USAID
FROM THE AMERICAN PEOPLE

DEVELOPING & TESTING POVERTY ASSESSMENT TOOLS

RESULTS FROM ACCURACY TESTS IN BANGLADESH

NOVEMBER 2005

This publication was produced for review by the United States Agency for International Development.
It was prepared by the IRIS Center, at the University of Maryland.

DEVELOPING & TESTING POVERTY ASSESSMENT TOOLS

RESULTS FROM ACCURACY TESTS IN BANGLADESH

SUBMITTED BY

The IRIS Center, University Research Corporation International

SUBMITTED TO

Scott Kleinberg

CONTRACT NUMBER

GEG-I-02-02-00029-00
Task Order No. 2: Developing Poverty Assessment Tools

AUTHORS

At the time this report was prepared, Manfred Zeller, Ph.D., was a professor for Socioeconomics of Rural Development at the Georg-August University of Göttingen's Institute of Rural Development in Germany (*www.uni-goettingen.de*). Since October 2005, he is Professor for Rural Development Theory and Policy at the University of Hohenheim, Germany (*www.uni-hohenheim.de*).

Gabriela Alcaraz V. and Julia Johannsen are Ph.D. candidates at the Institute of Rural Development, Georg-August University of Göttingen, Germany.

SERIES INFORMATION

This series presents a number of technical reports about USAID's program to develop Poverty Assessment Tools, implemented by the IRIS Center at the University of Maryland. These reports are made available to microenterprise practitioners, donor agency representatives, researchers and various stakeholders interested in the development of accurate and user-friendly tools to assess the poverty level of poor microenterprise clients in developing and transition economies.

CONTACT INFORMATION

IRIS Center
University of Maryland
Department of Economics
2105 Morrill Hall
College Park, MD 20742
USA

E-mail: info@iris.econ.umd.edu
Phone: +1.301.405.3110
Fax: +1.301.405.3020
Web: www.iris.umd.edu

ABSTRACT

This report presents the results of poverty assessment tool accuracy tests conducted by the IRIS Center, based on primary field research in Bangladesh in 2004. The report first describes the design of the field research and the computation of the applicable poverty line, followed by an overview of the selected analytical methods. A number of increasingly complex econometric methods are used to increase the accuracy of the poverty estimation. Then, the accuracy of Participatory Wealth Ranking as a poverty assessment tool is analyzed. The report presents a range of poverty assessment tools that differ with respect to their degree of accuracy and ease of implementation.

For more information on the project, please visit *www.povertytools.org.*

For more information on AMAP and related publications, please visit *www.microLINKS.org*.

For more information about the IRIS Center, visit *www.iris.umd.edu*.

CONTENTS

1 INTRODUCTION

USAID commissioned the IRIS Center to develop, test, and disseminate poverty assessment tools which meet Congressional requirements for accuracy and cost of implementation. IRIS has implemented accuracy tests of poverty indicators in Bangladesh, Peru, Uganda, and Kazakhstan. More information about this project is available at *www.povertytools.org*, and will not be summarized in this report.

This report presents the results of the accuracy tests in Bangladesh.[1] In Chapter 1, we provide an overview of the design of the field research for the accuracy test, and the computation of the applicable poverty line. Chapter 2 provides an overview of the regression analysis presented in this report.

In Chapter 3, we present the results on selected poverty indicators from nine regression models. Each of these models can be viewed as a potential, newly designed poverty assessment tool which is calibrated for Bangladesh based on a nationally representative sample. The regression models are run in SAS, using the MAXR function that maximizes the explained variance of the dependent variable (per-capita daily expenditure) by a set of BEST5, 10, and 15 regressors. Any set of five, ten, or fifteen poverty indicators can be considered a poverty assessment tool for purposes of identifying the poverty status of a household. The first six regression models differ with respect to the set of poverty indicators allowed in the model, starting from a model with a full set of potential regressors and gradually restricting the set of regressors on the ease (or practicality) of implementation. A seventh model is run as an example of a tool that considers only those poverty indicators that were rated as highly verifiable by Data Analysis and Technical Assistance, the survey firm in Bangladesh. A subsequent model compiles these indicators with powerful subjective and monetary indicators. Finally, the last model makes use of poverty indicators usually available in the World Bank's Living Standards Measurement (LSMS) surveys. Thus, the first eight models can be considered alternative best combinations of poverty indicators which were mainly derived from existing practitioner tools for poverty assessment, while Model 9 is a tool derived from poverty indicators usually available in LSMS surveys.

Chapter 4 presents results from an alternative estimation approach — the so-called "two-step" models. In addition to Ordinary Least Squares (OLS), we also test Quantile, Probit, and the so-called Linear Probability regression technique. Compared to the models presented in Chapter 3, these models perform much better.

Chapter 5 addresses two other methods of poverty assessment. The first section assesses the accuracy of loan size as a predictor of poverty status, a method that has been widely used by the microfinance industry. The second section assesses the accuracy of participatory wealth ranking. Chapter 6 summarizes our results.

1.1 FIELD SURVEY FOR ACCURACY TESTS IN BANGLADESH

The survey firm Data Analysis and Technical Assistance (DATA) in Dhaka, Bangladesh, carried out the survey and double-entered the data using SPSS Data Entry software.[2] In total, 30 interviewers in five teams implemented the composite questionnaire survey with 800 households, followed two weeks later by the benchmark questionnaire. Training of the interviewers began on February 17, 2004. The survey was carried out from March 17 to April 15, and double entry of all data was completed by July 15, 2004.

The questionnaires can be downloaded at *www.povertytools.org*. The composite and benchmark questionnaire required adaptation to Bangladesh's specific context. For the composite questionnaire, this meant including country-specific poverty indicators, such as the number of saris owned, as well as certain inferior foods (in Section E, see questions E151 through 157). Useful sources for the identification of country-specific poverty indicators include:

- Official statistical reports (BBS, 2002; and BBS, 2003)
- Results from the FANTA *Food Insecurity and Vulnerability Project* implemented by Dr. Patrick Webb (formerly with Tufts University, now with World Food Program)
- A publication by Matin et al. (2003) concerning the adaptation and use of the CGAP Poverty Assessment Tool (Henry et al. 2003; Zeller et al. 2001) in Bangladesh

The adaptation of the benchmark questionnaire mainly involved selecting major food items. For this, we referred to results from the most recent *Household Income and Expenditure Survey* (HIES, 2000), as well as a report published by the International Food Policy Research Institute (Zeller et al, 2002.)

The adaptation of the two questionnaires benefited greatly from DATA's expertise — particularly that of Md. Zahidul Hassan, Managing Director, and Md. Zobair, Director, as well as their supervisors and interviewers — in conducting poverty, food security, and expenditure surveys in Bangladesh over the past 15 years.

Two DATA employees with considerable experience in qualitative and quantitative research methods participated in a three-day training session held at the Bangladesh Academy for Rural Development in Comilla. This training session was led by Dr. D.S.K Rao and organized by PKSF as part of the Asia-Pacific Region Microcredit Summit Meeting of Councils in February 2002.

1.2 SAMPLING FRAME

1.2.1 REQUIREMENTS FOR SAMPLING

In view of budget and time constraints, it was determined to use a sample size of 800 households. The sample was required to be nationally representative.

Divisions are the highest administrative unit in Bangladesh. There are six divisions, which are disaggregated into 64 districts. Each districts has an average of eight counties (*Thanas*). There are about 500 *Thanas* in the country, each of which holds a number of unions — a grouping of several villages or urban wards. Within the units, one can further distinguish hamlets (*Para*) at the local level.

We used a multi-stage cluster technique to draw a random sample of households. This approach allowed us to draw successive samples at lower administrative units, which was useful in Bangladesh since data on population size are published only for the division, district, and *Thana* (county) levels. In order to minimize sampling error, the first stage of sampling was at the *Thana* level — the lowest administrative level with centrally available and published population data. Because of logistical and budget constraints, we decided to randomly select 10 *Thanas* located in five of Bangladesh's six divisions (excluding the *Sylhet* division, see Annex A).

The probability of selecting a particular *Thana* was equal to its share of the population of the country. This probability-proportionate-to-size sampling (PPS) was repeated at the second stage. Here, from the total number of unions in each of the 10 *Thanas* selected , two unions were randomly chosen proportionate to

the size of the unions compared to the *Thana*'s total population. In each of the twenty unions, one village was then randomly selected, again with a probability proportionate to size of the village within the given union. (Because the union and village data from the 2001 census was not yet published in February 2004, the latest population data for unions and villages was obtained at the administrative headquarters of the union or the *Thana*.).

Finally, in each of the 20 randomly selected villages, the random walk method (see Henry et al., 2003) was used to select a random sample of 40 survey households. Thus, the total sample size is 800 and the sample is a self-weighing, nationally representative sample. The sample for the participatory wealth ranking is made up of a subsample of 320 (out of the 800) households located in eight unions from three of the five divisions. This subsample was not randomly selected. Instead, we selected a purposeful sample, with the aim of compiling the best set of districts, considering criteria such as regional diversity, costs of transport and survey personnel, and the overall survey operations timetable.

1.3 POVERTY LINE

The Microenterprise Results and Accountability Act of 2004 identifies two alternative poverty lines in defining the "very poor." The term "very poor" refers to individuals:

- A — Living in the bottom 50 percent below the poverty line established by the national government

or

- B — Living on the equivalent of less than $1/day

This implies that a person could be considered very poor if he/she was either living on less than a dollar a day, *or* was in the bottom half of the distribution of those below the national poverty line. The legislation thus identifies two alternative measures of extreme poverty, relating to two commonly used poverty lines:

- National Poverty Line (A) — The bottom 50 percent of those classified as poor by any national poverty line. In Bangladesh, the national poverty line is expressed in *Taka*, the local currency.

- International Poverty Line (B) — $1 income per day per capita (equal to $1.08 per day in purchasing-power-parity dollars at 1993 prices)

Based on Bangladesh's most recent *Household Income and Expenditure Survey* (HIES, 2000), a total of 49.8 percent of households fall below the national poverty line. According to *Accountability Act of 2004*, only half (i.e., the bottom 50%) of this portion of the population can be considered very poor.[3] In absolute terms, this would mean that only 24.9 percent of the population would be counted very poor. On the other hand, 36 percent of the population in Bangladesh falls below the international poverty line of $1/day. Hence, the international poverty line (concept B) defines a higher percentage as being very poor than the national poverty line (concept A). Congress suggests (by using the term "or" in the legislative text) using the poverty line that yields a higher "very poor" headcount index. Thus, the applicable poverty line for the accuracy tests in Bangladesh is the international poverty line.

Because the benchmark questionnaire (see *www.povertytools.org*) enumerates per-capita expenditures in *Taka* (the local currency in Bangladesh), it is necessary to convert $1 into *Taka* using purchasing-power parity (PPP) rates. In October 2002, $1 was equivalent in purchasing power to 21.60 *Taka*.[4] To accommodate the accuracy test survey implemented by IRIS in March 2004, it was necessary to adjust the $1 poverty line by the loss in purchasing power (due to national inflation) between October 2002 and

March 2004. This requires multiplying the 21.6 *Taka* value by the increase in the national consumer price index (CPI) for the period from October 2002 to March 2004. Using published data on CPI for the period October 2002 to March 2003, and using the average monthly CPI in the 12 months after March 2003 as an estimate of the CPI change for the period March 2003 to March 2004, we calculate a total inflation of 7.14 percent over the 18-month period.[5] We therefore multiply the international poverty line of $1 (equivalent to 21.6 *Taka* as of October 2002) by 7.1 percent. The product is 23.1 *Taka*. This amount is the international poverty line expressed in *Taka* for the survey month of March 2004. We therefore defined households with a per-capita daily expenditure level below 23.1 *Taka* as very poor.

In the IRIS accuracy test sample, 31.4 percent of households were found to be very poor. This is reasonably close to the published headcount index of 36 percent, derived from the Bangladesh Bureau of Statistics' *Household Income and Expenditure Survey* (2000).

To stay true to the language of the legislation, throughout this report, we will use the term "very poor" (VP) for households with expenditures that fall below the international poverty line of $1/day per person — equivalent to 23.1 *Taka* — and the term "not very-poor" (NVP) for households with expenditures equal to or above the international poverty line. Readers should bear in mind that binomial (either/or) labels distort the underlying reality, which is continuous — the standard of living of a household just above the line is not that much different than that of a household just below the line. Thus, the term "not very-poor" is simply shorthand for "estimated to have per capita daily consumption expenditures more than $1.08/day at 1993 purchasing power parity." We wish to note that a considerable share of these so-called "not very-poor" are actually categorized as being poor by the national poverty line, and that even among those above the national poverty line there exist a considerable share of households that are vulnerable to poverty such that, for example, a bad harvest, an illness of a family member, or a social obligation may drive them into poverty.

2 OVERVIEW OF REGRESSION ANALYSIS

2.1 INTRODUCTION

In Chapter 3, we analyze the accuracy of a series of newly designed poverty assessment tools and develop nine regression models for generating tools. These models consider all of the poverty indicators compiled in the composite questionnaire, based on Zeller's (2003) review of practitioner tools that were submitted to IRIS in late 2003 (see *www.povertytools.org*). In addition, indicators were included based on recent poverty assessment studies published in the academic literature. Thus (with the exception of Model 9 that uses only LSMS-type indicators) the tools analyzed in Chapter 3 each aim to come up with the best combinations of poverty indicators derived from existing practitioners' tools.

2.2 COMPOSITE QUESTIONNAIRE

The structure of the composite questionnaire is as follows:

A. Identification of household (location, client status, etc.)

B. Household roster/demography, including individual as well as household-level indicators (derived from all practitioner tools)

C. Household expenditures by category (adapted from the FINCA and ACCION tools)

D. Housing indicators (generic questions adapted from tools by AIMS, ASA, CASHPOR, CIMS-OI, PRIZMA, and Trickle Up), plus poverty indicators concerning minimum wages acceptable to respondents

E. Food-consumption/food-security scales (adapted from tools by CGAP, Freedom from Hunger, and the World Food Program Food Security and Hunger questionnaire)

F. Asset based indicators (adapted from GRAMEEN Network and most other tools)

G. Social capital, voice, and vulnerability (adapted from recent advancements in social-science research)

H. Estimates of objective and subjective poverty (adapted from recent advancements in social-science research)

I. Information on client status of individual household members in programs and institutions supporting micro-finance or business development services (including information on loan size and outstanding debt)

K. Monetary voluntary savings by individual household members (WOCCU)

2.3 SELECTION OF INDICATORS

In Chapter 3, we present results of nine models that were run with ordinary least squares (OLS) using SAS software. The models differ by the type of regressors used. While Model 1 includes 257 regressors, the seventh model has only 97 potential poverty indicators.

As one can see from the results for Model 1, the set of best poverty indicators is dominated by different expenditure and asset categories, apart from household demographic characteristics.[6] In Model 1, there are only a few poverty indicators from other dimensions and sections of the composite questionnaire. In a gradual process starting with Model 2, we reduce the number of regressors so as to allow indicators from other dimensions and sections of the questionnaire to enter the best set of poverty indicators.

The overriding principle is to narrow down the list of poverty indicators with respect to two criteria:

- **Difficulty of indicators** — Information on some indicators is easy to obtain, while for others it is not. Difficulty can be expressed in terms of time, money, and social costs expended for obtaining information. Social costs are especially important when addressing culturally sensitive questions. The difficulty of an indicator will therefore vary depending on the socio-economic and cultural context. It will also depend on the skill level and quality of training of interviewers. Furthermore, difficulty is strongly affected by the educational level and intellectual skills of the respondent, and by the interview situation (whether in private at home, or among peers or strangers in public — where the respondent may incur high social costs for his/her answers to certain types of questions). For example, the value of total assets is very difficult and tedious to obtain, and therefore is not suitable for an operational poverty assessment tool. Another example is question C2 in the composite questionnaire, the value of food that is home-produced and consumed by the household in an average week.

- **Verifiability of indicator** — In operational terms, another useful characteristic is ease of verification (in terms of time, monetary, and social costs). Here, we distinguish between objective and subjective indicators. Subjective indicators include any respondent self-assessments (perceptions, feelings, attitudes, e.g., Section E9 onwards and Section H, regarding perceived adequacy of livelihood), or any assessments by the interviewer (e.g., rating the poverty status of a household on a scale from 1 to 5, as in Section A). While some subjective indicators are among the more powerful poverty indicators, as will be shown later, they are hardly verifiable — the scales used are subjective and not disclosed to others. In contrast, objective indicators use measurement scales that can be — at least in principle — verified by consistent measurement metrics standards. Examples of objective indicators include the age of a person (in years), the size of the rooms (in square meters), or whether the roof is made of natural fibers. These indicators are directly measurable through conventional and universally comparable scales. Measurability using comparable scales is a prerequisite for direct verifiability.

  Objective indicators, however, may also vary in their degree of verifiability. Examples of objective but hardly verifiable indicators include the number of luxury foods eaten in the past seven days, the money received from migrant relatives, or the number of days a child was sick in the past 12 months. Common to this group of hardly verifiable objective indicators is the fact that actions or states occurred in the past.

Having recognized that the difficulty and verifiability of an indicator cannot be generalized across different socio-economic and cultural contexts, we acknowledge that it might appear rather arbitrary to classify a particular indicator (or a group of indicators) as being more or less difficult to ask, or more or less verifiable. Therefore, we understand that our selection of progressively smaller subsets of regressors

for defining Model 1 through Model 6 will be agreeable to some readers, but certainly not to all. Our approach aims to develop a variety of tools that differ in terms of the dimensions of poverty considered. This approach should be understood as a first attempt to address the practicality issue by presenting different models with perhaps increasingly simple and verifiable indicators. In Model 7 and 8, we use DATA's subjective assessment of verifiability as an alternative attempt to address the practicality issue. To get more information on the practicality of poverty indicators, IRIS's Poverty Tools project includes practicality tests carried out by microfinance and business development services organizations.

Our sequence of regression models with progressively fewer poverty indicators (from Model 1 to Model 6) aims to generate a series of poverty assessment tools that gradually become less accurate but hopefully also gradually easier to implement, less costly, and less prone to falsification by respondents or survey intermediaries.

For each model presented in Chapter 3, we present a set of BEST5, 10, and 15 poverty indicators. Each of these three sets can be considered a poverty assessment tool in itself, and we document for each tool its level of Total Accuracy, Poverty Accuracy, and Non-Poverty Accuracy, as well as the degrees of Undercoverage and Leakage. From an operational point of view — and everything else being the same — a tool derived only from the five best indicators presents an easier, more practical poverty assessment tool than one that uses the BEST15 (or even more) poverty indicators.[7] This is quite obvious — fewer questions need to be asked and analyzed with a BEST5 tool compared to a BEST15 tool. However, the inclusion of fewer poverty indicators in the tool also tends to imply a lower degree of accuracy.

This highlights the important trade-off between the accuracy and practicality of a poverty assessment tool. To achieving the right balance we must carefully consider the trade-offs between accuracy (and residual errors) and practicality, and this will ultimately determine the choice and certification of certain poverty assessment tools.

2.4 SPECIFICATION OF REGRESSION MODELS

The following nine models were run as ordinary least squares in SAS. In all regressions, the sample size is 799 (one household had a missing benchmark interview). The dependent variable is the natural logarithm of per-capita daily expenditures in *Taka*.

Table 2.4.1 — Dependent variable per capita daily expenditures

Variable	N	Minimum	Maximum	Mean	Standard deviation
Per capita daily expenditures	799	7.45	151.44	35.96	22.35
Ln expenditures per capita (natural logarithm)	799	2.01	5.02	3.43	0.53

In all regressions, an INCLUDE statement always includes the following seven regressors as control variables:

Table 2.4.2 — Description of the seven control variables

Variable	N	Minimum	Maximum	Mean	Standard deviation
Household size	799	1	24	4.93	2.10
Household size squared	799	1.00	576.00	28.75	32.34
Age of household head	799	18.00	85.00	44.64	13.46
Division 1	799	0	10	0.30	0.46
Division 2	799	0	10	0.20	0.40
Division 3	799	0	10	0.10	0.30
Division 4	799	0	10	0.30	0.44

The first three control variables take into account the influence of important demographic factors that (in previous research) were found to be powerful variables in explaining per-capita expenditures at the household level. As pointed out above, a division is the highest administrative unit within Bangladesh. The four dummy variables — Division 1 through 4 — seek to capture regional differences. The inclusion of these dummy variables ensures that the estimated regression coefficients are controlled by regional differences.

All variables that are defined in monetary values (such as expenditures and assets) are converted into natural logarithms since the dependent variable is also expressed as a natural logarithm.[8] All ordinal variables (type of roof, for example, with lower values indicating inferior materials and higher values indicating superior materials) have been converted into dummy variables that reflect the different subtypes. Thus, if the database has three types of roof (1=natural material; 2=metal; 3=superior, such as tile), then dummy variables for two of the three different types of roof were formulated and tested in the statistical analysis for their potential of being a significant poverty indicator.

The nine different models were run in SAS using the MAXR technique that seeks to obtain a model with a high R-square. The R-square (R^2) is the ratio of the variance in the dependent variable that is explained by the model and its regressors, divided by the overall observed variance of the dependent variable. The coefficient ranges between 0 and 1. R^2 takes on the value of 1 when predicted values for the dependent variable for all households are the same as the observed values. A coefficient of 0.6 for R^2 implies that 60 percent of the observed variance in the dependent variable is explained by the model and its regressors.

High explanatory power is a prerequisite for good predictions of the dependent variable per-capita daily expenditures (and thereby poverty status). The maximum R^2 improvement technique (MAXR) is a subcommand for regressions in SAS. The MAXR technique seeks to maximize explained variance (i.e., R^2), and considers all combinations among pairs of regressors to move from one step to the next. In the first step, the MAXR method begins by finding the one-variable model producing the highest R^2. In the second step, another variable — the one that yields the greatest increase in R^2 — is added. Once the two-variable model is obtained, each of the variables in the model is compared to each of the variables not in the model. For each comparison of single pairs of variables, MAXR demonstrates whether removing one variable and replacing it with the other one increases R^2. After comparing all possible switches, MAXR makes the switch that produces the largest increase in R^2. Comparisons then begin again in the third step, and the process continues until MAXR finds that no switch can increase R^2. This limit may not be reached at 15 variables, but may include many more regressors. Thus, the MAXR technique allows us to identify the best model in each category: with only one variable, only 5 (termed in this paper the BEST5 model), only 10 (BEST10 model), only 15 (BEST15 model), or the best model using N regressors. The number N is determined by MAXR itself.

2.5 DIFFERENCES BETWEEN THE MODELS

From the composite questionnaire, we computed many poverty indicators. The following eight model types were run as ordinary least squares in SAS. From the composite questionnaire, many alternative poverty indicators were computed. For the regression analysis, all poverty indicators that were monetary variables in *Taka* were replaced by their natural logarithms, and all poverty indicators derived from original ordinal or nominal variables in the composite questionnaire were converted into dummy variables. For example, the ordinal variable education (see Section B of the composite questionnaire) was converted into dummy variables reflecting the achievement of different levels of education for individual household members. In total, 576 regressors were contained in the basic regression data file and tested as potential poverty indicators. Similar to the subsequent analysis of the eight models, the SAS MAXR procedure (as explained in section 2.4) was used to select the best 250 potential regressors (in addition to the seven control variables) for Models 1 through 9. All of the dimensions of poverty (as well as all submitted poverty indicators from practitioner tools) from the total number of composite questionnaire sections were represented in the final regression data file containing the best 250 indicators, and hence in the generation of tools. Special care was given to the generation and testing of gender-specific poverty indicators. Annex C, Table 1, lists the gender-specific indicators that were selected for the final regression analysis (i.e., the subset of 257 regressors).

The differences between the models are described next (see also Figure 2.5.1).

- **Model 1** — Model 1 includes all 257 regressors considered in the regression analysis using SAS software. As will be shown later, this model contains many regressors derived from indicators of expenditures or value of assets.

- **Model 2** — In Model 2, we drop all expenditure-related variables, except for clothing expenditures per capita in past 12 months and other household expenditures in the past 12 months (see Section B of the composite questionnaire). These variables were the two best expenditure categories among 13 tested using SAS MAXR technique.[9] Within the expenditure group, the variable "clothing expenditure" is one of the easiest for respondents to recall. A reduction of the number of expenditure variables is a first step towards a more operational set of poverty indicators. But, as already noted, self-reported expenditures by respondent (irrespective of whether the recall period for expenditures is one week, one month, or one year) are impossible to verify directly. In addition, the questions contained in Section C (questions C1 to C12) are prone to high measurement error and therefore require intensive interviewer training. The interviewer needs to facilitate the interview by asking prompting questions on major elements of the different expenditure categories. For example, a particularly difficult expenditure category is home-produced food — especially for interviewers unfamiliar with traditional (or metric) measures used for crop yields in agriculture and food subsistence production (see question C2). Furthermore, the interviewer needs to provide special assistance to respondents with no or low school education for even simple calculations such as adding up expenses, especially since some elements of a certain expenditure category are recalled by the respondent on a monthly basis, and others are best remembered on a weekly basis (1 bag of potatoes per month, but a basket of rice per week). While these questions did not pose significant difficulties for DATA's experienced interviewers, they may pose difficulties for less-experienced interviewers. In total, Model 2 has 244 regressors that were retained from Model 1 (see Annex B, Table 1).

- **Model 3** — The set of regressors in Model 3 is similar to those used in Model 2. The only difference is the exclusion of the variable "total value of household assets" as a regressor. This variable is the natural logarithm of the total value of all assets possessed by the household. The total asset value is a powerful poverty indicator, and its exclusion allows other variables for single

assets (or subgroups) to enter among the best regressors. The variable has been calculated from the value of all assets (from Section D and F of the composite questionnaire). This variable is considered a costly and therefore a less practical poverty indicator, since it would require asking many of the questions from Section D and F.

- **Model 4** — The only difference between Model 3 and 4 is the exclusion of the variables "clothing expenditures per capita in past 12 months" and "other household expenditures in the past 12 months." This variable is the natural logarithm of the per-capita clothing expenditures during the past 12 months. As this was the most powerful poverty indicator in the expenditure group, its exclusion allows other poverty indicators to enter into the best set of regressors.

- **Model 5** — Model 5 excludes all subjective poverty indicators. Such indicators include all ordinal rankings determined by the interviewer (such as those at the beginning of the interview in Section A or the assessment of the structure of the house) and all ordinal rankings by the respondent concerning feelings or self-assessment (for example, the ladder questions in Section H). While these subjective indicators can be powerful poverty indicators, they cannot be verified, at least not directly. Thus, such indicators allow the respondent to answer strategically, depending on his or her expectations of the interview. For example, if the respondent thinks that making herself appear poorer will give her a better chance of getting a loan or being accepted into a program, she may strategically alter her responses.[10] The subjective poverty indicators excluded in Model 5 (compared to Model 4) are presented in Annex B, Table 1.

- **Model 6** — This model is similar to Model 5, but excludes all monetary variables from the remaining subset of regressors. With this approach, we now solely base the model on demographic characteristics and the number and the type of assets possessed.

- **Model 7** — Compared to Model 6, this model is more restrictive with respect to verifiability criteria. It incorporates the indicators rated by DATA (see Annex D, Table 1) as "somewhat easy or easy verifiable".[11] The model contains many poverty indicators that are used in the housing index, as well as demographic, asset, monetary, and other observable indicators.

- **Model 8** — Model 8 is similar to Model 7, but includes the best two expenditure variables ("clothing expenditures per capita" and "other household expenditures"), plus five powerful subjective variables.[12] While the variable "other household expenditures" was the best in terms of accuracy, it was judged to be impractical because it requires that the interviewer first ask questions related to the prior 12 expenditure groups. Therefore, we replaced it with the next-best expenditure variable — "household expenditures on education." The five powerful subjective variables are:

  In the last 7 days, how many days lentils were served to the household members in a main meal?

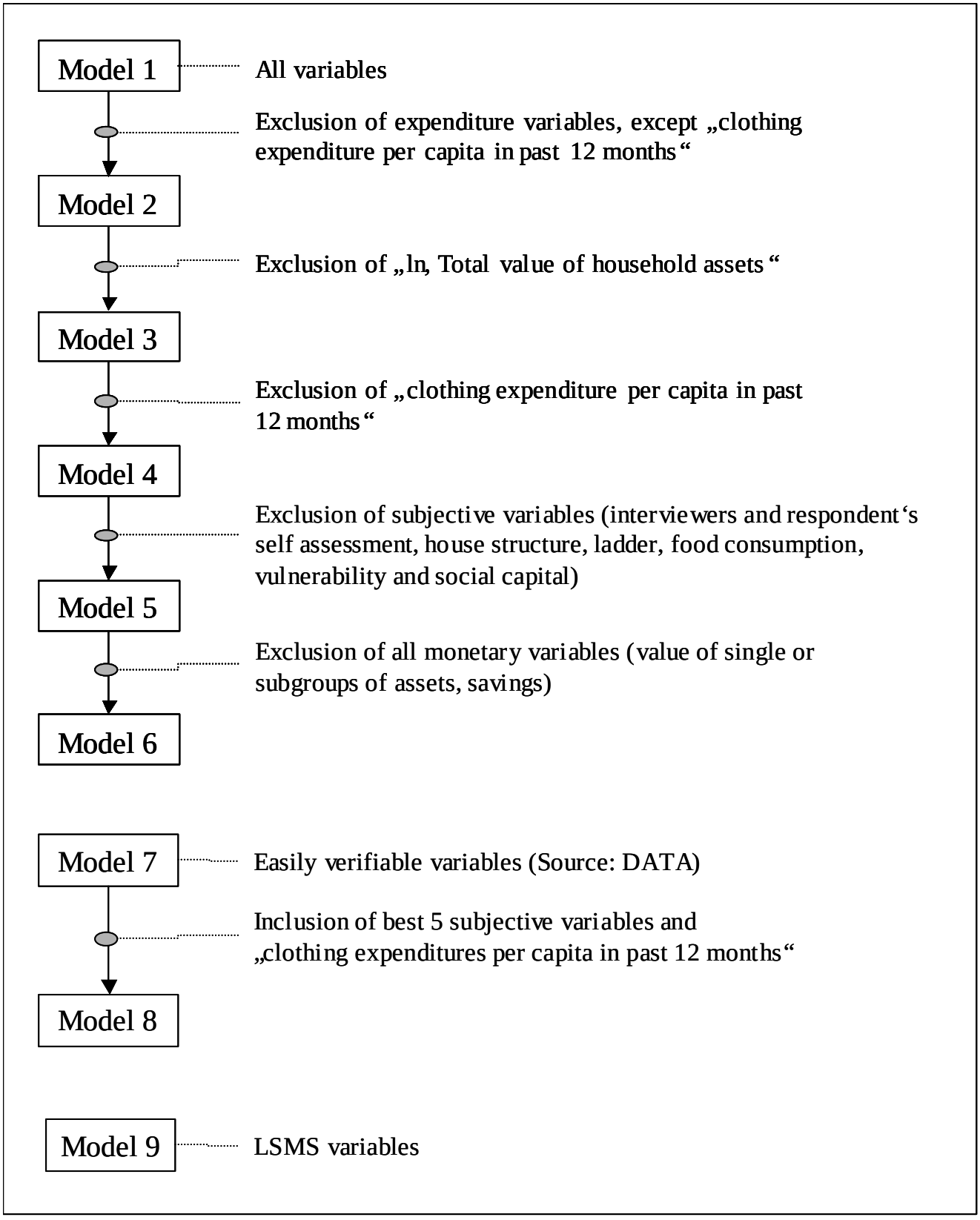
  In the last 30 days, for how many days did your household not have enough to eat everyday?

  Household feels that clothing expenses are below need

  Number of steps above the step identified as the respective poverty line

  Amount that household needs per month to live

Figure 2.5.1 — Schematic representation of the models' construction process.



Model 8 is an example of combining indicators that are deemed easily verifiable by survey experts in Bangladesh (some of the indicators are directly observable) with powerful subjective and objective indicators that are not directly verifiable. However, this poverty assessment tool may allow indirect verifiability of the clothing and education expenditures, as well as of the subjective indicators, by comparing them with the answers to the readily verifiable indicators.

- **Model 9** — Model 9 incorporates variables that are usually available in World Bank LSMS surveys. It includes 113 regressors related to demographic, asset, expenditures, housing, and credit and financial asset information.

Annex B, Table 1, presents a description of the 257 regressors entered into the different models. For each model, the corresponding column (M*) indicates the specific regressors included. Figure 2.5.1 presents an overview of the nine regression models tested.

In conclusion, the models differ in the sets of poverty indicators submitted to the regression analysis. The result of the regression analysis, i.e. the identified set of best regressors (be it 5, 10, or 15), could be potentially used as a tool in nationally representative surveys in Bangladesh for assessing whether a household is below or above the poverty line. The nine models differ in the number and type of regressors that are used, and Models 1 to 7 represent increasingly simple tools that are also progressively less prone to risks such as strategic answers and verification problems.

3 RESULTS FROM REGRESSION MODELS

In the following chapter, the results are summarized by listing

- The regressors that were among the BEST5, 10, and 15 models
- The adjusted R-square achieved (e.g., an R-square of 0.6 indicates that 60 percent of the observed variance in the dependent variable is explained by the regressors)

The set of best regressors is statistically determined using SAS's MAXR technique, which searches for the best model fit. Our use of the word "best" should not be misunderstood as a value statement that implies that the regressors are better in terms of the Total Accuracy of a particular model, or for any of the other performance measures listed below. The set of BEST5, 10, or 15 regressors simply refers to *the best model fit*, given the constraints on the set of available regressors and on the maximum number of regressors included (for example, five regressors in a BEST5 model).

In order to assess the predictive power of a each poverty assessment tool (regression model), we also present seven measures of performance accuracy:

- **Total Accuracy** — The percentage of the total sample of 788 households whose poverty status is correctly predicted by the regression model
- **Poverty Accuracy** — Accuracy among the very poor, which refers to the households correctly predicted as very poor, expressed as a percentage of the total very poor
- **Non-Poverty Accuracy** — Accuracy among the not very-poor, which refers to the households correctly predicted as not very-poor, expressed as percentage of the total number of not very-poor
- **Undercoverage** — The error of predicting very-poor households as being not very-poor, expressed as a percentage of the total number of very poor
- **Leakage** — The error of predicting not very-poor households as very poor, expressed as a percentage of the total number of very poor
- **Poverty Incidence Error** (PIE) — The difference between the predicted and the actual (observed) poverty incidence, measured in percentage points
- **Balanced Poverty Accuracy Criterion** (BPAC) — Poverty Accuracy minus the absolute difference between Undercoverage and Leakage, each expressed as a percentage of the total number of very poor. When Undercoverage and Leakage are equal, the BPAC is equal to the Poverty Accuracy. BPAC is measured in percentage points. The application of the BPAC criteria is based on three assumptions about the valuation of errors concerning the predictions of the very poor and the not very-poor (see IRIS, 2005).

Leakage and Undercoverage are often used in the literature to assess the poverty-targeting performance of development and safety net policies, institutions, or projects. The Poverty Incidence Error (PIE) tells us about the precision of a model (or poverty assessment tool) in correctly predicting poverty. Ideally, the value of PIE should be zero, implying that the predicted poverty rate equals the observed poverty rate. Positive values of PIE indicate an underestimation of the poverty incidence, whereas negative values indicate an overestimation of the poverty headcount index. PIE is useful if the objective of the poverty assessment is to measure the poverty outreach of an entire institution that provides microfinance or business development services. Hence, the evaluation question is: "What percentage of Institution X's clients are very poor?" It is important to note that a good PIE value (i.e., close to zero) can be reached through a combination of low Poverty Accuracy and low Non-Poverty Accuracy. This is because errors in predicting the very poor may cancel out with errors made in predicting the not very-poor. Therefore, a good PIE value can be obtained with a model that has a low Poverty Accuracy and Non-Poverty Accuracy, combined with high Leakage and Undercoverage. Because of this, using PIE to select a model means that one may risk choosing a model with low Poverty Accuracy and high Undercoverage and Leakage. The Balanced Poverty Assessment Criterion (BPAC) considers these three accuracy measures, and models with a higher positive BPAC value indicate a higher Poverty Accuracy, adjusted by the absolute difference between Leakage and Undercoverage. There may exist trade-offs between PIE and BPAC in the selection of models. A perfect prediction model would have a PIE value of zero and a BPAC value of 100. In such a perfect model, Leakage and Undercoverage would have a value of zero, and Total Accuracy, Poverty Accuracy, and Non-Poverty Accuracy would have a value of 100.

In section 3.1 through 3.9, we present results of the nine models (sets of regressors) using the Ordinary Least Squares (OLS) regression technique. In section 3.10, we use three alternative regression techniques. For each of the regression models presented in Chapter 3, we provide the above-listed performance measures for predicting the very poor and not very-poor.

The model performance measures are illustrated next, using the results from Model 1.

3.1 MODEL 1

Model 1 includes all 250 regressors available for the regression analysis. Table 3.1.1 presents the number of households classified as very poor and not very-poor by the international poverty line, as well as the predicted poverty status of the households within both groups.

Table 3.1.1 — Observed vs. Predicted poverty status for the BEST15 regressors set.

Poverty status (as measured by benchmark questionnaire in survey)	Predicted poverty status		
	Not very-poor	**Very poor**	**Total**
Not very-poor	516	32	548
Very poor	77	174	251
Total	593	206	799

Observed poverty status:

- Percentage of very poor = (251 / 799) * 100 = 31.4 %
- Percentage of not very-poor = (548 / 799) * 100 = 68.6 %

Predicted poverty status:

- Percentage of predicted very poor = (206 / 799) * 100 = 25.78 %
- Percentage of predicted not very-poor = (593 / 799) * 100 = 74.22 %

Model performance:

- Total Accuracy = ((516 + 174) / 799) * 100 = 86.36 %
- Poverty Accuracy = (174 / 251) * 100 = 69.32 %
- Non-Poverty Accuracy = (516 / 548) * 100 = 94.16 %
- Undercoverage = (77 / 251) * 100 = 30.68 %
- Leakage = (32 / 251) * 100 = 12.75 %
- PIE = 25.78-31.4 = -5.63 percentage points
- BPAC = 69.32-abs(30.68-12.75) = 51.39 percentage points

From Table 3.1.2, it can be observed that the highest performance is achieved in the BEST15 set, with 86.36 percent Total Accuracy and a BPAC of 51.39 percentage points. Furthermore, monetary variables (expenditures or other values) constitute more than 50 percent of the indicators incorporated in each set. This model has a tendency to focus on aspects related to assets and expenditures.

Table 3.1.2 — Summary of accuracy results, Model 1

Variables	Model performance (%, percentage point)	
BEST5 indicators: R^2 adjusted = 0.671		
▪ Proportion of dependents younger than 14 or older than 60 years (in relation to household size) ▪ Household feels that clothing expenses are below need ▪ Average clothing expenditures per capita, past 12 month ▪ Annualized total household expenditures ▪ Total value of household assets	Total Accuracy Poverty Accuracy Non-Poverty Accuracy Undercoverage Leakage Pred. Pov. Incidence PIE BPAC	83.73 65.74 91.97 34.26 17.53 26.16 -5.26 49.0
BEST10 indicators: R^2 adjusted = 0.703		
Next best five indicators: ▪ Value of dowry received by household ▪ Household expenditure on health in last 12 months ▪ Household expenditure on home in last 12 months ▪ Value of radio, TV, VCR and CD players ▪ Number of household members who can read only	Total Accuracy Poverty Accuracy Non-Poverty Accuracy Undercoverage Leakage Pred. Pov. Incidence PIE BPAC	85.73 68.53 93.61 31.47 13.94 25.91 -5.51 51.0
BEST15 indicators: R^2 adjusted = 0.717		
Next best five indicators: ▪ Household has a checking account ▪ Cooking fuel is collected bamboo, wood or sawdust ▪ House structure: Good ▪ In the last 7 days, how many days were lentils served by the household in a main meal? ▪ Value of formal savings of spouse	Total Accuracy Poverty Accuracy Non-Poverty Accuracy Undercoverage Leakage Pred. Pov. Incidence PIE BPAC	86.36 69.32 94.16 30.68 12.75 25.78 -5.63 51.39

Compared to the other tools presented in this report, Model 1 achieved the highest Total Accuracy, Poverty Accuracy, and adjusted R-square value, as well as the lowest Undercoverage and Leakage figures. Furthermore, the average PIE value from the three sets of variables was the closest to zero of all models. In terms of BPAC, Model 1 achieved the best performance for each set (5, 10, and 15) in comparison to the corresponding sets from the remaining models. This result is not surprising — Model 1 allowed the selection of all possible indicators from the composite questionnaire and it therefore presents the most powerful combination.

The indicators selected, however, may not be viewed as optimal in terms of practicality — i.e., the difficulty of obtaining information on and verifying the indicators. For example, the indicators "total value of household assets" and "annualized total household expenditures" would require intensive and detailed questioning about the assets owned by the households (and their valuation), as well as about expenditures in the last 12 months. In addition, this type of information is difficult to verify.

3.2 MODEL 2

Table 3.2.1 — Summary of the accuracy results, Model 2

Variables	Model performance (%, percentage point)	
BEST5 indicators: R^2 adjusted = 0.591		
▪ Proportion of dependents younger than 14 or older than 60 years (in relation to household size) ▪ House structure: Good ▪ Household feels that clothing expenses are below need ▪ Total value of household assets ▪ Average clothing expenditures per capita, past 12 month	Total Accuracy Poverty Accuracy Non-Poverty Accuracy Undercoverage Leakage Pred. Pov. Incidence PIE BPAC	81.85 58.17 92.7 41.83 15.94 23.28 -8.12 32.28
BEST10 indicators: R^2 adjusted = 0.639		
Next best five indicators: ▪ Household has a checking account ▪ Household feels that housing expenses are below need ▪ If household rates itself below the step reflecting the respective national poverty line ▪ Value of dowry received by household ▪ Value of radio, TV, VCR and CD players ▪ Other household expenditures in last 12 months (social events, gifts, taxes) ***Dropped from BEST5:*** ▪ Household feels that clothing expenses are below need	Total Accuracy Poverty Accuracy Non-Poverty Accuracy Undercoverage Leakage Pred. Pov. Incidence PIE BPAC	82.98 62.95 92.15 37.05 17.13 25.16 -6.24 43.03
BEST15 indicators: R^2 adjusted =0.658		
Next best five indicators: ▪ In the last 7 days, how many days lentils were served to the household members in a main meal? ▪ Proportion of households in the community that have access to GOAPS ▪ Costs of recent home improvements ▪ Value of formal savings of the spouse ▪ Number of household members who can read only	Total Accuracy Poverty Accuracy Non-Poverty Accuracy Undercoverage Leakage Pred. Pov. Incidence PIE BPAC	83.60 66.13 91.61 33.86 18.33 26.53 -4.87 -50.60

Model 2 excludes all expenditure or expenditure-derived variables (Section C of the composite questionnaire), with the exception of "average clothing expenditures per capita in the past 12 months" and "other household expenditures in the past 12 months." Compared to Model 1, this model registered a lower performance for all three sets. The highest adjusted R-squared (0.658 in the BEST15 set) is lower than the lowest adjusted R-squared obtained in Model 1 (BEST5).

The highest accuracy performance, as well as the lowest Undercoverage and Leakage measures, is achieved by the BEST15 regressors set. For this set, PIE and BPAC achieved a level of -4.87 and 50.60 percentage points, respectively. It is interesting to note that while in Model 1 the BPAC measure increased 0.39 percentage points from the BEST10 to the BEST15 set, in this model the increase was 7.57 percentage points.

Undercoverage increased an average of 5.45 percentage points when compared to Model 1. It registered its highest level in the BEST5 set, at 41.83 percent. On the other hand, Leakage increased about 2.4 percentage points in comparison to the average from Model 1. The highest level was observed in the BEST15 set, at 18.33 percent.

In terms of indicators, this model incorporated subjective, asset, and expenditure-related variables. A community-related variable ("proportion of households in the community that have access to GOAPS" — the Government Old Age Pension Scheme) appears for the first time in a best regressor set.

3.3 MODEL 3

Model 3 is based on Model 2, but excludes the variable value of total household assets. In terms of adjusted R-squared figures, Model 3 has a similar performance as Model 2, achieving a maximum of 0.654 in the BEST15 set. However, the accuracy measures dropped on all sets by around 1.5 percentage points. With regard to Undercoverage and Leakage, they increased (on average) 1.86 and 2.65 percentage points, respectively. PIE and BPAC decreased in performance.

As with Model 2, this model incorporated more subjective variables, especially those related to income and expenditure issues, which are not easily verifiable. In general, as more variables were added to the sets, housing and assets-related variables became more numerous. Together, they constitute nearly half of the variables chosen for the BEST10 and 15 sets.

The BEST15 set achieved the highest Total Accuracy and Poverty Accuracy, and the lowest Undercoverage. The highest Non-Poverty Accuracy and the lowest Leakage level were achieved in the BEST10 set.

In terms of PIE and BPAC, the BEST15 set achieved the best performance. As in the situation observed in Model 2, BPAC increased considerably from the BEST10 to the BEST15 set (8.77 percentage points).

Table 3.3.1 — Summary of the accuracy results, Model 3

Variables	Model performance (%, percentage point)	
BEST5 indicators: R^2 adjusted = 0.578		
▪ House structure: Good	Total Accuracy	80.22
▪ Household feels that clothing expenses are below need	Poverty Accuracy	58.17
▪ Value of radio, TV, VCR and CD players	Non-Poverty Accuracy	90.33
▪ Other household expenditures in last 12 months (social events, gifts, taxes)	Undercoverage	41.83
▪ Average clothing expenditures per capita, past 12 month	Leakage	21.12
	Pred. Pov. Incidence	24.91
	PIE	-6.49
	BPAC	37.46
BEST10 indicators: R^2 adjusted = 0.635		
Next best five indicators:	Total Accuracy	81.48
▪ Household has a checking account	Poverty Accuracy	59.76
▪ Proportion of dependents younger than 14 and older than 60 years (in relation to household size)	Non-Poverty Accuracy	91.42
▪ Household feels that housing expenses are below need	Undercoverage	40.24
▪ If household rates itself below the step reflecting the poverty line	Leakage	18.72
▪ Costs of recent home improvements	Pred. Pov. Incidence	24.65
▪ Value of dowry received by household	PIE	-6.75
	BPAC	38.24
Dropped from BEST5:		
▪ Household feels that clothing expenses are below need		
BEST15 indicators: R^2 adjusted =0.654		
Next best five indicators:	Total Accuracy	82.48
▪ In the last 7 days, how many days lentils were served to the household members in a main meal?	Poverty Accuracy	63.74
▪ Value of formal savings of the spouse	Non-Poverty Accuracy	91.06
▪ Amount that household needs per month to live	Undercoverage	36.25
▪ Number of milk cows owned by the household	Leakage	19.52
▪ Number of household members who can read only	Pred. Pov. Incidence	26.16
	PIE	-5.24
	BPAC	47.01

3.4 MODEL 4

Model 4 is similar to Model 3, but excludes the variables “average clothing expenditures per capita in the past 12 months” and “other household expenditures in the past 12 months.” Compared to Model 3, the adjusted R-squared levels were noticeably lower (maximum of 0.569 in the BEST15 set). While Total Accuracy decreased on average by 3.09 percentage points, Poverty Accuracy decreased by more than 6 percentage points.

For this model, the BEST15 set yielded the highest accuracy levels and the lowest Undercoverage. However, the lowest Leakage level was observed in the BEST10 set. When compared to Model 3, PIE and BPAC decreased in performance, meaning that this model derived a larger under-prediction of the actual poverty headcount (larger negative PIE values).

The combination of the variables selected as the best set is more balanced, covering aspects of dwelling characteristics, assets, food security, demographic characteristics, and subjective variables.

Following the trend observed from Model 2 up to this point, this model has a higher proportion of subjective and non-verifiable variables. Also, the model showed a large increase in BPAC from the BEST10 to the BEST15 set (14.75 percentage points).

Table 3.4.1 — Summary of the accuracy results, Model 4

Variables	Model performance (%, percentage point)	
BEST5 indicators: R^2 adjusted = 0.462		
▪ Proportion of dependents younger than 14 or older than 60 years (in relation to household size) ▪ Household feels that clothing expenses are below need ▪ Total value of land ▪ Amount that household needs per month to live ▪ Value of radio, TV, VCR and CD players	Total Accuracy Poverty Accuracy Non-Poverty Accuracy Undercoverage Leakage Pred. Pov. Incidence PIE BPAC	77.35 51.39 89.23 48.61 23.51 23.53 -7.87 26.29
BEST10 indicators: R^2 adjusted = 0.535		
Next best five indicators: ▪ What is the size of these rooms in square feet? ▪ In the last 7 days, how many days were lentils served to the household members in a main meal? ▪ In the last 30 days, for how many days did your household not have enough to eat everyday? ▪ Costs of recent home improvements ▪ Value of dowry received by household	Total Accuracy Poverty Accuracy Non-Poverty Accuracy Undercoverage Leakage Pred. Pov. Incidence PIE BPAC	78.1 52.19 89.94 47.81 21.91 23.28 -8.12 26.29
BEST15 indicators: R^2 adjusted =0.569		
Next best five indicators: ▪ Household has a checking account ▪ House structure: dilapidated ▪ How many meals were served to the household members during the last 2 days? ▪ Death of a working adult member in last 3 years ▪ Value of formal savings of the spouse ▪ Number of household members who can read only	Total Accuracy Poverty Accuracy Non-Poverty Accuracy Undercoverage Leakage Pred. Pov. Incidence PIE BPAC	80.60 59.76 90.14 41.24 21.51 25.53 -5.88 41.04
Dropped from BEST10: ▪ In the last 30 days, for how many days did your household not have enough to eat?		

3.5 MODEL 5

Model 5 is based on Model 4, but excludes all subjective variables. All variables related to food consumption, ladder, vulnerability, interviewers' and respondents' assessments, and condition of the house were dropped, leaving out some of important dimensions.

Table 3.5.1 — Summary of the accuracy results, Model 5

Variables	Model performance (%, percentage point)	
BEST5 indicators: R^2 adjusted = 0.479		
▪ What is the size of these rooms in square feet?	Total Accuracy	77.97
▪ Proportion of dependents younger than 14 or older than 60 years (in relation to household size)	Poverty Accuracy	49.40
	Non-Poverty Accuracy	91.06
▪ Total value of land	Undercoverage	50.60
▪ Value of radio, TV, VCR and CD players	Leakage	19.52
▪ Number of saris owned by the household	Pred. Pov. Incidence	21.65
	PIE	-9.75
	BPAC	18.32
BEST10 indicators: R^2 adjusted = 0.539		
Next best five indicators:	Total Accuracy	79.10
▪ Household has a checking account	Poverty Accuracy	53.78
▪ House structure: dilapidated	Non-Poverty Accuracy	90.69
▪ Costs of recent home improvements	Undercoverage	46.21
▪ Value of dowry received by household	Leakage	20.32
▪ Number of household members who can read only	Pred. Pov. Incidence	23.28
	PIE	-8.12
	BPAC	27.89
BEST15 indicators: R^2 adjusted =0.567		
Next best five indicators:	Total Accuracy	80.22
▪ Cooking fuel is purchased bamboo, wood or sawdust	Poverty Accuracy	58.57
▪ Death of a working adult member in last 3 years	Non-Poverty Accuracy	90.15
▪ Value of formal savings of the spouse	Undercoverage	41.43
▪ Number of milk cows owned by the household	Leakage	21.51
▪ Did households have access to VGF/VGD in the community? [1]	Pred. Pov. Incidence	25.16
	PIE	-6.24
	BPAC	38.65

This model presented similar adjusted R-square values and accuracy levels to those of Model 4. The best performance was achieved by the BEST15 set. The exclusion of subjective variables caused additional asset variables to enter into the best combinations in a higher proportion than other type of variables, making this model strongly reliant on asset information (ownership and value) and housing-related variables. Demographic variables continue to play a limited role in the sets' definition.

In spite of the similarity of the accuracy results with the results from Model 4, PIE and BPAC showed a lower performance. The model further underestimated the poverty incidence, yielding larger negative PIE values in the three sets and a lower average BPAC value.

BPAC increased 9.57 percentage points from the BEST5 to the BEST10 set, and 10.76 percentage points from the BEST10 to the BEST15 set.

[1] VGF (Vulnerable Group Feeding) and VGD (Vulnerable Group Development) are food aid programs.

In terms of the difficulty of obtaining information and the verifiability of the indicators, this model could be considered better than the previous models, due to the exclusion of the subjective variables and the incorporation of asset and housing variables which appear to be more verifiable.

3.6 MODEL 6

Model 6 excluded all monetary variables, leaving 145 variables in the analysis. The adjusted R-squares ranged from 0.453 to 0.530 — i.e., lower in all sets than in the previous models. As in the previous model, this model incorporates a high proportion of asset and housing-related variables. In addition, demographic variables appear more frequently in the best* sets. In general, these variables tend to be easily verifiable.

Table 3.6.1 — Summary of the accuracy results, Model 6

Variables	Model performance (%, percentage point)	
BEST5 indicators: R^2 adjusted = 0.453		
▪ Household head has an account (savings, checking or fixed term deposit) ▪ What is the size of these rooms in square feet? ▪ Proportion of dependents younger than 14 or older than 60 years (in relation to household size) ▪ House structure: dilapidated ▪ Number of saris owned by the household	Total Accuracy Poverty Accuracy Non-Poverty Accuracy Undercoverage Leakage Pred. Pov. Incidence PIE BPAC	78.47 48.21 92.34 51.79 16.73 20.40 -11.00 13.15
BEST10 indicators: R^2 adjusted = 0.502		
Next best five indicators: ▪ Lighting: Public grid with legal socket in house ▪ Household has improved toilet ▪ In last 3 years, number marriages of a first degree relative to household head or spouse? ▪ Death of a working adult member in last 3 years ▪ Number of milk cows owned by the household	Total Accuracy Poverty Accuracy Non-Poverty Accuracy Undercoverage Leakage Pred. Pov. Incidence PIE BPAC	79.22 54.18 90.69 45.82 20.32 23.40 -8.00 28.68
BEST15 indicators: R^2 adjusted =0.530		
Next best five indicators: ▪ Black and white TV ownership ▪ Household has a checking account ▪ Head of household is domestic worker ▪ House size: small ▪ Number of female adult household members ▪ Number household members who completed secondary/ post primary education only, except head ▪ Did households have access to VGF/VGD in the community?	Total Accuracy Poverty Accuracy Non-Poverty Accuracy Undercoverage Leakage Pred. Pov. Incidence PIE BPAC	79.72 56.97 90.15 43.03 21.51 24.66 -6.74 35.45
Dropped from BEST10: ▪ Household head has an account (savings, checking, or fixed term deposit) ▪ Death of a working adult member in last 3 years		

The best performance was observed in the BEST15 set, with a Total Accuracy of 79.72 percent and a Poverty Accuracy of 56.97 percent. In comparison to Model 5, Undercoverage increased on average 0.8 percentage points and Leakage decreased 0.93 percentage points.

In terms of PIE, it can be observed that the model further underestimated the actual poverty incidence. With regard to BPAC, the model decreased in performance, achieving a maximum of 35.45 percentage points in the BEST15 set.

3.7 MODEL 7

Table 3.7.1 — Summary of the accuracy results, Model 7

Variables	Model performance (%, percentage point)	
BEST5 indicators: R^2 adjusted = 0.432		
▪ Lighting: Public grid with legal socket in house	Total Accuracy	76.22
▪ House structure: Good	Poverty Accuracy	43.43
▪ No lock in main entrance door	Non-Poverty Accuracy	91.24
▪ Number of saris owned by household	Undercoverage	56.57
▪ Number of dependents younger than 15 or older than 64 years	Leakage	19.12
	Pred. Pov. Incidence	19.65
	PIE	-11.75
	BPAC	5.98
BEST10 indicators: R^2 adjusted = 0.467		
Next best five indicators:	Total Accuracy	77.47
▪ Household has improved toilet	Poverty Accuracy	49.80
▪ Head of household is domestic worker	Non-Poverty Accuracy	90.15
▪ House size: small	Undercoverage	50.20
▪ Number household members who completed secondary/ post primary education only, except head	Leakage	21.51
	Pred. Pov. Incidence	22.40
▪ Did households have access to VGF/VGD in the community?	PIE	-9.0
	BPAC	21.11
BEST15 indicators: R^2 adjusted =0.481		
Next best five indicators:	Total Accuracy	79.10
▪ Roof with leaves, jute stick or straw	Poverty Accuracy	51.0
▪ Death of a working adult member in last 3 years	Non-Poverty Accuracy	91.97
▪ Manual husking machine	Undercoverage	49.0
▪ Ratio of male to females	Leakage	17.53
▪ Motor tiller ownership	Pred. Pov. Incidence	21.53
	PIE	-9.89
	BPAC	19.52

This model incorporates poverty indicators that have been rated as easy verifiable by the managers of DATA based on their long-term experience in conducting field research and surveys in Bangladesh. It is important to note that this model shows the lowest overall performance among all models tested in this chapter.

By looking at table 3.7.1, it can be determined that for the first five accuracy measures, the BEST15 set achieved the best performance. This set not only registered the highest accuracy levels, but also the lowest Undercoverage and Leakage levels. However, in terms of PIE and BPAC, the BEST10 set performed best.

In addition, considering that the 15 indicators are fairly easy to obtain and deemed as verifiable by DATA, the Total Accuracy levels are quite high.

3.8 MODEL 8

Table 3.8.1 — Summary of the accuracy results, Model 8

Variables	Model performance (%, percentage point)	
BEST5 indicators: R^2 adjusted = 0.564		
▪ House structure: good	Total Accuracy	79.35
▪ Number of ceiling fans owned by the household	Poverty Accuracy	54.18
▪ Household feels that clothing expenses are below need	Non-Poverty Accuracy	90.88
▪ Number of steps above step identified as respective poverty line	Undercoverage	45.82
▪ Average clothing expenditures per capita, past 12 month	Leakage	19.92
	Pred. Pov. Incidence	23.28
	PIE	-8.14
	BPAC	28.29
BEST10 indicators: R^2 adjusted = 0.593		
Next best five indicators:	Total Accuracy	81.35
▪ Motor tiller ownership	Poverty Accuracy	58.96
▪ House size: small	Non-Poverty Accuracy	91.61
▪ Number of dependents younger than 15 or older than 64 years	Undercoverage	41.04
▪ In the last 7 days, how many days lentils were served to the household members in a main meal?	Leakage	18.33
	Pred. Pov. Incidence	24.28
▪ Amount that household needs per month to live	PIE	-7.13
	BPAC	36.26
BEST15 indicators: R^2 adjusted =0.600		
Next best five indicators:	Total Accuracy	81.98
▪ Lighting: Public grid with legal socket in house	Poverty Accuracy	60.56
▪ Black and white TV ownership	Non-Poverty Accuracy	91.79
▪ Number of female adult household members	Undercoverage	39.44
▪ Value of color TV's	Leakage	17.93
▪ Number of sari owned by the household	Pred. Pov. Incidence	24.66
▪ Did households have access to VGF/VGD in the community?	PIE	-6.76
	BPAC	39.04
Dropped variables:		
▪ Number of ceiling fans owned by the household		

Model 8 is similar to Model 7, but includes the two best expenditure variables combined with five powerful subjective variables. The five best subjective variables are:

- In the last 7 days, how many days lentils were served to the household members in a main meal?
- In the last 30 days, for how many days did your household not have enough to eat everyday?
- Household feels that clothing expenses are below need
- Number of steps above the step identified as the respective poverty line
- Amount that household needs per month to live

The incorporation of these variables increased the model's performance to a level between Model 3 and 4. Four of these seven variables were already selected in the BEST5 set, and six of them are included in the BEST10 and BEST15 sets. This reflects the importance of incorporating subjective and expenditure variables — even though they are not easy to verify.

The adjusted R-squared values ranged between 0.564 and 0.600. As in Model 7, the BEST15 set achieved the best performance.

3.9 MODEL 9

Model 9 used a set of 113 regressors which are usually found in the World Bank's LSMS surveys.

This model performed similarly to Model 4 in terms of the five accuracy measures. The BEST15 set achieved the highest level of Total Accuracy and Poverty Accuracy (80.6% and 56.57%, respectively), as well as the best PIE and BPAC measures (-7.88 and 31.47 percentage points, respectively). However, with regard to Non-Poverty Accuracy and Leakage, the BEST10 set performed best.

Table 3.9.1 — Summary of the accuracy results, Model 9

Variables	Model performance (%, percentage point)	
BEST5 indicators: R^2 adjusted = 0.542		
▪ Household has a checking account	Total Accuracy	78.47
▪ What is the size of these rooms in square feet?	Poverty Accuracy	52.19
▪ Average clothing expenditures per capita, past 12 month	Non-Poverty Accuracy	90.51
▪ Total value of land	Undercoverage	47.81
▪ Value of radio, TV, VCR and CD players	Leakage	20.72
	Pred. Pov. Incidence	22.90
	PIE	-8.50
	BPAC	25.10
BEST10 indicators: R^2 adjusted = 0.572		
Next best five indicators:	Total Accuracy	79.85
▪ Cooking fuel is purchased bamboo, wood or sawdust	Poverty Accuracy	53.78
▪ Value of formal savings spouse	Non-Poverty Accuracy	91.79
▪ Number of milk cows owned by the household	Undercoverage	46.21
▪ Number of household members with no schooling or incomplete grade 1,except head	Leakage	17.93
	Pred. Pov. Incidence	22.53
▪ Number of saris owned by household	PIE	-8.87
	BPAC	25.50
BEST15 indicators: R^2 adjusted =0.584		
Next best five indicators:	Total Accuracy	80.60

Variables	Model performance (%, percentage point)	
▪ Squared age of household head	Poverty Accuracy	56.57
▪ Household has improved toilet	Non-Poverty Accuracy	91.61
▪ Cooking fuel is collected bamboo, wood or sawdust	Undercoverage	43.43
▪ Roof with leaves, jute stick or straw	Leakage	18.33
▪ Number of motor tillers owned by household	Pred. Pov. Incidence	23.53
	PIE	-7.88
	BPAC	31.47

3.9.1 RESULTS FROM OTHER SINGLE-STEP REGRESSION TECHNIQUES — QUANTILE, PROBIT, AND LINEAR PROBABILITY MODEL

In contrast to the two-step models presented in the next chapter, which use two regression runs, here we present single-step regressions — i.e., regressions that consist of only one run.

In the previous nine sections, we presented models that were estimated in a single run (termed "single-step") with the OLS regression technique using the continuous dependent variable logarithm of daily per-capita expenditures. Annex E, Table 1, summarizes their results, whereas Annex F, Table 1, shows the BEST15 regressors for each of the nine models.

Alternative single-step regression techniques include Probit, Quantile Regression, and Linear Probability Models. The Linear Probability Model (LPM) and the Probit model have as dependent variable a dummy variable that is coded one if the household is very poor and zero otherwise. The LPM model is also estimated with OLS using the SAS package, and the selection of BEST15 regressors is done by the MAXR procedure.

In the Probit and the Quantile regressions, it is not feasible to use the MAXR procedure to select the set of BEST15 regressors. In order to test the accuracy performance of the Quantile Regression model (which uses the log of daily per-capita expenditures as the dependent variable), the BEST15 regressors set (as it was determined by the OLS-MAXR regression) is used. The Quantile Regression models are estimated with the STATA software package, whereas the Probit model is estimated with SAS. For the Probit model, where the dependent variable is a dummy variable similar to the LPM, we use the BEST15 regressors that were identified in the LPM model with the SAS MAXR procedure. The Probit model (like the LPM model) estimates the probability of a household being below the poverty line.

Table 3.9.2 — Summary of the accuracy results from the single-step regression techniques for Model 1

Model 1 Poverty rate: 31.41%	Adj. R^2	% Total Accuracy	% Poverty Accuracy	% Under-coverage	% Leakage	PIE (% points)	BPAC (% points)
Single-step methods — MAXR variable selection							
OLS	0.717	86.36	69.32	30.68	12.75	-5.63	51.39
Quantile Regression (estimation point: 42)		86.23	77.69	22.31	21.51	-0.25	76.89
Linear Probability	0.425	85.73	70.12	29.88	15.54	-4.51	55.78
Probit		86.61	75.30	24.7	17.93	-2.13	68.53

Annex E, Table 3, presents the accuracy performance for these alternative single-step regression techniques. We restrict the testing of these alternative regression techniques to four sets of regressors, namely Model 1, 4, 7, and 9, and estimate the models only with a set of fifteen regressors.

For Model 1, we show the complete results for accuracy performance in Table 3.9.2.

For the set of regressors as identified as Model 1 (see Annex E, Table 3), Quantile Regression is the best single-step regression technique in terms of maximizing BPAC. Through an iterative procedure involving a series of regressions with the given set of BEST15 regressors, alternative percentile points of estimation for the quantile model are tested in order to maximize BPAC. With an optimal point of estimation set at the 42nd percentile, the Quantile Regression achieves a PIE of -0.25 percentage points. In other words, this model almost perfectly predicts the observed poverty rate. Moreover, the value for Poverty Accuracy is 77.69 percent, and for BPAC it is 76.89 percentage points. In comparison with the single-step OLS regression technique, the gains in Poverty Accuracy and Balanced Poverty Accuracy Criterion from using the Quantile Regression technique are considerable.

Similar results concerning the differences in accuracy performance between the four alternative single-step regression techniques are shown next. The tables below present the results for the sets of regressors termed Model 4, 7, and 9, respectively.

Table 3.9.3 —Summary of the accuracy results from the single-step regression techniques for Model 4

Model 4 Poverty rate: 31.41%	Adj. R^2	% Total Accuracy	% Poverty Accuracy	% Under-coverage	% Leakage	PIE (% points)	BPAC (% points)
Single-step methods — MAXR variable selection							
OLS	0.598	80.60	59.76	40.24	21.51	-5.88	41.04
Quantile Regression (estimation point: 42)		79.85	68.53	31.47	32.67	0.38	67.33
Linear Probability	0.352	82.10	63.35	36.65	20.32	-5.13	47.01
Probit		82.23	68.13	31.87	24.70	-2.25	60.96

Model 4 represents the set of regressors that excludes the total value of household assets and all expenditure variables. It includes all subjective poverty indicators and most indicators from the practitioner tools. Table 3.9.3 compares the accuracy performance of four single-step regression techniques for the set of regressors termed Model 4. The best regression technique is the single-step Quantile. This technique achieves a value for BPAC of 67.33 and a value of PIE of 0.38 percentage points. Compared to the other regression techniques, this is a noticeable improvement.

Table 3.9.4 — Summary of the accuracy results from the single-step regression techniques for Model 7

Model 7 Poverty rate: 31.41%	Adj. $\mathbf{R^2}$	% Total Accuracy	% Poverty Accuracy	% Under-coverage	% Leakage	PIE (% points)	BPAC (% points)
Single-step methods -MAXR variable selection							
OLS	0.481	79.10	51.00	49.00	17.53	-9.89	19.52
Quantile Regression (estimation point: 43)		77.97	64.14	35.86	34.26	-0.50	62.55
Linear Probability	0.293	80.1	57.37	42.63	20.72	-6.88	35.46
Probit		79.73	60.56	39.44	25.10	-4.5	46.21

Model 7 represents the set of regressors that only includes poverty indicators that the survey firm rated as easily verifiable (score 4 or 5). Annex D, Table 1, provides the ratings for all regressors. Table 3.9.4 compares the accuracy performance of the four single-step regression techniques for the set of regressors termed Model 7. The best regression technique in terms of BPAC is again the Quantile model. This technique achieves a value for BPAC of 62.55 percentage points and a value of PIE of -0.5 percentage points. Compared to the other regression techniques (especially OLS), this result of the best single-step regression technique again constitutes a considerable improvement with respect to BPAC.

Table 3.9.5 — Summary of the accuracy results from the single-step regression techniques for Model 9

Model 9 Poverty rate: 31.41%	Adj. R^2	% Total Accuracy	% Poverty Accuracy	% Under-coverage	% Leakage	PIE (% points)	BPAC (% points)
Single-step methods — MAXR variable selection							
OLS	0.552	80.86	57.37	42.63	18.33	-7.63	33.07
Quantile Regression							
(estimation point: 44)		81.98	72.91	27.09	30.28	1.00	69.72
Linear Probability	0.325	82.60	61.35	38.65	16.73	-6.88	39.44
Probit		82.48	65.34	34.66	21.12	-4.26	51.79

Model 9 represents the set of regressors that is usually contained in Living Standard Measurement Surveys (LSMS). Table 3.9.5 compares the accuracy performance of four single-step regression techniques for the set of regressors termed Model 9. The best regression technique in terms of BPAC is, as in the previous models, the Quantile model. This technique achieves a value for BPAC of 69.72 percentage points and a value of PIE of 1 percentage point. Compared to the other techniques, this result of the best single-step regression technique again constitutes a considerable improvement with respect to BPAC.

In conclusion, the use of Quantile Regression techniques (and to a lesser extent also Probit) allows us to considerably improve the accuracy performance compared to single-step Ordinary Least Squares (OLS). The superiority of single-step quantile holds true for all four sets of regressors (i.e. Model 1, 4, 7, and 9) which were tested in this section. In the next chapter, the accuracy performance of the two-step methods is explored.

4 TWO-STEP MODELS

4.1 INTRODUCTION

The accuracy measures presented in Models 1 through 9 refer to the accuracy of the models in predicting the average poverty status for all expenditure percentiles in the full sample. However, they do not take into account the differences in accuracy observed at different levels of expenditure (benchmark indicator "daily expenditures per capita"). The models presented in Chapter 3 exhibit a high Total Accuracy, but a lower Poverty Accuracy. They underestimated the Actual Poverty Incidence by a margin as large as 11 percentage points. The relatively low performance of the OLS models is partly driven by the level of the actual incidence of the very poor (at 31.4%). The more a country's poverty rate deviates from a level of 50 percent, the more the single-step OLS models tend to show a weaker performance.

In order to further improve the estimation of poverty status, we employed a two-step approach (see Grootaert et al., 1998) that breaks down the differences in the accuracy measures by deciles of the benchmark indicator. The original model is evaluated by comparing the level of the predicted per capita expenditures against different cut offs (at percentile level) from the benchmark indicator, for the full sample (step one). In step two, the model is estimated using a subsample that only includes those households whose predicted expenditures fall below the different cut offs, in order to identify the best regressor set for that subsample. The estimation in step two is repeated with OLS, using the MAXR routine of SAS. Finally, the combined accuracy level of the two models is calculated by considering the predicted status from step one for the households with predicted expenditures above the different cut offs and the predicted status from step two for the subsample of predicted expenditures below the corresponding cut offs.

In the remaining part of this introduction, we present in detail first the results of the two-step OLS approach for the BEST15 regressor set of Model 1. Sections 4.2 to 4.4 present the results for similar two-step OLS approaches but using alternative sets of regressors, as defined by Models 4, 7, and 9. Overall, the two-step OLS models have a much better performance than the single-step OLS models presented in Chapter 3. The models lead to an improvement in Poverty Accuracy and a reduction of the PIE. Also, the BPAC increases noticeably (see Annex E, Table 2). Section 4.5 combines the two-step approach with the three alternative regression techniques, i.e., Quantile, Probit, and Linear Probability Model. For Models 7 and 9, the two-step Quantile Regression technique achieved the highest BPAC of over 67 percentage points and PIE values near 0 percentage points. For the regressors set constituting Model 1 and 4, the highest BPAC was observed in the two-step LPM technique, with values above 70 percentage points. The results show that in general, for the case of Bangladesh, the Quantile and LPM regression techniques perform well and can achieve a fairly good accuracy performance.

4.1.1 FIRST STEP — MODEL 1, BEST15 SET ON FULL SAMPLE

We first evaluate the performance of Model 1 with the BEST15 regressors. Table 4.1.1 presents the results, which correspond to the results already shown in Table 3.1.2.

Table 4.1.1 — Accuracy level for the BEST15 regressor set

Measure	Level
Total Accuracy	86.36 %
Poverty Accuracy	69.32 %
Non-Poverty Accuracy	94.16 %
Undercoverage	30.68 %
Leakage	12.75 %
PIE	-5.63 % points
BPAC	51.39 % points

Table 4.1.2 presents a comparison of the predicted expenditures and the actual expenditures, both expressed in *Taka*. It can be observed that the model tended to overestimate the level of expenditures, especially in the extremes of the distribution, while it underestimated the expenditures around the mean. Nevertheless, the predicted poverty incidence was 5.63 percentage points lower than the actual poverty incidence (negative PIE).

Table 4.1.2 — Comparison between predicted and actual expenditures

Variable	Minimum	Maximum	Mean	Std. Deviation
Actual daily expenditures per capita, *Taka* (benchmark)	7.45	151.44	35.96	22.35
Predicted daily expenditures per capita, *Taka*	8.48	165.69	34.53	18.54

4.1.2 SECOND STEP AND COMBINED ACCURACY OF THE TWO-STEP MODEL

By testing the set of variables from Model 1 on the different subsamples (e.g. all expenditure percentiles above the headcount rate), the new BEST15 regressor sets were identified. Afterwards, the combined accuracy measures for all subsamples were determined and the optimal subsample was selected. For this, the main evaluation criterion was the maximization of BPAC.

Following this approach, the highest BPAC level was found when using the 55^{th} percentile as the cutoff point for the subsample estimated in the second step. The combined accuracy measures from the two-step model are presented in Table 4.1.3.

It can be observed for the subsample that while the adjusted R^2 value was lower than in the BEST15 set from the first step (0.717), the model performed better. In spite of a slightly decrease on Total Accuracy (from 86.36 to 86.23%), Poverty Accuracy increased 7.17 percentage points. While Undercoverage decreased, Leakage increased by 7.57 percentage points. The predicted poverty incidence increased, deriving on a PIE level of -1 percentage points, 4.63 points higher than in the single-step model.

BPAC increased from 51.39 percent in the single-step model to 73.31 percent, which translates into an increase of 21.92 percentage points.

Table 4.1.3 — Combined accuracy from two-step estimation, Model 1

Measure	Percentile 55th
Number of observations in the subsample	438
Adjusted R^2 for the subsample	0.487
Total Accuracy (%)	86.23
Poverty Accuracy (%)	76.49
Undercoverage (%)	23.51
Leakage (%)	20.32
PIE (% points)	-1.00
BPAC (% points)	73.71

Table 4.1.4 presents the BEST15 regressor set obtained for the subsample at the 55th percentile. The BEST15 set from the first step (corresponding to BEST15 in Table 3.1.2) is presented for comparison. Six variables (shaded in gray) appear to be important in both steps of the model. These were:

- Average clothing expenditures per capita, past 12 months
- Value of dowry received by household
- Household expenditure on health in last 12 months
- Annualized total household expenditures
- Total value of household assets
- Number of household members who can read only

It is important to mention that none of these variables was considered easily verifiable.

Table 4.1.4 — BEST15 regressor sets derived from the second step

Variables	Full sample	Percentile 55th
Household has a checking account	X	
Cooking fuel is collected bamboo, wood, or sawdust	X	
Percentage of dependents younger than 14 and older than 60 years (in relation to household size)	X	
House structure: Good	X	
In the last 7 days, how many days were lentils served to the household members in a main meal?	X	
Household feels that clothing expenses are below need	X	
Average clothing expenditures per capita, past 12 months	X	X
Value of dowry received by household	X	X
Value of formal savings spouse	X	
Household expenditure on health in last 12 months	X	X
Household expenditure on home in last 12 months	X	
Annualized total household expenditures	X	X
Total value of household assets	X	X
Value of radio, TV, VCR, and CD players	X	

Variables	Full sample	Percentile 55th
Number of household members who can read only	X	X
Age of oldest household member		X
Percentage of dependents younger than 18 and older than 60 years (in relation to household size)		X
Quality of walls: poor		X
Do you have access to electricity in your community?		X
Number of female adult household members		X
Household belongs to a political group		X
Percentage of households in the community that have access to GOAPS		X
Household feels that child education expenses are above need		X
Number of ceiling fans owned by household		X
Total number of new regressors	15	9

The last row in Table 4.1.4 shows the number of new regressors that substitute for some of the original regressors used in step 1. The BEST15 set for the subsample rely mostly on demographic and expenditure-related variables.

A practitioner tool based on a two-step model would have to include questions which obtain information on the 15 regressors selected by the BEST15 model of the first step. In addition, the practitioner tool would need to obtain information about the new additional poverty indicators that have been identified among the BEST15 regressors (percentile 55th) of the second step.

In practice, all questions related to the first and second step (15 plus 9 indicators) can be integrated into a single interview with each household. The interviewer could begin with the BEST15 indicators in the first step and then compute an estimated per capita daily expenditure. If the estimated expenditure falls above the cutoff value for the 55th percentile, the household is rated as not very-poor and the interview can be terminated. If, however, the predicted per capita expenditure value falls below this cut off, the interview would need to be continued by asking questions related to the nine additional regressors of the second step. Based on the values obtained for the nine regressors (plus the original regressors from the first step), a second value for predicted per capita daily expenditures is computed. If this second value is below the applicable poverty line, the household is rated as very poor. In practice, however, it is recommended not to interrupt the interview for the calculation based on the first fifteen indicators, but to continue with the questions for the remaining nine poverty indicators. In this case, the calculations of one (or two) expenditure values would be done after the interview.

4.2 TWO-STEP MODEL 4

As mentioned in section 2.5, Model 4 excluded the variable “total value of household assets” as well as all expenditure variables. With this, it was possible to create a regressors set containing all subjective poverty indicators and most indicators from the practitioners’ tools. Table 4.2.1 presents the performance of the two-step approach for this set of regressors.

Table 4.2.1 — Accuracy results for Model 4

Measure	Model 4	Percentile 50th
Number of observations	799	400
Adjusted R^2 for the sample/subsample	0.598	0.378
Total Accuracy (%)	80.60	83.23
Poverty Accuracy (%)	59.76	71.31
Undercoverage (%)	40.24	28.69
Leakage (%)	21.51	24.70
PIE (% points)	-5.88	-1.25
BPAC (% points)	41.04	67.33

Among the subsamples, the highest combined BPAC was found at the 50th percentile. Total Accuracy increased 2.63 percentage points. Poverty Accuracy registered a considerable increase of 11.55 percentage points (meaning a similar reduction in Undercoverage). Leakage increased by only 3.19 percentage points.

The two-step approach predicted a higher incidence of poverty than that predicted by the single-step model. PIE changed from -5.88 to -1.25 percentage points, reducing the difference between predicted and observed poverty headcount. The gains in BPAC derived from this approach reach 26.32 percentage points.

4.3 TWO-STEP MODEL 7

As explained in Chapter 2, Model 7 was constructed using the variables that DATA, the survey firm, rated as easy verifiable. Table 4.3.1 presents the performance of the two-step approach for this set of regressors.

Table 4.3.1 — Accuracy results for Model 7

Measure	Model 7	Percentile 46th
Number of observations	799	352
Adjusted R^2 for the sample/subsample	0.481	0.227
Total Accuracy (%)	79.10	79.84
Poverty Accuracy (%)	51	57.37
Undercoverage (%)	49	42.62
Leakage (%)	17.53	21.51
PIE (% points)	-9.89	-6.63
BPAC (% points)	19.52	36.25

Among the subsamples, the highest combined BPAC was found at the 46th percentile. Despite Total Accuracy presented only a minor increase of 0.74 percentage points, Poverty Accuracy registered a larger increase of 6.37 percentage points. Undercoverage decreased around 6 percentage points, and Leakage increased by around 3.98 percentage points.

The two-step approach predicted a higher incidence of poverty than that predicted by the single step model. PIE improved from -9.89 to -6.63 percentage points, reducing the difference between predicted and observed poverty headcount. The gains in BPAC derived from this approach reach 16.73 percentage points.

4.4 TWO-STEP MODEL 9

As presented in the previous chapter, Model 9 incorporated 113 variables which are commonly found in LSMS datasets.

Table 4.4.1 — Accuracy results for Model 9

Measure	Model 9	Percentile 45th
Number of observations	799	324
Adjusted R^2 for the sample/subsample	0.584	0.293
Total Accuracy (%)	80.60	82.98
Poverty Accuracy (%)	56.57	68.92
Undercoverage (%)	43.43	31.08
Leakage (%)	18.33	23.11
PIE (% points)	-7.88	-2.50
BPAC (% points)	31.47	60.96

The highest combined BPAC was found at the 45th percentile. For the second step, the subsample consisted on 324 households and the model yielded an adjusted R^2 of 0.293, considerably lower than for the single-step (full sample) model.

With respect to the accuracy measures, a general improvement can be observed. Total Accuracy increased 2.38 percentage points. Poverty Accuracy increased from 56.57 to 68.92 percent, yielding a change of 12.35 percentage points. Leakage increased 4.78 percentage points. PIE improved reaching -2.5 percentage points and the gain in BPAC was 29.49 percentage points, which is the largest increase among the four models presented in this chapter

4.5 RESULTS FROM OTHER TWO-STEP REGRESSION TECHNIQUES — QUANTILE, PROBIT, AND LINEAR PROBABILITY MODEL

The previous three sections have presented models that were estimated with the OLS regression technique using the continuous dependent variable logarithm of daily per-capita expenditures. Annex E, Table 2, summarizes their results, whereas Annex F, Table 2, shows the BEST15 regressors for each of the three regressions using different sets of regressors (i.e. Model 1, 4, 7, and 9).

Similar to single-step regression techniques, alternative formulations of the two-step approach again consist of using the Probit, Quantile, and Linear Probability Models as alternative regression techniques. For example, in a two-step modeling framework, a two-step Probit model consists of running two Probit regressions. Similar to the above OLS models, the first run includes the full sample, whereas the second subsample includes a subset of poorer households.

As already mentioned in section 3.10, the Linear Probability Model and the Probit model have as dependent variable a dummy variable that is coded one if the household is very poor and zero otherwise. Similar to the OLS regression technique presented in sections 4.1 to 4.4, the Quantile Regression model uses the log of daily per-capita expenditures as the dependent variable. Similar to the single-step models, the regressors used in the two-step Quantile Regressions are the same as those identified by SAS MAXR for the two-step OLS regressions. In addition, the percentile cutoff point for the second-step subsample in Quantile Regressions is the same as the one determined in the two-step OLS model. Moreover, the point of estimation for the first step Quantile Regression is similar to the one found optimal for the single-step

Quantile model presented in Chapter 3. To identify the optimal second point of estimation for the second-step Quantile Regression, we again employ an iterative procedure that runs a series of regressions with the given set of BEST15 regressors (as determined by the second-step OLS regression). Also similar to the single-step models, the regressors used in the two-step Probit regressions are the same as those identified by SAS MAXR for the two-step LPM regressions, and the cutoff point for the subsample in the two-step Probit is the same as in the LPM model.

We restrict the testing of the three alternative two-step regression techniques to four sets of regressors, namely Model 1, 4, 7 and 9. Again, the models are estimated with a set of best fifteen regressors.

For Model 1, the results concerning the accuracy performance of the four two-step regression techniques are shown in Table 4.5.1.

Table 4.5.1 — Summary of the accuracy results of two-step regression techniques for Model 1

Model 1 Poverty rate: 31.41%	Adj. R^2	% Total Accuracy	% Poverty Accuracy	% Under-coverage	% Leakage	PIE (% points)	BPAC (% points)
Two-step methods — MAXR variable selection							
OLS Percentile 55th	0.487 subsample	86.23	76.49	23.51	20.32	-1.00	73.31
Quantile Regression (estimation points 42, 26) Percentile 55th		85.48	76.89	23.11	23.11	0	76.89
Linear Probability Percentile 57th	0.402 subsample	88.11	80.88	19.12	18.73	-0.13	80.48
Probit Percentile 57th		86.98	78.09	21.91	19.52	-0.75	75.69

Table 4.5.1 shows the accuracy performance of the three alternative two-step regression techniques. The OLS model is similar to the one presented in section 4.1.2. For the set of regressors as identified by Model 1, the above table shows that the best two-step regression technique in terms of maximizing BPAC is the Linear Probability Model. Using the poorest 57 percent as the subsample for the second step, the LPM achieves a PIE of –0.13 percentage points. In other words, this model almost perfectly predicts the observed poverty rate. The value for Poverty Accuracy is 80.88 %, and for BPAC it is 80.48 percentage points.

For Model 4, the results concerning the accuracy performance of the four two-step regression techniques are shown in Table 4.5.2.

For the set of regressors termed Model 4, Table 4.5.2 shows that the best two-step regression technique in terms of maximizing BPAC is again the Linear Probability Model. Using the poorest 53 percent , the LPM achieves a PIE of 0.13 percentage points.. In other words, this model almost perfectly predicts the observed poverty rate. The value for Poverty Accuracy is 74.5 percent and for the BPAC 74.1 percentage points. In comparison with the two-step OLS regression technique, results in Poverty Accuracy and BPAC from using two-step LPM have improved.

Table 4.5.2 — Summary of the accuracy results of two-step regression techniques for Model 4

Model 4 Poverty rate: 31.41%	Adj. R^2	% Total Accuracy	% Poverty Accuracy	% Under-coverage	% Leakage	PIE (% points)	BPAC (% points)
Two-step methods — MAXR variable selection							
OLS Percentile 50th	0.378 subsample	83.23	71.31	28.69	24.70	-1.25	67.33
Quantile Regression (estimation points 42, 24) Percentile 50th		82.06	72.51	27.49	27.89	0.13	72.11
Linear Probability Percentile 53rd	0.331 subsample	83.85	74.5	25.5	25.9	0.13	74.10
Probit Percentile 53rd		82.23	70.52	29.48	27.09	-0.75	68.13

For Model 7, the results concerning the accuracy performance of the four two-step regression techniques are shown in Table 4.5.3.

Table 4.5.3 — Summary of the accuracy results of two-step regression techniques for Model 7

Model 7 Poverty rate: 31.41%	Adj. R^2	% Total Accuracy	% Poverty Accuracy	% Under-coverage	% Leakage	PIE (% points)	BPAC (% points)
Two-step methods — MAXR variable selection							
OLS Percentile 46th	0.227 subsample	79.84	57.37	42.62	21.51	-6.63	36.25
Quantile Regression (estimation points 43, 22) Percentile 46th		79.72	68.53	31.47	33.07	0.50	66.93
Linear Probability Percentile 48th	0.179 subsample	81.22	68.12	31.87	27.88	-1.25	64.14
Probit Percentile 48th		81.98	68.53	31.47	25.9	-1.75	62.94

For the set of regressors termed Model 7, Table 4.5.3 shows that the best two-step regression technique in terms of maximizing BPAC is the Quantile Regression. With points of estimation set at the 43rd percentile for the first step and at the 22nd percentile for the second step and using the poorest 46 percent (equal to the two-step OLS) as the subsample for the second step, the Quantile Regression achieves a PIE of 0.5 percentage points. In other words, this model almost perfectly predicts the observed poverty rate. Moreover, the value for Poverty Accuracy is 68.12 percent and the value for BPAC is 66.93 percentage points. In comparison with the two-step OLS regression technique, gains in Poverty Accuracy and BPAC from using the two-step Quantile Regression are considerable.

For Model 9, the results concerning the accuracy performance of the four two-step regression techniques are shown in Table 4.5.4.

Table 4.5.4 — Summary of the accuracy results of two-step regression techniques for Model 9

Model 9 Poverty rate: 31.41%	Adj. R^2	% Total Accuracy	% Poverty Accuracy	% Under-coverage	% Leakage	PIE (% points)	BPAC (% points)
Two-step methods — MAXR variable selection							
OLS Percentile 45th	0.293 subsample	82.98	68.92	31.08	23.11	-2.50	60.96
Quantile Regression (estimation points 43, 22) Percentile 45th		83.48	74.50	25.50	27.09	0.50	72.98
Linear Probability Percentile 43rd	0.213 subsample	84.85	73.71	26.29	21.91	-1.37	69.32
Probit Percentile 43rd		84.61	73.71	26.29	22.71	-1.13	70.12

For the set of regressors termed Model 9 (i.e., the regressors usually contained in LSMS data sets), Table 4.5.4 shows that Quantile Regression is the best two-step regression technique in terms of maximizing BPAC. With points of estimation set at the 43rd percentile for the first step and at the 22nd percentile for the second step and using the poorest 45 percent (equal to the two-step OLS) as the subsample for the second step, the Quantile Regression achieves a PIE of 0.50 percentage points. In other words, this model almost perfectly predicts the observed poverty rate. Moreover, the value for Poverty Accuracy is 74.50 percent, and for BPAC it is 72.98 percentage points. In comparison with the two-step OLS regression technique, the results in Poverty Accuracy and BPAC from using the two-step quantile regression have again considerably improved.

Annex E, Table 3, presents the accuracy performance for these alternative two-step regression techniques and shows the results for the four single-step regression techniques that were already presented in section 3.10. The table shows that the two-step Linear Probability technique achieves the highest BPAC for the first two sets of regressors (i.e., Models 1 and 4), whereas in Model 7 and 9 the highest BPAC is achieved using the Quantile Regression technique. Annex F, Table 3, shows the set of regressors that were used by these two-step techniques with the best BPAC results.

5 PRACTITIONER TOOLS

5.1 LOAN-SIZE TOOL

5.1.1 INTRODUCTION

Loan size has been used in the past as an indicator of poverty (see Schreiner, 2001, and the Microenterprise Results Reporting database). In this chapter, we test this indicator, along with other variables, for accuracy in predicting the poverty status of borrowers.

In the sample of 800 households, there are 345 households with adult members who are current clients of financial institutions. In these 345 households, a total of 476 adults had obtained a loan from a formal financial institution. The following table shows the type of institutions and their market share of the total of 476 clients, in absolute number of loans and percentage share.

Table 5.1.1 — Share of clients according to type of financial institution

Type of organization	Frequency	Percentage
Public Bank (main or exclusive ownership by government)	138	29.0
Private Bank (main or exclusive ownership by private investor)	83	17.4
Cooperatives (main or exclusive ownership by members)	1	0.2
Top 45 MFI-NGOs in Bangladesh*	189	39.7
Other NGO providing microfinance service	42	8.8
Other governmental institution providing microfinance	19	4.0
Other governmental institution providing microfinance and business development service	1	0.2
Private firm or institution providing microfinance and business development service	3	0.6
Total	**476**	**100.0**

*As classified in the Microfinance Statistics by Credit and Development Forum, Bangladesh.

5.1.2 ACCURACY OF INDICATORS OF LOAN SIZE

In the survey we asked for the size of the first loan (see Section I of composite questionnaire). As loan size usually progresses over time, we then asked about the size of current outstanding (not fully repaid) loans. If all loans were fully repaid at the time of the survey, we asked about the size of the most recent loan.

The average values of loan size and total debt, by type of organization, are presented in the following table (n=345 households).

Table 5.1.2 — Average loan size by type of financial institution

Type of financial institution	First loan: Average amount borrowed, *Taka*	Most recent loan: Average amount borrowed, *Taka*	Maximum size of most recent loan, *Taka*	Total outstanding debt per household, *Taka* (n=198)	Average size of outstanding loans, *Taka* (n=198)
Top 45 NGOs in Bangladesh, and Grameen Bank (n=169)	4,155	6,766	7,347	5,107	3,753
Other NGOs and civic institutions (n=31)	4,399	8,182	9,094	4,903	4,112
Public bank or government credit program (n=119)	8,254	10,728	12,343	10,217	6,671
Privately owned bank/ coops/other institutions (excl. Grameen Bank) (n=12)	5,403	8,240	8,838	12,238	11,145
Total (n=345)	5,745	8,435	9,435	6,786	4,913

Note: $1 is approx. 60 *Taka* (as of March/April 2004, time of survey).

From the sample of 800 households, 345 households borrowed at least one time. Instead of presenting results from an OLS regression model over the sample of 345 households, we chose the more appropriate two-stage Heckman model — estimated in the first stage over 800 households (calculating the probability of being a borrower) and in the second stage testing each of the above indicators as a predictor of per-capita expenditures. The second stage in a Heckman model corrects for a potential selection bias, detecting a non-random pattern of who is a borrower and who is not. This selection bias was found to be highly significant. For example, households living in villages more distant from market and public institutions were significantly less likely to borrow. Among the three regressors for loan size, the best predictor was found to be the maximum size of most recent loans in the household. This indicator can be obtained by asking any borrowing household member about the size of the most recent loan, and — if there are multiple borrowers in a household — taking the value of the largest of these loans.

The following table shows the results of the best-fitted regression model, using the natural logarithm of the maximum size of most recent loans combined with the following control variables: household size, household size squared, age of household head, and four dummies for four out of five divisions. The regression was run with STATA as a two-stage regression model correcting for selection bias.

Table 5.1.3 — Accuracy of the best loan size indicator model

Model / Variables	Accuracy results (%, percentage points)
Best loan-size indicator model	
7 control variables +	Total Accuracy: 68.11
Maximum size of most recent loan	Poverty Accuracy: 15.23
	Non-Poverty Accuracy: 91.25
	Undercoverage: 84.76
	Leakage: 20
	PIE: -19.68
	BPAC: -49.53

One can see that the best predictor in the data set — among five potential predictors of loan size or debt available — only achieves a Total Accuracy of 68.11 percent. This model presents a very low accuracy of

15.23 percent for predicting the poverty status of the very poor (and therefore high Undercoverage). More than four out of five very-poor households are wrongly predicted as not very-poor. This result is confirmed by the deficient performance on the PIE and BPAC measures. Moreover, it is important to note that the accuracy of the loan size is overestimated with the above model as we include the control variables (and their predictive power) in the regression. Thus, these results demonstrate that loan size as a predictor of poverty can lead to high misclassifications overall — and especially among the very poor.

5.2 ACCURACY TESTS OF PARTICIPATORY WEALTH RANKING

Participatory wealth ranking (PWR) is a method of poverty assessment and targeting which relies on the information and judgment of the community members about the relative poverty of their peers' households. The process is facilitated by field investigators, and the method is described in detail in a manual on PWR by Gibbons and Simanowitz with Nkuna (1999).

In this section, the results of PWR in eight villages of four districts in Bangladesh (a total of 1655 households) are analyzed. Two DATA supervisors were trained on how to conduct PWR in February 2004, using the manual prepared by Gibbons et al. (1999). Throughout March 2004, a PWR ranking exercise was carried out by two teams, each consisting of a supervisor and two assistants. Gibbons et al. recommended that larger villages — above 100 households — be split into hamlets, since each reference group should not rank more than 100 households. In total, the households belonging to 19 hamlets in eight villages were therefore ranked by three reference groups each.

After the PWR was carried out in each of the eight villages, 40 randomly selected households were asked to complete a full benchmark questionnaire (see *www.povertytools.org*). This allowed us to calculate — for each of the 320 households — daily per-capita expenditure. These 320 households are a subset of the 799 sample households that were analyzed in Chapter 3. On the basis of this information, the 320 households were categorized as either very poor or not very-poor.

The following analysis investigates how accurate the PWR scores are in predicting a household's poverty status. [13] Section 5.2.1 investigates the quality of the data on participatory wealth ranking, following the criteria outlined by Gibbons et al. (1999). Section 5.2.2 presents the results for the whole sample first, and then searches for the so-called best score. The best score is defined as the average score from the three reference groups which achieve the highest accuracy in predicting the very poor and not very-poor.[14] We then simulate by how much accuracy improves if we consider two subsamples, one with fairly consistent scores and another with highly consistent scores. Section 5.2.3 examines how much accuracy will increase if the best score is calibrated to smaller geographical units — i.e., to the four sample districts, to the eight survey villages, and finally to the 19 hamlets. Section 5.2.4 summarizes our findings.

5.2.1 QUALITY OF THE DATA FROM PARTICIPATORY WEALTH RANKING

Scores from PWR range between any positive number and the maximum score of 100. A higher score means more poverty relative to the other community members. As explained in the PWR manual, three reference groups each assign a score to each household in the community.

Each household in a hamlet was given a PWR score by three independent reference groups. A reference group consists of several women volunteers who are members of the hamlet in which the PWR is carried out. Following Gibbons and Simanowitz with Nkuna (1999), a set of three scores given by three independent reference groups is considered consistent if the difference between any of the three scores is 25 or less. In Table 5.2.1 and Table 5.2.2, the third column shows the percentage of households that are consistently scored. Table 5.2.1 refers to all 1655 households in the 8 villages, whereas Table 5.2.2 refers only to the 320 survey households for which the benchmark expenditure data is available. Column 2 shows the percentage of households for which two of the three scores are within the limit of 25, while with

the third score differs from the other by less than 50. Scores shown in Column 2 are good, and can be used directly for wealth ranking.

When only one of the three scores matches by a difference of 25, it means that the difference with respect to the other scores could be in the range from above 25 to less than 50 or from 50 and above. In the former case (see Column 1b), this somewhat inconsistent score can still be averaged with the other two scores (see Gibbons et al., 1999). In the latter case, however, a difference of 50 and above is considered highly inconsistent, and any score creating a difference of 50 and above with the other scores should not be used for analysis. In Table 5.2.1 and Table 5.2.2, Column 1 shows the percentage of sets that have none or only one out of three scores that match by a difference of 25 or less. In Column 1a, the percentage of households with such highly inconsistent scores is shown. However, if there are more than 10 percent highly inconsistent scores (difference at least equal to 50) assigned by the same reference group, a new reference group needs to be formed and a fourth score given. Formation of a new reference group is continued until a more reliable score is found, but not exceeding a maximum of five groups. Ranking can be repeated and a new reference group formed while discarding all values from the old reference group, only if scores in the group are very different from those of the two others. (see Gibbons et al., 1999, p.60-62).

In seven out of eight villages, the PWR scores are in the acceptable range (see Table 5.2.1).[15] However, we observe that the village *Chak Shadu* (code=9) exceeds the critical ten percent — a total of 11 percent of all the households ranked have highly inconsistent scores. Further information reveals that there were three hamlets in *Chak Shadu*, each handled by three different reference groups. Out of the three hamlets ranked in this village, only one hamlet called (*Uttarpara Dakta*) was consistently done (i.e., with less than 10% highly inconsistent cards). Thus, the PWR results are not of acceptable quality in *Chak Shadu* except for this hamlet. These unacceptable results might either be due to strategic response behavior by the reference groups, or by inadequate implementation of the PWR by the facilitators.

Table 5.2.1 — Score categories for all households (n=1655), by village

	Percentage of scores, by quality of score				
	Column 1: At most one score matches by a difference of 25		**Column 2: two of the three scores match by a diff of 25**	**Column 3: all three scores match by a diff of 25**	Total number of households (number of hamlets in parentheses)
Village code	**Column 1a: Difference is above 50 (Bad score)**	**Column 1b: Difference is between 26 and 49**			
Chak Shadu	11	7	19	63	214 (3)
Chak Radhika	1	18	10	71	214 (3)
Hossenpur	4	9	18	69	216 (3)
Fatepur Nand.	3	8	5	84	156 (2)
Sathbaria	1	4	3	92	272 (3)
Dimchalia	3	4	9	84	77 (1)
Kalagachhia	1	6	12	81	278 (3)
Hogalpati	2	9	9	80	278 (3)
Total	**-**	**-**	**-**	**-**	**1,655 (21)**

If we limit ourselves to the 320 households only, we see in Column 1 of Table 5.2.2, that in the village *Chak Shadu*, out of the eight households whose scores are inconsistent, there are only five percent (that is two out of 40 households) whose scores are just fairly inconsistent and can still be used. The remaining 15 percent (i.e., 6 households out of 40), however, are highly inconsistent. This exceeds by five percent the

acceptable maximum of 10 percent. In the other villages there is not much inconsistency, apart from *Holgapati* and *Fatepur Nandara*, where it is at 2.5 percent and 5 percent, respectively. These values are far below the limit of 10 percent. Therefore, the problem lies only in the village *Chak Shadu*, where two hamlets must be excluded: *Moddha Para* (18.4% inconsistency) and *Uttarpara Karig* (13.2% inconsistency).[16]

Table 5.2.2 — Score categories for all households (n=320), by village

	Percentage of scores, by quality of score				
	Column 1: At most one score matches by a difference of 25		**Column 2: two of the three scores match by a diff of 25**	**Column 3: all three scores match by a diff of 25**	
Village code	**Column 1a: Difference is above 50 (Bad score)**	**Column 1b: Difference is between 26 and 49**			Total number of households
Chak Shadu	15	5	20	60	40
Chak Radhika	0	25	12.5	62.5	40
Hossenpur	0	15	15	70	40
Fatepur Nand.	5	12.5	10	72.5	40
Sathbaria	0	2.5	5	92.5	40
Dimchalia	0	2.5	10	87.5	40
Kalagachhia	0	10	22.5	67.5	40
Hogalpati	2.5	12.5	5	80	40
Total	**-**	**-**	**-**	**-**	**320**

Based on the inspection of the data quality, we removed the two hamlets in *Chak Shadu*. Thus, the sample size for accuracy analysis is reduced by 27 households, from 320 to 293 households. We concluded that the overall quality of the remaining data was within the acceptable ranges as set out in the manual by Gibbons et al. (1999). For the analysis of accuracy, we further identified the four households (out of the 293 households) that had at least one highly inconsistent score (difference of 50 or more from the other two scores). Such "bad card" scores were removed and the remaining two scores averaged, as shown in Table 5.2.3.

Table 5.2.3 — Bad cards and calculation of the average score

Score to remove	Code of household	Formula for average score
Score 1	450, 633	(Score2 + score3) /2
Score 2	347	(Score1 + score3) /2
Score 3	462	(Score1 + score2) /2

5.2.2 DOES THE ACCURACY OF PWR IMPROVE WITH THE CONSISTENCY OF SCORES?

Based on the preceding data quality inspection and exclusion of 27 survey households, we worked with a sample of 293 households, for which the average scores were computed from a set of scores that do not differ by 50 or more points.[17]

The accuracy of the PWR was assessed through a simulation exercise. We chose an arbitrary value for the average score (say 80), and assumed that our "Participatory Wealth Ranking Poverty Assessment Tool" predicted that every household with an average PWR score with a value below 80 is not very-poor. Similarly, we assumed that our tool predicted that every household with a score of 80 or more is very poor.

Thus, in this example, the poverty assessment tool based on PWR data would be defined as follows: *Any household with an average score of 80 or above is rated as very poor, otherwise not very-poor*.

We then used this tool to calculate the predicted percentages for the very poor and not very-poor, and compared the results with the actual numbers of very poor and not very-poor households (as defined by the benchmark expenditures). For example, in Table 5.2.2.1, for the PWR tool with a cut-off score of 80, we obtain a Total Accuracy of 67.6 percent for the sample of 293 households. For this cut-off value, we also present the other four performance measures. In addition, we present PIE and BPAC. Out of the 293 households, 96 are poor.

Table 5.2.4 presents the performance measures for the entire range of PWR scores that we observed in the sample. These results were obtained by calculating the performance measures for alternative tools using the entire range of PWR scores observed in the sample. Thus, when iterating in a stepwise fashion through the entire observed range of PWR scores, accuracy levels and measures of Undercoverage and Leakage were calculated for a set of alternatively calibrated PWR tools. We were then able to identify the "best" score, i.e., the score that maximizes a certain accuracy criterion.[18] In the first report published in November 2004, we calibrated the best score in order to maximize Total Accuracy. After the introduction of BPAC as the valuation criterion, we calibrated the best scores so as to maximize the value of the BPAC.

We defined the best score as the score for which the highest value for the BPAC is reached. In Table 5.2.4, the best score is 85, and a PWR tool calibrated with the value 75 would yield the highest BPAC in the sample. This tool would achieve a value for BPAC of 49.03 percent, a Total Accuracy of 68.3 percent and a Poverty Accuracy of 54.22 percent. In other words, two out of three households would be misclassified. Among the very poor, more than half would be misclassified. One can observe from the table that choosing a tool with a higher cut-off score (for example 90) would increase Total Accuracy, but reduce the Poverty Accuracy and BPAC as Undercoverage quickly exceeds Leakage error.

Table 5.2.4 shows the variation of the five performance measures. The simulated range of the score is from 70 to 100. Within this range, accuracy increases. But, as expected, Poverty Accuracy decreases and Non-Poverty Accuracy increases.

Table 5.2.4 — Whole sample (n=293 households from eight villages in four districts of Bangladesh)

Simulated score (in percent / percentage points)	70	75	80	85	90	94	100
Total Accuracy	64.5	67.2	67.6	68.3	69.3	69.6	70.3
Poverty Accuracy	78.03	68.56	64.60	54.22	43.84	36.52	33.46
Non-Poverty Accuracy	57.91	66.54	69.06	75.16	81.71	85.72	88.25
Undercoverage	21.98	31.44	35.40	45.78	56.16	63.48	66.54
Leakage	86.37	68.66	63.49	50.97	37.53	29.30	24.11
PIE	21.10	12.20	9.20	1.70	-6.10	-11.20	-13.90
BPAC	13.64	31.34	36.51	49.03	25.21	2.34	-8.97

Table 5.2.5 deals with the subsamples of households with at least two good scores filtered from the whole sample of 293 households. Hence, the sample size retained is 257 households, of which 83 are very poor. It displays, like the previous table, the variation of performance measures in the score range from 70 to 100. The maximum Total Accuracy is only 0.9 percent better than in the whole sample while the best score is now 86.67. The value for BPAC increases by 3.99 percentage points (compared to the full sample of 293 households) indicating that an improved PWR process yields also higher accuracy results.

Table 5.2.5 — Sample with at least two good scores (n=257 households from eight villages in four districts of Bangladesh)

Simulated score (in percent / percentage points)	70	75	80	86,67	90	94	100
Total Accuracy	65	67.7	68.1	70.04	70.4	70.4	71.2
Poverty Accuracy	79.56	73.37	68.73	54.22	50.46	42.10	38.69
Non-Poverty Accuracy	58.05	64.99	67.80	77.59	79.91	83.90	86.71
Undercoverage	20.44	26.63	31.27	45.78	49.54	57.90	61.31
Leakage	87.94	73.39	67.50	46.98	43.37	42.12	33.75
PIE	21.80	15.10	11.70	0.39	-1.17	-2.40	-7.80
BPAC	12.06	26.61	32.50	53.02	49.39	43.04	17.95

Table 5.2.6 deals with the subsample of 223 households for which all three scores differ by 25 or less. Thus, it includes only the households with highly consistent scores. Depending on the cut-off score used to calibrate the PWR poverty assessment tool, Total Accuracy varies from 64.1 to 70.9 percent. Maximum Total Accuracy is achieved again with a score of 100. Total Accuracy, however, is only 0.6 percent higher than in the total sample, and actually 0.3 percent below the one with at least two good scores. With regard to the BPAC, there was an increased by 1.03 percentage points — from 53.02 percent in the previous sample (with at least two good scores) to 54.05. The best score with the highest BPAC value is now 91.67. In the sample, three good scores have been assigned to 223 households among which 74 are poor.

Table 5.2.6 — Sample with three good scores (n=223 households from eight villages in four districts of Bangladesh)

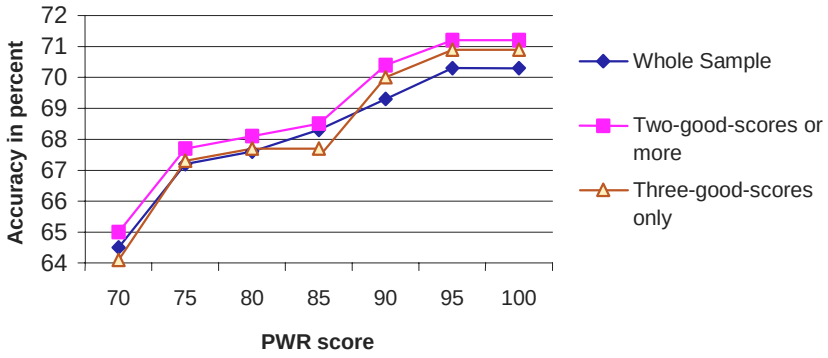
Simulated score (in percent / percentage points)	70	75	80	85	91.67	94	100
Total Accuracy	64.1	67.3	67.7	67.7	69.96	70	70.9
Poverty Accuracy	86.44	79.81	74.39	63.54	55.41	47.26	43.35
Non-Poverty Accuracy	53.01	61.09	64.38	69.77	77.18	81.29	84.58
Undercoverage	13.56	20.19	25.61	36.46	44.59	52.74	56.65
Leakage	94.62	78.35	71.72	60.87	45.95	37.67	31.05
PIE	26.90	19.30	15.30	8.10	0.45	0.45	-5.00
BPAC	5.38	21.65	28.28	39.13	54.05	54.05	32.19

Table 5.2.7 summarizes the results from the preceding three tables, and Figure 5.2.2.1 is a graphical representation of the results.

Table 5.2.7 — Levels of calibrated best score and accuracy, by quality of PWR data

Sample with different quality of PWR scores	Best score	% Total Accuracy	% Poverty Accuracy	% Non-Poverty Accuracy	% Under-coverage	% Leakage	PIE (% points)	BPAC (% points)
Whole Sample (n=293)	85	68.3	54.22	75.16	45.78	50.97	1.70	49.03
Two-good-scores or more (n=257)	86.67	68.5	56.65	74.15	43.35	46.98	0.39	53.02
Three-good-scores only (n=223)	91.67	6996	55.41	77.18	44.49	45.95	0.45	54.05

Figure 5.2.1 — Levels of accuracy in four districts, by quality of PWR data for several PWR scores



If Total Accuracy is the criterion for defining the "best" score, then the best score as shown in Tables 5.2.5 to 5.2.7 is always 100. However, if the BPAC is used to define the "best" score, then it ranges from 85 in Table 5.2.5 to a value of 91.67 in Table 5.2.6. There is only a slight improvement in Total Accuracy, from nearly 70.3 percent in the whole sample to 71.2 and 70.9 percent in the samples with two and three consistent scores, respectively. Poverty Accuracy increases with increasing quality of PWR data while Non-Poverty Accuracy decreases. The level of Total Accuracy of about 70 percent implies that if 10 households are ranked using the PWR technique, there is a risk of misclassifying three of them. The BPAC increased by 3.99 percentage points in the sample with at least two consistent scores, and by another 1.03 percentage points in the sample with three good scores. Overall, the BPAC values range from 49.03 percentage points in the full sample of 293 households to 54.05 percentage points in the subsample of 223 households with highly consistent scores. Table 5.2.1 further shows that the PIE values achieved are very satisfying. In the full sample of 293 households, the PIE value is 1.7 percent, implying that a PWR tool defining a household as poor — if it has a score of 85 or above — would overestimate the observed headcount index by only 1.7 percentage points.

Thus, Total Accuracy seems to improve only very slightly with an improved PWR process achieving a higher share of consistent scores whereas BPAC shows some noticeable improvement. In addition, there is a noticeable decline in misclassifying the very poor as not very-poor with an improved PWR process — but at the cost of having lower Non-Poverty Accuracy. Among the very poor, 6 to 7 out of 10 households would be misclassified as being not very-poor by a PWR tool calibrated with a score of 100.

How do these results compare with the accuracy performance of tools derived from the regression analysis performed in Chapter 4? For comparison, one might choose Model 7 that uses highly verifiable variables but has the weakest accuracy performance. In the two-step Quantile framework, this model achieved a BPAC value of 66.93 percent. In comparison, the PWR tool achieves a BPAC value of 49.03 percent if one takes all 297 valid cases. Hence, the use of PWR implies a loss of BPAC by about 18 percentage points. Compared to the loan size tool with a negative BPAC value, the PWR yields a considerable improvement in poverty assessment.

In the following section, we address the question whether PWR scores are more accurate in predicting the poverty status if a PWR tool is calibrated for a smaller geographical unit. We use Total Accuracy as criterion for identifying the best scores, but other accuracy performance criteria could be also be used.

5.2.3 ACCURACY OF PWR IN SMALLER GEOGRAPHICAL UNITS

PWR yields a wealth ranking score relative to all members of the same community. It is recommended by Gibbons et al. (1999) that this "community" be no larger than 100 households because reference groups

were found to have difficulty ranking over 100 households. Presumably, this occurs for the reasons given above — i.e., a person's information about peers' wealth levels quickly declines at the margin with the size of the group to be ranked. Therefore, in the eight villages, PWR was carried out in a total of 19 hamlets. As hamlets within villages differ in their wealth, and as these differences become larger with larger geographical units (villages, districts, and nation), one would expect a higher accuracy in hamlets compared to villages or districts, and the lowest accuracy in the "national sample." Another reason supporting this hypothesis is that the average information available about one's peers declines with the size and social, economic, and cultural heterogeneity of the group to be rated.

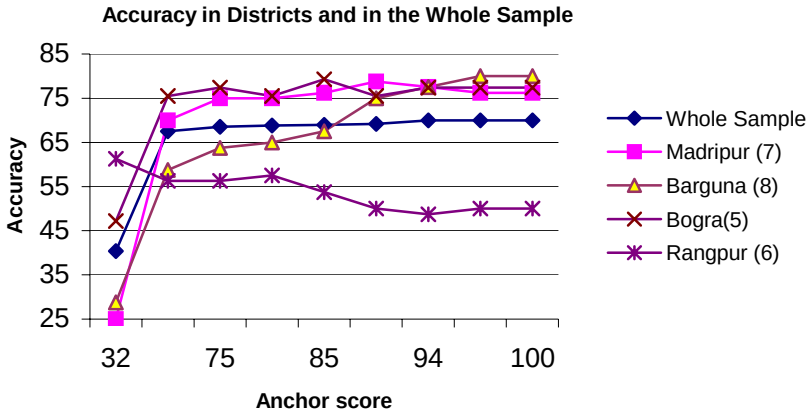
In this section, we search for the best score that maximizes not BPAC, but Total Accuracy at a lower geographical unit. In the preceding section, we calibrated one best score for the whole sample, i.e., the aggregate of 19 hamlets in eight villages of four districts in two of Bangladesh's five divisions. Compared to this "national" sample, we first search for the best score for each of the four districts, then for each of the eight villages, and then for each of the 19 hamlets.

Calibrating PWR for poverty assessment at the district level. The best scores differ significantly by district. They are summarized in Table 5.2.8, below. The best score is 93.3 in *Madaripur*, 100 in *Barguna*, 82 in *Bogra*, and only 32 in *Rangpur*.

Table 5.2.8 — Levels of best score and accuracy, by district

District	Best score	% Total Accuracy	% Poverty Accuracy	% Non-Poverty Accuracy	% Under-coverage	% Leakage	PIE (% points)	BPAC (% points)
Madaripur	93.3	78.75	0.00	95.31	100.00	31.24	-9	-18.76
Barguna	100	80.00	57.89	86.89	42.11	42.1	0	57.87
Bogra	70	79.30	31.43	97.28	68.57	56.31	13	43.69
Rangpur	32.22	61.25	35.56	68.57	64.44	68.89	39	31.11
AVERAGE	-	74.83	31.22	87.01	68.78	49.6	10.8	28.5
Whole sample (n=293)	**100**	**70.30**	**33.46**	**88.25**	**66.54**	**24.11**	**-14**	**-8.97**

Figure 5.2.2 — Graphical representation of accuracy in the whole sample and in districts (n=293 households from eight villages)



The wide range of best scores — from 32 for *Rangpur* to 100 for *Barguna* — demonstrates that PWR scores are not comparable across larger geographical areas. Total Accuracy is as low as 61.25 percent (with a Poverty Accuracy of only 35.56%) in *Rangpur*. In the other three districts, Total Accuracy ranges

between 78.75 and 80 percent. *Bogra* also has an excellent balance between Poverty and Non-Poverty Accuracy, whereas in the other two districts the tool using the best score discriminates against the very poor. Figure 5.2.2 summarizes these results.

Calibrating PWR for poverty assessment at the village and hamlet level. As expected, average accuracy of best scores in villages is still higher than in districts. From the summary table below we see that the accuracy of best scores ranges between 65 percent in *Hossenpur* to an excellent 90 percent in *Holgapati*.

Table 5.2.9 — Levels of best score and accuracy, by village

Village	Best score	% Total Accuracy	% Poverty Accuracy	% Non-Poverty Accuracy	% Under-coverage	% Leakage	PIE (% points)	BPAC (% points)
Chak Shadu	93.33	84.6	0	91.66	100	100.1	0	-0.1
Chak Radhika	70	82.5	86.67	80	13.33	33.33	8	66.67
Hossenpur	32.22	65	100	12.5	0	58.33	35	41.67
Fatepur Nandaram	87.78	65	71.4	57.9	28.6	38.09	5	61.91
Sathbaria	94.44	80	14.3	93.9	85.7	28.76	-10	-42.64
Dimchalia	87 or 90 or 93.33	80	33.3	93.5	66.7	22.39	-10	-11.01
Kalagachia	95 or 100	70	37.5	78.1	62.5	87.6	5	12.4
Hogalpati	95 or 100	90	72.7	96.6	27.3	8.96	-5	54.36
AVERAGE		**77.1**	**52**	**75.5**	**48**	**47.2**	**3.5**	**22.9**

A further increase in accuracy can be noticed if the PWR scores are calibrated at the hamlet level. The table below summarizes the results.

Table 5.2.10 — Levels of best score and accuracy, by hamlets

#	Hamlet	Best score	% Total Accuracy	% Poverty Accuracy	% Non-Poverty Accuracy	% Under-coverage	% Leakage	PIE (% points)	BPAC (% points)
1	Moddha Para	68.33	57.1	60	55.5	40	80.10	14	19.90
2	Uttarpara, Dakta	93.33	84.6	0	91.7	100	99.6	0	-0.4
3	Uttarpara, Karig	100	69.2	33.3	100	67.7	0	-31	-33.40
4	Chanundha para	71.11	76.9	87.5	60	12.5	25	8	75
5	Maddha para	71.67 or 73.33	84.6	75	88.9	25	25	0	75
6	Paschimpara	67.78	92.9	66.9	100	33.1	0	-7	33.8
7	Fakirpara, Pasch	18.89 or 32.22	78.6	100	25.1	0	30	14	70
8	*Fakirpara, Purbo*	83.33	64.7	88.9	37.5	11.1	55.6	24	44.4
9	*Uttarpara Jangi*	33.33	66.7	100	25.1	20	59.9	33	40.1
10	*Kabirazpara*	87.78	65	71.4	57.9	28.6	38.1	5	61.9

#	Hamlet	Best score	% Total Accuracy	% Poverty Accuracy	% Non-Poverty Accuracy	% Under-coverage	% Leakage	PIE (% points)	BPAC (% points)
11	*Paschimpara*	80 or 100	72.2	0.1	92.8	99.9	25.2	-17	-74.6
12	*Purbopara, Pasc*	94.44	86.4	33.3	94.8	66.7	32.9	-5	-0.47
13	*Dimchalia*	86.7 or 93.33	80	33.3	93.5	66.7	77.8	8	22.16
14	*Dakkhinpara*	64.44	70	75	66.7	25	50	10	50.1
15	*Paschimpara*	87.78 or 100	81.8	Not defined	81.8	Not defined	Not defined	2	Not defined
16	*Purbopara*	100	73.7	74.8	73.4	25.2	99.8	16	0.25
17	*Maddha P.*	88.89 or 94.44	75	0	90	100.2	50	-8	-50.2
18	*Purbopara Pasc*	86.67 or 100	94.1	83.3	100	16.7	0	-6	66.6
19	*Purbopara Pd.*	100	90.9	100	87.5	0	33.33	9	66.7
Average (19 hamlets, whole sample n=320)			**77.07**	**60.16**	**74.85**	**41.02**	**43.46**	**3.63**	**25.94**
Average excluding two hamlets of Chak Shadu (n=293)			**78.7**	**61.8**	**74.1**	**39.4**	**43.9**	**5.1**	**30.0**

Note: Not defined means that this hamlet did not have any very poor people in the sample.

5.2.4 COMPARISON OF RESULTS FOR DIFFERENT GEOGRAPHICAL UNITS

Table 5.2.11 below summarizes the results for the different geographical units. The difference in Total Accuracy between the smallest unit, the hamlet, and the largest unit observed (the "nation"), is about 8.4 percentage points The observed differences in Total Accuracy are as expected since the ranking is done with the hamlet as a reference. The PWR's accuracy is therefore much lower when used at district or national level.[19]

Table 5.2.11 — Comparison of average accuracy of PWR tools with best scores in "nation," districts, villages, and hamlets (n=293)

Level	Average of Total accuracy (%)	Poverty Accuracy(%)	Non-Poverty Accuracy (%)	Average Under-coverage (%)	Average Leakage (%)
Nation	70.30	33.46	88.25	66.54	11.75
District	74.82	31.22	87.01	68.78	12.98
Village	77.14	51.99	75.46	48.01	24.48
Hamlet	78.71	61.84	73.53	38.16	26.47

5.2.5 ACCURACY LEVELS OF ANCHORED PWR SCORES

The purpose of this section is to investigate the accuracy of "anchored" PWR scores. An anchor could be any alternative poverty indicator that is highly correlated with the benchmark indicator, and that is used to calibrate the PWR tool for a given geographical unit — i.e., to determine the cut-off value for the PWR score above (or below) which a household is classified as being very poor (or not very-poor).

While not operational in practice, the most accurate anchor is clearly the benchmark expenditure itself. In the following, we use the benchmark expenditures as anchor, and ascertain the level of maximum accuracy

that could possibly be achieved by the anchor method. We use two examples, one at the hamlet and one at the "national" level.

We illustrate the anchor method first with the example of a hamlet that has a Total Accuracy of 76.9 percent (as determined in the previous analysis). This level is close to the average Total Accuracy for all hamlets. With our simulation method — i.e., calculating the Total Accuracy level over the entire range of observable scores and choosing the one score as best score which maximizes Total Accuracy — we determined the best score for this hamlet to be 71.11 (i.e. the tool would suggest that everybody having a score of 71.11 or higher is predicted very poor by this hamlet-specific PWR tool).

In calculating the accuracy measures of the anchor method, two alternatives are considered first.

First, use the PWR score of the household closest to but above the poverty line. In the table below, the PWR scores from 13 households are listed (out of the approximately 100 households of this hamlet that were scored by PWR and for which benchmark expenditures are known). The households are sorted by per-capita daily expenditure. The poverty line is 23.1 *Taka*.

Table 5.2.12 — Per-capita daily expenditures and corresponding average PWR scores in *Chanundha* hamlet

Benchmark: daily expenditures per capita	PWR score	Remark
8.05	100.00	
16.71	88.89	
17.12	100.00	
17.58	100.00	
18.79	71.11	best score, see Table 5.2.98
19.38	35.55	
21.53	100.00	
21.98	76.66	Anchor method, alternative 2
24.78	88.89	Anchor method, alternative 1
32.35	100.00	
48.84	53.33	
55.65	42.22	
84.56	47.78	

With alternative 1, one would choose as anchor score the value 88.89 — i.e., the tool would consider as not very-poor those who have a score of 88.89 or less than 88.89 in that hamlet (or rating as very poor to those who have a score higher than 88.89).

Second, choose the score for the household that is just BELOW the poverty line. When following alternative 2, the anchor score would be 76.66, and the tool would be formulated as follows: Everybody with a PWR score greater or equal to 76.66 is rated as very poor.

The accuracy results for the two anchored PWR scores and the best score are shown below.

Table 5.2.13 — Accuracy results of anchor method in hamlet

Anchor Method	Total Accuracy (%)
Best-score method: ▪ Very poor if 71.11 or higher	76.92
Anchor method, Alternative 1l: ▪ Very poor if score is greater than 89.89	61.54
Anchor method, Alternative 2: ▪ Very poor if score is 76.66 or higher	69.23

It is obvious from this example that picking a household close (below or above) to the poverty line and then using its PWR score as anchor can lead to inaccurate and unreliable results.

Anchors calibrated for the "national" level. We now turn to the full sample of 293 households that were rated with scores of acceptable quality. Out of this sample, the following list shows households with a benchmark expenditure between 22.1 and 24.1 *Taka* per day (i.e., one *Taka* plus or minus off the poverty line). One can see that the average PWR scores from households located in different districts, villages, and hamlets range from about 27.77 to 100, but that all these households have very similar per-capita daily expenditures. Applying anchor method alternative 1 or 2 would lead to cut-off values of 73.33 and 86.67, respectively.

Table 5.2.14 — Per-capita daily expenditures and corresponding average PWR scores for households close to poverty line, national level (n=293)

District	Union	Village	Hamlet	Benchmark: daily expenditures per capita	PWR score
6	12	12	12	22.46	93.33
8	15	15	4	22.70	52.22
5	9	9	9	22.72	38.33
5	10	10	7	22.76	78.33
8	16	16	8	22.83	27.77
8	16	16	13	22.88	100.00
6	12	12	2	22.91	100.00
6	11	11	6	22.98	83.33
8	16	16	13	23.06	100.00 Best Score
5	9	9	9	23.06	46.67
7	13	13	10	23.07	86.67 Alternative 2
7	14	14	1	23.24	73.33 Alternative 1
6	11	11	5	23.44	63.33
5	9	9	9	23.80	93.33
8	15	15	11	23.90	94.44
6	12	12	2	24.03	93.33

Table 5.2.15 — Accuracy results of anchor method at "national" level (n=293)

Anchor method	Total Accuracy (%)
Best Score method: ▪ Very poor if 100 or higher	70.3
Anchor method, Alternative 1: ▪ Very poor if score is greater than 73.33	65.3
Anchor method, Alternative 2: ▪ Very poor if score is 86.67 or higher	67.7
Anchor method, Alternative 3: ▪ Very poor if score is 83.44 or higher	66.3

A third alternative would be to take the mean of households hovering around the poverty line. This is simulated, for example, by taking the mean PWR score of the five closest households above or below the poverty line. The mean is 83.44, and the tool would rate a household as being very poor if the score is 83.44 or higher.

The comparison of accuracy results for the national level show that the anchor method — even if using the best possible, but in practice not applicable, anchor — achieves levels of Total Accuracy at the "national" level that fall below those associated with the loan size tool. If one uses an operational (but more inaccurate) anchor, the levels of accuracy achieved by the anchor method will be lower as the ones displayed in

Table 5.2.15, where the benchmark expenditures (perfect anchor) are used.

5.2.6 CONCLUSION

The PWR data are of good quality, except for two hamlets that were excluded from the analysis of accuracy. The data from 293 households follow the criteria prescribed by Gibbons and Simanowitz with Nkuna (1999, p.60-62). The analysis results are as follows:

- **PWR achieves relatively low levels of Total Accuracy if used for assessing the poverty level of people living in larger geographic units.** The performance of PWR with respect to Total Accuracy improves somewhat if PWR is calibrated to smaller geographical regions. Note that the scales at the hamlet level are subjectively established, and whether a reference group distinguishes four or six wealth-differentiated groups of people in their hamlet is up to them. Moreover, their frame of reference is the people of the hamlet which is to be rated. Thus, the subjective scales of PWR cannot be compared across larger geographic units without accepting some reductions in Total Accuracy and corresponding increases in Leakage and Undercoverage.

- **PWR is a fairly accurate targeting tool to reach the poorest, if and when used in hamlets or villages, but not for larger geographic areas such as districts or the nation.** Thus, the validity of PWR as a poverty targeting tool is confirmed if it is used at the village or hamlet level. The results further confirm the theoretical expectation that subjective scales of poverty ranking, where the hamlet or community is the frame of reference, cannot be compared across populations in larger geographical units. The relatively low Total Accuracy level of PWR of only 70 percent at the "national level" and associated very low Poverty Accuracy of about 35 percent (compared to

other tools presented in this report all being evaluated at the true national level) suggest that PWR achieves relatively low accuracy as a poverty assessment tool for use in larger geographical areas, such as several districts or the nation. Moreover, as many microfinance and business development programs operate in larger geographical areas or nation-wide, the PWR's comparative advantage of using personalized, but localized information about the wealth of peers vanishes.

- **When comparing PWR with other tools at the national level, the PWR tool clearly outperforms the loan size tool which achieves a negative BPAC value.** At the "national" level (which corresponds to 297 households from four districts), the BPAC value of the PWR tool is 49.03 percent. For comparison, one might choose Model 7 that uses highly verifiable variables but has the weakest accuracy performance among all sets of poverty indicators tested in Chapter 3 and 4. In the two-step Quantile framework, this model achieved a BPAC value of 66.93 percent. Hence, the use of PWR implies a loss of BPAC by about 18 percentage points.

5.3 POVERTY INCIDENCE AMONG CLIENTS OF FINANCIAL INSTITUTIONS

In the sample of 799 households, 345 households are current clients of financial institutions. The following table shows the average daily expenditures per capita (in *Taka*) for all 345 client households, differentiated by type of financial institution.

Table 5.3.1 — Mean expenditures and poverty headcount for clients of financial institutions, by type of institution

Type of financial institution	Mean of per capita daily expenditures (*Taka*)	Percentage of households below international poverty line of $1 PPP (=23.1 *Taka* as of March 2004)
Top 45 NGOs in Bangladesh, and Grameen Bank	29.89	44.38
Other NGOs and civic institutions	42.89	11.11
Public bank or government credit program	43.65	17.97
Privately owned bank/ coops/other institutions, excluding Grameen Bank	34.60	25.00
Total clients (n=345)	**36.50**	**30.43**
Total sample (n=799)	**35.96**	**31.40**

The above table shows that NGOs and Grameen Bank are able to reach the very poor in relatively high numbers. This poverty outreach is impressive, especially given the fact that many of the so-called not very-poor in this analysis are actually falling below the national poverty line, and many above that line are highly vulnerable to poverty.

As expected, older clients have a lower poverty headcount than fairly recent clients, as shown in the following table for all 476 persons who are current clients of a financial institution. This might be due to the poverty-reduction impact of the program.[20]

Table 5.3.2 — Poverty incidence of clients of financial institution, by years of being a client

Years of being a client	Mean of per capita daily expenditures (*Taka*)	Percentage of households below international poverty line of $1 PPP (=23.1 *Taka* as of March 2004)
Less than one year	34.62	30.34
One to less than 6 years	35.09	31.30

Six to less than 11 years	41.58	18.95
More than 11 years	44.86	14.52
Total (n=476)	**37.57**	**26.47**

These results suggest that it may be necessary to only undertake poverty assessments on incoming clients or new clients. Otherwise, successful programs that have targeted the poor in the past and have raised their living standards may be penalized, which appears much in opposite to the spirit driving the legislation regarding the development and certification of poverty assessment tools.

6 SUMMARY

This report first presented nine single-step regression models, each with a set of BEST5, 10, and 15 regressors. These models were run with the Ordinary Least Squares (OLS) regression technique. Because of the level of the poverty headcount index (31.41 %), the OLS models proved not efficient to predict the percentage of very-poor households, in spite of Total Accuracy levels exceeding 76 percent. Whereas tests of the single-step OLS regression technique were performed for nine different sets of regressors, termed Model 1 through 9, the alternative single-step and two-step regression techniques were limited to four sets of regressors — Models 1, 4, 7, and 9. As in the other three test countries (Peru, Uganda, and Kazakhstan), Model 1 includes all poverty indicators enumerated in the field countries. Compared to Model 1, Model 4 excludes all expenditure categories and the total value of household assets but still contains most poverty indicators from practitioners' tools as well as subjective poverty indicators. Model 7 includes only indicators that are deemed "easily verifiable" and easy to ask by experienced survey-firm staff — it is thus the most practical model. Model 9 uses indicators similar to those found in World Bank LSMS data sets.

Apart from regression analysis, which searched for the best combinations of poverty indicators, we also tested the accuracy of two practitioner tools — the loan size tool and the Participatory Wealth Ranking tool. The loan size tool was found to have a dismal Poverty Accuracy, and was clearly outperformed by the PWR tool. Furthermore, the analysis demonstrated PWR's usefulness for poverty targeting at lower geographical levels, such as villages or hamlets. When using PWR for nation-wide assessments, the analysis revealed that the tool's accuracy performance was inferior compared to the performance of tools derived from identifying and combining poverty indicators through regression analysis.

This report also contains tests of three alternative single-step regression techniques — Probit, Quantile, and Linear Probability Model (LPM). Among those, the single-step Quantile Regression technique yielded the highest value for the Balanced Poverty Accuracy Criterion (BPAC) for all sets of regressors. In addition, we tested two-step models using the four different regression techniques.

The nine single-step OLS models show satisfactory levels of Total Accuracy, that is, they accurately predicted a large percentage of households which actually fall into a given category. However, all nine models show lower Poverty Accuracy levels, and all consistently underestimate the poverty headcount, yielding negative values of PIE. Annex E, Table 1, provides a summary of accuracy results for all nine single-step OLS models. Annex F, Table 1, summarizes the variables used as BEST15 regressors in the different models.

Considerable improvements could be achieved by using Quantile Regression techniques in a single-step framework. For Models 1, 4, 7, and 9, positive values for BPAC of over 60 percentage points could be achieved, while the value of PIE was close or equal to zero (Model 9), indicating a perfect prediction of observed poverty rate. These results constitute considerable improvements compared to the results obtained with the single-step OLS techniques.

In Annex E, Table 1, it is observed that all models estimated with single-step using Ordinary Least Squares (OLS) were less accurate for the very poor than for the not very-poor. This implies that the inaccuracies in prediction are not equally distributed over all expenditure percentiles but are systematically higher for the very poor than for the not very-poor. This problem of unbalanced accuracies can be potentially reduced by the use of two-step models, following a method pioneered by Grootaert et al. (1998). The computational costs of these models, however, are higher than single-step models.

The results of the two-step OLS models presented in Chapter 4 compare favorably with the single-step OLS models presented in Chapter 3. While the Total Accuracy of the two-step models is only marginally higher than for the OLS models, the two-step models have a clear advantage in estimating the proportion of the population that is very poor and thereby somewhat better estimating the headcount indices. As well, Poverty Accuracy improves.

We further explore alternative regression techniques in a two-step regression framework for the four different sets of regressors. Again, these are:

- Model 1 — full set of regressors
- Model 4 — all regressors except total value of assets and expenditure categories
- Model 7 — the model deemed to be most practical
- Model 9 — the model with a set of regressors usually contained in World Bank LSMS data sets

The alternative regression techniques are Quantile, Probit, and the Linear Probability Model. When considering all eight different regression techniques tested (i.e., the four single-step and the four two-step techniques), the two-step Linear Probability Model achieved the highest BPAC for the first two sets of regressors (Models 1 and 4) whereas the Quantile Regression model achieved the highest BPAC for Model 7 and 9. Annex F, Table 1, lists the set of best regressors that were used in the model achieving the highest value of BPAC.

In conjunction with tests in Uganda, Kazakhstan, and Peru, the accuracy tests in Bangladesh show that the choice of a suitable regression technique is an empirical issue. The choice is influenced by the level of the poverty rate. In countries with a low poverty rate, two-step techniques appear to yield better results in terms of the BPAC.

7 BIBLIOGRAPHY

Bangladesh Bureau of Statistics (2002). Report the Poverty Monitoring Survey May 1999. Dhaka, Bangladesh.

Bangladesh Bureau of Statistics (2003). Statistical Yearbook of Bangladesh, 22nd edition (December). Dhaka, Bangladesh.

Gibbons, D.S., Anton Simanowitz, and Benjamin Nkuna. 1999. CASHPOR-SEF Operational Manual, Cost-effective Targeting: Two Tools to Identify the Poor. Edited by Helen Todd. Produced by CASHPOR Technical Services. Sermban, Negri Sembilan, Malaysia. 74 pp.

Grootaert, Christiaan, and Jeanine Braithwaite. 1998. "Poverty correlates and indicator-based targeting in eastern Europe and the Former Soviet Union." Poverty Reduction and Economic Management Network, Environmentally and Socially Sustainable Development Network. Washington D.C.: The World Bank.

Henry, Carla, Manohar Sharma, Cécile Lapenu, and Manfred Zeller. 2003. Microfinance poverty assessment tool. Technical Tools Series No. 5, September 2003. Published by the Consultative Group to Assist the Poor (CGAP) and The World Bank, Washington, D.C. ISBN-0-8213-5674-7 (Download PDF at *http://www.cgap.org/)*.

IRIS. 2005. Note on Assessment and Improvement of Tool Accuracy. Mimeograph, Revised version from June 2, 2005. IRIS center, University of Maryland.

Matin, Imran, Marie Jo Cortijo, and Zakir Hassan. 2003. An assessment of the poverty outreach of Palli Daridro Bimochon Foundation (PDBF). Report prepared for CIDA, Canada.

Schreiner, Mark. 2001. Seven aspects of loan size. Center for Social Development, Washington University in St. Louis, Missouri.

Zeller, Manfred, Manohar Sharma, Akhter Ahmed, and Shahidur Rashid. 2002. Group-based financial institutions for the rural poor in Bangladesh: An institutional-and household-level analysis. Research report No. 120. Washington, D.C.: International Food Policy Research Institute.

Zeller, Manfred, Manohar Sharma, Carla J. Henry, and Cécile Lapenu. 2001. An operational tool for evaluating poverty outreach of development policies and projects. Discussion Paper No. 111, Food Consumption and Nutrition Division, International Food Policy Research Institute, Washington, D.C, June.). (Download PDF at *http://www.ifpri.org/*).

Zeller, Manfred. 2004. Review of Poverty Assessment Tools. Report submitted to IRIS and USAID as part of the Developing Poverty Assessment Tools Project. January 2004. (Available online at *http://www.povertytools.org*).

Zeller, Manfred, and Gabriela V. Alcaraz. 2005. Developing and testing poverty assessment tools: Results from accuracy tests in Uganda. IRIS Center, University of Maryland, College Park. First report in May 2005. Final report in August 2005 (Available online at *http://www.povertytools.org*).

Zeller, Manfred, Julia Johannsen, and Gabriela V. Alcaraz. 2005. Developing and testing poverty assessment tools: Results from accuracy tests in Peru. IRIS Center, University of Maryland, College Park. First report in February 2005. Final report in August 2005 (Available online at *http://www.povertytools.org*).

Zeller, Manfred, and Gabriela V. Alcaraz. 2005. Developing and testing poverty assessment tools: Results from accuracy tests in Kazakhstan. IRIS Center, University of Maryland, College Park. First report in June 2005, and final report in August 2005. (Available online at *http://www.povertytools.org*).

Zeller, Manfred, and Joseph Feulefack. 2005. An evaluation of participatory wealth ranking as a poverty targeting and assessment tool for various geographic levels. Unpublished manuscript, Institute of Rural Development, University of Göttingen, Germany.

ANNEXES

ANNEX A. SIZE AND DISTRIBUTION OF SAMPLE

Annex A, Table 1 — Size and distribution of Bangladesh sample

Division	District	Thana	Union	Number of survey households	Sample for Participatory Wealth Ranking
Barisal	*Barguna*	*Bamna*	*Bamna*	40	40
Barisal	*Barguna*	*Bamna*	*Dauatala*	40	40
Chittagong	*Chandpur*	*Hajiganj*	*Uttar Gandharabpur*	40	
Chittagong	*Chandpur*	*Hajiganj*	*Uttar Rajargaon*	40	
Chittagong	*Cox's Bazar*	*Chakaria*	*Dulahazara*	40	
Chittagong	*Cox's Bazar*	*Chakaria*	*Magnama*	40	
Dhaka	*Dhaka*	*Nowabganj*	*Agla*	40	
Dhaka	*Dhaka*	*Nowabganj*	*Joykrishnapur*	40	
Dhaka	*Madaripur*	*Rajoir*	*Isibpur*	40	40
Dhaka	*Madaripur*	*Rajoir*	*Paikpara*	40	40
Dhaka	*Netrokona*	*Khaliajuri*	*Khaliajuri*	40	
Dhaka	*Netrokona*	*Khaliajuri*	*Nagar*	40	
Khulna	*Jessore*	*Jessore*	*Arabpur*	40	
Khulna	*Jessore*	*Jessore*	*Lebutala*	40	
Rajshahi	*Bogra*	*Gabtali*	*Gabtali*	40	40
Rajshahi	*Bogra*	*Gabtali*	*Nepaltali*	40	40
Rajshahi	*Naogaon*	*Porsha*	*Ghatnagar*	40	
Rajshahi	*Naogaon*	*Porsha*	*Tentulia*	40	
Rajshahi	*Rangpur*	*Pirganj*	*Bara Alampur*	40	40
Rajshahi	*Rangpur*	*Pirganj*	*Mithapur*	40	40
Total				**800**	**320**

ANNEX B. DESCRIPTION OF ALL REGRESSORS

Annex B, Table 1 — Description of all regressors (N=257) by type of model (N=799)

Variables	Min.	Max.	Mean	Std. Dev.	M1	M2	M3	M4	M5	M6	M7	M8	M9
Household size	1	24	4.93	2.10	X	X	X	X	X	X	X	X	X
Household size squared	1.00	576.00	28.75	32.34	X	X	X	X	X	X	X	X	X
Age of household head	18.00	85.00	44.64	13.46	X	X	X	X	X	X	X	X	X
Division 1	0	10	0.30	0.46	X	X	X	X	X	X	X	X	X
Division 2	0	10	0.20	0.40	X	X	X	X	X	X	X	X	X
Division 3	0	10	0.10	0.30	X	X	X	X	X	X	X	X	X
Division 4	0	10	0.30	0.44	X	X	X	X	X	X	X	X	X
Household head has an account (savings, checking, or fixed term deposit)	0	1	0.18	0.38	X	X	X	X	X	X			X
Spouse has an account (savings, checking, or fixed term deposit)	0	1	0.10	0.30	X	X	X	X	X	X			X
Squared age of household head	324	7225	2173.88	1301.88	X	X	X	X	X	X			X
Age of oldest household member	20	125	49.90	15.74	X	X	X	X	X	X			
Age of youngest household member	0	70	8.14	10.47	X	X	X	X	X	X			
Total agricultural area (irrigated or not)	0	3840	74.91	222.02	X	X	X	X	X	X			X
Average age of household members, except head	1	65	15.86	7.47	X	X	X	X	X	X			
Household borrows from informal market and/or emergencies	0	1	0.68	0.47	X	X	X	X	X	X			X
Household borrowed in past 12 months from formal lenders	0	1	0.31	0.46	X	X	X	X	X	X	X	X	
Do you have bus station?	0	1	0.05	0.22	X	X	X	X	X	X	X	X	
Black and white TV ownership	0	1	0.13	0.34	X	X	X	X	X	X	X	X	X
Contribution farmers group	0	1	0.00	0.04	X	X	X	X	X	X			
Household has a checking account	0	1	0.10	0.29	X	X	X	X	X	X			X
Number of females with chronic illness	0	4	0.60	0.72	X	X	X	X	X	X			X

Variables	Min.	Max.	Mean	Std. Dev.	M1	M2	M3	M4	M5	M6	M7	M8	M9
Contribution informal credit group	0	1	0.01	0.08	X	X	X	X	X	X			
Contribution neighbors group	0	1	0.01	0.09	X	X	X	X	X	X			
Contribution other groups	0	1	0.01	0.12	X	X	X	X	X	X			
Contribution other NGO	0	1	0.00	0.05	X	X	X	X	X	X			
Contribution professional association	0	1	0.01	0.07	X	X	X	X	X	X			
Contribution sport group	0	1	0.00	0.04	X	X	X	X	X	X			
Contribution traders association	0	1	0.00	0.04	X	X	X	X	X	X			
Contribution youth group	0	1	0.01	0.09	X	X	X	X	X	X			
What is the size of these rooms in square feet?	33.75	2160	383.72	297.02	X	X	X	X	X	X			X
Exterior walls: CI sheet (corrugated tin)	0	1	0.49	0.50	X	X	X	X	X	X	X	X	X
Exterior walls: Brick/cement	0	1	0.07	0.26	X	X	X	X	X	X	X	X	X
Lighting: cannot afford light at night	0	1	0.01	0.07	X	X	X	X	X	X	X	X	X
Lighting: candles / battery lights / pocket lights	0	1	0.00	0.05	X	X	X	X	X	X			X
Lighting: tap electricity socket of neighbor / public grid	0	1	0.02	0.14	X	X	X	X	X	X			X
Lighting: Public grid with legal socket in house	0	1	0.27	0.44	X	X	X	X	X	X	X	X	X
Lighting: own private generator	0	1	0.00	0.04	X	X	X	X	X	X	X	X	X
Household has improved toilet	0	1	0.25	0.43	X	X	X	X	X	X	X	X	X
Have you made a recent home improvement in the last three years?	0	1	0.78	0.41	X	X	X	X	X	X			
Male accepts wage at poverty line ?	0	1	0.44	0.50	X	X	X	X					
Female accepts wage at poverty line ?	0	1	0.20	0.40	X	X	X	X					
Head of household is nonagricultural daily worker	0	1	0.10	0.30	X	X	X	X	X	X			X
Head of household sleeps on thin mattress made of natural fibers	0	1	0.21	0.41	X	X	X	X	X	X			
Head of household sleeps on thin mattress made of industrial fibers or thick mattress	0	1	0.02	0.14	X	X	X	X	X	X			
Household ate rice starch sometimes, often or mostly in last 12 months because food was scarce	0	1	0.12	0.32	X	X	X	X					

Variables	Min.	Max.	Mean	Std. Dev.	M1	M2	M3	M4	M5	M6	M7	M8	M9
Household ate rice starch rarely in last 12 months because food was scarce	0	1	0.12	0.32	X	X	X	X					
Cooking fuel is collected bamboo, wood or sawdust	0	1	0.23	0.42	X	X	X	X	X	X			X
Cooking fuel is purchased bamboo, wood or sawdust	0	1	0.11	0.31	X	X	X	X	X	X			X
Percentage of dependents younger than 14 and older than 60 years	0	100	39.52	21.01	X	X	X	X	X	X			
Percentage of dependents younger than 18 and older than 60 years	0	100	47.76	20.20	X	X	X	X	X	X			
Agree that most people in this village/neighborhood are basically honest and can be trusted?	0	1	0.85	0.36	X	X	X	X					
Agree that if you have a problem, there is always someone to help you?	0	1	0.85	0.36	X	X	X	X					
House structure: dilapidated	0	1	0.24	0.42	X	X	X	X	X	X	X	X	
House structure: Good	0	1	0.29	0.46	X	X	X	X	X	X	X	X	
Percentage of household members with any disability	0	50	1.29	5.63	X	X	X	X	X	X			X
Number of females with some disability	0	1	0.03	0.17	X	X	X	X	X	X	X	X	X
Household head has any disability	0	1	0.02	0.12	X	X	X	X	X	X	X	X	X
Number of males with some disability	0	1	0.03	0.17	X	X	X	X	X	X	X	X	X
Household head is divorced	0	1	0.00	0.06	X	X	X	X	X	X	X	X	X
Household ate less food for less than 10 days during past 12 months	0	1	0.12	0.32	X	X	X	X					
No lock in main entrance door	0	1	0.17	0.38	X	X	X	X	X	X	X	X	
Any sort of lock besides key lock	0	1	0.12	0.32	X	X	X	X	X	X	X	X	
Household borrows from neighbors/relatives often or mostly	0	1	0.19	0.39	X	X	X	X					
How far away the doctor chamber (km)?	0	25	6.40	6.40	X	X	X	X	X	X	X	X	
Head of household is domestic worker	0	1	0.01	0.12	X	X	X	X	X	X	X	X	X
Quality of walls: poor	0	1	0.19	0.39	X	X	X	X	X	X			
Roof with leaves, jute stick or straw	0	1	0.12	0.32	X	X	X	X	X	X	X	X	X
Roof with bamboo/wood, tiles or brick/cement	0	1	0.05	0.21	X	X	X	X	X	X	X	X	X

Variables	Min.	Max.	Mean	Std. Dev.	M1	M2	M3	M4	M5	M6	M7	M8	M9
House size: small	0	1	0.32	0.47	X	X	X	X	X	X	X	X	
House size: large	0	1	0.23	0.42	X	X	X	X	X	X	X	X	
Household usually purchases staple food fortnightly or monthly	0	1	0.19	0.39	X	X	X	X					
Household ate rarely sweet potato because other food was scarce	0	1	0.09	0.28	X	X	X	X					
Water source: Dam/pond/river/spring or open public well/borehole.	0	1	0.03	0.16	X	X	X	X	X	X	X	X	X
Water source: Well/borehole in residence yard (open or sealed with pump)	0	1	0.57	0.50	X	X	X	X	X	X	X	X	X
How many meals were served to the household members during the last 2 days?	2	6	5.75	0.69	X	X	X	X					
In the last 7 days, how many days Chicken/duck, eggs served by the household in a main meal eaten?	0	7	1.26	1.80	X	X	X	X					
In the last 7 days, how many days were lentils served by the household in a main meal eaten?	0	7	1.05	1.67	X	X	X	X				X	
In the last 30 days, for how many days did your household not have enough to eat?	0	30	4.14	6.59	X	X	X	X				X	
For how many weeks will your stock of rice last?	0	52	2.68	5.26	X	X	X	X					
Household had enough to eat, but not always the kind of food they wanted	0	1	0.39	0.49	X	X	X	X					
In last 12 months did you have to eat the same foods daily because you did not have money to buy other foods?	0	1	0.24	0.43	X	X	X	X					
In last 12 months has any adult in your household eaten less food because you did not have enough money to buy?	0	1	0.52	0.50	X	X	X	X					
Did any other adult household member lose weight in last 12 months because you did not have enough money to buy food?	0	1	0.37	0.48	X	X	X	X					
Do you have access to electricity?	0	1	0.70	0.46	X	X	X	X	X	X	X	X	
Homestead area (decimal)	0.01	120	8.29	9.81	X	X	X	X	X	X			X
Orchard/Bamboo area (decimal)	0	242	3.57	14.18	X	X	X	X	X	X			X

Variables	Min.	Max.	Mean	Std. Dev.	M1	M2	M3	M4	M5	M6	M7	M8	M9
Bush/forest/non arable area (decimal)	0	231	1.48	12.56	X	X	X	X	X	X			X
Number of relatives working elsewhere in Bangladesh and sending money	0	2	0.07	0.28	X	X	X	X	X	X			X
Number of relatives working in Dhaka and sending money	0	2	0.11	0.34	X	X	X	X	X	X			X
Number of female adult household members	0	5	1.43	0.74	X	X	X	X	X	X	X	X	X
Household did not eat for entire days in past 12 months	0	1	0.06	0.24	X	X	X	X					
Number of members, relatives working abroad and sending money	0	2	0.09	0.32	X	X	X	X	X	X			X
In last 3 years, number marriages of a first degree relative to household head or spouse?	0	3	0.27	0.50	X	X	X	X	X	X			
Death of a working adult member in last 3 years	0	1	0.02	0.15	X	X	X	X	X	X	X	X	
Occurrence of serious (but not chronic) illness of a working adult member in last 3 years	0	12	0.50	1.45	X	X	X	X			X	X	
Relocation of residence/house because of violence in last 3 years	0	1	0.01	0.11	X	X	X	X	X	X	X	X	
Did your household have a very serious problem or failure in your own crop production in last 3 years?	0	1	0.32	0.47	X	X	X	X			X	X	
Did your household have a very serious problem or failure in your own animal production in last 3 years?	0	1	0.29	0.46	X	X	X	X			X	X	
I feel accepted as a member of this village	0	1	0.88	0.33	X	X	X	X					
Total household members in civic group	0	1	0.01	0.08	X	X	X	X	X	X			
Total household members in cooperatives	0	3	0.01	0.13	X	X	X	X	X	X			
Household in cooperatives	0	1	0.00	0.06	X	X	X	X	X	X			
Total household members in informal credit group	0	2	0.02	0.14	X	X	X	X	X	X			
Household in informal credit group	0	1	0.02	0.13	X	X	X	X	X	X			
Total household members in NGO for MFI	0	4	0.33	0.61	X	X	X	X	X	X			
Household in other groups	0	1	0.07	0.25	X	X	X	X	X	X			
Total household members in other NGO	0	2	0.01	0.11	X	X	X	X	X	X			
Household in political group	0	1	0.04	0.20	X	X	X	X	X	X			

Variables	Min.	Max.	Mean	Std. Dev.	M1	M2	M3	M4	M5	M6	M7	M8	M9
Total of household members in political group	0	3	0.05	0.24	X	X	X	X	X	X			
Household in professional association	0	1	0.01	0.12	X	X	X	X	X	X			
Household in religious group	0	1	0.04	0.19	X	X	X	X	X	X			
Total household members in sports group	0	1	0.01	0.07	X	X	X	X	X	X			
Total household members in women's group	0	4	0.01	0.17	X	X	X	X	X	X	X	X	
Household in women's group	0	1	0.01	0.09	X	X	X	X	X	X	X	X	
Total household members in youth group	0	1	0.02	0.14	X	X	X	X	X	X			
Have you or members of household are denied service or only limited opportunity to education/schools	0	1	0.01	0.10	X	X	X	X					
Have you or members of household are denied service or only limited opportunity to credit/finance	0	1	0.04	0.19	X	X	X	X					
Household members are denied service or have only limited opportunity to transportation	0	1	0.00	0.05	X	X	X	X					
Have you or members of household are denied service or only limited opportunity to sanitation services	0	1	0.00	0.05	X	X	X	X					
Have you or members of household are denied service or only limited opportunity to agricultural extension	0	1	0.01	0.11	X	X	X	X					
Have you or members of household are denied service or only limited opportunity to justice/conflict resolution	0	1	0.04	0.20	X	X	X	X					
Have you or members of household are denied service or only limited opportunity to security/police services	0	1	0.02	0.13	X	X	X	X					
Proportion of households in the community with access to GOAPS	0	8	2.20	1.80	X	X	X	X	X	X			
Household feels that food expenses are below need	0	1	0.60	0.49	X	X	X	X					
Household feels that clothing expenses are below need	0	1	0.64	0.48	X	X	X	X				X	
Household feels that clothing expenses are above need	0	1	0.07	0.25	X	X	X	X					
Household feels that health care expenses are below need	0	1	0.58	0.49	X	X	X	X					
Household feels that health care expenses are above need	0	1	0.10	0.30	X	X	X	X					

Variables	Min.	Max.	Mean	Std. Dev.	M1	M2	M3	M4	M5	M6	M7	M8	M9
Household feels that child education expenses are below need	0	1	0.58	0.49	X	X	X	X					
Household feels that child education expenses are above need	0	1	0.07	0.25	X	X	X	X					
Household feels that housing expenses are below need	0	1	0.63	0.48	X	X	X	X					
Household feels that housing expenses are above need	0	1	0.07	0.25	X	X	X	X					
On which step of this ladder are you located today?	1	10	2.91	1.44	X	X	X	X					
Household feels much worse or worse compared to 7 years ago	0	1	0.41	0.49	X	X	X	X					
Household feels better or much better compared to 7 years ago	0	1	0.45	0.50	X	X	X	X					
Head of household is self-employed in handicrafts	0	1	0.01	0.10	X	X	X	X	X	X			X
Household head has no schooling or did not complete grade 1	0	1	0.55	0.50	X	X	X	X	X	X			X
Household head completed only primary education (grade 7)	0	1	0.04	0.18	X	X	X	X	X	X			X
Household head completed only secondary/post primary education	0	1	0.04	0.20	X	X	X	X	X	X			X
Household head completed higher education	0	1	0.01	0.11	X	X	X	X	X	X			X
Manual husking machine	0	1	0.10	0.30	X	X	X	X	X	X	X	X	X
Household rates itself below the step reflecting the poverty line	0	1	0.62	0.49	X	X	X	X					
Number of steps above step identified as respective national poverty line, if minus below	-7	6	-0.61	1.71	X	X	X	X				X	
Household rates itself below the step reflecting the respective national poverty line	0	1	0.62	0.49	X	X	X	X					
Average clothing expenditures per capita, past 12 months	0.76	8.13	6.19	0.97	X	X	X						X
Head of household chooses leisure	0	1	0.04	0.18	X	X	X	X	X	X	X	X	X
Number of adult household members who can read and write	0	11	1.21	1.37	X	X	X	X	X	X			X

Variables	Min.	Max.	Mean	Std. Dev.	M1	M2	M3	M4	M5	M6	M7	M8	M9
Number of household members who can read and write	0	11	2.23	1.84	X	X	X	X	X	X			X
Total value of land	5.34	15.04	10.78	2.09	X	X	X	X	X				X
Value of milk cows	-0.69	11.41	2.91	3.54	X	X	X	X	X				X
Costs of recent home improvements	2.34	12.90	6.96	2.79	X	X	X	X	X				
Minimum wage female income earner accepts if offered 8 hours work in peak season	3.40	5.01	4.36	0.12	X	X	X	X	X				
Value of agricultural land under irrigation	4.60	14.42	7.50	3.61	X	X	X	X	X				X
Value of agricultural land no irrigation	3.21	14.22	4.72	3.15	X	X	X	X	X				X
Value of pond area	2.07	12.81	4.26	3.38	X	X	X	X	X				X
Value of orchard area	2.47	13.04	4.43	3.32	X	X	X	X	X				X
Value of bush/forest area	-0.07	11.70	0.43	2.08	X	X	X	X	X				X
Value of other area	1.76	14.69	2.29	2.05	X	X	X	X	X				X
Funds inherited	-0.51	11.51	-0.33	1.39	X	X	X	X	X				
Value of dowry given by household	0.03	10.82	0.72	2.41	X	X	X	X	X				
Value of dowry received by household	1.42	12.61	2.48	2.82	X	X	X	X	X				
Value of monetary savings in house or safeguarded by somebody else	-0.25	11.51	1.15	2.88	X	X	X	X	X				
Value of informal debt owed by household	1.77	12.35	5.16	3.41	X	X	X	X	X				
Money received from family members working elsewhere	3.00	12.61	4.48	2.85	X	X	X	X	X		X	X	X
Value of pigs	-6.91	7.09	-6.88	0.55	X	X	X	X	X				X
Value of poultry	-1.15	10.37	3.88	3.02	X	X	X	X	X				X
Value of joint savings	-6.21	6.91	-6.17	0.77	X	X	X	X	X				X
Value of savings of other household members	0.01	11.92	0.60	2.20	X	X	X	X	X				X
Value of formal savings of spouse	-0.18	11.58	0.63	2.51	X	X	X	X	X				X
Household monthly expenditure on utilities (electricity, phone, water, etc)	0	7.82	1.61	2.23	X						X	X	
Household expenditure on health in last 12 months	0	11.51	7.40	1.29	X								

Variables	Min.	Max.	Mean	Std. Dev.	M1	M2	M3	M4	M5	M6	M7	M8	M9
Household expenditure on home in last 12 months	0	12.7	5.00	3.74	X								
Household expenditure on other expenditures in last 12 mo (social events, gifts, taxes)	0	11.53	4.60	3.37	X	X	X						
Value of ceiling fans	-1.47	8.29	0.21	3.34	X	X	X	X	X				X
Average clothing expenditure males	-0.47	8.23	5.90	1.62	X								
Sum of household clothing expenditures in past 12 months	1.21	10.22	7.69	1.20	X								
How much does your household need per month to live?	6.91	9.74	8.31	0.46	X	X	X	X				X	
Value of *kantha*	-0.58	8.92	5.71	1.22	X	X	X	X	X				X
Value of tractors	-0.27	13.27	-0.24	0.61	X	X	X	X	X				X
Total value of all animals	1.34	12.02	6.55	2.74	X	X	X	X	X				X
Value of black/ white TVs	-1.19	9.62	-0.05	2.96	X	X	X	X	X		X	X	X
Value of CD players	-2.54	8.85	-2.20	1.83	X	X	X	X	X		X	X	X
Value of color TVs	-0.45	10.74	0.02	2.09	X	X	X	X	X		X	X	X
Value of electric/ gas cooking	-3.99	9.47	-3.95	0.71	X	X	X	X	X				X
Value of mosquito nets	-1.74	7.50	4.42	1.81	X	X	X	X	X				X
Value of motor tiller	-0.68	11.00	-0.48	1.43	X	X	X	X	X				X
Value of radios	-1.93	8.16	-0.13	3.32	X	X	X	X	X				X
Value of refrigerators	-2.48	9.90	-2.41	0.94	X	X	X	X	X				X
Value of standing fans	-3.21	8.70	-2.73	2.11	X	X	X	X	X				X
Value of video recorders	-2.13	9.31	-1.73	1.95	X	X	X	X	X				X
Annualized total household expenditures	8.83	12.89	10.68	0.58	X								
Total value of household assets	4.94	13.32	8.75	1.38	X	X							
Value of radio, TV, VCR, and CD players	0.25	10.78	2.56	3.36	X	X	X	X	X				X
Value of transport assets	0.94	13.27	3.31	3.12	X	X	X	X	X				X
Ratio of male to females	0	5	1.20	0.87	X	X	X	X	X	X	X	X	X
Household head is married and spouse is migrant	0	1	0.05	0.21	X	X	X	X	X	X	X	X	X

Variables	Min.	Max.	Mean	Std. Dev.	M1	M2	M3	M4	M5	M6	M7	M8	M9
Mosquito net ownership	0	1	0.94	0.24	X	X	X	X	X	X	X	X	X
Motor tiller ownership	0	1	0.02	0.14	X	X	X	X	X	X	X	X	X
Number of auto rickshaws owned by household	0	1	0.00	0.04	X	X	X	X	X	X	X	X	X
Number of CD players owned by household	0	1	0.03	0.18	X	X	X	X	X	X	X	X	X
Number of ceiling fans owned by household	0	5	0.37	0.85	X	X	X	X	X	X	X	X	X
Number of color TVs owned by household	0	2	0.05	0.22	X	X	X	X	X	X	X	X	X
Number of disasters suffered past 5 years (out of 5)	0	4	1.95	1.36	X	X	X	X	X	X			
Milk cow number	0	9	0.46	0.95	X	X	X	X	X	X			X
Number of motor tillers owned	0	15	0.08	0.83	X	X	X	X	X	X			X
Number of household members with no schooling or incomplete grade1,except head	0	16	1.92	1.44	X	X	X	X	X	X			X
Household declares to not have a savings habit	0	1	0.20	0.40	X	X	X	X			X	X	
Maximum education of any household member is no education	0	1	0.09	0.29	X	X	X	X	X	X			
Head of household is self-employed in non-farm microenterprise	0	1	0.06	0.23	X	X	X	X	X	X			X
Number of household members with completed superior education, except head	0	0	0.00	0.00	X	X	X	X	X	X			X
Number of other vehicles owned by household	0	1	0.04	0.19	X	X	X	X	X	X	X	X	X
Pigs number	0	2	0.00	0.08	X	X	X	X	X	X	X	X	X
Poultry number	0	41	3.53	4.25	X	X	X	X	X	X			X
Number of refrigerators owned by household	0	1	0.01	0.08	X	X	X	X	X	X	X	X	X
Number of saris owned by household	0	80	6.24	6.51	X	X	X	X	X	X	X	X	X
Sheep and goat number	0	10	0.34	0.87	X	X	X	X	X	X			X
Number of tractors owned by household	0	2	0.00	0.08	X	X	X	X	X	X	X	X	X
Number of dependents younger than 15 and older than 64 years	0	12	2.11	1.44	X	X	X	X	X	X	X	X	
Number of dependents younger than 18 and older than 60 years	0	15	2.48	1.56	X	X	X	X	X	X	X	X	

Variables	Min.	Max.	Mean	Std. Dev.	M1	M2	M3	M4	M5	M6	M7	M8	M9
Number household members who completed secondary/post primary education only, except head	0	6	0.23	0.55	X	X	X	X	X	X	X	X	X
Number of VCRs owned by household	0	2	0.05	0.22	X	X	X	X	X	X	X	X	X
Does the household own the house?	0	1	0.91	0.28	X	X	X	X	X	X	X	X	X
Degree of participation NGO for entrepreneurial services	0	1	0.01	0.11	X	X	X	X					
Degree of participation other groups	0	1	0.05	0.22	X	X	X	X					
Degree of participation other NGO	0	1	0.00	0.06	X	X	X	X					
Sum of degree of participation out of 17 institutions	0	2	0.36	0.59	X	X	X	X					
Household is active in at least one institution	0	1	0.30	0.46	X	X	X	X					
Degree of participation school committee	0	1	0.02	0.13	X	X	X	X					
Degree of participation sports group	0	1	0.00	0.04	X	X	X	X					
Degree of participation in trade union	0	1	0.00	0.04	X	X	X	X					
Degree of participation youth group	0	1	0.01	0.09	X	X	X	X					
How far away is the primary school (km)?	0	3	0.50	0.82	X	X	X	X	X	X	X	X	
Maximum education of males is primary level (complete)	0	1	0.05	0.22	X	X	X	X	X	X			
Median education of adult household members is primary level (complete)	0	1	0.05	0.23	X	X	X	X	X	X			
Median education household of females is primary level (complete)	0	1	0.03	0.16	X	X	X	X	X	X			
Median education of household members is primary level (complete)	0	1	0.03	0.18	X	X	X	X	X	X			
Median education of household males is primary level (complete)	0	1	0.04	0.20	X	X	X	X	X	X			
Do you have police station?	0	1	0.05	0.22	X	X	X	X	X	X			
Dependency ratio younger than 18 or more than 60 years	0	5	1.22	0.94	X	X	X	X	X	X			
Ratio of remittances received and sent	0	330758.4	6554.75	24353.51	X	X	X	X	X				X
Percentage of adult household members who read only	0	33.33	0.44	3.10	X	X	X	X	X	X			X

Variables	Min.	Max.	Mean	Std. Dev.	M1	M2	M3	M4	M5	M6	M7	M8	M9
Household head can read only	1	4	2.54	1.23	X	X	X	X	X	X			X
Number of household members who can read only	0	4	0.14	0.41	X	X	X	X	X	X			X
Spouse can read only	1	4	2.41	1.12	X	X	X	X	X	X			X
Remittances received/total household expenditures	0.24	1.08	0.42	0.26	X	X	X	X	X				X
Do you have satellite clinic?	0	1	0.05	0.22	X	X	X	X	X	X			
Maximum education of any adult is secondary/post primary level (complete)	0	1	0.11	0.31	X	X	X	X	X	X			
Median education of household members is secondary/post primary level (complete)	0	1	0.03	0.16	X	X	X	X	X	X			
Median education of household males is secondary/post primary level (complete)	0	1	0.04	0.18	X	X	X	X	X	X			
Sex of household head	0	1	0.88	0.32	X	X	X	X	X	X	X	X	X
Average number of days of sickness per household member in past 12 months	0	182.5	16.39	20.96	X	X	X	X	X	X			X
Total number of days sick by females	0	525	37.79	59.71	X	X	X	X	X	X			X
Average number of days sick by males	0	182.5	8.28	14.94	X	X	X	X	X	X			X
Total land (including area under land use, homestead and other land)	0	3890	91.46	235.28	X	X	X	X	X	X			X
Total area under land use (including agriculture, forest, orchards, ponds)	0	3840	82.48	230.40	X	X	X	X	X	X			X
Did households have access to VGF/VGD in the community?	0	1	0.60	0.49	X	X	X	X	X	X	X	X	
Household head is widow/er	0	1	0.05	0.22	X	X	X	X	X	X	X	X	X

ANNEX C. GENDER-SPECIFIC VARIABLES

Note: This list does not include gender-specific poverty indicators among the first set of 576 regressors that were submitted to the first MAXR analysis but to the set of the best 250 indicators that came out of that regression.

Annex C, Table 1 — Gender-specific variables used in regression analysis

Variables	Min.	Max.	Mean	Std. Dev.
Spouse has an account (savings, checking or fixed term deposit)	0	1	0,10	0,30
Number of females with some chronic illness	0	4	0,60	0,72
Male accepts wage at poverty line ?	0	1	0,44	0,50
Female accepts wage at poverty line ?	0	1	0,20	0,40
Number of females with some disability	0	1	0,03	0,17
Number of males with some disability	0	1	0,03	0,17
Number of female adult household members	0	5	1,43	0,74
Household in women's group	0	1	0,01	0,09
Minimum wage female income earner accepts if offered 8 hours work in peak season	3,40	5,01	4,36	0,12
Value of formal savings of spouse	-0,18	11,58	0,63	2,51
Average clothing expenditure males	-0,47	8,23	5,90	1,62
Ratio of male to females	0	5	1,20	0,87
Maximum education of males is primary level (complete)	0	1	0,05	0,22
Median education household of females is primary level (complete)	0	1	0,03	0,16
Median education of household males is primary level (complete)	0	1	0,04	0,20
Spouse can read only	1	4	2,41	1,12
Median education of household males is secondary/post primary/j1 level (complete)	0	1	0,04	0,18
Sex of household head	0	1	0,88	0,32
Total number of days sick by females	0	525	37,79	59,71
Average number of days sick by males	0	182,5	8,28	14,94

ANNEX D. VERIFIABILITY SCORES PROVIDED BY DATA

Variable assessment scale: 1 = very hard, 5 = easily verifiable

Note: The indicators with verifiability scores of 4 or 5 have been included in Model 7 and Model 8

Annex D, Table 1 — Verifiability score of the variables

Variable	Measurement	Verifiability
Household head has an account (savings, checking, or fixed-term deposit)	Yes/No	2
Spouse has an account (savings, checking, or fixed-term deposit)	Yes/No	2
Squared age of household head	Years	4
Age of oldest household member	Years	4
Age of youngest household member	Years	4
Total agricultural area (irrigated or not)	Decimals	4
Average age of household members, except head	Years	4
Household borrows from informal market and/or emergencies	Yes/No	3
Household borrowed in past 12 months from formal lenders	Yes/No	5
Do you have bus station?	Yes/No	5
Black and white TV ownership	Yes/No	5
Contribution farmers group	Contribution/No	4
Household has a checking account	Yes/No	4
Number of females with some chronic illness	Number	3
Contribution informal credit group	Contribution/No	4
Contribution neighbors group	Contribution/No	4
Contribution other groups	Contribution/No	4
Contribution other NGO	Contribution/No	4
Contribution professional association	Contribution/No	4
Contribution sport group	Contribution/No	4
Contribution traders association	Contribution/No	4
Contribution youth group	Contribution/No	4

Variable	Measurement	Verifiability
What is the size of these rooms in square feet?	Sq. feet	4
Exterior walls: CI sheet (corrugated tin)	Yes/No	5
Exterior walls: Brick/cement	Yes/No	5
Lighting: cannot afford light at night	Yes/No	5
Lighting: candles/ battery lights / pocket lights	Yes/No	4
Lighting: tap electricity socket of neighbor / public grid	Yes/No	3
Lighting: Public grid with legal socket in house	Yes/No	5
Lighting: own private generator	Yes/No	5
Household has improved toilet	Yes/No	5
Have you made a recent home improvement in the last three years?	Yes/No	3
Male accepts wage at poverty line ?	Yes/No	3
Female accepts wage at poverty line ?	Yes/No	3
Head of household is nonagricultural daily worker	Yes/No	4
Head of household sleeps on thin mattress mad of natural fibers	Yes/No	2
Head of household sleeps thin mattress made of industrial fibers or thick mattress	Yes/No	2
Household ate rice starch sometimes, often or mostly in last 12 months because other food was scarce	Yes/No	4
Household ate rice starch rarely in last 12 months because other food was scarce	Yes/No	2
Cooking fuel is collected bamboo, wood or sawdust	Yes/No	4
Cooking fuel is purchased bamboo, wood or sawdust	Yes/No	4
Percentage of dependents younger than 14 and older than 60 years (in relation to household size)	Ratio	4
Percentage of dependents younger than 18 and older than 60 years (in relation to household size)	Ratio	4
Agree that most people in this village/neighborhood are basically honest and can be trusted?	Yes/No	2
Agree that if you have a problem, there is always someone to help you?	Yes/No	2
House structure: dilapidated	Yes/No	5
House structure: Good	Yes/No	5
Percentage of household members with any disability (in relation to household size)	Ratio	4
Number of females with some disability	Number	5

Variable	Measurement	Verifiability
Household head has any disability	Yes/No	5
Number of males with some disability	Number	5
Household head is divorced	Yes/No	5
Household ate less food for less than 10 days during past 12 months	Yes/No	2
No lock in main entrance door	Yes/No	5
Any sort of lock besides key lock	Yes/No	5
Household borrows from neighbors/relatives often or mostly	Yes/No	3
How far away the doctor chamber (km)?	Km	5
Head of household is domestic worker (1=Yes, 0=No)	Yes/No	5
Quality of walls: poor	Yes/No	4
Roof with leaves, jute stick or straw	Yes/No	5
Roof with bamboo/wood, tiles or brick/cement	Yes/No	5
House size: small	Yes/No	5
House size: large	Yes/No	5
Household usually purchases staple food fortnightly or monthly	Yes/No	2
Household ate rarely sweet potato because food scarce	Yes/No	2
Water source: Dam/pond/river/spring or open public well/borehole.	Yes/No	5
Water source: Well/borehole in residence yard (open or sealed with pump)	Yes/No	5
How many meals were served to the household members during the last 2 days?	Number	4
In the last 7 days, how many days Chicken/duck, eggs served by the household in a main meal eaten?	Number	2
In the last 7 days, how many days lentil served by the household in a main meal eaten?	Number	2
In the last 30 days, for how many days did your household not have enough to eat everyday?	Number	3
For how many weeks will your stock of rice last?	Weeks	3
Household had enough to eat but not always the kind they wanted	Yes/No	2
In last 12 months did you have to eat the same foods daily because you did not have money to buy other foods?	Yes/No	2
In last 12 months have you or any other adult in your household eaten less food because you did not have enough money to buy?	Yes/No	2

Variable	Measurement	Verifiability
Did you or any other adult household member lose weight in last 12 months because you did not have enough money to buy food?	Yes/No	3
Do you have access to electricity?	Yes/No	5
Homestead area (decimal)	Decimals	4
Orchard/Bamboo area (decimal)	Decimals	4
Bush/forest/non arable area (decimal)	Decimals	4
Number of family members/relatives working elsewhere in Bangladesh and sending money	Number	3
Number of family members/relatives working in Dhaka and sending money	Number	3
Number of female adult household members	Number	5
Household did not eat for entire days in past 12 months	Yes/No	2
Number of family members/relatives working abroad and sending money	Number	2
In last 3 years, number marriages of a first degree relative to household head or spouse?	Number	3
Death of a working adult member in last 3 years	Yes/No	5
Occurrence of serious (but not chronic) illness of a working adult member in last 3 years	Number	5
Relocation of residence/house because of violence in last 3 years	Yes/No	5
Did your household have a very serious problem or failure in your own crop production in last 3 years?	Yes/No	5
Did your household have a very serious problem or failure in your own animal production in last 3 years?	Yes/No	5
I feel accepted as a member of this village	Yes/No	1
Total household members in civic group	Number	4
Total household members in cooperatives	Number	4
Household in cooperatives	Yes/No	4
Total household members in informal credit group	Number	4
Household in informal credit group	Yes/No	4
Total household members in NGO for MFI	Number	4
Household in other groups	Yes/No	4
Total household members in other NGO	Number	4
Household in political group	Yes/No	4

Variable	Measurement	Verifiability
Total of household members in political group	Number	4
Household in Professional assoc.	Yes/No	4
Household in religious group	Yes/No	4
total household members in sports group	Number	4
Total household members in women's group	Number	5
Household in women's group	Yes/No	5
Total household members in youth group	Number	4
Have you or members of household are denied service or only limited opportunity to education/schools	Yes/No	3
Have you or members of household are denied service or only limited opportunity to credit/finance	Yes/No	3
Have you or members of household are denied service or only limited opportunity to transportation	Yes/No	3
Have you or members of household are denied service or only limited opportunity to sanitation services	Yes/No	3
Have you or members of household are denied service or only limited opportunity to agricultural extension	Yes/No	3
Have you or members of household are denied service or only limited opportunity to justice/conflict resolution	Yes/No	3
Have you or members of household are denied service or only limited opportunity to security/police services	Yes/No	3
Households Percentage have access to GOAPS	Percentage	3
Household feels that food expenses are below need	Yes/No	3
Household feels that clothing expenses are below need	Yes/No	3
Household feels that clothing expenses are above need	Yes/No	3
Household feels that health care expenses are below need	Yes/No	3
Household feels that health care expenses are above need	Yes/No	3
Household feels that child education expenses are below need	Yes/No	3
Household feels that child education expenses are above need	Yes/No	3
Household feels that housing expenses are below need	Yes/No	3
Household feels that housing expenses are above need	Yes/No	3
On which step of this ladder are you located today?	Step on ladder	3
Household feels much worse or worse compared to 7 years ago	Yes/No	3
Household feels better or much better compared to 7 years ago	Yes/No	3

Variable	Measurement	Verifiability
Head of household is self-employed in handicrafts	Yes/No	4
Household head has no schooling or did not complete grade 1	Yes/No	4
Household head completed only primary education (grade 7)	Yes/No	4
Household head completed only secondary/post primary education	Yes/No	4
Household head completed higher education	Yes/No	4
Manual husking machine ownership	Yes/No	5
Household rates itself below the step reflecting the poverty line	Yes/No	3
Number of steps above step identified as respective national poverty line, if minus below	Step on ladder	1
Household rates itself below the step reflecting the respective national poverty line	Yes/No	1
Average clothing expenditure per capita, past 12 months	*Taka*	2
Head of household chooses leisure (1=Yes, 0=No)	Yes/No	5
Number of adult household members who can read and write	Number	4
Number of household members who can read and write	Number	4
Total value of land	*Taka*	4
Value of milk cows	*Taka*	4
Costs of recent home improvements	*Taka*	3
Minimum wage female income earner accept if offered 8 hours work in peak season	*Taka*	4
Value of agricultural land under irrigation	*Taka*	3
Value of agricultural land no irrigation	*Taka*	3
Value of pond area	*Taka*	3
Value of orchard area	*Taka*	3
Value of bush or forest area	*Taka*	3
Value of other area	*Taka*	3
Funds inherited	*Taka*	2
Value of dowry given by household	*Taka*	3
Value of dowry received by household	*Taka*	3
Value of monetary savings in house or safeguarded by somebody else	*Taka*	3

Variable	Measurement	Verifiability
Value of informal debt owed by household	*Taka*	2
Money received from family members working elsewhere	*Taka*	5
Value pigs	*Taka*	2
Value poultry	*Taka*	2
Value of joint savings	*Taka*	3
Value of savings other household members	*Taka*	2
Value of formal savings spouse	*Taka*	2
Household monthly expenditure on utilities (electricity, phone, water, etc)	*Taka*	5
Household expenditure on health in last 12 months	*Taka*	3
Household expenditure on home in last 12 months	*Taka*	3
Household expenditure on other expenditures in last 12 mo (social events, gifts, taxes)	*Taka*	3
Value of ceiling fans	*Taka*	4
Average clothing expenditure of males	*Taka*	4
Sum of household clothing expenditures in past 12 months	*Taka*	4
How much does your household need per month to live?	*Taka*	4
Value of kantha	*Taka*	4
Value of tractors	*Taka*	2
Total value of all animals	*Taka*	4
Value of black/ white TVs	*Taka*	5
Value of CD players	*Taka*	5
Value of color TVs	*Taka*	5
Value of electric/ gas cooking	*Taka*	2
Value of mosquito nets	*Taka*	4
Value of motor tiller	*Taka*	2
Value of radios	*Taka*	4
Value of refrigerators	*Taka*	2
Value of standing fans	*Taka*	2

Variable	Measurement	Verifiability
Value of video recorders	*Taka*	2
Annualized total household expenditures	*Taka*	4
Total value of household assets	*Taka*	3
Value of radio, TV, VCR, and CD players	*Taka*	2
Value of transport assets	*Taka*	4
Ratio of male to females	Ratio	5
Household head is married and spouse is migrant	Yes/No	5
Mosquito net ownership	Yes/No	5
Motor tiller ownership	Yes/No	5
Number of auto rickshaws owned by household	Number	5
Number of CD players owned by household	Number	5
Number of ceiling fans owned by household	Number	5
Number of color TVs owned by household	Number	5
Number of disasters suffered past 5 years (out of 5)	Number	3
Milk cow number	Number	4
Number of motor tillers owned by household	Number	4
Number of household members with no schooling or incomplete grade 1,except head	Number	4
Household declares to not have a savings habit	Yes/No	5
Maximum education of any household member is no education	Yes/No	4
Head of household is self-employed in non-farm microenterprise	Yes/No	4
Number of household members with completed superior education, except head	Number	4
Number of other vehicles owned by household	Number	5
Pigs number	Number	5
Poultry number	Number	4
Number of refrigerators owned by household	Number	5
Number of saris owned by household	Number	5
Sheep and goat number	Number	4

Variable	Measurement	Verifiability
Number of tractors owned by household	Number	5
Number of dependents younger than 15 and older than 64 years	Number	5
Number of dependents younger than 18 and older than 60 years	Number	5
Number of household members who completed secondary/post primary education only, except head	Number	5
Number of VCRs owned by household	Number	5
Does the household own the house?	Yes/No	5
Degree of participation NGO for entrepreneurial services	Active participation/ No participation	4
Degree of participation in other groups	Active participation/ No participation	4
Degree of participation in other NGO	Active participation/ No participation	3
Sum of degree of participation out of 17 institutions	Number	4
Household is active in at least one institution	Yes/No	4
Degree of participation in school committee	Active participation/ No participation	4
Degree of participation in sports group	Active participation/ No participation	4
Degree of Participation in trade union	Active participation/ No participation	4
Degree of participation in youth group	Active participation/ No participation	4
How far away is the primary school (km)?	Km	5
Maximum education of males is primary level (comp)	Yes/No	4
Median education of adult household members is primary level (comp)	Yes/No	4
Median education of household females is primary level (comp)	Yes/No	4
Median education of household members is primary level (comp)	Yes/No	4
Median education of household males is primary level (comp)	Yes/No	4
Do you have police station?	Yes/No	4
Dependency ratio younger than 18 or more than 60 years	Ratio	4

Variable	Measurement	Verifiability
Ratio of remittances received and sent	Ratio	3
Percentage of adult household members who read only (in relation to household size)	Ratio	4
Household head can read only	Yes/No	3
Number of household members who can read only	Number	4
Spouse can read only	Yes/No	3
Remittances received/total household expenditures	Ratio	3
Do you have satellite clinic?	Yes/No	4
Maximum education of any adult is secondary/post primary/j1 level (comp)	Yes/No	4
Median education of household members is secondary/post primary/j1 level (comp)	Yes/No	4
Median education of household males is secondary/post primary/j1 level (comp)	Yes/No	4
Sex of household head	Male/female	5
Average number of days of sickness per household member in past 12 months	Days	3
Total number of days sick by females	Days	3
Average number of days sick by males	Days	3
Total land (including area under land use, homestead and other land)	Decimals	4
Total area under land use (including agriculture, forest, orchards, ponds)	Decimals	4
Did households have access to VGF/VGD in the community?	Days	5
Household head is widow/er	Days	5

Source: Scores were imputed for some variables based on DATA's own assessment. Communication via email in February 2005.

ANNEX E. ACCURACY PERFORMANCE OF REGRESSION MODELS

Annex E, Table 1 — Single-step OLS models with per-capita daily expenditures as continuous dependent variable (selection of regressors by MAXR)

Model	Description	Type	Adj. R^2	% Total Accuracy	% Poverty Accuracy	% Under-coverage	% Leakage	PIE (% points)	BPAC (% points)
1	All 257 regressors (Ref. Table 3.1.2)	B-5	0.6714	83.73	65.74	34.26	17.53	-5.24	49.01
		B-10	0.703	85.73	68.53	31.47	13.94	-5.49	51.00
		B-15	0.7167	86.36	69.32	30.68	12.75	-5.62	51.39
2	Exclusion of expenditure variables except clothing expenditures per capita in past 12 month and other household expenditures in the past 12 months (Ref. Table 3.2.1)	B-5	0.5918	81.85	58.17	41.83	15.94	-8.12	32.28
		B-10	0.6396	82.98	62.95	37.05	17.13	-6.24	43.03
		B-15	0.6581	83.6	66.13	33.86	18.33	-4.87	50.60
3	Exclusion of total value of household assets (Ref. Table 3.3.1)	B-5	0.5781	80.22	58.17	41.83	21.12	-6.49	37.46
		B-10	0.6355	81.48	59.76	40.24	18.72	-6.75	38.24
		B-15	0.6541	82.48	63.74	36.25	19.52	-5.24	47.01
4	Exclusion of clothing expenditures per capita in past 12 month and other household expenditures in the past 12 months (Ref. Table 3.4.1)	B-5	0.4622	77.35	51.39	48.61	23.51	-7.87	26.29
		B-10	0.5355	78.1	52.19	47.81	21.91	-8.12	26.29
		B-15	0.5698	79.72	58.96	41.04	23.51	-5.49	41.43
5	Exclusion subjective variables (Ref. Table 3.5.1)	B-5	0.4799	77.97	49.4	50.6	19.52	-9.75	18.32
		B-10	0.5396	79.1	53.78	46.21	20.32	-8.12	27.89
		B-15	0.5678	80.22	58.57	41.43	21.51	-6.24	38.65
6	Exclusion monetary variables (Ref. Table 3.6.1)	B-5	0.4535	78.47	48.21	51.79	16.73	-11.00	13.15
		B-10	0.5025	79.22	54.18	45.82	20.32	-8.00	28.68
		B-15	0.5308	79.72	56.97	43.03	21.51	-6.74	35.45
7	Easily verifiable variables (DATA) (Ref. Table 3.7.1)	B-5	0.432	76.22	43.43	56.57	19.12	-11.75	5.98
		B-10	0.4672	77.47	49.8	50.2	21.51	-9.00	21.11

Model	Description	Type	Adj. R^2	% Total Accuracy	% Poverty Accuracy	% Under-coverage	% Leakage	PIE (% points)	BPAC (% points)
		B-15	0.4816	79.1	51	49	17.53	-9.87	19.53
8	Model 7 plus strong subjective and expenditure regressors (Ref. Table 3.8.1)	B-5	0.4851	76.6	49.4	50.6	23.9	-8.37	22.70
		B-10	0.5305	78.1	52.99	47.01	22.71	-7.62	28.69
		B-15	0.5458	78.85	53.78	46.21	21.12	-7.87	28.69
9	LSMS-type regressors (Ref. Table 3.9.1)	B-5	0.5423	78.47	52.19	47.81	20.72	-8.50	25.10
		B-10	0.5727	79.85	53.78	46.21	17.93	-8.87	25.50
		B-15	0.5844	80.6	56.57	43.43	18.33	-7.87	31.47

Annex E, Table 2 — Two-step models with a continuous dependent variable (OLS estimation) for models 1, 4, 7, and 9

OLS 2-Step Poverty rate: 31.41%	Adj. R^2	% Total Accuracy	% Poverty Accuracy	% Under-coverage	% Leakage	PIE (% points)	BPAC (% points)
Model 1 Percentile 55th	0.487 subsample	86.23	76.49	23.51	20.32	-1.00	73.31
Model 4 Percentile 50th	0.378 subsample	83.23	71.31	28.69	24.70	-1.25	
Model 7 Percentile 46th	0.227 subsample	79.84	57.37	42.62	21.51	-6.63	36.25
Model 9 Percentile 45th	0.293 subsample	82.98	68.92	31.08	23.11	-2.50	60.96

Annex E, Table 3 — Summary results for all single and two-step regressions for Models 1, 4, 7, and 9

	Adj. R^2	% Total Accuracy	% Poverty Accuracy	% Under-coverage	% Leakage	PIE (% points)	BPAC (% points)
Model 1 Poverty rate: 31.41%							
Single-step methods — MAXR variable selection							
OLS	0.717	86.36	69.32	30.68	12.75	-5.63	51.39
Quantile Regression (estimation point: 42)		86.23	77.69	22.31	21.51	-0.25	76.89
Linear Probability	0.425	85.73	70.12	29.88	15.54	-4.51	55.78

	Adj. R^2	% Total Accuracy	% Poverty Accuracy	% Under-coverage	% Leakage	PIE (% points)	BPAC (% points)
Probit		86.61	75.30	24.7	17.93	-2.13	68.53
Two-step methods — MAXR variable selection							
OLS Percentile 55th	0.487 subsample	86.23	76.49	23.51	20.32	-1.00	73.31
Quantile Regression (estimation points 42, 26) - 55% cut off		85.48	76.89	23.11	23.11	0	76.89
Linear Probability, Percentile 57th	0.402 subsample	88.11	80.88	19.12	18.73	-0.13	80.48
Probit, Percentile 57th		86.98	78.09	21.91	19.52	-0.75	75.69
Model 4 **Poverty rate: 31.41%**							
Single-step methods — MAXR variable selection							
OLS	0.598	80.60	59.76	40.24	21.51	-5.88	41.04
Quantile Regression (estimation point: 42)		79.85	68.53	31.47	32.67	0.38	67.33
Linear Probability	0.352	82.10	63.35	36.65	20.32	-5.13	47.01
Probit		82.23	68.13	31.87	24.70	-2.25	60.96
Two-step methods — MAXR variable selection							
OLS, Percentile 50th	0.378 subsample	83.23	71.31	28.69	24.70	-1.25	67.33
Quantile Regression (estimation points 42, 24) - 50% cut off		82.06	72.51	27.49	27.89	0.13	72.11
Linear Probability, Percentile 53rd	0.331 subsample	83.85	74.5	25.5	25.9	0.13	74.10
Probit, Percentile 53rd		82.23	70.52	29.48	27.09	-0.75	68.13
Model 7 **Poverty rate: 31.41%**							
Single-step methods — MAXR variable selection							
OLS	0.481	79.10	51.00	49.00	17.53	-9.89	19.52

	Adj. R^2	% Total Accuracy	% Poverty Accuracy	% Under-coverage	% Leakage	PIE (% points)	BPAC (% points)
Quantile Regression (estimation point: 43)		77.97	64.14	35.86	34.26	-0.50	62.55
Linear Probability	0.293	80.1	57.37	42.63	20.72	-6.88	35.46
Probit		79.73	60.56	39.44	25.10	-4.5	46.21
Two-step methods — MAXR variable selection							
OLS, Percentile 46th	0.227 subsample	79.84	57.37	42.62	21.51	-6.63	36.25
Quantile Regression (estimation points 43, 22) - 46%cut off		79.72	68.53	31.47	33.07	0.50	66.93
Linear Probability, Percentile 48th	0.179 subsample	81.22	68.12	31.87	27.88	-1.25	64.14
Probit, Percentile 48th		81.98	68.53	31.47	25.9	-1.75	62.94
Model 9 Poverty rate: 31.41%							
Single-step methods — MAXR variable selection							
OLS	0.584	80.60	56.57	43.43	18.33	-7.88	31.47
Quantile Regression (estimation point: 43)		80.98	69.72	30.28	30.28	0	69.72
Linear Probability	0.351	81.72	58.17	41.83	16.33	-8.01	32.67
Probit		82.98	64.94	35.06	19.12	-5.01	49
Two-step methods — MAXR variable selection							
OLS, Percentile 45th	0.293 subsample	82.98	68.92	31.08	23.11	-2.50	60.96
Quantile Regression (estimation points 43, 22) - 45% cutoff		83.48	74.50	25.50	27.09	0.50	72.98
Linear Probability, Percentile 43rd	0.213 subsample	84.85	73.71	26.29	21.91	-1.37	69.32
Probit, Percentile 43rd		84.61	73.71	26.29	22.71	-1.13	70.12

ANNEX F: VARIABLES INCLUDED IN THE BEST15 MODELS

Annex F, Table 1 — Variables included in the single-step OLS models (BEST15 sets)

Variable label	M1	M2	M3	M4	M5	M6	M7	M8	M9
Household has a checking account	X	X	X	X	X	X			X
Cooking fuel is collected bamboo, wood or sawdust	X								X
Percentage of dependents younger than 14 and older than 60 years (in relation to household size)	X	X	X	X	X	X			
House structure: Good	X	X	X					X	
In the last 7 days, how many days Lentil served by the household in a main meal eaten?	X	X	X	X				X	
Household feels that clothing expenses are below need	X			X				X	
Average clothing expenditures per capita, past 12 months	X	X	X					X	X
Value of dowry received by household	X	X	X	X	X				
Value of formal savings spouse	X	X	X	X	X				X
Household expenditure on health in last 12 months	X								
Household expenditure on home in last 12 months	X								
Annualized total household expenditures	X								
Total value of household assets	X	X							
Value of radio, TV, VCR and CD player	X	X	X	X	X				X
Number of household members who can read only	X	X	X	X	X				
What is the size of these rooms in square feet?				X	X	X			X
House structure: dilapidated				X	X	X	X		
How many meals were served to the household members during the last 2 days?				X					
Death of a working adult member In last 3 years				X	X		X		
Total value of land				X	X				X
Costs of recent home improvements		X	X	X	X				
Amount that household needs per month to live			X	X				X	
Lighting: Public grid with legal socket in house						X	X		
Household has improved toilet						X	X		X
No lock in main entrance door							X		
Head of household is domestic worker						X	X		
Roof with leaves, jute stick or straw							X		X
House size: small						X	X	X	

Variable label	M1	M2	M3	M4	M5	M6	M7	M8	M9
Manual husking machine							X		
Ratio of male to females							X		X
Motor tiller ownership							X	X	X
Number of saris owned by household					X	X	X	X	X
Number of dependents younger than 15 and older than 64 years							X	X	
Value of color TV's								X	
Number household members who completed secondary /post primary education only, except head						X	X		
Did households have access to VGF/VGD in the community					X	X	X	X	
Squared age of household head									X
Cooking fuel is purchased bamboo, wood or sawdust					X				X
Milk cow number			X		X	X			X
Number of household members with no schooling or incomplete grade 1,except head									X
Households percentage have access to GOAPS		X							
Household feels that housing expenses are below need		X	X						
Household rates itself below the step reflecting the respective national poverty line		X							
Household expenditure on other expenditures in last 12 months (social events, gifts, taxes)		X	X						
Household rates itself below the step reflecting the poverty line			X						
Black and white TV ownership						X		X	
Number of female adult household members						X		X	
In last 3 years, number marriages of a first degree relative to household head or spouse?						X			
Household monthly expenditure on utilities (electricity, phone, water, etc)									X
In the last 30 days, for how many days did your household not have enough to eat everyday?									X
Number of steps above step identified as respective national poverty line, if minus below								X	X

Annex F, Table 2 — Variables included in the two-step OLS regressions (Models 1, 4, 7, and 9)

Variables Two-step OLS	Model 1		Model 4		Model 7		Model 9	
	1st step	**2nd step**	**1st step**	**2nd step**	**1st step**	**2nd step**	**1st step**	**2nd step**
Household has a checking account	X		X				X	
Cooking fuel is collected bamboo, wood or sawdust	X						X	X
Percentage of dependents younger than 14 and older than 60 years (in relation to household size)	X		X	X				
House structure: Good	X				X			
In the last 7 days, how many days Lentil served by the household in a main meal eaten?	X		X					
Household feels that clothing expenses are below need	X		X					
Average clothing expenditures per capita, past 12 months	X	X					X	X
Value of dowry received by household	X	X	X					
Value of formal savings spouse	X		X				X	X
Household expenditure on health in last 12 months	X	X						
Household expenditure on home in last 12 months	X							
Annualized total household expenditures	X	X						
Total value of household assets	X	X						
Value of radio, TV, VCR and CD player	X		X	X			X	
Number of household members who can read only	X	X	X					
Age of oldest household member		X						
Percentage of dependents younger than 18 and older than 60 years (in relation to household size)		X						
Quality of walls: poor		X						
Do you have access to electricity?		X		X				
Number of female adult household members		X				X		
Household in political group		X						
Proportion of households in the community that have access to GOAPS		X		X				
Household feels that child education expenses are above need		X						
Number of ceiling fans owned by household		X						X
What is the size of these rooms in square feet?			X	X			X	X
House structure: dilapidated			X			X		
How many meals were served to the household members during the last 2 days?			X					
Death of a working adult member In last 3 years			X			X	X	
Total value of land			X				X	
Costs of recent home improvements			X					
How much does your household need per month to live?			X					
Lighting: tap electricity socket of neighbor / public grid				X				
No lock in main entrance door				X	X	X		

Have you or members of household are denied service or only limited opportunity to education/schools	X				
Have you or members of household are denied service or only limited opportunity to security/police services	X				
Household feels that child education expenses are below need	X				
Household rates itself below the step reflecting the poverty line	X				
Number of motor tillers owned by household	X			X	
Number of household members with no schooling or incomplete grade 1,except head	X			X	
Number of saris owned by household	X	X	X	X	X
Household head is widow/er	X		X		
Lighting: Public grid with legal socket in house		X			X
Household has improved toilet		X		X	
Head of household is domestic worker		X	X		
Roof with leaves, jute stick or straw		X	X	X	X
House size: small		X			
Manual husking machine		X			
Ratio of male to females		X			X
Motor tiller ownership		X			
Number of dependents younger than 15 and older than 64 years		X	X		
Number of members who completed secondary /post primary education only, except head		X	X		
Did households have access to VGF/VGD		X	X		
Exterior walls: CI sheet (corrugated tin)			X		
Money received from family members working elsewhere			X		
Number of dependents younger than 18 and older than 60 years			X		
Number of VCRs owned by household			X		
Squared age of household head				X	
Cooking fuel is purchased bamboo, wood or sawdust				X	
Milk cow number				X	
Number of family members/relatives working in Dhaka and sending money					X
Household head has no schooling or did not complete grade 1					X
Household head completed higher education					X
Value of agricultural land no irrigation					X
Value pigs					X
Sex of household head					X

Annex F, Table 3 — Poverty indicators used in the best model (in terms of maximization of BPAC)

Variable	Model 1 **2-step LPM**	Model 4 **2-step LPM**	Model 7 **2-step Quant**	Model 9 **2-step Quant**
Household expenditures				
Per-capita daily average clothing expenditures	X			
Annualized total household expenditures	X			
Expenditures on health, past 12 months	X			
Per capita average clothing expenditures, past 12 months				X
Education				
Household Head				
Household head has no schooling or did not complete grade 1		X		X
Household head completed higher education		X		X
Household Members				
Spouse can read only	X	X		
Number of household members who completed secondary/post primary education only, excluding household head			X	
Number of household members with no schooling or incomplete grade 1, excluding household head				X
Housing characteristics				
House structure: Good	X	X	X	
House size: small	X	X	X	
Roof material is leaves, jute stick or straw		X	X	X
Size of the dwelling in square feet		X		X
Toilet: shared or own ventilated, improved latrine or flush toilet			X	X
Lighting source: Public grid with legal socket in house			X	X
House structure: dilapidated			X	
No lock in main entrance door			X	
Exterior walls material: CI sheet (corrugated tin)			X	
Cooking fuel is collected bamboo, wood or sawdust				X
Cooking fuel is purchased bamboo, wood or sawdust				X
Assets				
Consumer durables				
Black and white TV ownership	X	X		
Number of ceiling fans owned by the household	X			X
Total value of household assets	X			
Value of radio, TV, VCR and CD player		X		X
Number of saris owned by the household			X	X

Agriculture				
Number of milk cows owned by the household		X		X
Manual husking machine ownership			X	
Motor tiller ownership			X	
Number of motor tillers owned by the household				X
Total value of land				X
Value of pigs				X
Value of not irrigated agricultural land				X
Financial				
Money received from family members working elsewhere			X	
Value of formal savings spouse				X
Number of members/relatives working in Dhaka and sending money				X
Household has a checking account				X
Other				
Ratio of males to females	X	X	X	X
Number of female adult household members	X	X	X	
Age of youngest household member	X			
Household borrows from informal market for food or emergencies	X			
Proportion of dependents younger than 14 or older than 60 years (in relation to household size)	X	X		
Number of marriages from household members in the past 3 years	X	X		
Household head is domestic worker		X	X	
Household head is seller at the bazaar		X		
Household head is widow		X	X	
Household belongs to religious group		X		
Death of a working adult member during the last 3 years			X	
Number of dependents younger than 15 or older than 64 years old			X	
Number of dependents younger than 18 or older than 60 years			X	
Squared age of household head				X
Gender of household head				X
Subjective variables				
Household always had enough to eat but not always the kind of food they wanted	X	X		
Household feels that health expenditures are below need	X	X		
Household feels that child education expenditures are above need		X		
Amount that household needs per month to live		X		
In the last 7 days, how many days lentils were served to the household members?		X		
Community				
Proportion of households in the community with access to GOAPS (Government Old-Age Pension Scheme)	X	X		

Do you have access to electricity in your community?	X		
Distance to doctor chamber (km)	X		
Do you have police station in your community?	X		
In the past 24 months, the households had access to VGF/VGD (Vulnerable Group Feeding/ Vulnerable Group Development)		X	

ENDNOTES

[1] This report consists of original work and data analysis. Citations of entire paragraphs or tables in published material by other authors is only permitted after prior consent with the authors and the IRIS Center. The cleaning and processing of data, as well as the entire analysis presented in this report, was carried out at the Institute of Rural Development, University of Göttingen, Germany. We gratefully acknowledge the valuable comments and support given by the IRIS project members, particularly Thierry van Bastelaer, Omar Azfar, Tresja Denysenko, Kate Druschel, and Lauren Hendricks. The input by the SEEP Network and its Poverty Assessment Working Group, the Advisory Panel for the Developing Poverty Assessment Tools project, and the USAID is gratefully acknowledged. In particular, Christian Grootaert provided valuable comments and advice during all phases of the field research and data analysis, especially also with regard to the choice of regression technique and the presentation of results. We are also grateful to Don Sillers, Thierry van Bastelear, and Christian Grootaert for valuable comments on an earlier draft. The analysis on accuracy of Participatory Wealth Ranking has been conducted by Joseph Feulefack, an M.Sc. student at the Institute of Rural Development. All remaining error are ours.

[2] Contact Information:

Data Analysis and Technical Assistance (DATA)
8/4, Block A (Unit 2)
Lalmatia, Dhaka — 1207
Bangladesh
Phone: (880-2) 8114870, 9111328, 9129644
Fax: (880-2) 9111328
E-mail: dataqzz@bangla.net
Web: *http://www.databd.org*

[3] See World Bank (2004), World Development Indicators.
www.worldbank.org/data/wdi2004/pdfs/table2-5.pdf

[4] Purchasing power parity exchange rates between the U.S. dollar and other currencies are available *www.worldbank.org/povmonitor/ppp1993.htm.*

[5] For monthly inflation rates, we use those published by the Bangladesh Bureau of Statistics. We plan to update the calculation of the international poverty line, expressed in local currency, when new data on CPI changes for the period March 2003 to March 2004 become available.

[6] The best sets of poverty indicators identified on each of the nine models, refer to the combination of 5, 10 or 15 indicators selected by the SAS-MAXR procedure.

[7] The term regressor or poverty indicator are interchangeably used in this document. Literally speaking, they refer to a certain type of variable used in the regression. The regressors can be derived from one or many questions from the composite questionnaire. For example, some regressors or poverty indicators

are directly computed from the variable obtained in the survey, such as the age of the household head. Other regressors require computation (using info from one or several questions) as they are not directly asked but are derived from the responses to the questions asked. An example is the size of the household (which is calculated from the information given in Section B of the questionnaire).

[8] In case a monetary variable had a value of zero *Taka* given by the respondent, this was replaced. For the case of zeroes as original monetary values, these were replaced by the value of one pro mille of the mean in order to compute the natural logarithm.

[9] Using the MAXR function of SAS, we selected in a prior model the best regressor among 13 expenditure categories (referring to questions C1 to C12 as well as clothing expenditures of Section B of the composite questionnaire) and expenditure derived variables (i.e., percentage share of food expenditures in total household expenditures). The inclusion of only the single best of the expenditure categories was done so as to avoid dominance of expenditure variables in subsequent models.

[10] It is therefore important to consider the framework of incentives for when, where, and by whom a poverty assessment is carried out (incentives for the respondent as well as the interviewer). The following quote taken from an e-mail by Jan Maes (with the Trickle Up Program) highlights some of the issues involved here: "One way of preventing clients from exaggerating their poverty or otherwise responding in a way they think 'would help their case,' is to conduct the poverty assessment survey after loan approval rather than to use it as part of the approval process. In other words, this implies that the USAID certified tools will be ex post poverty assessment tools rather than ex ante poverty targeting tools.…If you use the assessment as part of the loan application or selection process, you will have to interview all potential clients, including of course those who 'fail the poverty test.' On the downside, since you only get your poverty results after clients have already entered the program, you might learn when it is already too late that you are not reaching the poorest."

[11] The managing directors of DATA were asked to rate the verifiability of each of the indicators on a scale from 1 to 5 where 1 is very difficult or impossible to verify, and 5 stands for easy verifiability. In Annex D, we list the rating given by the survey firm DATA in Bangladesh. In Model 7, we include only the regressors that have been rated as easily verifiable (i.e., a score of 5).

[12] These variables were identified by the SAS-MAXR procedure as the strongest variables among all subjective variables which were excluded in Model 5.

[13] This section is an excerpt of a paper by Zeller and Feulefack (2005).

[14] Similar to the use of the term best in Chapter 3 for the set of BEST5 regressors for example, the term "best" does not imply a value judgment. Our method of searching for the best score has been applied here to calibrate PWR so as to achieve the highest Total Accuracy or the highest value for the Balanced Poverty Accuracy Criterion. However, our method could also be used to find the best score minimizing Leakage or Undercoverage.

[15] We verified that in none of the hamlets of these seven villages, the critical number of 10 percent of highly inconsistent cards is reached.

[16] Alternatively, new reference groups may be formed to obtain repeat rankings until more consistent scores are found, up to the limit of five total reference groups. As mentioned above, additional reference groups can be formed without, however, exceeding the maximum of five (Gibbons & Simanowitz with Nkuna, 1999, p.61). However, this was not done during the PWR exercise, and we are only left with the option to exclude these two hamlets from the data set for accuracy analysis of PWR.

[17] We also computed the accuracy results using the sample of 320 households. The level of accuracy is marginally lower than the one for 293 households.

[18] The term best score refers simply to the score that maximizes accuracy of a calibrated PWR tool. The term “best score” is not meant as a value judgment. With our best score method, one can also identify alternative best scores that maximize accuracy among the poor or accuracy among the non-poor, or that minimize Leakage or Undercoverage. For this reason, we provide the accuracy results for a range of scores so as to display the comparative advantages of other scores with respect to the other four performance criteria.

[19] The loss in accuracy over larger geographical units implies a lower accuracy for a truly national sample. As the nation in this section reflects only data from 4 districts, the true result of PWR at a full national scale comparable to the sample of 799 households analyzed in Chapter 3 is likely to be lower than the 70.3 percent obtained for the sample of 293 households.

[20] This is simply noted as a possibility. The descriptive results shown in the table do not provide any proof of impact.