CHAPTER 24

Cultural Research on the Origin and Maintenance of Agricultural Diversity

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The puzzle of the diversity of life has given rise to numerous domains of human knowledge. In Western science alone, natural history, ethnobiology, evolutionary biology, systematics, and molecular biology address this theme. A more specific discourse has examined the diversity of crops (Darwin 1868; Conklin 1957). Throughout, tension between holism and reductionism has characterized scientific and policy debates. Reductionism is perhaps inevitable, a compelling trend in both theoretical and applied sciences; and one that has dominated research on the origin and nature of crop diversity. This paper explores the limits of reductionism with respect to a current scientific narrative of crop diversity — the idea of genetic erosion.

Conservation Biology

The applied-science conservation biology has emerged at the millennium from our anxiety of an impending collapse in the Earth's biosphere, the menace of extinction (Soulé 1986). Whereas Darwin posed the origin of species as his central question, conservation biology poses the survival of species. Conservation biology is grounded in the theory and mathematics of Island Biogeography (McArthur & Wilson 1967), and it has flourished with the effective use of key symbols and narratives, and familiar fare in popular culture, derived from the structural or master narratives in Western consciousness. The symbols are the "charismatic megafauna" that have represented untamed nature for centuries — wolves, tigers, leviathans. The narratives include stability and diversity, the balance of nature, and the human descent from nature. Conservation biology's vision is patrician, intended to affect public policy and behavior, fashioned of general models and state variables — diversity, energy, ecosystems. In both symbol and narrative, the reductionism of conservation biology aims to save species' diversity by salvaging key fragments of wilderness. The intent of conservation biology is to save a domain for nature so that it can reconquer the Earth's surface if and when human disturbance ceases, whether this be a century, a millennium, or longer.

Unfortunately social science finds predicting the distant future unfashionable, discredited, and implausible. Thus, conservation biology has no ready-made social science to turn to for estimating the future of most "state variables" that threaten the Earth's biosphere — human population growth, land conversion, the extinction rates of species caught in the path of human expansion, and the emission of

climate destabilizing pollutants. Social science potentially has much to offer in understanding all of these variables, but our voice is faint in discourses of biosphere modeling or ecopolitics, diminished not only by disciplinary prejudices but also by uncertainty within social science. Social science's own key narratives, for instance liberal progress or domination and resistance, are contradictory. Even population, a well studied state variable, has widely divergent estimates of when and at what size it will cease growing (Harris 1996). For the other state variables, such as land clearing and use, social science is rather like a primitive form of weather forecasting, informing us that tomorrow's weather will be similar to that of today. The best that social science can say about the near future is that it will be similar to the recent past. We are, therefore, still bereft of ways to address the true time horizon of conservation.

The loss of genetic resources of crops illustrates some of the challenges and conflicts of alloying social science and conservation. This case illustrates the limits of logical models that begin with large state variables but are ultimately determined by human agency and local conditions. Resistance, resiliency, inertia and obstinacy in human affairs are found everywhere, and what happens at the local level is often a chaotic contradiction of general predictions. Local exceptions have long provided grist for anthropologists as critics positioned on the periphery, in opposition to the other disciplines' narratives. However, agnosticism in the face of scientific orthodoxy raises disturbing questions for our discipline. What are we to make of contradictions between global processes and village life? Have we looked in the wrong places or used improper methods? Does local detail obscure larger and longer-term reality?

Genetic Erosion of Crop Resources

Shortly after the rise of modern genetics and the seed industry, crop breeders recognized that their success could well destroy the natural resource base of the industry — the vast stores of genetic material in landraces of crops kept by peasant farmers in centers of crop evolution and diversity. By the 1960s, a narrative of destruction of local crop diversity by global processes — population, technology, commercialization — was firmly established in both crop science and international policy (Frankel and Bennett 1970). This narrative of genetic erosion has two central parts — the production of superior general technology by science and industry and the domination of market relations in all production systems. The rapid diffusion of hybrid crops in the United States and Europe was an early harbinger of a worldwide replacement of local crops. The "Green Revolution" was proof that industrial seeds would bring similar changes to the heartland of genetic diversity in the tropics and subtropics. The response was to collect the genetic resources and store them as "world collections" in gene banks at international agricultural research centers. The narrative of genetic erosion was compelling for several reasons. It evoked the familiar Enlightenment idea of the destruction of nature flowing in the wake of human development. The narrative vouched for the

success of agricultural development in less developed countries and rationalized the appropriation of the world's genetic resources into collections controlled by industrial nations.

Anthropologists should quickly perceive a fundamental flaw in the narrative of genetic erosion because it is grounded in an essentialist definition of behavior and culture with a fixed attachment between tradition and crop diversity. The news of the Green Revolution and genetic erosion reached me in Peru, a novice anthropologist researching human ecology and agricultural adaptation in an Andean valley, in the epicenter of genetic diversity of potatoes. Although few industrial inputs were used in the valley, the first Peruvian equivalent of "miracle seed," the *renacimiento* ("renaissance") variety, was found in many of the potato fields, testifying to the Andean farmers' constant vigil for new seed and to the prowess of the *renacimiento* variety. While tendrils of the Green Revolution had established themselves in the village, the impacts seemed neither revolutionary nor erosive. The *renacimiento* variety was just one of many in farmers' inventories of potatoes, and it was not perceived by them as something extraordinary. Here was a local contradiction of the narrative of the Green Revolution: industrial technology in the form of seed was absorbed into the local production system and managed as a local component rather than as the transformative element envisioned by the architects of the Green Revolution.

The fact that farmers in Uchucmarca kept their local potato varieties could not, however, dispel the conclusion that genetic erosion was imminent or inevitable. The hobgoblins of village studies immediately raised up — a single, qualitative observation cannot challenge a narrative of a global process. Anthropologists, looking for the exotic and indigenous, have little trouble finding places where agricultural technology, including crop variety inventories, remains "traditional." However, the concept of genetic erosion needs testing in places experiencing technological change, with new seeds, industrial inputs, and commercial production. I attempted to overcome issues of site specificity and qualitative data by collecting survey data from numerous households and from widely dispersed sites, carried out where new seeds and commercial production were prominent. Nonetheless, my earlier observations were confirmed. Improved varieties easily root themselves in peasant production without displacing local varieties or dramatically reducing their diversity.

While the case of potatoes in Peru challenged the received wisdom about genetic erosion, a tuber crop in a high mountain environment is, perhaps, atypical and too exotic to challenge the narrative. Further research in Peru would not satisfy these challenges, so I initiated research on radically different crops and in different parts of the world. Research in Mexico and Turkey confirmed what I observed in my initial human ecology of Andean agriculture — processes such as technology adoption and commercialization are mediated and transformed at the local level in such a way as to contradict the predictions of the narrative of genetic erosion.

Studies of potatoes, maize, and wheat in centers of domestication and diversity suggest three distinct explanations for the persistence of biological diversity on

farms. First, on-farm diversity survives because of environmental advantages of different types of crops and varieties. Thus, one variety or class of varieties will do well at higher altitudes and another in more favorable places. Second, diversity survives because it lowers the risk of crop failure to the household, by providing a form of biological insurance against pests, pathogens, or unfortunate weather. Third, diversity survives because it has a special cultural value, because local varieties, with their aura of social meanings, make good gifts, or because they are prized for taste and quality.

Behaviorism

Challenging the narrative of genetic erosion proved costly to my anthropology. As the genetic erosion narrative pertains to process, so too must the challenge. Ethnobiology initially informed my research, but attention to the structure of lexicons was replaced by behavioral variables of peasant household economy. Culture, an ethereal phenomenon at best, became a residual category in quantitative and ecological analysis of crop variety selection. Confronting a historical process without historical data, avoiding the bias of a single site, and acquiring quantitative data drew me inexorably away from the holistic, descriptive terrain where anthropologists are most comfortable. The most profound problem was approaching a historical process (genetic erosion) with data from a single point in time. Cross sectional analysis aims to surmount this problem by reducing processes (e.g. commercialization or technology adoption) into variables that can be contrasted across households, in relation to a dependent variable (e.g. on-farm diversity). Nevertheless, even our best attempts to capture evolutionary processes in cross-sectional analysis are rather flimsy efforts to contain the chaos of history. The limits of this analysis are reflected in the modest amounts of statistical variability that can be correlated with independent variables. Yet, the absolute lack of critical historical data, either biological or social, afforded no alternative to cross sectional research.

Focus on the household involves its own form of reductionism. Other social units — villages, markets, classes, cultures — play significant roles in provisioning and valuing seed, but their force is mediated through the household. The household is a surrogate to the individual in behavioral analyses of farming systems — a theoretically free agent rationally choosing among alternative production strategies to affect the diversity of crops. Structural and cultural factors — markets, values, class, tastes, community — are only observed through the choices of households.

Three explanations for the persistence of diversity — environmental advantage, risk management, and cultural value — emerged from research on household variety choice. In the behavioral models, these are motivations or utilities deduced from regression models. Anthropologists should find these three explanations to be logically linked into the alloy of ideas, strategies, and behaviors included in culture and social structure, but quantitative behavioral research finds this alloy both

methodologically and theoretically cumbersome. It is unlikely that environment, risk, and culture are equally weighted in the collective experience of peasants. Applying Occam's razor, one should logically emerge as pre-eminent. Nevertheless, we continue to show that environment, risk, and culture are synergistic and cannot be ranked.

Stage-wise regression modeling helped to manage the alloy of three distinct explanations, but the loss of ethnographic texture and moment was an outcome of this research strategy. Ironically, success in challenging the narrative has led me back to a problem where anthropological theory and methods are particularly salient. That problem is the one of missing markets.

Anthropology

Explanations deduced from regression analysis of household choice only address one half of the narrative of genetic erosion. Demonstrating that environmental, risk, and cultural value advantage local crop varieties compared to "modern" ones is a testimony of the limits of science and industry to generate universal technology, but it still leaves the puzzle of diversity unsolved. The role of market relations in determining the basis and fate of crop diversity remained unexamined.

Markets, or the lack thereof, weigh heavily on why diversity exists at the household level and why successful efforts by science and industry to breed improved crops may not erode diversity. The rule of comparative advantage pertains as much to households as it does to localities, regions or nations. Households within a village should ascertain that specialization and exchange are advantageous, following the logic explained by Ricardo. Yet, our research on crop variety choice in Peru, Mexico, and Turkey, revealed that peasant households produce more diversity than is necessary or optimal given environmental and risk conditions. Overproduction of diversity may be explained by cultural value of local varieties, especially taste and cooking qualities, but why is it that peasant households have not discovered then the benefits from specialization and exchange, so that not all households need to produce a whole array of varieties? In fact, markets for local varieties at the village level do not seem to operate, and households which consume a particular variety must also grow it. In the parlance of economists (deJanvry et al. 1991), this is a case of "missing markets."

The master narrative on human development in late capitalist society is that market relations will supplant all others in farm economies and production systems. Market hegemony may, indeed, be in store for households everywhere, but there is much to suggest otherwise. Research on crop selection revealed a pattern that has long been familiar to anthropologists. Markets operate in some spheres but not in all, including production. Farmers in all of our study sites were active in the market, especially transactions that were centrifugal to the village, and all types of varieties were marketed, whether local or modern. Nevertheless, consumption of local varieties was not satisfied by local markets. The fact that markets do not work is expressed in the search costs to farmers who attempt find particu-

lar varieties for sale or exchange locally and in the risk that they would not be found. The logical response to these costs and risks is to produce diversity at home rather than rely on the market. "Why don't local markets work?" is familiar terrain to anthropologists, who have examined spheres of exchange and embeddedness of economic transactions in the culture of peasant society. The analysis of one narrative, genetic erosion, thus brings us to a much older and profound narrative — the tension between ordering social intercourse according to the presumptions of the market versus non-market principles.

Conclusion

In the proximate future, crop diversity in places like Peru, Mexico, and Turkey would seem to be insulated by the complexity of environment, the limits of science and industry, and the failure of markets to achieve hegemony within village economies. This finding does not excuse us from pursuing conservation, but rather it permits us to improve conservation of crop resources by including farmers as partners in the effort.

A premise of the genetic erosion narrative is that seed can be understood as a utilitarian asset, even though seed is a cultural artifact as well as a production input. The natural place to begin research on crop diversity may be production, but this does not exhaust the social basis of diversity of seed. The crude economics of the genetic erosion narrative, a human analog of Gause's law in ecology, suggests that a diversity should ultimately be supplanted by successful varieties or monocrops. However, a re-appraisal of Gause's law in the face of diversity in nature (Tilman & Pacala 1993) is mirrored in the social science of cultural resistance and resilience. The existence in single places of numerous constraints to survival and unavoidable trade-offs in strategies to meet these constraints result in opportunities for diversity to flourish. Understanding the ecology and fate of crop diversity requires reductionism in both biological and social research, but the limits to reductionism in both sciences are apparent. Our research suggests that the reductionism of marginal utility misrepresents both the complexity and resiliency of local practices (Brush 1992). The search for utility may, in fact, misdirect research on diversity. Boster (1985) makes the point that cognition and perception play critical roles in the rise and maintenance of diversity. Social exchange, cultural aesthetics, word play, and the poetics of identity, robust areas of anthropological research, are likely to inform on the origin and maintenance of crop diversity. One contribution of anthropology to the ecology of diversity is to continue to insist that the complexity of culture is a determinate a factor in the fate of cultural artifacts. While it may be practically and politically impossible to plan conservation without reductionism, understanding diversity cannot rest on utility alone.

References

Boster, J. S. 1985. Selection for perceptual distinctiveness: Evidence from Aguaruna cultivars. Economic Botany 39: 310–25.

Brush S. B. 1992. Ethnoecology, biodiversity, and modernization in Andean potato agriculture. Journal of Ethnobiology 12: 161–85.

Conklin, H. C. 1957. Hanunóo agriculture: A report on an integral system of shifting cultivation in the Philippines. Rome: FAO.

Darwin, C. 1868. The variation of animals and plants under domestication. London: J. Murray.

deJanvry, A., M. Fefchamps, and E. Sadoulet 1991. Peasant household behavior with missing markets — some paradoxes explained. Economic Journal 101: 1400–17.

Frankel, O. H and E. Bennett, eds. 1970. Genetic resources in plants — Their exploration and conservation. IBP Handbook No, 11. Oxford: Blackwell Scientific Pubs.

Harris, J. M. 1996. World agricultural futures: regional sustainability and ecological limits. Ecological Economics 17: 95–115.

McArthur, R. H. and E. O. Wilson 1967. The Theory of Island Biogeography. Princeton: Princeton University Press.

Soulé, M. E., ed. 1986. Conservation biology: The science of scarcity and survival. Sunderland, Massachusetts USA: Sinauer.

Tilman, D. and S. Pacala, 1993. The maintenance of species richness in plant communities. In Species diversity in ecological communities: Historical and geographical perspectives, edited by R. E. Ricklefs and D. Schluter. Chicago: The University of Chicago Press.