
Rethinking the Origins of Agriculture

Four Neglected Concepts with a Role to Play in Explaining the Origins of Agriculture

by Bruce Winterhalder and Douglas J. Kennett

Explanations of the socioeconomic changes accompanying the transition from foraging through mixed economies to societies that take up full-time agriculture will entail concepts of risk, discounting, economies of scale, and transaction costs. The spatial form and temporal scale of agricultural production fundamentally change the parameters of risk management. Delays between investment decisions and consumption of yields grow in duration and significance, elevating the salience of discounting. Localization and control over property and productivity generate opportunities for specialization and economies of scale, at the same time setting up the possibility of exchange among specialists and between locales with differential production advantages and consumption needs. Full evolutionary analysis of the origins of agriculture entails these ideas; their use in anthropology will require that we temper our history of economic substantivism with recognition that certain concepts forged to understand market economies are applicable much more broadly.

In a stimulating paper, Richerson, Boyd, and Bettinger (2001) argued that post-Pleistocene agricultural development was inevitable, and they proposed seven reasons why the full evolutionary transformation from foraging to food production might go slowly. Their list is ecumenical but tends to focus on external factors, such as climate instability, and the constraints posed by processes of cultural evolution.

Independently, Winterhalder and Kennett (2007) devised their own list of reasons for the persistence of “low-level food production” (the term comes from Smith 2001), by coincidence seven in number. Their list also is diverse, but, in contrast to that of Richerson and colleagues, it is focused on internal, socioeconomic factors abetting a persistent mixed economy. This is an economy that includes, in long-enduring combinations, both foraging and the low-level use of cultivars or domesticates.

Indirectly, both papers highlight important shortfalls in our conceptual and empirical understanding of agricultural ori-

gins. We know much about macroevolutionary features of this critical evolutionary transformation: the what, when, where, and who (Zeder 2006). We are rapidly learning about morphological, functional, and genetic features of domestication itself and how it occurred, from the perspective of selection pressure on domesticated phenotypes and plant and animal genetics (Zeder et al. 2006). However, we know next to nothing about the origins of agriculture as a socioeconomic transformation in the production, distribution, and consumption of foodstuffs and materials in actual societies. How did this happen in terms of individual behavior, groups, and their institutions, that is, the grounded, day-to-day origins of socioeconomic change in subsistence decisions and their ramifications (Winterhalder and Goland 1997)? Without understanding this process, whatever else we know, we will have an incomplete answer to the question of why agriculture eventually and in some places took hold and persisted.

One reason for our ignorance is that we are bereft of ethnographic analogies, or at least ones that we recognize as such. The societies in which agriculture originated may be unlike any of the contemporary ones we know (see Bettinger, Richerson, and Boyd 2009, in this issue). Paradoxically (*especially* if you are a classically trained anthropologist), our best opportunity to understand prehistoric economies for which we have few or no living examples lies in embracing tools forged early in the analysis of our most recent economic system, market capitalism. This claim is rank heresy in some parts of

Bruce Winterhalder is Professor of Anthropology in the Department of Anthropology at the University of California, Davis (One Shields Avenue, Davis, California 95616-8522, U.S.A. [bwinterhalder@ucdavis.edu]). **Douglas J. Kennett** is Associate Professor and Bray Fellow in the Department of Anthropology at the University of Oregon (Eugene, Oregon 97403, U.S.A. [dkennett@uoregon.uoregon.edu]). This paper was submitted 1 X 08 and accepted 1 V 09.

our discipline, but it may be our best point of departure. In fact, it asks nothing more than that anthropologists recognize how thoroughly and successfully microeconomic concepts have become essential to the evolutionary analysis of adaptive behavior in *any* species and how far behind is analysis of our own species' history in this respect.

Our general argument—that evolutionary or behavioral ecology analysis is critical to explanations of the origins of agriculture (Winterhalder and Goland 1997) or to prehistory generally (Bird and O'Connell 2006; O'Connell 1995)—should be familiar. Promising examples have existed for some time (Kennett and Winterhalder 2006; Piperno and Pearsall 1998; Russell 1988); nonetheless, many of the implications are not yet developed (Winterhalder and Kennett 2006). There is no doubt that some of the conceptual tools of economic analysis are applicable to human prehistory, opportunity cost and marginal analysis (see Gremillion and Piperno 2009, in this issue), the underlying bases of foraging theory, among them. Our key questions, then, are what *further* microeconomic concepts have this broad utility and what are their implications for the analysis of systems of production, distribution, and consumption not based so thoroughly on markets? In the spirit of the discussion at Plattsburgh (Cohen 2009, in this issue) and to provoke creative, forward-looking debate, we propose four concepts—analytical tools—that have high promise: risk, discounting, economies of scale, and transaction costs.

Risk. In an early paper, Winterhalder (1990) described several problems posed by the evolutionary transformation from risk-reducing mechanisms known to work well for hunter-gatherers to those that might be suitable for temperate-zone agricultural production. He has made no progress on this issue, and to our knowledge neither has anyone else. This is a prominent failure and an enticing challenge (see Hayden 2009, in this issue).

The institutional question—how is risk managed at individual and group levels in early mixed or agricultural societies?—may take us places we have scarcely imagined. Ethnographic analogies will be of limited or only indirect use. For instance, there has been virtually no formal discussion in anthropology of the risk-minimizing aspect of exchange (Ofek 2001; Seabright 2004; Silver 1995). Likewise, we have no models to guide speculation on whether egalitarianism is an advantage or a hindrance in managing early agricultural risk. We do know that risk-sensitive adaptations are ubiquitous elements of behavior (Winterhalder, Lu, and Tucker 1999). But this knowledge has not been applied to the problems posed by agricultural origins.

Discounting. This fundamental economic concept likewise raises neglected socioeconomic issues. Although there was an early, intuitive, and qualitative statement in Woodburn's (1982) ethnographic distinction between immediate- and delayed-return economies, only recently have anthropologists made discounting a central and formal element in the analysis of mixed or early agricultural economies (Alvard and Kuznar

2001; Tucker 2006). A discussion of discounting is essential because of the elevated significance of investment in delayed-return activities in temperate-zone agriculture and animal husbandry. The recent discussion of discounting in relation to the origins of agricultural economies, like that of risk and related in some ways to it, highlights how little we know. Thus, the question of storage in early food-producing economies (Kuijt 2009, in this issue) not only raises issues of the evolution of property rights but also engages risk and discounting. Agriculture greatly extends the delay from production decisions to consumption, because field preparation and planting, weeding, irrigation, harvest and processing, and perhaps a long period of storage are interposed between investment and return.

Economies of scale. In general, there are few economies of scale for mobile foragers or those who disperse singly or in small groups from a home base in search of game and plant foods. Search-and-pursuit foraging is resolutely generalist in the array of tactics and capacities it demands; the structure and logistics of foraging resist specialization. What works for the manufacture of pins does not help in the stalking of a moose. Harvesting of species for which there seem to be economies of scale from specialization and group effort appears late in the prehistoric record, entailing activities like capture of anadromous fish or whaling. These developments tend to be loosely associated with so-called complex foragers (Price and Gebauer 1995). Although it has been argued that complex foragers living in salubrious environments planted the seeds of agricultural development (Gebauer and Price 1992), we frankly do not know whether simple or complex foragers were the more propitious antecedents of societies that initiate and eventually complete the transformation to food production. In fact, multiple dynamic pathways could have resulted in persistent agroecological systems of food production.

Understanding how economies of scale come into play through the development of agricultural production will be key to analyzing the institutional changes that occur in parallel. What institutional, socioeconomic changes are required to solve the coordination problems associated with remodeling a foraging band or a complex foraging society into an agricultural village? How is this affected by specialization? By storage? By emergent social inequality? By changing notions of property? Concepts like economies of scale will be instrumental in answering such questions.

Transaction costs. Substantivism injected a salutary dose of relativism into early speculations about the economic forms of prehistory (Dalton 1975), but over the long term it has cost anthropology dearly. Nowhere is this clearer than on the subject of exchange or trade. Although archaeologists routinely describe long-distance movement of materials in prehistory (e.g., Ames 2002; Malville 2001), formal theoretical investigation of the conditions under which we should expect these material "interaction spheres" is almost completely absent. As in other areas, the economists threaten to steal our

subject matter with intriguing ideas (Ofek 2001), although without our empirical understanding of actual cases.

This situation is so anomalous that we suggest adopting a stance that assumes that exchange would be advantageous in all times and places and thus ubiquitous in its occurrence. It then becomes our burden to explain why it is missing (de Janvry, Fafchamps, and Sadoulet 1991) in particular circumstances, if indeed it is. A key concept in this debate will be transaction costs: exchange may fail to occur because whatever benefits it poses otherwise, the costs in terms of danger, uncertainty, transportation, etcetera, prevent it. Markets may be rare in prehistory, but we should be able to say in theoretical terms why that is the case. It is not sufficient simply to recoil at the apostasy of posing the question because our best examples of exchange and our most sophisticated analytical tools for analyzing it were originally developed in the historical context of early capitalism (Sahlins 1972).

The “cereals used at the Natufian site of Mureybet . . . may not have been growing locally [but] . . . may have been imported or introduced from farther north Transport of raw materials across considerable distances is well known in the Near East, adding weight to the argument that cereals were also transported” (Willcox 2005, 539). We need not imagine this to be the result of an institutionalized market in cereal futures (Bernstein 1996) in order to ask whether microeconomic tools will help us to understand how differential valuation in zones of production and consumption, balanced against the transaction costs associated with such movements of goods, rights, and/or consumers, will further analysis and explanation.

In this short contribution to the Plattsburgh debates, we have focused on conceptual ways of framing the question of agricultural origins in terms of risk, discounting, economies of scale, and transaction costs. We chose this rather than a functional approach (does a productive environment or inequality function to facilitate this transformation?) or even a causal one (is climate change, population growth, or feasting the most important causal force?). We have done so because we believe that basic concepts of economics and behavioral ecology are more likely than these approaches to provoke creative insights. We hazard the belief that these fundamental economic concepts are applicable whatever the mode of production, as is already clear for “marginal valuation” and “opportunity cost.”

We have scarcely begun to imagine what kind of behavioral-ecology models might draw on risk, discounting, economies of scale, and transaction costs and be suited to the examination of agricultural origins. This will require that we do the work of translating these concepts into hypotheses (Winterhalder and Kennett 2006); biologists focused on nonhuman behavior have little need to do so. We might nurture here a little friendly competition with the economists who already have turned their (in)sights on prehistory (Ofek 2001; Pryor 2005; Seabright 2004; Silver 1995). Analysis of the economy

of early mixed or agricultural societies necessarily will employ terms with which they already are comfortable.

This viewpoint, with its opportunities to understand early mixed and agricultural economies, will require that we finally set aside the substantivist legacy of Polanyi (1944), as historically minded economists already are doing (Hejeebu and McCloskey 2000, 2004). It is time to set about identifying which tools of modern economics are most applicable to the precapitalist record. We are long past the question of whether any of them are applicable. Our inquiry now must focus on which of them will teach us the most.

Explanations of the socioeconomic element of the transition from foraging through mixed economies to those that take up full-time agriculture will entail not only marginal analysis and opportunity costs but also risk, discounting, economies of scale, and transaction costs. We know this because the spatial form and temporal scale of agricultural production fundamentally change the parameters of risk management; because delays between investment decisions and consumption of yields grow in duration and significance, elevating the salience of discounting; and because localization and control over property and productivity generate opportunities for specialization and economies of scale and at the same time set up the possibility of exchange among specialists and between locales with differential production advantages and consumption needs. Responses to these shifts may have been rapid or slow, depending on the case, but we should presume that they are among the set of forces shaping societal evolution and be prepared to analyze them.

References Cited

- Alvard, M. S., and L. A. Kuznar. 2001. Deferred harvests: the transition from hunting to animal husbandry. *American Anthropologist* 103:295–311.
- Ames, K. M. 2002. Going by boat: the forager-collector continuum at sea. *In* Beyond foraging and collecting: evolutionary change in hunter-gatherer settlement systems. B. Fitzhugh and J. Habu, eds. Pp. 19–52. New York: Kluwer Academic/Plenum.
- Bernstein, P. L. 1996. *Against the gods: the remarkable story of risk*. New York: Wiley.
- Bettinger, R., P. Richerson, and R. Boyd. 2009. Constraints on the development of agriculture. *Current Anthropology* 50:627–631.
- Bird, D. W., and J. F. O’Connell. 2006. Behavioral ecology and archaeology. *Journal of Archaeological Research* 14: 143–188.
- Cohen, M. N. 2009. Introduction: rethinking the origins of agriculture. *Current Anthropology* 50:591–595.
- Dalton, G. 1975. Karl Polanyi’s analysis of long-distance trade and his wider paradigm. *In* Ancient civilization and trade. J. A. Sabloff and C. C. Lamberg-Karlovsky, eds. Pp. 63–132. Albuquerque: University of New Mexico Press.

- de Janvry, A., M. Fafchamps, and E. Sadoulet. 1991. Peasant household behaviour with missing markets: some paradoxes explained. *Economic Journal* 101:1400–1417.
- Gebauer, A. B., and T. D. Price. 1992. Foragers to farmers: an introduction. *In* *Transitions to agriculture in prehistory*. A. B. Gebauer and T. D. Price, eds. Pp. 1–10. Madison, WI: Prehistory.
- Gremillion, K. J., and D. R. Piperno. 2009. Human behavioral ecology, phenotypic (developmental) plasticity, and agricultural origins: insights from the emerging evolutionary synthesis. *Current Anthropology* 50:615–619.
- Hayden, B. 2009. The proof is in the pudding: feasting and the origins of domestication. *Current Anthropology* 50: 597–601.
- Hejeebu, S., and D. McCloskey. 2000. The reproving of Karl Polanyi. *Critical Review* 13(3–4):285–314.
- . 2004. Polanyi and the history of capitalism: rejoinder to Blyth. *Critical Review* 16(1):135–142.
- Kennett, D. J., and B. Winterhalder, eds. 2006. *Behavioral ecology and the transition to agriculture*. Berkeley: University of California Press.
- Kuijt, I. 2009. What do we really know about food storage, surplus, and feasting in preagricultural communities? *Current Anthropology* 50:641–644.
- Malville, N. J. 2001. Long-distance transport of bulk goods in the pre-Hispanic American Southwest. *Journal of Anthropological Archaeology* 20:230–243.
- O'Connell, J. F. 1995. Ethnoarchaeology needs a general theory of behavior. *Journal of Archaeological Research* 3: 205–255.
- Ofek, H. 2001. *Second nature: economic origins of human evolution*. Cambridge: Cambridge University Press.
- Piperno, D. R., and D. M. Pearsall. 1998. *The origins of agriculture in the lowland Neotropics*. San Diego, CA: Academic Press.
- Polanyi, K. 1944. *The great transformation*. Boston: Beacon.
- Price, T. D., and A. B. Gebauer. 1995. New perspectives on the transition to agriculture. *In* *Last hunters first farmers: new perspectives on the prehistoric transition to agriculture*. T. D. Price and A. B. Gebauer, eds. Pp. 3–19. Santa Fe, NM: School of American Research.
- Pryor, F. L. 2005. *Economic systems of foraging, agricultural, and industrial societies*. Cambridge: Cambridge University Press.
- Richerson, P. J., R. Boyd, and R. L. Bettinger. 2001. Was agriculture impossible during the Pleistocene but mandatory during the Holocene? a climate change hypothesis. *American Antiquity* 66:387–411.
- Russell, K. W. 1988. *After Eden: the behavioral ecology of early food production in the Near East and North Africa*. Oxford: British Archaeological Reports.
- Sahlins, M. 1972. *Stone Age economics*. Chicago: Aldine.
- Seabright, P. 2004. *The company of strangers: a natural history of economic life*. Princeton, NJ: Princeton University Press.
- Silver, M. 1995. Economic structures of antiquity. *Contributions in Economics and Economic History*, 159. Westport, CT: Greenwood.
- Smith, B. D. 2001. Low-level food production. *Journal of Archaeological Research* 9:1–43.
- Tucker, B. 2006. A future discounting explanation for the persistence of a mixed foraging-horticulture strategy among the Mikea of Madagascar. *In* *Behavioral ecology and the transition to agriculture*. D. J. Kennett and B. Winterhalder, eds. Pp. 22–40. Berkeley: University of California Press.
- Willcox, G. 2005. The distribution, natural habitats and availability of wild cereals in relation to their domestication in the Near East: multiple events, multiple centres. *Vegetation History and Archaeobotany* 14:534–541.
- Winterhalder, B. 1990. Open field, common pot: harvest variability and risk avoidance in agricultural and foraging societies. *In* *Risk and uncertainty in tribal and peasant economies*. E. A. Cashdan, ed. Pp. 67–87. Boulder, CO: Westview.
- Winterhalder, B., and C. Goland. 1997. An evolutionary ecology perspective on diet choice, risk, and plant domestication. *In* *People, plants, and landscapes: studies in paleoethnobotany*. K. J. Gremillion, ed. Pp. 123–160. Tuscaloosa: University of Alabama Press.
- Winterhalder, B., and D. J. Kennett. 2006. Behavioral ecology and the transition from hunting and gathering to agriculture. *In* *Behavioral ecology and the transition to agriculture*. D. J. Kennett and B. Winterhalder, eds. Pp. 1–21. Berkeley: University of California Press.
- . 2007. Seven reasons to remain a forager despite the availability of cultivars. Unpublished MS, University of California, Davis.
- Winterhalder, B., F. E. Lu, and B. T. Tucker. 1999. Risk-sensitive adaptive tactics: models and evidence from subsistence studies in biology and anthropology. *Journal of Archaeological Research* 7:301–348.
- Woodburn, J. 1982. Egalitarian societies. *Man* 17:431–451.
- Zeder, M. A. 2006. Central questions in the domestication of plants and animals. *Evolutionary Anthropology* 15: 105–117.
- Zeder, M. A., D. G. Bradley, E. Emshwiller, and B. D. Smith, eds. 2006. *Documenting domestication: new genetic and archaeological paradigms*. Berkeley: University of California Press.