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Use of an Indigenous Board Game, 'Bao', for Assessing Farmers' Preferences among Alternative Agricultural Technologies

INTRODUCTION

Researchers in the tropics are increasingly recognizing the farmer as a partner, not just a client or a customer, in developing new agricultural technologies. The farming systems approach in the 1980s helped researchers to focus on smallholder farmers' needs and circumstances (Byerlee and Collinson, 1980; Caldwell, 1987). In the 1990s, the participatory research paradigm has helped scientists to understand how farmers experiment on their own and to seek partnerships with them in developing technology (Chambers *et al.*, 1989).

But a major weakness of participatory research is that few practical tools exist that both scientists and farmers can use together for diagnosing problems and developing new technologies (Okali *et al.*, 1994). In fact, economists often view participatory research approaches, such as informal surveys, as inimical to quantitative data analysis. On the other hand, participatory researchers often view accepted scientific research tools, such as trial replication or questionnaire surveys, as incompatible with farmers' investigative processes. Conflicts are apparent in the way the two sides examine farmers' evaluations of technology. Participatory researchers view questionnaires that ask farmers to rate alternative technologies across selected criteria as 'top-down', Western cultural constructs that are not translatable to rural, third-world situations. In contrast, scientists view participatory approaches as subjective, lacking in detail, and, being qualitative, incapable of being subjected to tests of statistical significance. In fact, economists tend to shy away from investigating farmers' evaluations of technology altogether, preferring to calculate financial and economic returns or assess factors that influence adoption. The neglect of farmer evaluations is indeed misplaced, as knowledge of values, non-monetary as well as monetary, is a key element of agricultural economics research (Johnson, 1986).

The objective of this paper is to present a method for obtaining data on farmers' preferences that is of use and is user-friendly to both farmers and researchers. The method involves the use of 'bao', a traditional board game found throughout Africa, Indonesia and the Caribbean. The method permits the collection of quantitative data in a manner that allows the farmer to participate

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actively and benefit. First the method is described. Second, three case studies, two from Kenya and one from Burundi, are presented in which farmers use bao to evaluate technologies. Finally, bao's advantages and disadvantages for evaluating technology are compared with conventional scoring exercises using questionnaires and with a common participatory research tool, matrix ranking.

TOOLS FOR OBTAINING FARMERS' EVALUATIONS

In developed countries, tools for obtaining quantitative data on consumer evaluations are common and often involve asking respondents to score from poor to excellent, or 1 to 10, across selected criteria. A few examples exist in the literature of researchers in the tropics using such methods to ask farmers to rate or rank technologies (Franzel, 1983; Negassa *et al.*, 1991; Polson and Spencer, 1991). Even though they generate quantitative data, these methods are generally unsatisfactory, for three reasons. First, asking farmers to rate alternatives on a 1 to x basis (1 being a poor grade and x being an excellent grade) was generally problematic, because such verbal scoring exercises were not easily understood by farmers. Second, where terms such as 'excellent', 'good', 'fair' and 'poor' were substituted for numerical scores, farmers were better able to understand the scoring process. However, there were often considerable problems translating such terms into other languages and the data obtained could only be considered as ordinal, rather than interval, data (Clark and Schkade, 1974). Third, because the farmers' involvement was passive, that is, they merely answered questions, they quickly became bored with the process.

Participatory researchers, on the other hand, use visual, rather than verbal or written, tools for obtaining farmers' evaluation. These methods are more suited to farmers' conditions. For example, in matrix ranking, farmers draw a matrix on the ground and place alternative technologies (for example, crop varieties) along the left-hand side of each row, and symbols to denote criteria (for example, taste or drought resistance) across the top of each column. Farmers then rank the technologies on each criterion, using one stone to designate first place, two for second place, and so on (Ashby, 1990). Farmers control the ranking process and, along with researchers, observe the results of their ratings. In a review of 15 articles on preference ranking, Maxwell and Bart (1995) found three examples in which researchers used the tool to score rather than rank alternatives. However, none of the articles tabulated data from a sample of farmers and used statistical methods to describe the results. In fact, participatory research emphasizes working with groups of farmers and achieving consensus rather than collecting data from individual farmers.

THE BAO GAME

Bao players move seeds among carved-out pockets of the board, which are laid out in a matrix. The numbers of rows and columns vary, depending on the area. To use the game in evaluating different technological alternatives, such as tree species or crop varieties, researchers and farmers first need to find out the criteria farmers use in assessing alternatives. This is best done by touring the farm, viewing the different alternatives in question (for example, tree species) and discussing their performance, uses, advantages and disadvantages. During the discussions, researchers note the different criteria that farmers use in evaluating and comparing the species. For example, farmers may compare tree properties in relation to different end uses (straightness for timber or heat production for fuelwood) or different growth characteristics (speed of growth, compatibility with crops, or resistance to pests). Next, researchers and farmers find a comfortable place and, in the case of trees, put a twig of each important tree species next to each row of the game. Then, for each criterion the farmer mentioned during the tour, he or she rates each species from one seed to a pocket (performing poorly) to five seeds (performing well). Farmers are asked to add further criteria if they wish and researchers may also suggest criteria. The exercise often ends with farmers being asked to give overall scores for the species, taking into account all of the criteria. Scores are preferable to ranks because they provide interval data, whereas ranks give only ordinal data. Since 1992, ICRAF staff and partners have used the bao game to assess farmers' preferences among tree species in 13 exercises in six countries. Franzel (2000) provides detailed guidelines on how the game is used to obtain evaluations.

CASE STUDIES OF THE BAO GAME

In the three case studies presented here, farmers used the bao game to score alternative tree species and benefits obtained from using a new practice. In the first example, a sample of 25 farmers in central Burundi who expressed interest in trees at farmer meetings used the bao game to evaluate the different tree species on their farms (Franzel *et al.*, 1995). The objective of the exercise was to involve farmers in species selection; by finding out the criteria they used in evaluating trees and how trees they knew performed on the criteria, researchers could identify trees for testing that could meet farmers' needs and circumstances. In the second case study, 37 members of farmers' groups in western Kenya who were testing newly introduced tree species in an on-farm experiment used the bao game to score the species across criteria important to them (Franzel *et al.*, 1999). The objective was to find out which of the trees in the trial they wished to plant, and their reasons. In the third study, 67 farmers planting improved tree fallows (the planting of fast-growing trees and shrubs on fallow land to improve soil fertility) in western Kenya were asked to score the different types of benefits they obtained from the practice (Pisanelli *et al.*, 2000). The percentage of female farmers was 32 per cent in the Burundi sample, 51 per cent in the sample of farmers in western Kenya testing new trees, and 74 per cent for the improved fallow users.

In the Burundi case study, farmers rated eight wood-producing trees across seven criteria focusing on management, growth and uses for timber and firewood (Table 1). Overall, there were intriguing discrepancies between farmers' ratings and the prevalence of different tree species on farms. *Eucalyptus* and

TABLE 1 *Farmers' mean ratings, using the bao game, of selected tree species that grow on their farms, central Burundi*

	Management & growth			Use for timber		Use for firewood	
Species	Compatibility with crops	Speed of growth	Resistance to insects	Wood appearance	Straightness	Quick in drying	Durability of fire
Maesopsis eminii	3.8 (0.5)	4.7 (0.4)	4.2 (1.0)	4.8 (0.4)	4.2 (0.6)	3.1 (0.8)	3.5 (0.9)
Cedrela serrata	4.6 (0.5)	4.3 (0.7)	4.5 (0.8)	5.0 (0)	5.0 (0)	—	—
Grevillea robusta	4.9 (0.3)	4.6 (0.5)	2.5 (0.7)	2.6 (0.9)	4.1 (0.8)	3.2 (1.0)	2.8 (1.2)
Casuarina cunning hamiana	1.0 (0.0)	2.2 (0.8)	4.2 (1.0)	4.1 (1.1)	3.9 (0.9)	3.0 (0.6)	3.8 (0.7)
Markhamia lutea	3.7 (1.0)	1.9 (0.9)	4.5 (0.8)	4.3 (0.6)	1.8 (0.8)	2.3 (1.1)	4.2 (0.7)
Eucalyptus spp.	1.1 (0.3)	4.3 (0.8)	4.0 (1.2)	2.5 (0.5)	3.6 (1.0)	4.7 (0.5)	5.0 (0.0)
Cupressus lusitanica	1.0 (0.0)	3.2 (0.8)	4.5 (0.8)	4.6 (0.5)	3.9 (0.8)	4.6 (0.5)	3.5 (1.0)
Albizia chinensis	4.0 (1.2)	3.5 (1.3)	1.3 (0.7)	—	1.3 (0.4)	2.3 (0.8)	3.3 (0.7)

Notes: Twenty-five persons were interviewed; the number rating a specific species on a particular criterion varies from five to 20. The rating of 1 to 5 refers to the score in number of seeds the farmers gave to a species on a particular criteria. A rating of 5 was considered excellent, a rating of 1, poor (mean rating and standard deviation in parentheses). For some species certain criteria are irrelevant; for example, *C. serrata* is never used for firewood and *A. chinesis* is never used for timber.

Source: Franzel *et al*. (1995).

Grevillea robusta were the most common species found on farms and they were highly rated by farmers: *eucalyptus* for fast growth and firewood and *grevillea* for fast growth and compatibility with crops. But two other species, *Maesopsis eminii* and *Cedrela serrata*, were also highly rated but were not commonly grown. They were relatively new in the area and lack of information and planting material were the biggest constraints to their adoption. On-farm trials testing these species will help confirm their usefulness to farmers and should promote their diffusion.

The game was also useful in revealing other criteria that farmers use for rating trees. For example, males and females appeared to have similar interests in the various species, with one important exception. Women rated *Markhamia lutea* much more highly than men, because they use its leaves for preparing a medicine to treat diarrhoea in children.

In the case of new tree species in western Kenya, farmers rated five trees across six criteria including growth characteristics and use for fodder and firewood (Table 2). Standard deviations were highest for farmers' ratings in relation to compatibility with crops, reflecting farmers' uncertainty about how trees performed. Farmers were also asked to use the game to indicate which trees in the experiment they wished to plant on their farms. The influence of selected farm and household characteristics on farmers' ratings of their interest in planting different species was assessed using a linear logistic model for ordered category response data (Collett, 1991). The variables considered included wealth level, farm size, off-farm income, ethnic group, age, gender, district and livestock ownership. Only 'district' emerged as a significant variable, reflecting differences in biophysical circumstances, such as soil type, which affected tree growth. The small number of farmers who could be monitored in this experiment, 37, limited the degree to which factors affecting adoption potential could be rigorously examined.

As in the Burundi case, researchers learned about new criteria that farmers used in evaluating species. *Casuarina junghuhniana* was introduced into the trial as a wood species but grew poorly. Nevertheless, farmers rated it second on preference for planting because they appreciated it as an ornamental.

In the third case study, farmers' scores reflecting the importance of benefits that they obtained from improved fallows in western Kenya indicated that improved soils and crop yields were the most important. Improved soils and crop yields received mean ratings of 4.5 (SD = 0.78) and 4.4 (SD = 0.82) out of 5, respectively (Table 3). Fuelwood received a mean rating of 3.9 (SD = 1.19) and reduced weeds (mainly *Striga hermonthica*), 3.6 (SD = 1.26). These benefits were each mentioned by over 90 per cent of the farmers; other benefits, mentioned by fewer than half, included seed production and pest reduction. Females rated improved fallows significantly higher than males on improving soils ($p = 0.04$) and on reducing weeds ($p = 0.06$). Women's higher scores reflect the finding of Ohlsson *et al.* (1998) that women spend much more time in cropping activities than men and are thus more able to ascertain and appreciate the effects of improved fallows on soils and weeds. The higher standard deviations of men's estimates suggest that they have less knowledge about the fallows and are more uncertain about their performance.

TABLE 2 *Farmers' mean ratings of species in an on-farm trial using the 'bao' game, 30 months after planting, western Kenya*

Species	Growth	Biomass production	Compatibility with crops	Fodder	Firewood	% farmers preferring for future planting
Grevillea robusta	4.4 (0.9)	—	4.0 (1.3)	—	4.1 (1.0)	73
Casuarina junghuhniana	3.2 (1.1)	—	4.5 (0.7)	—	—	46
Leucaena leucocephala	—	3.4 (0.8)	3.8 (1.8)	4.0 (1.4)	3.8 (1.0)	29
Leucaena diversifolia	—	3.7 (0.9)	3.6 (1.6)	3.4 (1.5)	3.8 (0.7)	24
Calliandra calothyrsus	—	4.9 (0.2)	3.3 (1.8)	4.1 (1.3)	4.1 (1.1)	41
Eucalyptus spp.	4.3 (1.0)	—	1.4 (0.9)	—	3.6 (1.2)	27

Notes: Data from 37 farmers. The rating of 1 to 5 refers to the score in number of seeds the farmers gave to a tree on a particular criterion. A rating of 5 was excellent, a rating of 1, poor (mean rating and standard deviation in parenthesis).

TABLE 3 *Farmers' mean scores on the importance of different benefits of improved fallows using the bao game, western Kenya*

Benefit	Overall score: No. of Farmers	Overall score: Mean score	Males: No. of farmers	Males: Mean score	Females: No. of farmers	Females: Mean score	Difference in means (females–males)	Standard error of the differences	Significance of difference (*p*-value)	95% confidence interval for the difference
Improved crop yields	63	4.4 (0.82)	16	4.2 (0.98)	45	4.5 (0.73)	0.3	0.23	0.169	(–0.14; 0.78)
Improved soils	63	4.5 (0.78)	17	4.1 (0.99)	45	4.6 (0.66)	0.5	0.22	0.037	(0.02; 0.90)
Reduced weeds	62	3.6 (1.26)	16	3.1 (1.29)	44	3.7 (1.20)	0.7	0.36	0.059	(–0.03; 1.14)
Fuelwood production	67	3.9 (1.19)	17	3.6 (1.23)	48	3.9 (1.18)	0.3	0.34	0.333	(–0.35; 1.01)
Seed production	31	3.7 (1.05)	13	4.0 (0.86)	17	3.4 (1.12)	–0.5	0.37	0.183	(–1.27; 0.25)
Pest reduction	10	3.3 (1.25)	4	3.8 (1.50)	6	3.0 (1.10)	–0.7	0.82	0.384	(–2.64; 1.14)

Notes: Sixty-seven farmers were involved in the evaluation. 'No. of farmers' refers to numbers mentioning a particular benefit. Numbers of males and females do not sum to totals because, in some cases, males and females preferred to score benefits together. Standard deviations in parentheses.

CONCLUSIONS

The bao game combines the strengths of conventional tools for scoring, such as questionnaires, with those of participatory research techniques, such as matrix ranking. Like questionnaires in consumer evaluations, the bao game is useful for generating quantitative data useful for testing hypotheses and statistical analysis. At the same time, bao is a participatory tool that the farmer finds engaging. Moreover, because farmers control the scoring process, they take the exercise more seriously than in responding to questionnaires. Finally, because the bao game is a visual tool, respondents can check their data and members of a group can discuss differences in scores among themselves. Obtaining farmers' evaluations of agricultural technology is a neglected subject among agricultural economists in developing countries. The bao game can be used for conducting such evaluations in an accurate, entertaining, yet statistically rigorous manner.

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