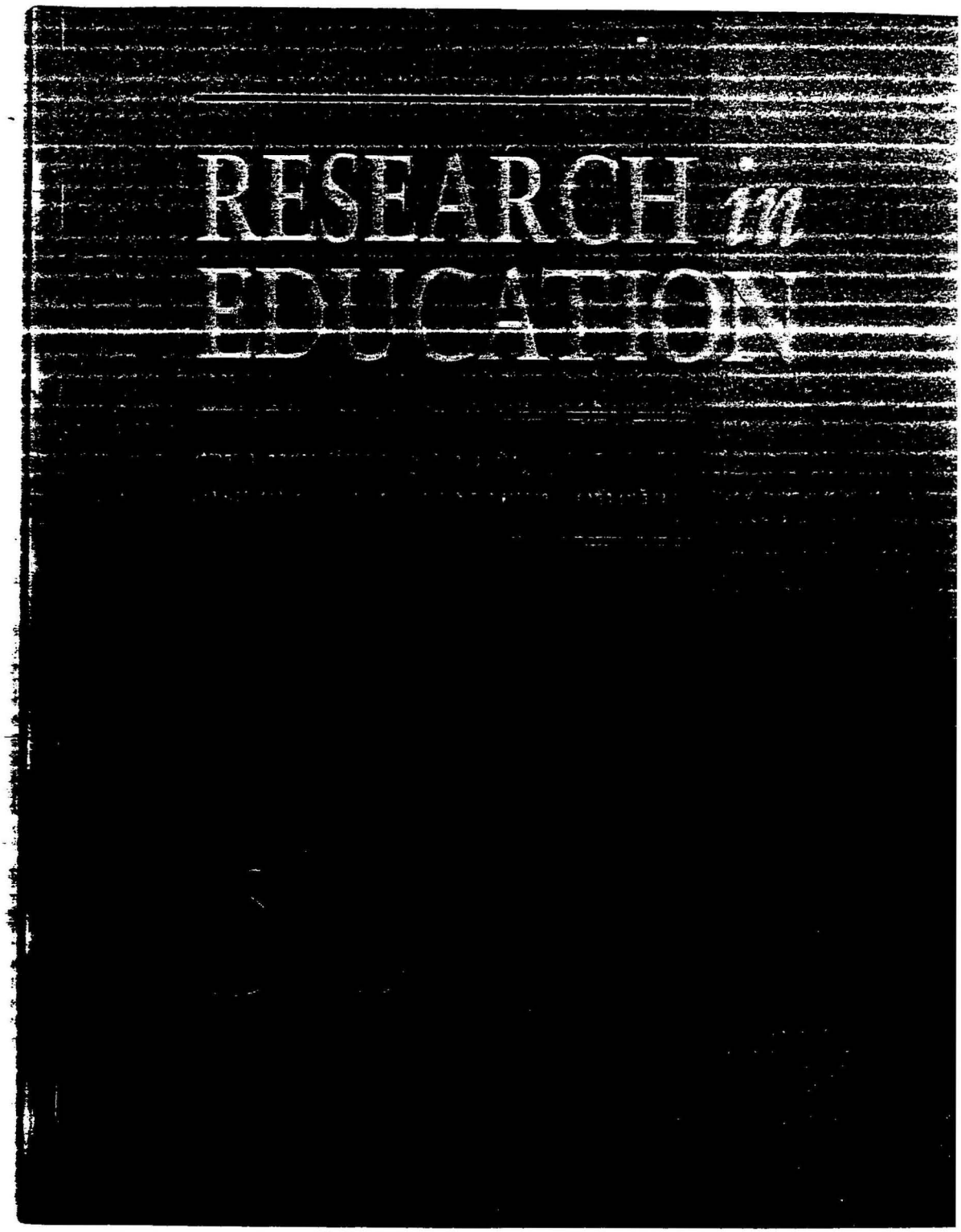

1997

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Gender difference in the arithmetical knowledge of children in Bangladesh

Like other social, cultural, economic and educational activities gender differentiation in mathematics is well established. As mathematics is vital to employment, and is also one of the fundamentals of science, everyone should have the same opportunity to learn and achieve in mathematics. Different studies have shown that, on average, girls do not score as high as boys do in mathematics tests (Robinson *et al.*, 1996; Hedges and Nowell, 1995; Leder, 1990; Hyde *et al.*, 1990; Bailey, 1988). The gender gap becomes wider as the age of pupils increases (Beller and Gafni, 1996; Mulles *et al.*, 1993). Females are also underrepresented in advanced mathematics courses and college majors and in careers that involve mathematics (Armstrong, 1985; Keeves, 1973). To explore the reasons for gender imbalance in mathematics education, different factors have been identified by different studies conducted in different areas of the world. Attitude to mathematics, sex-stereotyped curriculum, socio-cultural factors, family background and educational experience, classroom organisation, etc., are some of those factors (Fox, 1980; Sherman, 1979; Hewitt, 1979). On the other hand, the widespread nature of the imbalance has led some investigators to suggest that it is the result of innate differences in ability between the sexes (Witkin, 1973; Buffery and Gray, 1972).

Bangladesh is a developing country with a high level of illiteracy. About a quarter of its school-age children are still out of school (Nath, forthcoming). Of those who enrol, nearly a quarter leave their school during first grade, about 60 per cent never reach the fourth grade and 88 per cent leave school at the end of fifth grade (Bangladesh Bureau of Statistics, 1994). As a percentage of males the current enrolment rate of females is 86 per cent in the primary stage, 46 per cent in the secondary stage and 19 per cent in the tertiary stage (UNDP, 1994). Percentages of female enrolment are even lower in the rural areas, where women lag far behind men in all aspects of opportunity and achievement. About 85 per cent of rural women are functionally illiterate (UNESCO, 1989).

Children in Bangladesh usually start their mathematics learning through arithmetic. Mathematics is a compulsory subject for all pupils up to the age of 16. The results of public examinations show that girls do not perform as well as boys in mathematics. Mathematics is also feared by most of the members of the learner community. This is for those who enrol in schools. But for those who don't, life experience is their main foundation of arithmetical as well as mathematical concepts. Educational research in Bangladesh is very poor, and until now no study has been undertaken to explore the reasons behind the gender gap in mathematics education.

In early 1992, for the first time, a survey was conducted in Bangladesh to assess the basic education level of children aged 11–12 years. Reading, writing, numeracy and life skills were considered in measuring basic education (Chowdhury *et al.*, 1992). The study was repeated in early 1993 with minor modifications (Nath *et al.*, 1993). Both the surveys assessed children irrespective of whether they had been to school or not. Using data generated in the 1993 survey, this article attempts to explore gender differences in the arithmetical knowledge of Bangladeshi children. The article also identifies some socio-economic factors that influence such variation.

METHOD

Sampling

The focus of the study was children aged 11–12 years. The reason behind choosing this age group was that the official primary school age is 6–10 years in Bangladesh, and it was decided to assess children after the age of compulsory primary schooling. Children were selected from all over the country. Six different groups of children were surveyed, five in rural administrative divisions and one in urban Bangladesh. Each group comprised 420 children (irrespective of sex) selected from thirty random clusters, fourteen children from each cluster. A three-stage sampling strategy was used (Cochran, 1963). In the first stage, applying probability proportional to sizes with a systematic sampling technique, thirty *thanas*[1] (or *pourashavas*, municipalities, in urban areas) were selected. In the second stage, one union[2] (or ward in urban areas) was selected at random from each selected *thana*. In the third stage, one village[3] (or *para*/*mahallah* in urban areas) was selected at random from each selected union/ward. This means that, for each stratum, thirty villages/*paras* were selected, totalling 180 (30 × 6) for the whole of Bangladesh. Thus the total sample for this study was 2,520 (180 × 14).

Test instrument

The assessment instrument covered six topics containing thirteen question items. The following are brief descriptions of several topics of the assessment instrument.

1. *Counting.* The children were asked to count aloud all numbers between 40 and 50 inclusive.

2. *Reading numbers.* Three numbers with different and varying number of digits were shown the children for reading out loud. The numbers were 3, 49 and 500.

3. *Writing numbers.* Three numbers with different and varying numbers of digits were dictated to the children to write. The numbers were 5, 67 and 208.

4. *Addition.* A solution to the following addition was required:

$$\begin{array}{r} 5 \\ +53 \\ +20 \\ \hline \\ \hline \end{array}$$

5. *Subtraction.* A solution to the following subtraction was required:

$$\begin{array}{r} 70 \\ -43 \\ \hline \\ \hline \end{array}$$

6. *Mental arithmetic.* Children were given four different mental arithmetic problems needing skill in addition, subtraction, multiplication and division. The following were the problems.

i. Suppose you have to spend Tk 15 on fish, Tk 5 on potatoes and Tk 2 on green chillies in a local market. How much have you spent in total?
ii. You had Tk 30 in your pocket. You buy paper, pencil, etc., for Tk 5. How much will you have in your pocket now?
iii. If one pen costs Tk 3, how much will four cost?
iv. If you divide Tk 40 among four people, how much will each person get?

It should be noted that topics 3–5 were pencil-and-paper-based and others were oral. The interviews took place either inside the child's own house or in the courtyard. The nucleus of information collection was a team of two interviewers. There were thirty-six such teams of interviewers in the survey. Each of the question items was assessed as to whether the answer was correct or incorrect. No response and 'Don't know' were treated as incorrect. Socio-economic background information was collected from parents or guardians.

The quality of the data was checked by the test–retest method (Gupta and Kapoor, 1984). For this, 5 per cent of the sample was selected randomly and reinterviewed within a week of the test. The reliability coefficient was 0·96, i.e., the data were 96 per cent reliable (Nath *et al.*, 1993). Both internal and external tests confirmed that the instrument was valid (Chowdhury *et al.*, 1994).

RESULTS

General characteristics of the respondents

Of the children interviewed, 50·6 per cent were girls and 49·4 per cent were boys. On average, 76·7 per cent of the children were currently enrolled at the time of the survey, 9·5 per cent had dropped out of school and 13·8 per cent had never been to school at any time. The current enrolment rate and mean years of schooling were higher for boys than for girls. On the other hand, the drop-out rate and the proportion of never enrolled in school were higher for girls than for boys. Nearly 64 per cent of the children's mothers and 43·2 per cent of the children's fathers had had no formal education. Nearly half the children's households' economic status was reported by parents as 'always in deficit' or 'sometimes in deficit'. However, no statistically significant gender difference was observed in the socio-economic status of the respondents.

Arithmetical knowledge

Data analysis started with the percentage distribution of children who had correctly answered each of the items. Table 1 presents this distribution by area of residence

Table 1 Percentage of children who correctly answered different items in arithmetic assessment by area of residence and sex

	Rural			*Urban*		
Item	*Boys*	*Girls*	*Both*	*Boys*	*Girls*	*Both*
Count number	90·8	78·3	84·5	97·5	88·6	92·9
Reading number						
3	85·8	81·6	83·7	96·5	90·9	93·6*
49	64·6	50·4	57·4	85·1	71·2	77·9
500	69·4	56·8	63·1	89·1	76·3	82·4
Writing number						
5	81·6	75·1	78·3	94·0	88·6	91·2*
67	56·4	43·8	50·1	81·1	66·7	73·6
208	52·1	39·6	45·8	75·6	63·6	69·5
Addition	65·2	56·2	60·7	85·1	72·6	78·6
Subtraction	39·5	24·5	32·0	62·2	50·2	56·0*
Mental arithmetic						
Addition	90·8	83·1	87·0	97·5	90·5	94·0
Subtraction	87·7	72·7	80·2	95·0	87·7	91·2
Multiplication	87·6	76·7	82·1	95·5	88·1	91·7
Division	87·7	76·8	82·2	95·0	85·8	90·2

Note Gender difference in all the items is significant at $p < 0·001$, except the asterisked cases of urban areas. Asterisked cases are significant at $p < 0·05$. Urban *v.* rural differences are significant at $p < 0·001$ in all cases.

and the sex of the children. The table shows that the urban children did significantly better than the rural children on all the thirteen items ($p < 0{\cdot}001$). On average, on seven items more than 90 per cent of the urban children answered correctly, whereas on none of the items did the rural children surpass the urban children. Gender differences were statistically significant in all the items for both rural and urban children, which indicates that irrespective of residence girls lagged far behind the boys. Both boys and girls did better in the oral part of the test than in the pencil-and-paper part. Irrespective of residence, children of both sexes did worse in subtraction. Only 56 per cent of the urban (62·2 per cent of the boys and 50·2 per cent of the girls) and 32 per cent of the rural (39·5 per cent of the boys and 24·5 per cent of the girls) children correctly answered the subtraction.

Only 28·7 per cent of the interviewed children (36·1 per cent among the boys and only 21·5 per cent among the girls) could correctly answer all the thirteen items (Table 2). Two per cent of the boys and 4 per cent of the girls failed to answer at least one of the items correctly. About half the girls correctly answered nine or fewer items, whereas the figure was only 35·1 per cent among the boys.

Tables 3–7 present means and standard deviations of the number of items correctly answered by boys and girls according to some of their socio-economic characteristics. On average, boys answered significantly ($p < 0{\cdot}001$) more items correctly than girls (9·9 *v.* 8·5 items). The mean number of correctly answered items was

Table 2 Percentage of children by number of items correctly answered and sex

	Boys		*Girls*		*Both*	
No. of items	*%*	*Cumulative %*	*%*	*Cumulative %*	*%*	*Cumulative %*
0	2·0	2·0	4·0	4·0	3·0	3·0
1–4	8·0	10·0	17·3	21·3	12·7	15·7
5–9	25·1	35·1	27·9	49·2	26·5	42·2
10–12	28·8	63·9	29·3	78·5	29·0	71·2
13	36·1	100·0	21·5	100·0	28·7	100·0

Table 3 Mean number of correct items and standard deviation by area of residence and sex

Area of Residence	*Boys*		*Girls*		*Level of significance*
	Mean	*S.d.*	*Mean*	*S.d.*	
Rural	9·6	3·7	8·2	4·1	$p < 0{\cdot}001$
Urban	11·5	2·6	10·2	3·6	$p < 0{\cdot}001$
All	9·9	3·6	8·5	4·1	$p < 0{\cdot}001$

highest for urban boys and lowest for rural girls (Table 3). In both the areas gender differences were found to be highly significant ($p < 0{\cdot}001$).

It can be seen that, as the years of schooling of the children increased, the mean number of items correctly answered also increased (Table 4). But in each specific grade girls lagged far behind their male counterparts. It was also observed that as parental education level increased the mean number of items correctly answered also increased. However, gender differences in the arithmetical knowledge of the interviewed children became narrower with the increase of mothers' education as compared with fathers' education (Tables 5–6). Comparing Tables 5–6, it can be said that, if both parents had had a similar education, the mother's education made a greater contribution to the arithmetical knowledge of the children.

The economic status of the household also played a positive role in increasing the arithmetical knowledge of the children but gender differences were shown to be equally prominent ($p < 0{\cdot}001$) among the children in each of the four economic categories of household (Table 7).

Table 4 Mean number of correct items and standard deviation by years of schooling and sex

Years of schooling	*Boys*		*Girls*		*Level of significance*
	Mean	*S.d.*	*Mean*	*S.d.*	
Nil	4·3	2·4	3·1	2·2	$p < 0{\cdot}001$
One	6·4	3·3	4·8	2·9	$p < 0{\cdot}001$
Two	8·0	3·2	6·2	3·3	$p < 0{\cdot}001$
Three	9·8	2·6	8·4	3·4	$p < 0{\cdot}001$
Four	11·1	2·2	10·0	2·8	$p < 0{\cdot}001$
Five	12·0	1·6	11·0	2·3	$p < 0{\cdot}001$
Six or more	12·7	1·0	12·2	1·2	$p < 0{\cdot}001$

Table 5 Mean number of correct items and standard deviation by mother's education and sex

Mother's education (years)	*Boys*		*Girls*		*Level of significance*
	Mean	*S.d.*	*Mean*	*S.d.*	
Nil	8·7	3·8	7·1	4·1	$p < 0{\cdot}001$
1–5	10·9	2·8	10·1	3·4	$p < 0{\cdot}001$
6–9	12·2	1·8	11·5	2·2	$p < 0{\cdot}010$
10+	12·9	0·2	12·8	0·5	n.s.

Note *n.s.* not significant at $p=0{\cdot}10$.

Table 6 Mean number of correct items and standard deviation by father's education and sex

Father's education (years)	*Boys*		*Girls*		*Level of significance*
	Mean	*S.d.*	*Mean*	*S.d.*	
Nil	8·3	3·9	6·5	4·0	$p < 0·001$
1–5	9·9	3·2	8·7	4·0	$p < 0·001$
6–9	11·5	2·5	10·0	3·3	$p < 0·001$
10+	12·2	1·6	11·5	2·3	$p < 0·001$

Table 7 Mean number of correct items and standard deviation by economic status of household and sex

Economic status of household	*Boys*		*Girls*		*Level of significance*
	Mean	*S.d.*	*Mean*	*S.d.*	
Always in deficit	7·4	4·0	6·2	3·9	$p < 0·001$
Occasionally in deficit	9·1	3·7	7·7	4·0	$p < 0·001$
In balance	10·7	3·0	9·2	3·9	$p < 0·001$
In surplus	11·9	2·0	10·6	3·3	$p < 0·001$

Regression analysis

Linear regression analysis was performed to explore the relative influence of socio-economic factors in explaining the arithmetical knowledge of the children. To help understand the factors responsible for gender differentiation, three multiple regression models were done for boys, girls and all children respectively. In all three models the number of items correctly answered by the children was regarded as the dependent variable. The explanatory variables were the child's sex, the child's years of schooling, the mother's education (in years), the father's education (in years) and the economic status of the household (Table 8).

The results of regression analysis show that the child's years of schooling and the economic status of the household both had a significant positive influence in explaining the arithmetical knowledge of boys and girls alike. The results also revealed that the education of both parents played a positive role in explaining the arithmetical knowledge of their children. But, interestingly, fathers' education was found to be more predictive of boys' scores as compared with mothers' education. On the other hand, in explaining girls' scores mothers' education played a greater role than fathers' education. The model where all the children (both boys and girls) were considered shows that after adjusting for children's years of schooling, parental education and the economic status of the household, boys performed significantly better than girls

Table 8 Results from regression analysis, taking into consideration the number of items correctly answered by children as dependent variable

	Boys		*Girls*		*All children*	
Explanatory variable	*Reg. coeff.*	*Sig. level*	*Reg. coeff.*	*Sig. level*	*Reg. coeff.*	*Sig. level*
Sex of children	*a*		*a*		1·13	0·000
Years of schooling	1·24	0·000	1·40	0·000	1·32	0·000
Mother's education	0·04	0·239	0·14	0·000	0·09	0·001
Father's education	0·05	0·022	0·04	0·052	0·05	0·004
Economic status	0·37	0·000	0·17	0·035	0·27	0·000
Constant	4·27	0·000	2·96	0·000	3·04	0·000
Adjusted R^2	0·62		0·63		0·63	
F value	498·31	0·000	542·39	0·000	869·64	0·000

Notes Explanatory variables: sex of children (1 girls, 2 boys); years of schooling (one grade, two grades, three grades, . . . six or more grades); mother's education (one grade, two grades, three grades, . . . six or more grades); father's education (one grade, two grades, three grades, . . . twelve or more grades); economic status (1 always in deficit, 2 occasionally in deficit, 3 in balance, 4 in surplus). *a* This variable was not considered.

($p < 0·001$). The regression coefficients indicate that years of schooling of the children was the most influential factor in increasing the arithmetical knowledge of boys and girls alike.

DISCUSSION

In this article an attempt has been made to explore the gender differentiation in arithmetical achievement of the children of Bangladesh. The focus was on children aged 11–12 years, irrespective of whether they have been enrolled in school or not. This allows the findings to give an overall picture of the Bangladesh community. In Bangladesh girls are discriminated against from birth. The socio-cultural situation is always in favour of boys. This is reflected in the school enrolment of the children (Nath, forthcoming; Bangladesh Bureau of Statistics, 1994). More boys than girls are enrolled in schools, and girls drop out earlier than boys (UNDP, 1994). Most of the girls engage in household activities to help their mothers and to look after their younger siblings. Girls are always given less time to concentrate on education. This is reflected in their overall educational performance. Arithmetical knowledge is not out of step in this critical condition.

The results of the study show that girls lagged much behind the boys on all the items of the assessment instrument. Urban children did far better than rural children. Urban boys showed the best performance and rural girls the worst. This urban domination in achievement can be explained by the infrastructure and quality of education. Schools in rural areas need to be given more attention in this regard. Only 28·7 per

cent of the children could answer all the question items correctly, and on average the interviewed children answered only nine items correctly. These figures indicate that the overall performance of the children in arithmetic education was not satisfactory. Although the assessment instrument was of a very basic type, 4 per cent of the girls and 2 per cent of the boys failed to answer even one of the items correctly. This situation is frustrating, and clearly these children aged 11–12 years did not derive any knowledge of arithmetic, even from their social life.

The findings of the study suggest that length of schooling was the most important factor in achieving arithmetical knowledge among both boys and girls. This again confirms that there is no alternative to schooling (Mohsin *et al.*, 1996). However, the regression coefficients against years of schooling indicate that this factor had a greater impact on girls' achievement than on boys'. Parental education was also shown to be important in this respect. The mother's education was found to be more effective for girls' achievement and the father's education for boys', but, overall, mothers' education was found more influential in increasing the arithmetical knowledge of their children. One possible explanation of the relationship between parents' education and their children's achievement in arithmetic can be that girls are generally closer to their mother and that patriarchal domination favours boys. Increasing mothers' education leads to a reduction in gender imbalance, which suggests the necessity of educating girls up to a sufficient level. The economic status of the household was also more favourable to boys than to girls. The reason behind this may be found by analysing the control of wealth and decision-making power in the household. Unfortunately, both are still in the hands of the male member of the household, i.e. the father of the children.

In conclusion it can be said that children in Bangladesh have a long way to go with their arithmetic. To increase the arithmetical knowledge of the country's children, Bangladesh needs to pay more attention to its education system. There is also scope for strengthening the quality of arithmetic education. To reduce gender discrimination in knowledge of arithmetic, girls' schooling should be ensured up to a sufficient level. Parents' and teachers' attitudes to mathematics, classroom behaviour, the mathematics curriculum, etc., need to be examined. More research into mathematics education may also help in this regard.

NOTES

1. *Thana:* a government administrative unit with an average population of 260,000.
2. Union/ward: a local government unit with an average population of 22,000.
3. Village: the smallest component of the local government unit, with an average household of 200 and population of 1,000.

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ACKNOWLEDGEMENTS

Funding for the research leading to this article was provided by UNICEF, Dhaka. The Research and Evaluation Division of Bangladesh Rural Advancement Committee provided logistical support in the research. The authors are grateful to both organisations. Our thanks to those experts who worked hard in developing the assessment instrument. Thanks are also due to research assistants. We are also grateful to Kathy Sylva of the University of Oxford and anonymous referees for their comments on a draft of this article.

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