vis biophysical sciences. This needs to be maintained but refined into constructive channels. Rather than essentialize "Science" as a monolith, we should construe it as a dynamic and heterogenous cultural institution of which we are a part and can thus change. Critical observations need to be tempered by an appreciation for the theoretical insights and analytical methods that biophysical sciences can deliver. This is also a core premise, and promise, of FB2F.

Building on the FB2F approach, the proposed ethnographic analysis of the interface between farmers' practices (technical, institutional, and cultural) and scientists' practices (technical, institutional, and cultural) is of both applied and theoretical interest. Anthropologists and STS scholars alike have increasingly recognized that all knowledge is local: local to the social spaces within which it is recognized as valid (technically and socially). Stemming from this recognition, a key challenge is how to move beyond the tired, old dichotomy of "local and scientific knowledge systems." It is extremely useful as a heuristic[3] because we intuitively recognize that there are substantial qualitative differences between the institutional spaces and processes through which knowledge and technology are produced and validated. However, in the end, they are not substantially different in epistemological underpinnings.

In response to recognizing scientific research as an important cultural space, rather than just standing *with* our colleagues/researchers and pointing our analytical lens at farmers' technical practices and cultural contexts, and then acting as a "cultural mediator" between farmers and researchers, this article proposes that an update of the FB2F approach requires us to change our angle, ever so subtly, in order to bring the technical practices and cultural contexts of research scientists themselves squarely into the frame of analysis. This will still enable anthropologists to act as "cultural mediators" when useful, but provides a more complete analytical perspective on the processes of knowledge and technology production. This proposal suggests analyzing the relevant technical and cultural variables of all actors within processes of knowledge or technological production, creating an ethnography that transcends the dichotomies of "local knowledge" and "scientific knowledge."

Agricultural scientists continue to experiment with ways of engaging in participatory research and technology development in order to more effectively address pressing problems such as climate adaptation (Bartels et al. 2013; Siregar and Crane 2011; Winarto and Stigter 2011) and improving seed systems (Akpo et al. n.d.; Almekinders 2011; Offei et al. 2010). The integration of agricultural anthropology and STS is particularly important in terms of analyzing the dynamics of any sort of participatory action research or participatory technology development. While anthropologists may often ultimately be more motivated by interest in farmers' cultures, this interest may sometimes be best served by widening the analytical focus to more thoroughly include research scientists and technologists. In addition to widening our analytical focus, we can also, in Rhoades's own tradition, turn our own agency, as members of research institutions, toward transforming them in ways that prioritize technological development that begins and ends with farmers' interests.

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Notes

1. It bears mentioning here that the institutions and practices of commerce/capital have been much more thoroughly dealt with due to a strong current of political economy perspectives in agricultural anthropology.
2. An aggressive weed that parasitizes the roots of grain crops. *Striga* spp. infestation is a severe problem in Sahelian Africa, particularly under conditions of poor soil fertility.
3. Having rejected its reality, it is still admittedly difficult to identify effective linguistic alternatives.

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