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Theory of the square chicken: advances in agricultural intensification theory

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Abstract: *Scientific understanding of agricultural change has grown considerably since Boserup's seminal 1965 work, but her model's simplicity has provided a foundation for building more complex understandings of farming societies. Much of the development of these more sophisticated understandings has been led by Harold Brookfield. The first section of this paper summarises our current understanding of the salient points of commonality in intensive smallholder systems. The second section looks at findings from studies that relax Boserupian constraints, revealing new kinds of variability in agricultural systems. Both sections stress the need for continued research on the political-economic context of agricultural intensification.*

Keywords: *intensification, Tiv, Benue, Kofyar, smallholders, political economy, political ecology, Nigeria, genetically modified crops*

Ester Boserup's *The Conditions of Agricultural Growth* was a small book that has had a large effect on the booming literature on non-industrial agriculture over the last 35 years. Its account of agricultural variability was simple and schematic, its main point being that population density was the prime engine driving change in methods and technology in 'primitive' agriculture. It is remarkable that a 110-page tract had such an effect, especially since it ran contrary in many ways to the ancient orthodoxy of Malthus, which was entrenched in scientific thought in the public imagination.[1] It is equally remarkable how much ink has gone (and still goes) towards attacking Boserup, given that geographers, anthropologists and others have gone so far beyond her bare-bones model. This 'Beyond Boserup' literature has addressed many of the complexities that Boserup simplified; it has attended to many of the variables she left out of the equation; and it has shown how her simple mechanism can fit into larger-scale dynamics.

Meanwhile the anti-Boserup literature (much of it from my fellow anthropologists) continues to flow unabated. It includes wide-ranging and

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often strenuous critiques, going from the obvious point that population is not the only factor driving change, to charges that Boserup denigrates other key processes, misconstrues data, misuses synchronic comparisons, and obscures ecological problems in the developing world.[2] Boserup often comes off no better than Saturday Night Live's A. Whitney Brown, who was once introduced as 'setting sail in a sea of misinformation, in a lifeboat of oversimplification'.

Yet the fact remains that the relationship Boserup described *is* a key element in the variability in non-industrialised agriculture. Rising 'Population Pressure on Resources' (PPR) within a constrained area frequently *does* force farmers to alter their production tactics, often demanding greater inputs in the process. It is often predictable.

That the Boserupian model cannot account for all of the complexity in intensification (Morrison, 1994) was obvious from the beginning. The model is patently oversimplified, as are all general models including demographic transition, biological evolution, the psyche, the economy, planetary motion, and the atom. But even in simplifying she provides an invaluable framework for isolating the other variables in the intricate process of agricultural change. I co-teach with a geologist who likes to begin consideration of multivariate phenomena with what he calls a 'square chicken' model – reducing the problem to an obviously artificial simplicity to allow an initial mathematical approximation.[3] In the social sciences this might be called a *ceteris paribus* model, but I prefer the rural unpretentiousness of the chicken. What a 'square chicken' accomplishes is, first, explain a large portion of the observed variability, and second, organise the consideration of other causal factors by forcing the question: 'What have we had to do to square this chicken?' The Boserup model indeed does not account for all variability in the dynamics of non-industrial agriculture, but it does provide the square chicken model *par excellence*. Its value is not in being the final word but in being the first word; it is a model made to be gone beyond, and over the past 35 years we have done just that.[4]

This collection, which showcases the progress made on Papua New Guinea agricultural systems, is a fitting venue to consider this progress. It is in the Pacific that agrarian research has provided some of the best accounts of the nuances of agricultural ecology (see, for example, Bourke in this volume), some of the best studies of long-term agricultural change (see, for example, the work of Kirch), and some of the best writing on the theory of agricultural systems (because of the work of various researchers, most notably Harold Brookfield).

My intent is to present some key examples of this 'beyond Boserup' research, showing how Boserup's simplicity has provided a foundation for building more complex understandings of farming societies. It is a selective tour rather than a proper survey. The chapter is divided into two parts. Part I looks at some points of commonality among intensive farmers, crystallised recently in Robert Netting's generalised 'smallholder' model. This is a much richer view of intensive farmers than Boserup provided, especially regarding the relationships between culture and agriculture. Yet the smallholder model is

also a square chicken, keeping at arm's length some important aspects of the political-economic context within which smallholders operate. I comment on some of these issues and argue that it is in this arena that our most important questions for future research lie. Part II then looks at examples of research that relax Boserupian constraints, especially those concerning the social and economic contexts of agricultural decision-making, again winding up with the pressing issues in the political economy of small-scale agriculture.

PART I: THE SMALLHOLDER MODEL

The cultural ecology of smallholders

Robert Netting's (1993) *Smallholders, Householders: farm families and the ecology of intensive, sustainable agriculture* is, like Boserup's *Conditions of Agricultural Growth* in its use of worldwide case studies to illuminate an archetypal pattern, explained by a theoretical argument but with an eye towards the practical world of agriculturalists. But while Boserup's book examined agricultural change with only superficial consideration of its social aspects, Netting's is as much about culture as agriculture; where Boserup's is a coarse sketch with limited case studies, Netting's is a nuanced study drawing on a voracious reading of the literature on agrarian societies in Europe, East Asia (particularly China), Latin America, and sub-Saharan Africa. What emerged from Netting's survey is a 'smallholder' pattern comprising 'a limited set of social and economic factors that are regularly associated with a definable type of productive activity' (1993: 2). I see the following nine characteristics as the most salient:

- Smallholders live under conditions of scarcity. From the Yangtzi Delta to the Swiss Alps, from the Jos Plateau of Nigeria to the Basin of Mexico, PPR is generally high. That various other factors also affect agriculture does not change this fact.
- Smallholders are not economically isolated. It is not necessary to hold constant the augmentation of farm income by wage work or the purchase of manufactured goods in order to see the pattern.
- The smallholder economy is not devoted to subsistence production and use-value *or* to profit maximisation and exchange-value. It crosses this divide and shows it to be a poorly informed distinction. Smallholders may sell their goods and/or labor, but are never wholly dependent on the market economy; they always provide for a substantial portion of their own subsistence.
- Smallholder agriculture is 'sustainable' as defined in energy terms: production is predictable and sufficient to feed the producers, and stable over the long run. (The Chinese wet rice cultivators, described in his most in-depth case study, have been at it for millennia).
- Smallholders exhibit a wide range of agricultural technology. Markets, population, and other factors favouring higher production concentration (output per unit time/area) do not necessarily result in technological

innovation. (The Nigerian Kofyar, one of Netting's prime case studies, practise an intensive agriculture based simply on the use of hoes.)
- Smallholders farm intensively: they tend to have high rates of production concentration at the expense of low output per worker and per unit of input. They do, as Boserup has maintained, work harder.
- Equally important to the *quantity* of work is the *quality* of work. Smallholder agriculture demands individual discipline, social coordination, physical skill, and expert knowledge to carry out such tasks as hand-weeding, transplanting and fertilising, and the making and maintaining of dykes, terraces, ridged fields and irrigation canals.
- Smallholders have great incentive for tenure security on their intensively used land, often with sellable, rentable, heritable rights (although such property regimes can co-exist with communally managed resources).
- Finally, and most importantly, smallholder agriculture is run by households. There is wide cross-cultural variation in form and function of the household (Wilk and Netting, 1984), but several pivotal features of smallholder farming 'increase the number and importance of economic activities carried on in a household, and hence the centrality of the household as a social institution' (Netting, 1993: 61). These features include the need for high levels of skilled and coordinated labour, sustained use and improvement of resources, establishment and transmission of property rights, and multiyear storage and management of resources to minimise risk.

THE POLITICAL ECONOMY OF SMALLHOLDERS

The real accomplishment of this study is the recognition and explanation of a pattern of cultural and agricultural features that cut across diverse economic and ecological settings. Although Netting never subscribed to Julian Steward's concept of a 'culture core',[5] he did locate the study within the Steward tradition of focusing on key cultural institutions that mediate the human-environment relationship, and of seeing the 'penetration and imbedment of labor – that is, the social relations of production – in the total fabric of society' (Murphy, 1990: 332).

Netting's primary concern was theory, but he describes a pattern that is of enormous practical importance. He shows a capacity within agrarian households to sustainably raise production under population pressure in ways that are persistently misunderstood by administrators in Third World nations and development agencies. He also shows what smallholders must be allowed to do if they are to perform 'intensive sustainable agriculture'.

The key features of smallholder culture and agriculture could be restated as a set of policy guidelines:

- Do not interdict the household's ability to own land (since this is a prerequisite to the sort of land. improvements often required to intensify).
- Minimise disruption of the household's ability to deploy its own labour (since intensive farming requires not only long hours, but fine coordination).

- Allow households to minimise risk by controlling resources from year to year and by developing a balance between the monetarised and non-monetarised components of their economy.

Of course, smallholders are often *not* allowed these freedoms. Where Netting's analysis leaves off is with the history of the overlapping institutions of the state and the ruling class dictating how, what and where smallholders farm and how they manage their household labour, farm output, and land tenure. The harshest criticism has come from Guyer: 'There is no famine in [Netting's] smallholder world, no sale of wives and children in desperation, no ambiguities of tenure, no stagnation…'; the book leaves one 'paralyzed by the lack of any political economy whatsoever' (Guyer, 1997: 23).

Whether or not Netting's analysis is 'paralysed', it is a fact that Netting's concern is with the workings of cultural and agricultural systems that are productive and sustainable when not seriously deformed by inimical policies. Building directly on Boserup, Netting depicts farmers driven primarily by local factors including labour, markets, and land (which they can own or control). He does recognise how the state can misunderstand and obstruct these systems; his example is the rice-growing portion of China, where production was disrupted for over 20 years by collectivisation programmes that eradicated the reward structure that is requisite to smallholder agriculture.[6] However, he does not take up state meddling as a topic in its own right, preferring a 'somewhat limited' (1993: 262) perspective on smallholder farming. While some fault this 'somewhat limited' view, I applaud it. To attempt an 'unlimited' view this book would have paid a heavy price in clarity and coherence. As it is, it sets the stage nicely for subsequent investigation of smallholder political economy.

How and why states meddle in, undercut, and even destroy smallholder systems is one of the key questions now confronting agrarian research. A recent synthetic analysis is Scott's *Seeing Like a State: how certain schemes to improve the human condition have failed* (1999), which argues that the apparent disorder of indigenous agricultural systems is intolerably 'illegible' to state bureaucratic models, and so it invites generally disastrous re-engineering from above. But any understanding of the effects of such policies is greatly enriched by Netting's analysis of the functionality of the systems that are being re-engineered.

PART II: NON-BOSERUPIAN CAUSES, CONSEQUENCES, AND MECHANISMS

I have argued that Boserup's model is the square chicken model *par excellence* for the dynamics of non-industrial agriculture; that its simplifications are requisite elements of any highly general model; and furthermore that its simplifications offer a framework for moving towards a more comprehensive understanding of agricultural systems. To use the Boserup model as such a framework, let us break it down into a cause (or independent variable), a result (or dependent variable), and a mechanism that relates the two. The cause is

PPR and the result is higher production concentration and a heavier workload. The causal mechanism is fundamentally an ecological one: sparse population generally allows extensive farming in which labour is relatively light and efficient, primarily because it capitalises on the advantages of fire and fallowing. In other words, the substitution of labour for land is inherently inefficient, and thus done only when forced by PPR.

The job is to move from this simplicity to the complexity of farmers' lives, and this work has been conducted chiefly in the wake of Harold Brookfield. Brookfield's long-range aim has been 'a much more adequate theory of production ... which will relate production to society as a whole, and rid the subject of its long-lived calorific obsession' (1972: 46), and his 1972 *Intensification and disintensification in Pacific agriculture: a theoretical approach* was a crucial early step. Brookfield's thinking has evolved considerably since 1972, but it continues to play a leading role in 'beyond Boserup' scholarship. The following discussion, which 'unsquares' the chicken by examining causes of intensification other than PPR, results of PPR other than intensification, and different causal mechanisms relating PPR and intensification, necessarily takes its cues from Brookfield's body of work.

OTHER CAUSES OF INTENSIFICATION

Farmers take steps to raise production concentration for various reasons other than PPR or outright land shortage. One of Brookfield's early contributions was the separation of 'subsistence production, social production and trade or case production' (Brookfield, 1972). In other words, Boserup's schematic agroecological system is embedded in social and economic systems. Let us examine each of these.

Social Systems: Social context affects both the demands for agricultural produce and the relative efficiency of production methods. Overall demand was affected not only by caloric needs but by 'social production, which comprises goods produced for the use of others in prestation, ceremony and ritual, and hence having a primarily social purpose' (1972: 38). Among New Guinea groups one could observe production levels that were 'wildly uneconomic' in terms of energetics, but which earned a very real (although hard to measure) social dividend. Social production as defined by Brookfield is still essential to understanding production systems (for example Kirch, 1992), and we have also seen other ways in which the social context of agriculture affects intensification. For instance, the social system may allow reduction of intensification, as with the Iraqw who invest in social networks rather than in their farm plots, making up food shortfalls through relatives cultivating more productive areas (Snyder, 1996; also see Berry, 1993).

But at the same time that agriculture is practised partly for social ends, it is practised by social means, and this can have marked effects on responses to PPR. Ecological analyses tend to see social institutions as adapting to production; the value of this perspective is indisputable, and the smallholder model is an obvious example. Yet this does not mean that cultural forms do not

influence adaptation (Bennett, 1967: 21). All strategies of food procurement and production require technology, including social technology – conventions for mobilising human resources. Social technology that facilitates a food production strategy lowers the cost of that strategy. Earle writes that 'because social relationships play an important role in procurement strategies, the possible forms for the organisation of labour in exploitative tasks are set by a group's structure … as well as by the technical requirements of the work. To the degree that social structure affects the possible organisational forms, it affects the costs of exploiting a resource and, thus, its importance in the subsistence economy' (Earle, 1980: 4). Thus, efficiency of production strategies can vary culturally, and even a purely 'calorific' analysis must consider social technology that affects costs and benefits.

My own research on Kofyar and Tiv farmers in Plateau State of Nigeria provides an example.[7] Expanding out of a crowded homeland on and around the Jos Plateau, Kofyar farmers began to move south into the Benue Lowlands in the 1950s (Figure 1). By the early 1960s, there were Kofyar living in dispersed communities with population densities below 10/sq km (Stone, 1996). Whereas farming in the homeland had been highly intensive, frontier farming was mostly extensive, with heavy reliance on fallowing and swiddening (Netting, 1968).

Since then the frontier Kofyar have been the subject of longitudinal research, with especially detailed data from the 'Core Area' south of Namu (Figure 1).

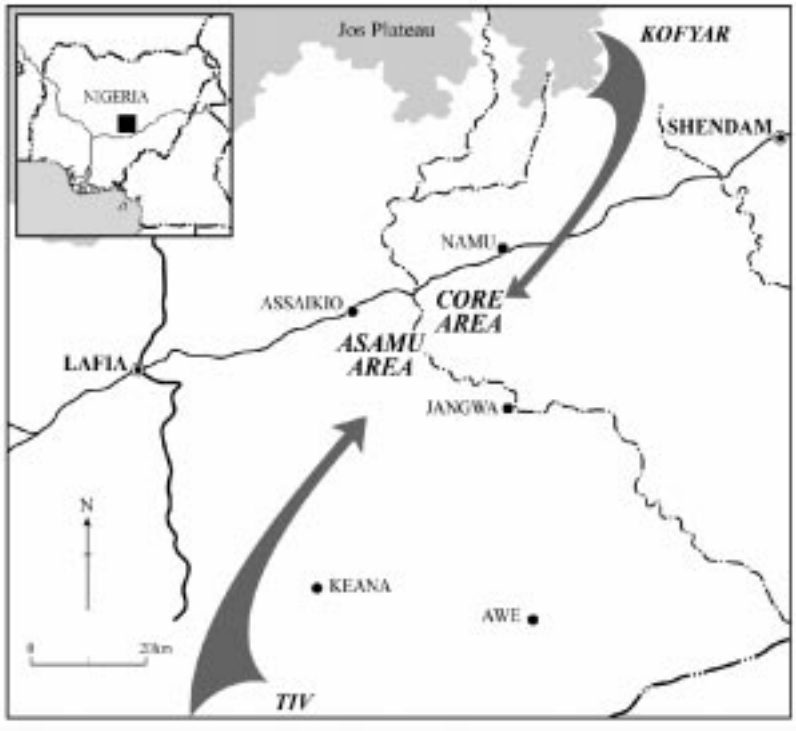

Figure 1. Benue Lowlands, Central Nigeria

By the mid-1980s, there had been considerable agricultural intensification in the Core Area, with 70 per cent of the land in cultivation (Stone, 1996: 104) and a mean yearly labour input of over 1500 hours (Stone *et al.*, 1990; Stone *et al.*, 1995). Intensification had been prompted by PPR as population density in the Core Area had risen to 100/sq km; it had also been spurred by market involvement, as roughly half the hours put in by a sample of closely monitored farmers went to crops primarily destined for the market (Netting *et al.*, 1989).

The Kofyar willingness to intensify their agriculture was shaped in part by social institutions facilitating intensive farming in the homeland. Particularly important was a varied set of social mechanisms for mobilising labour with beer, food, cash, specific reciprocity or generalised reciprocity. (Intensification was also favoured by ideology, which valued stability of communities [Stone, 1998] and zealous work ethic.) At the same time, the main alternative to intensification – migrating and starting over in a less crowded area – was time-consuming, expensive, and risky.

These points about Kofyar agriculture illustrate the involvement of social institutions but do not contradict Boserup's predictions. However, alongside the relatively stable, intensive-farming Kofyar were Tiv farmers whose response to PPR followed quite a different course. Migrating northward through the Benue Lowlands, the Tiv had arrived in the Asamu area by the 1930s (Figure 1).[8] Their homeland was known for settlement mobility – both the creeping expansion that the Bohannans likened to a steamroller (later termed 'predatory expansion') and also 'leapfrog expansion' whereby individuals or small groups moved to areas controlled by agnatic kin. However, on this northern frontier, the Tiv moved in different ways. There was little that resembled steamroller settlement; there was leapfrog migration but moves were not just to localities controlled by agnates but also cognates, affines and distantly-related patrons who offer protection from *tsav* ('witchcraft'). Indeed there was a pattern of furious mobility that was more reminiscent of corn popping than a frog leaping.

There was an unmistakable aversion to intensifying agriculture. Some intensification was unavoidable, especially by marginalised households, yet the Asamu Tiv were putting in just over one-third as many hours of work per hectare as were the Core Area Kofyar (Stone, 1997). Tivs offered a variety of explanations for their avoidance of intensification, some of which sounded ironically Boserupian: if they cut their fallows too much, their yields would drop, the fields would become choked with weeds, and there would be no time for anything else. Instead, as population density at Asamu slowly climbed (because of immigration by Tiv and other groups including Kofyar and Mwahavul), they concentrated on moving and on forcing others (especially Kofyar and Mwahavul!) to move.

Where the Kofyar had relied on pre-existing institutions for mobilising labour to facilitate intensification, the Tiv relied on a set of interlocking institutions to facilitate movement. As long as they could maintain a relatively low population density, they could keep in place an agricultural regime that was extensive enough to allow substantial amount of free time. A prime use of

free time was travel, which allowed them to collect information and maintain social networks to a degree that Kofyar rarely could. These networks greatly lowered the costs and risks of moving. (Residential moves were prompted by several factors other than a dwindling landbase, not the least of which was fear of *tsav* where they were living.)

These Tiv had basically the same crops and technology, and lived under the same conditions of ecology and market access. The tendency for one group to intensify while the other strove to avoid intensification is best explained by differences in cultural institutions. This is not meant to endow cultural institutions with simple causal primacy over adaptation – causality is clearly a two-way street – but it is to illustrate the potential importance of cultural institutional factors that are held constant in the Boserup model.

Economic Systems: Brookfield points out that agricultural decision-making is embedded in economic as well as social systems, and this points to one of the most important set of factors squared in the Boserup chicken. Boserup's scheme reduces the value of agricultural input and output to a single currency: inputs of farmer labour and outputs of edible crops are measurable in terms of energy. It is a self-contained economic system, with farmers avoiding long working hours and low returns on time worked.[9] Real farmers usually have to contend with economic factors that affect the cost of inputs and value of outputs beyond the simple energetics of the local system. Three pivotal ways in which larger economic systems can override Boserupian energetics are as follows:

- Market incentives can induce farmers to intensify in the absence of land shortage (for example Turner and Brush, 1987; Netting *et al.*, 1989). Eder's observation that farmers 'make their production decisions in terms of pesos per hour, not kilograms per hour' (1991: 246) is apt, although the reality is not so much a cash/energy dichotomy but a gradient. Few small farmers today grow none or all of their crops specifically for sale; it is almost always in between, and may include crops that are favoured because they can be used for food *or* sale. (One of the reasons Pennisetum millet is such a vital crop to the Kofyar is that it can be sold *or* eaten *or* brewed into beer for a work party.) Market involvement does not totally negate the Boserup model, as Netting argues in his analysis of smallholder farming, but it clearly introduces variables that can override the effects of local population and energetics.
- Market participation can expose the farmer to price fluctuations that introduce elements of risk not normally found in subsistence systems. Below I discuss risk as a non-Boserupian element in all agricultural systems; suffice it to say here that farm production for exchange value rather than use value almost invariably raises the farmer's risk exposure.
- Boserup models incorporate costs as a function of local agricultural ecology and available technology. The costs of an agricultural operation and the benefits of an agricultural technology are fixed, and technology is developed or adopted as the need for more operations arises. This holds constant the

possibility for subsidy of agricultural technology that is provided by the state, by local governments, by NGOs and by international aid. From African smallholders to American agribusinesses, farmers share a keen interest in subsidies, and farmers may well achieve a higher marginal return by working to attract subsidy than by spending extra time at weeding or fertilising (discussed below).

THE CAUSAL MECHANISM

I have pointed to some aspects of the economic and cultural systems within which agriculture may be embedded, factors which must be taken into account to move beyond the 'calorific obsession' of Boserup's energetics-driven theory. But what of the causal mechanism itself? If we hold constant the social and economic factors outside the Boserup model, how well can we account for agricultural variation by assuming that raising production concentration necessarily requires more work and lower efficiency, and that farmers are primarily driven to lower workload and raise efficiency?

The answer is that it works fairly well at the very general level at which it is intended. There is empirical support from cross-cultural analyses and ethnographic and historic accounts of agricultural change.[10] I have heard Kofyar describe how they have had to change their methods over the years, replacing shifting methods with more intensive ones as their frontier has filled (see Stone, 1996: 93–94). Concern for marginal returns on inputs is a common denominator in virtually all farming systems. Substituting labour for land does tend to cause a drop off in efficiency. Yet efficiency considerations can be overridden, and raising production concentration does not always correspond to a decline in efficiency.

I noted above that risk minimisation promotes different strategies from efficiency maximisation. This may be crucial, 'as almost all discussion assumes a constant environment for agricultural production . . . [t]he degree and nature of risk varies greatly from place to place, but no agricultural system is without it' (Brookfield, 1984: 38). Managing such risk can easily override the desire to optimise efficiency. A good example comes from Wilk, whose study of Kekchi Maya agriculture stressed that while optimisation theories concern average yields, 'farmers do not have the luxury . . . instead, farmers must combine techniques that have different intensity and yield to ensure an adequate supply of food each year . . . thus, even without population pressure or other pressure on land resources people may adopt some intensive techniques to cope with risk of crop failure' (1997: 103).

The importance of risk management as a factor affecting agriculture has come to be widely recognised, but the relationship between production concentration and efficiency is less settled. Boserup recognises that variation in local ecology should result in variation in the technical details of intensification, but nonetheless sees the process of intensification as cutting across environment. Brookfield was one of the first to recognise this by pointing out the thresholds of intensification that varied with local environment (1972: 44), which continues to be an important point in analyses of intensi-

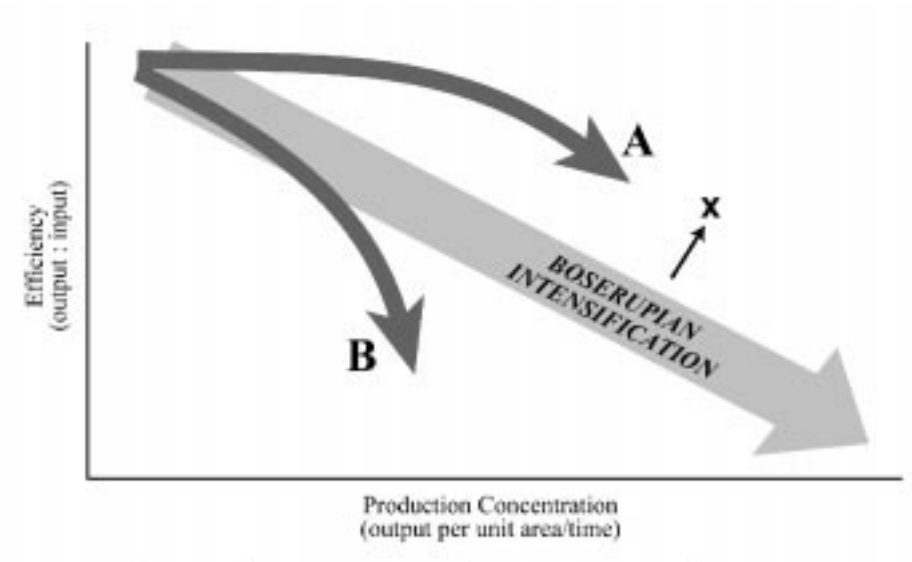

Figure 2. Different concentration/efficiency trajectories for agricultural intensification

fication (for example Turner and Ali, 1996). Geographers and anthropologists alike have continued to examine how agricultural change varies with local ecology (Turner *et al.*, 1977; Turner and Brush, 1987, *inter alia*).

Boserup's model claims universal applicability but rests on specific agroecological processes (pertaining especially to fire and fallow). These processes do not occur everywhere, or may be overridden by other local factors of ecology. The relationship between production concentration and efficiency is not constant; it is quite variable.

Figure 2 contains a simple schematic depicting different concentration/ efficiency trajectories. For each level of production concentration, envision a most efficient method of production; a line drawn through these optima is the theoretical 'intensification slope.'[11] Intensification slopes may be modelled at various scales. The large arrow represents the global slope described by Boserup, a pattern emerging from the many cases where productive concentration can be raised, but only at the expense of lowered efficiency. This is the broad pattern confirmed by the empirical studies cited above. It is specifically this trajectory that should be called 'Boserupian intensification', defined as the process of raising production concentration by accepting higher labour demands and lower efficiency. The key to Boserupian intensification is that *the labour costs of intensification are both necessary and sufficient to raise production concentration*. They are *necessary* in that higher production requires proportionately more work, and *sufficient* in that the proportionate increase in work succeeds in raising output.[12] Where these critical conditions are not met, Boserupian intensification does not occur. Where lowered efficiency is not necessary for higher production concentration, the slope would be flatter, as indicated by trajectory *A*. The other non-Boserupian pattern occurs where productive concentration cannot be raised, or where the cost of

raising it is intolerable: trajectory *B*. Such a trajectory requires nonagricultural responses to rising population pressure.

Wet rice is an increasingly convincing candidate for trajectory A (although some key questions remain, as discussed below), and this would be an enormous exception indeed. There is no question that wet rice paddy or *sawah* cultivation requires high labour inputs (for example Clark and Haswell, 1967), but the Boserupian ecology of declining yields may be overridden by the distinctive ecology of the paddy (for example podzolisation and the tendency for fertility to increase rather than decrease, as described by Bray, 1986).

Trajectory B is exemplified by Kofyar farmers on clay soils (above). Downum and I have also recently presented the case of prehistoric Wupatki as an example. This was a frontier area in northern Arizona, United States of America, that received a major population influx in the 12th century AD. Along with several hundred small habitation sites, a few conspicuously large pueblos appeared at Wupatki during the 1100s. Conditioned to automatically assume intensification to attend population increase, numerous writers had interpreted the archaeological evidence as indicating intensification at Wupatki. Yet we found almost no evidence of Boserupian intensification, and argued that intensification likely occurred only in the highly limited contexts where added work on agricultural plots could have reliably raised output. The priority of Wupatki farmers would not have been the Boserupian goal of keeping input efficiency as high as possible while intensifying, but of strengthening territorial control to allow continued *extensive* farming. The large pueblos were not accommodations to the housing needs of a growing population, but monumental emblems of ethnic polities that controlled real estate (Stone and Downum, 1999).

Of what value, then, is the Boserupian mechanism of agricultural change, if it is not universal but specific to certain ecological conditions, and if risk management can override it? In the end, it is of value because it explains a large portion of the observed variability, and then helps us to isolate these other factors in agricultural change. This is the essence of a square chicken model.

CURRENT AND FUTURE DIRECTIONS: POLITICAL ECOLOGY

Probably the most important 'beyond Boserup' research today is in the direction of 'political ecology' (although this term has picked up too many meanings already; see Vayda and Walters, 1999). Of the many issues neglected in the Boserup model, the most pressing to many contemporary scholars is the disparity in farmers' ability to intensify agriculture as they wish (for example Bray, 1986: 60). As Blaikie and Brookfield put it, the model 'may be likened to a toothpaste tube – population growth applies pressure on the tube, and somehow, in an undefined way, squeezes out agricultural innovation at the other end. However ... what appears at the other end of the tube is often not innovation but degradation' (Blaikie and Brookfield, 1987: 30). (It is perhaps a quibble, but the contrast between innovation and degradation is not necessarily valid. For instance, some of the most innovative ways of clearing forest, such as chaining, may be the most destructive.) Farmers within a set of ecological/

technological conditions may differ dramatically in their ability to adopt various forms of intensification. This key point, a signpost towards some of the most fruitful issues in future agricultural research, was once again made by Brookfield (Blaikie and Brookfield, 1987). One such issue is the effects of class-based landholding that Blaikie and Brookfield discuss. Another issue, scarcely recognised in the literature on agricultural theory, is the differential ability of farmers to capture production subsidy. This aspect of political ecology merits more extended consideration, because – as I argue below – it is likely to bear directly on the effects of the most profound innovation in agricultural technology: genetically modified crops.

My discussion of intensification slopes relaxed Boserupian assumptions, but it is built around key simplifying assumptions of its own. One of these is that the costs of agricultural changes are borne by the farmer, either directly or indirectly. If increased production requires more weeding, the farmer invests more time in weeding (or hires labour, or mobilises household or communal labour); if increased production requires ploughing, the farmer must absorb the costs of a plough, draught animals, etc. The costs and benefits in this simple model come from the ecology of agricultural production and are thus set by local conditions.

What this neglects is the possibility of external subsidy for factors of agricultural production: for example, getting fertiliser from a government programme, irrigation ditches constructed by an NGO, or new seed stocks from a development project. In the terms of Figure 2, the shape of the intensification slope is altered by new possibilities of raised production, as represented by point *X*. From the farmer's perspective, this allows raising production without Boserupian efficiency costs. But there may have been no absolute improvement in the intensification slope at all, merely a shifting of some costs to the outside.

There are two key points to be made about the pursuit of state subsidy as a facet of intensification. First is that subsidy-seeking does not co-vary with the farmers need/desire to raise production concentration. That is, we cannot say that 'under PPR or other stimulus, farmers increasingly seek state subsidy.' Subsidy seeking is more a function of the relationship between farmers and the state than farmers and the land. The intensive-farming Kofyar and more extensive-farming Tiv described show equal enthusiasm for subsidised fertiliser and land acquired through manipulation of development projects.

The second is that the ability of state subsidy to transform agriculture is tied directly to its reliability. This becomes apparent with Kofyar farmers who go to considerable pains to bring chemical fertilisers to the farm, yet maintain their herds of goats as a reliable source of fertiliser. Urea, phosphate and NPK, in 50 kg bags at government-subsidised rates, were made available after the civilian regime took office in Nigeria in 1980. The Kofyar began to try fertilisers both on the frontier and in the homeland. Headloading a 50 kg bag up the escarpment was hard work, but in the long run it was an easy way to enhance production. If the supply of subsidised fertiliser was dependable, home

farmers could eventually curtail the time spent on the goat herds. The problem was that it was not dependable; the local government's allotment of 3600 bags in 1983 dropped to 1200 in 1984, and many Kofyar found themselves unable to get fertiliser even at scalpers' prices. That is why the goat herds have stayed (Stone, 1998).

It is the use by farmers of substantial direct and indirect subsidy from outside the local production system that finally transforms agriculture into a production system for which the Boserup model is of little use, even as a square chicken. We can point out that PPR is not the only cause of intensification, that intensification is not the only result of PPR, and that intensification does not always embody the production efficiency trend that Boserup described, but we can still be building an edifice on a Boserupian foundation. The farmer, after all, is still making decisions about agricultural tools and tactics, absorbing most of the cost when efficiency drops and benefiting when production rises. But the more the farmer relies on off-farm subsidies, the more we have to calculate input costs across a large and diffuse catchment of indirect inputs.

What is the cost of a basketload of the goat-dung compost Kofyar still use on some fields? Although logistically difficult to compute, it is conceptually simple: we would add the cost of the goats, the labour in feeding the herd and maintaining the corral, and in headloading it to the field. What is the cost of the 50 kg bag of NPK, sold at a subsidised rate by a local official who expects political support in return, delivered by a truck burning subsidised gasoline, and driving on a government-built road, manufactured in a factory built with World Bank support, using a recipe developed at a state university in the US midwest?

When I discussed chemical fertiliser with Kofyar farmers, they usually asked if I could provide it for them. There was no doubt about it: they wanted to maximise input efficiency, exactly as Boserup had said. But the relative merits of the localised tactics Boserup described might be dwarfed by the efficiency of subsidies that would transfer the costs to outside the local system. As this happens, the Boserupian model of independent agricultural decision-making based on local energetics becomes increasingly irrelevant because it ignores the subsidisers that may become central components in agricultural production. Quantity, quality, and reliability of inputs increasingly becomes a function of the farmer's political relationship to subsidisers. What the farmer can and will invest under various conditions may be overshadowed by what subsidisers can and will invest, and by what each farmer is able to claim out of that investment. The American agricultural sector, which received over $24 billion in subsidy in 1999 (three years *after* a 'free-market' reform!), is an extreme example, but recent decades have brought many cases of developing world farmers boosting production through externalising input costs while accepting political dependencies. (Many would argue that this is the central legacy of the green revolution in India.)

As the world turns its attention to the possibility of a profound transformation of world agriculture through genetic engineering, these political

factors beyond the realm of Boserup (and beyond the realm of western agronomic calculations, for that matter) are crucial. It is imperative that we not envision genetically modified crops merely as fortuitous new points on an intensification slope, offering greater yield and lower pesticide bills for a small donation to the coffers of Monsanto or Novartis. Harvesting the fruits from genetics laboratories half a world away may require deep changes in the political and economic context of the farmer, and it is in this – decidedly non-Boserupian – direction that some of our most pressing research should lead.

FINAL COMMENT

In 1984, Brookfield concluded his insightful rethinking of intensification theory by noting that no final answers were available, but that we were better aiming ourselves towards 'a general theory of innovation/intensification' (1984: 39). Have we progressed towards such a theory?

If one wished, a case could probably be made that we have not. In fact, as I was revising this essay for publication, the latest attack on Boserup's 1965 book appeared in *Current Anthropology*, suggesting an alternative model which most of the commentators found to be no step forward at all (Leach, 1999). Yet even as part of the field remains stuck on the corners of the square chicken, the truth is that much of it has moved far beyond. On that article, Patrick Kirch (himself a leading contributor to the 'beyond Boserup' literature) commented that 'Boserup's important 1965 monograph occupies a rightful place in the intellectual history of economic anthropology, but surely no scholar today would hold to its unilinear scheme …' (Kirch, 1999: 328). I certainly concur. We are indeed closer to a general theory of agricultural change.

NOTES

1 However, Boserup's insistence that her model diametrically opposes Malthus is partly a matter of rhetorical spin. One of the fruitful areas of theory development has concerned Boserup-Malthus syntheses, although these are discussed only fleetingly in this essay.

2 Recent examples include Kalipeni (1994), Morrison (1996), Guyer (1997), Erickson (n.d.), and Leach (1999). See Stone and Downum (1999) for an evaluation of the major criticisms of the Boserup model.

3 Inspired no doubt by John Harte's *Consider a Spherical Cow* (Harte, 1985).

4 My fellow anthropologists show a fondness for critiquing the original model's simplifications, as if there had not been decades of subsequent analysis. Geographers seem more comfortable with the use of general models and the need for simplifying assumptions. Consider von Thünen's (1966 [1826]) renowned model of the spatial organisation of land use. In that work, the simplifying assumptions are so important as to have given the book its title *The Isolated State*, and W. B. Morgan later concluded that von Thünen's true genius lay in the use of assumptions in a 'partial equilibrium analysis' (Morgan, 1973: 301).

5 Steward's (1955) problematic concept of 'cultural core,' referring to each culture's set of principal institutions for production and protection, was a cornerstone in his cultural ecology. Although many geographers define themselves as cultural ecologists, Steward has been much more of a point of reference in anthropology. Geographers often write on the same topics without even citing Steward, and in general the work does not suffer for the

omission (for example, Jordan and Kaups, 1989). Steward himself said that his approach was more of a research *strategy* than a developed theory, and smallholders bear this out.

6 Mao's disruption of smallholder farming was actually much greater than Netting describes, and the results more devastating. It is now clear that Chinese peasants were victims of the largest known mass starvation: 30–70 million deaths during Mao's Great Leap Forward in 1958–60 (Ashton *et al.*, 1984). It was no Malthusian disaster; there had been no population surge, and Chinese peasants had a clear historic capability of feeding themselves at such densities. A better explanation of the astonishing death toll is that Mao's policies interdicted virtually all of the central features of the smallholder household, including the elimination of stored grains, disruption of household labour management, and confiscation of private property. Indeed Mao explicitly set out to nullify the household unit of production, which he regarded as a feudal form that was responsible for having 'plunged the peasants into perpetual poverty' (Becker, 1996: 51). This was in addition to replacing the fine-tuned cultivation tactics that were the hallmark of intensive agriculture.

7 In this discussion I am drawing on research by Robert Netting, and research by myself in collaboration with Netting and M. Priscilla Stone.

8 Asamu is a pseudonym for a locality in the same general area as the Kofyar Core Area.

9 Boserup herself does not actually use these terms, but this statement is nevertheless true to the thrust of her analysis.

10 Examples of empirical support include cross-cultural statistical studies (Turner *et al.*, 1977, Brown and Podolefsky, 1977); controlled comparisons (Lagemann, 1977; Netting, 1969); overviews (Gleave and White, 1969; Pingali *et al.*, 1987; Netting, 1993); collections of case studies (Turner *et al.*, 1993; Wiggins, 1995); and historical studies (Hanks, 1972; Netting, 1981; Huang, 1990; Stone, 1996).

11 Compare to Brookfield's (1984) schematic of 'Boserup Series', Lee's (1986) 'Boserup spaces', Wood's (1998) 'Malthus-Boserup rachet'. These models are designed to show the relationship among different production regimes. My schematic is designed to show broad-scale patterning in the ecology of intensification.

12 Some writers, Netting included (1993: 271), use 'intensification' for the raising of production concentration whether it lowers efficiency or not. However, Boserup is clear in describing a pattern of increased workload and increased productivity as occurring when and only when it is necessitated by rising population, and I think we must specify this process to be Boserupian intensification. It is important to be clear on the Boserupian process because a popular tactic has been to define intensification as any increase in production, and then use a case where the increase did not lower efficiency to invalidate the entire Boserup model (for example Erickson, n.d.). The model is hardly *invalid* but neither is it *universal*, even when its simplifying assumptions are met, and the real advance would be in specifying the conditions under which it does and does not apply.

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