Multidimensional Poverty in Bhutan: Estimates and Policy Implications

Maria Emma Santos and Karma Ura***

Abstract

This paper estimates multidimensional poverty in Bhutan applying a recently developed methodology by Alkire and Foster (2007) using the 2007 Bhutan Living Standard Survey data. Five dimensions are considered for estimations in both rural and urban areas (income, education, room availability, access to electricity and access to drinking water) and two additional dimensions are considered for estimates in rural areas only (access to roads and land ownership). Also, two alternative weighting systems are used: a baseline using equal weights for every dimension and another one using weights derived from the Gross National Happiness Survey. Estimates are decomposed into rural and urban areas, by dimension and between districts. It was found that multidimensional poverty is mainly a rural phenomenon, although urban areas present non-depreciable levels of deprivation in room availability and education. Within rural areas, it was found that poverty in education, electricity, room availability, income and access to roads, contribute in similar shares to overall multidimensional poverty, while poverty in land ownership and water have a relatively smaller contributions. The districts of Samtse, Mongar, Chukha, Trashigang and Samdrup Jongkhar are identified as giving the highest contribution to overall multidimensional poverty. The methodology is suggested as a potential formula for national poverty measurement and for budget allocation among the districts and sectors.

* Oxford Poverty and Human Development Initiative (OPHI), Oxford University and Consejo Nacional de Investigaciones Cientificas y Tecnicas (CONICET)-Universidad Nacional del Sur, Argentina.

** President, The Centre for Bhutan Studies, Thimphu.

1. Introduction

Fostered by Sen's (1985, 1990, 1999) pioneering 'capability approach', there is now an increasing consensus that poverty is an intrinsically multidimensional phenomenon. This has led scholars to propose different multidimensional poverty measures. However, some of the proposed measures seem to have incorporated a multi-dimensional perspective at the cost of giving up the simplicity and intuition that characterise the unidimensional measures. Departing from this, Alkire and Foster (2007) propose a new family of multidimensional poverty measures which is a variant of the extensively used Foster, Greer and Thorbecke's (1984) class of one-dimension poverty measures (FGT from now on). The *dimension adjusted* FGT measures keep the simple structure of the one-dimension case and satisfy a set of convenient properties, among which decomposability across population subgroups and the possibility to break it down by dimension are useful for policy purposes.

In this paper, the mentioned new class of measures is applied to estimate multidimensional poverty in Bhutan. Bhutan constitutes an extremely interesting example of how a country can define development goals, tailor its policies to these goals, and see them materialized. Since 1961, the country implemented coordinated efforts towards development through consecutive five-years-plans. In particular, the country has made significant progress in extending the access to safe drinking water and sanitation, protecting and managing the country's natural resources, providing basic health care and increasing the access to primary education. However, more can still be done in some of the mentioned areas as well as in others. Within this development agenda, the Millennium Development Goals play a key role since Bhutan is seriously committed to contribute to the realisation of the Millennium Declaration.

In this context, this paper intends not only to present estimates of multidimensional poverty in Bhutan, which would complement the income poverty estimates performed by the National Statistics Bureau, but also to suggest the applied methodology as a potential formula for budget allocation among the twenty districts, and within each district, among the different gewogs, the lowest administration units.

The data used in this paper correspond to the 2007 Bhutan Living Standard Survey. It constitutes a unique data source of this country, representative both at the national and district levels. Estimations are performed for rural and urban areas considering five dimensions and also for rural areas exclusively, with two additional dimensions. Each measure is also estimated at the district level, and in all cases, using two alternative weighting structures: a baseline of equal weights and another one with weights derived from the ranking of 'sources of happiness' identified through the Gross National Happiness Survey.

Results confirm that, indeed, income deprivation should not be the only considered dimension. Deprivation in other dimensions such as education, access to electricity and room availability in the house, are significant both in rural and urban areas, and not necessarily related to deprivation in income. Additionally, deprivation in access to roads is a significant component of multidimensional poverty in the rural areas. Land ownership in the rural areas and access to drinking water in both rural and urban areas, seem to be relatively less important. It was also found that multidimensional poverty is mainly a rural problem, which is particularly important given that 74% of the population in Bhutan live in rural areas. When analysing at the district level, it is found that Samtse, Mongar, Chukha, Trashigang and Samdrup Jongkhar are the five districts with the highest contributions to aggregate multidimensional poverty. However, even in the other districts with lower contributions, improvements in the mentioned dimensions are still important.

The rest of the paper is organised as follows. Section 2 briefly revises the literature on multidimensional poverty measures. Section 3 presents the methodology used in the paper (measures estimated, data-set used, selected dimensions, deprivation cutoff values and weighting structures). Section 4 presents the estimation results. Finally, Section 5 contains the concluding remarks.

2. Literature review

Since Sen (1976), the measurement of poverty has been conceptualised as following two main steps: identification and aggregation. In the unidimensional space, the identification step is relatively an easy one. Even when it is recognised that the concept of a poverty line-as a threshold that dichotomises the population into the poor and the non-poor- is somehow artificial, it is agreed to be necessary. Greater consideration is given to the properties that should be satisfied by the poverty index that will aggregate individuals' data into an overall indicator. However, in the multidimensional context, the identification step is more complex. Given a set of dimensions, each of which has an associated deprivation cutoff or poverty line, it is possible to identify for each person whether he/she is deprived or not in each dimension. However, the difficult task is to decide who is to be considered multidimensionally poor.

One proposed approach has been to aggregate achievements in each dimension into a single cardinal index of well-being and set a deprivation cutoff value for the well-being measure rather than for each specific dimension to identify the multidimensionally poor. This approach has some practical drawbacks, in particular, in that it is based on a number of restrictive assumptions, such as the existence of prices for all dimensions. Moreover, it does not agree with the conceptual framework of the capability approach which considers each dimension to be intrinsically important. Then, each dimension with its corresponding deprivation cutoff value needs to be considered at the identification step of the multidimensionally poor.

In this perspective, two extreme approaches have been traditionally used. On the one hand, there is the *intersection* approach, which requires the person to be poor in every dimension under consideration so as to be identified as multidimensionally poor. Clearly, this is a demanding identification criterion, by which the set of the poor is reduced as the number of dimensions considered increases, and may exclude people that are indeed deprived in several important dimensions. On the other hand there is the *union* approach, which requires the person to be poor in at least one of the considered dimensions. Clearly, with this criterion, the set of poor increases as the number of dimensions does, and it may include people that many would not considered to be multidimensionally poor (Alkire and Foster, 2007, pp.8). The union approach has received important support both in the theoretical and empirical literature. In particular, Tsui (2002) and Bourguignon and Chakravarty (2003) adopt it for the measures they propose.

Tsui (2002) develops an axiomatic framework for multidimensional poverty measurement (which includes subgroup consistency) and derives two relative multidimensional poverty measures, one of which is a generalization of Chakravarty's (1983) one-dimensional class of poverty indices, and the other is a generalization of Watt's (1968) poverty index. He also derives two absolute multidimensional poverty measures.[1]

Bourguignon and Chakravarty (2003) distinguish two groups of multidimensional poverty indices, depending on whether they consider dimensions to be independent or to have some substitutability or complementarity. Those that consider

---

[1] The distinction between relative and absolute poverty indices is due to Blackorby and Donaldson (1980). Relative poverty indices are invariant to changes in scale, such as a doubling of the poverty line and all incomes, while absolute indices are invariant to translations or additions of the same absolute amount to each income and to the poverty line (Foster and Shorrocks, 1991). In practice, relative poverty indices are the ones that have been most frequently used.

attributes to be independent satisfy what they call the One Dimensional Transfer Principle, by which poverty decreases whenever there is a Pigou-Dalton progressive transfer of the achievement in some dimension between two poor people. The progressive nature of the transfer is judged by the achievements of the two poor people in that specific dimension, independently of the achievements in the other dimensions. These indices are additively decomposable. The second group of indices are non-additive –ie. non decomposable- and by choosing appropriate values of the parameters they can reflect either a substitutability or a complementarity relationship between the dimensions. For both groups of indices, extensions of the FGT class are proposed.

On a more practice-based perspective, the Unsatisfied Basic Needs Approach, widely used in Latin America, also uses a union criterion, identifying as households with unsatisfied basic needs those that are deprived in one or more of the selected indicators.

In view of the two prevailing extreme criteria to identify the multidimensionally poor, Alkire and Foster (2007) propose a new identification methodology which, while containing the two extremes, also allows for intermediate options. Assume that there are $k = 1,.....,d$ considered dimensions, and that c_i represents the number of dimensions in which individual $i = 1,.......,n$ is deprived, then an individual is considered to be multidimensionally poor if $c_i \geq k$. When $k = 1$, the approach coincides with the union approach, whereas when $k = d$, it is the intersection approach. For $1 < k < d$, the identification criterion lies somewhere in the middle between the two extremes. Then, for the aggregation step, they use the well-known FGT class of poverty indices. The resulting family of measures satisfies a set of convenient properties including decomposability by population subgroups and the possibility of being broken down by dimensions. These last properties make it particularly suitable for policy targeting. Additionally, the class includes measures that can be used with ordinal data, which is very common in a multidimensional context. A detailed description of this class of measures is presented in Section 3.2.

A final note must acknowledge the probably most popular multidimensional poverty measure, which is the Human Poverty Index (HPI), developed by Anand and Sen (1997), companion index of the Human Development Index (HDI). Both indices are periodically estimated by the United Nations Development Programme for all countries to monitor the level of deprivation and development correspondingly with a broader perspective than income. The components of the HPI are survival deprivation (measured by the probability at birth of not surviving to age 40), deprivation of education and knowledge (measured by the adult literacy rate) and economic deprivation (measured by the average of the percentage of population without access to an improved water source and children under weight for age). In developed countries the indicators for each of the components are specified according to the higher living standards.[2] An important advantage of the HPI is that it only requires macro-data, which can be especially important for countries in which micro-data collection is still at its beginnings and its quality is not assured. However, it has some disadvantages. Clearly, the three selected dimensions can be argued to be arbitrary as well as the weighting system used to calculate the measure. When micro-data sets are available more informative measures can be calculated, with a higher number of dimensions and alternative weighting systems.

---

[2] In particular, the survival deprivation is estimated as the probability at birth of not surviving to age 60, the deprivation of education and knowledge is defined as adults lacking functional skills, the economic deprivation is defined as the percentage of population below 50% of he median adjusted disposable income, and a social exclusion component is also added, defined as the rate of long-term unemployment (lasting 12 months or more).

3. Methodology

3.1 Data

The dataset used is the 2007 Bhutan Living Standard Survey (BLSS) conducted by the National Statistics Bureau (NSB). There are 9798 households in the sample and 49165 people. This is the second BLSS performed; the previous one was done in 2003. Both surveys have followed the Living Standard Measurement Study methodology developed by the World Bank. However, the 2007 survey has more than doubled the 2003 sample size and it has also extended the coverage, so that the sample is representative both nationally and at each of the 20 Bhutanese districts (Dzongkhags), in rural and urban areas.

The unit of analysis to identify the poor is the household. However, households are weighted by their size (as well as by their sample weights), so that results are presented in population terms. Table A.1 in the Appendix presents the composition of the sample.

3.2 Multidimensional poverty measures

The poverty measure applied in this paper corresponds to Alkire and Foster's (2007) family of multidimensional poverty measures. Before introducing it, it is convenient to clarify notation in the first place.

Let $M^{n,d}$ denote the set of all $n \times d$ matrices, and interpret a typical element $y \in M^{n,d}$ as the matrix of achievements of n people in d different dimensions. For every $i = 1, 2, ..., n$ and $j = 1,2,...,d$, the typical entry y_{ij} of y is individual i´s achievement in dimension *j*. The row vector $y_i = (y_{i1}, y_{i2}, ..., y_{id})$ contains individual i´s achievements in the different dimensions; the column vector $y_{\cdot j} = (y_{1j}, y_{2j}, ..., y_{nj})'$ gives the distribution of achievements in dimension *j* across individuals. Let $z_j > 0$ be the deprivation cutoff value (or poverty line) in dimension *j*. Following Alkire and Foster (2007)'s notation, the sum of entries in any given vector or matrix v is denoted by $|v|$, while $\mu(v)$ is used to represent the mean of v (or $|v|$ divided by the number of entries in v).

For any matrix *y*, it is possible to define a matrix of deprivations $g^0 = [g_{ij}^0]$, whose typical element g_{ij}^0 is defined by $g_{ij}^0 = 1$ when $y_{ij} < z_j$, and $g_{ij}^0 = 0$ when $y_{ij} \geq z_j$. That is, the ij^{th} entry of the matrix is 1 when person *i* is deprived in dimension *j*, and 0 when he/she is not. From this matrix, define a column vector of deprivation counts, whose i^{th} entry $c_i = |g_i^0|$ represents the number of deprivations suffered by person *i*. If the variables in *y* are cardinal, then a matrix of normalised gaps $g^1 = [g_{ij}^1]$ can be defined, where the typical element $g_{ij}^1 = (z_j - y_{ij})/z_j$ when $y_{ij} < z_j$, and $g_{ij}^1 = 0$ otherwise. The entries of this matrix are non-negative numbers between 0 and 1, and each non-zero entry gives the extent of the deprivation experienced by person *i* in dimension *j*. This matrix can be generalised to $g^\alpha = [g_{ij}^\alpha]$, with $\alpha > 0$, whose typical element g_{ij}^α is the normalised poverty gap raised to the α-power.

The methodology to identify the multidimensionally poor proposed by Alkire and Foster (2007) compares the number of deprivations with a cutoff level *k*. When each selected dimension has the same weight, the possible values of *k* go in the range of $k = 1,......,d$. However, the methodology also allows other weighting systems, which will be explained at the end of the section. In general, for any weighting system, let ρ_k be the identification method such that $\rho_k(y_i, z) = 1$ when

$c_i \geq k$, and $\rho_k(y_i, z) = 0$ when $c_i < k$. That means that an individual is identified as multidimensionally poor if he/she is deprived in at least k dimensions. This methodology is said to be a *dual cutoff* method, because it uses the *within dimension* cutoffs z_j to determine whether an individual is deprived or not in each dimension, and the *across dimensions* cutoff k to determine who is to be considered multidimensionally poor. It is also presented as a *counting approach*, since it identifies the poor based on the number of dimensions in which they are deprived. When equal weights are used, when $k = 1$, the identification criterion corresponds to the union approach, whereas when $k = d$, the identification criterion corresponds to the intersection approach. This identification criterion defines the set of the multidimensionally poor people as $Z_k = \{i : \rho_k(y_i; z) = 1\}$. Once identification is applied, a censored matrix $g^0(k)$ can be obtained from g^0 by replacing the i^{th} row with a vector of zeros whenever $\rho_k(y_i, z) = 0$. Matrix $g^\alpha(k)$ can be defined analogously for $\alpha > 0$, with its typical entry $g_{ij}^\alpha(k) = g_{ij}^\alpha$ if i is such that $c_i \geq k$, while $g_{ij}^\alpha(k) = 0$ if i is such that $c_i < k$.

A first natural measure to consider is the percentage of people that are multidimensionally poor: the multidimensional Headcount Ratio $H = H(y; z)$ defined by $H = q/n$, where q is the number of people in set Z_k. This measure is the analogous to the unidimensional Headcount Ratio, and it has the advantages that it is easy to compute and understand, and that it can be calculated with ordinal data. However, it suffers from the disadvantages first pointed by Watts (1969) and Sen (1976) for the one-dimensional case, namely, being insensitive to the depth and distribution of poverty, violating monotonicity and the transfer axiom. Moreover, in the multidimensional context, it also violates what Alkire and

Foster (2007) call *dimensional monotonicity*: if a poor person becomes deprived in an additional dimension (in which he/she was not previously deprived), *H* does not change.

Considering this, Alkire and Foster (2007) propose the dimension adjusted FGT measures, given by $M_{\alpha}(y;z)=\mu(g^{\alpha}(k))$ for $\alpha \geq 0$. When $\alpha = 0$, the measure is the Adjusted Headcount Ratio, given by $M_0=\mu(g^0(k))=HA$, which is the total number of deprivations experienced by the poor ($|c(k)|=|g^0(k)|$), divided by the maximum number of deprivations that could possibly be experienced by all people (nd). It can also be expressed as the product between the percentage of multidimensionally poor individuals (*H*) and the average deprivation share across the poor, which is given by $A=|c(k)|/(qd)$. In words, *A* provides the fraction of possible dimensions *d* in which the average multidimensionally poor individual is deprived. In this way, M_0 summarises information on both the incidence of poverty and the average extent of a multidimensional poor person's deprivation. As *H*, this measure is easy to compute, and can be calculated with ordinal data. However, it is superior to *H* in that it satisfies dimension monotonicity: if a poor becomes deprived in an additional dimension, *A* will increase and therefore M_0 will also increase.

When $\alpha = 1$, the measure is the Adjusted Poverty Gap, given by $M_1=\mu(g^1(k))=HAG$, which is the sum of the normalised gaps of the poor ($|g^1(k)|$) divided by the highest possible sum of normalised gaps (nd). It can also be expressed as the product between the percentage of multidimensionally poor individuals (*H*), the average deprivation share across the poor (*A*) and the average poverty gap (*G*), which is given by $G=|g^1(k)|/|g^0(k)|$. M_1 summarises information on the incidence of poverty, the average range of deprivations and the average depth of deprivations of the poor. It satisfies not only dimension monotonicity but also monotonicity: if an individual becomes more deprived in a certain dimension, M_1 will increase.

Finally, when $\alpha = 2$, the measure is the Adjusted Squared Poverty Gap, given by $M_2 = \mu(g^2(k)) = HAS$, which is the sum of the squared normalised gaps of the poor ($|g^2(k)|$) divided by the highest possible sum of normalised gaps (nd). It can also be expressed as the product between the percentage of multidimensionally poor individuals (*H*), the average deprivation share across the poor (A) and the average severity of deprivations (*S*), which is given by $S = |g^2(k)| / |g^0(k)|$. M_2 summarises information on the incidence of poverty, the average range and severity of deprivations of the poor. If a poor person becomes more deprived in a certain dimension, M_2 will increase more the larger the initial level of deprivation was for this individual in this dimension. This measure satisfies both types of monotonicity and also transfer, being sensitive to the inequality of deprivations among the poor.

All members of the $M_\alpha(y;z)$ family are decomposable by population subgroups. Given two distributions x and y, corresponding to two population subgroups of size $n(x)$ and $n(y)$ correspondingly, the weighted average of sum of the subgroup poverty levels (weights being the population shares) equals the overall poverty level obtained when the two subgroups are merged:

$$M(x,y;z) = \frac{n(x)}{n(x,y)} M(x;z) + \frac{n(y)}{n(x,y)} M(y;z)$$

Clearly, this can be extended to any number of subgroups.

Additionally, once the identification step has been completed, all members of the $M_\alpha(y;z)$ family can be broken down into dimension subgroups. To see this, note that the measures can be expressed in the following way: $M_\alpha(y;z)=\sum_{i=1}^{n}\mu(g_{*j}^{\alpha}(k))/d$, where g_{*j}^{α} is the j^{th} column of the censored matrix $g^\alpha(k)$. Strictly speaking, this is not decomposability in terms of dimensions, since the information on all dimensions is needed to identify the multidimensionally poor. However, it is still a very convenient break-down property. Once identification has been applied, and the non-poor rows of g^α have been censored to obtain $g^\alpha(k)$, for each *j*, $(\mu(g_{*j}^{\alpha}(k))/d)/M_\alpha(y;z)$ can be interpreted as the post-identification contribution of dimension *j* to overall multidimensional poverty.

The $M_\alpha(y;z)$ family adopts the neutral assumption of considering dimensions as independent. In this way, it satisfies a property, based on Atkinson and Bourguignon (1982), called *weak rearrangement*. Imagine that one individual that begins with weakly higher achievements in every dimension than another individual, switches one or more dimension achievement levels with this other individual, so that this ranking no longer holds. This is called an association decreasing rearrangement. Under such rearrangement one would expect multidimensional poverty not to increase. This is postulated by the weak rearrangement axiom and it is precisely satisfied by the $M_\alpha(y;z)$, which will not change under such transformation. Because of its completely additive form, it evaluates each individual's achievements in each dimension independently of the achievements in the other dimensions and of others' achievements. In this way, the $M_\alpha(y;z)$ family can be associated with the first group of measures of Bourguignon and Chakravarty (1983).[3]

Until now, the $M_\alpha(y;z)$ family has been presented assuming that all dimensions receive the same weight. However, the family can be extended into a more general form, admitting different weighting structures. Let w be a d dimensional row vector, whose typical element w_j is the weight associated with dimension *j*. Then, define the matrix g^α of size $n \times d$, where the typical element $g_{ij}^\alpha = w_j((z_j - y_{ij})/z_j)^\alpha$ when $y_{ij} < z_j$, while $g_{ij}^\alpha = 0$ otherwise. Then, as before, from this matrix, a column vector of deprivation counts can be defined, whose i^{th} entry $c_i = |g_i^0|$ represents the sum of weights for the dimensions in which person i is deprived. c_i varies between 1 and *d*, and so the dimensional cutoff for the identification step of the multidimensionally poor will be a real number *k*, such that $0 < k \le d$. Note that when $k = \min\{w_j\}$, the criterion coincides with the union approach, whereas when $k = d$, it is the intersection approach. Also note that when $w_j = 1$, it is the previous case where all dimensions receive the same weight and the dimensional cutoff *k* is an integer. Then, the methodology works exactly in the same way as before, defining the

[3] Alkire and Foster (2007) explain that their measures can be converted into measures that consider either all dimensions as substitutes or all dimensions as complements, and in this way, they would be in line with the second type of measures considered by Bourguignon and Chakravarty (2003). However, they remark that imposing the same type of relationship between all dimensions, and with the same assumed degree of either substitutability or complementarity seems rather restrictive. Moreover, such transformation would be at the cost of losing the possibility of breaking down the measure into dimensions.

censored matrices $c(k)$ and $g^{\alpha}(k)$, and the $M_{\alpha}(y;z)$ measures.

3.3 Dimensions and deprivation cut-offs

The selection of the dimensions for the multidimensional poverty measure is guided by the eight Millennium Development Goals (MDG) that Bhutan has defined to fulfil the Millennium Declaration, and it is subject to data availability.[4] Table 1 presents the dimensions with their corresponding cutoff values.

Having an adequate income, and for rural households, having access to roads and owing some land, can be framed into the first MDG, which is *to Eradicate Extreme Poverty and Hunger*. For the income cutoff, the official Bhutanese poverty line was used, which is calculated in Nu 1,096.94 per capita per month. During 2007, this was equivalent approximately to US$25. This poverty line is composed of a food poverty line, which is the cost of a food basket consisting of 53 items that is considered to fulfil the requirement of 2,124 Kcal. per person per day, plus a non-food allowance.[5] Given that the

---

[4] The eight goals are: Goal 1: Eradicate extreme poverty and hunger, Goal 2: Achieve universal primary education, Goal 3: Promote gender equality and empower women, Goal 4: Reduce child mortality, Goal 5: Improve maternal health, Goal 6: Combat HIV/AIDS, malaria and other diseases, Goal 7: Ensure environmental sustainability, Goal 8: Develop a global partnership for development.

[5] The 2,124 Kcal per person per day is the nutritional norm applied in Nepal, and the NSB decided to follow it for the case of Bhutan. The cost of the food poverty line is Nu 407.98, which in 2007 was equivalent to US$ 9 approximately. The NSB does not account for differences in nutritional requirements across age and sex, that is, they do not use equivalised scales. They do not account for economies of scale in the household either. Despite this, it is a common practice to consider both issues in poverty estimates. It was decided to stick to the NBS methodology to make the results of this paper comparable to the official income poverty estimates. The non-food allowance is estimated averaging the non-food per capita expenditure of households in the reference population that spent for

percentage of people below the food poverty line is only 6%, the target in Bhutan with respect to this MDG is more demanding, and it consists of halving poverty, rather than extreme poverty (2005 MDG Progress Report). This is why the overall poverty line rather than the food poverty line is used for the multidimensional poverty estimation. If a household does not make a monthly per capita income of at least Nu 1,096.94, it is considered *income deprived*, and so are all its household members.

To achieve the mentioned target in terms of income poverty, Bhutan faces some significant constraints, one of which is the geographical isolation of some rural areas. Lack or limited road access and links to markets impede the development of the area and, more seriously, it can cause food shortage in these remote regions. The further development of rural road and communication infrastructure and access to markets has become a priority in the country. Based on this, access to services is included among the selected dimensions. A household in a rural area that can not reach either a feeder or a tarred road within 30 minutes by any means of transport, it is considered to be *access deprived*, and so are all its household members.

Another potential constraint to reduce poverty regards land ownership. Households in rural areas with small land holdings are at risk in terms of food access, since small land holdings are usually compounded with low productivity, inadequate storage facilities, poor irrigation and vulnerability to natural disasters, crop depredation by wild animals, birds and pests (2005 MDG Progress Report, pp. 26-28). The BLSS has information on different type of land holdings: wet land, dry land, orchard, sokshing (leaf litter wood lot), pasture and tseri (swidden cultivation land). Given that sokshing and pastures have been recently nationalised, it was decided to only consider the other four types of land. Despite the differences of land qualities between the different types of

---

food a value near the food poverty line.

land, a deprivation cutoff of 1 acre of total land holding (either any of them or the sum of any combination) was defined. The selected threshold is clearly debatable. However, 1 acre seems a reasonable amount of land that would allow cultivating for subsistence, even considering that land quality may vary.[6] A household in a rural area with less than 1 acre of land holdings is considered to be *land deprived,* and so are all its household members.

A third selected dimension is closely related to the second MDG: *Achieve Universal Primary Education*. The target of the country regarding this MDG is that by 2015 all children are able to complete a full course of primary schooling. The country has achieved significant progress towards this target, raising the primary enrolment rate from 55% in 1990 to 84% in 2004. Reaching children in rural and remote communities, reducing early dropouts, and improving the quality of education are among the priorities of the education policy and programs. A need to expand secondary school education has also been identified, as the number of those completing primary education continues to increase.

The education indicator constructed for this paper is composed of two requirements. In the first place, following Basu and Foster's (1998) idea of *proximate literacy,* it is required that at least one household member is literate. The logic behind this is that illiterate people that live in a household where at least someone is literate enjoy some of the literate person's abilities; in other words, they enjoy an intra-household externality. Despite that the literacy rate in the country is still low (55%), the proximate literacy requirement is a mild one, since even if the adults in the household are illiterate, as long as the children are literate - which is very likely given the progress in primary school enrolment, the household will be considered literate.

[6] Although an absolute poverty line approach is followed for all indicators in this paper, it is worth mentioning -for reference-, that 1 acre is half of the median rural land holdings and less than the country's median land holdings (which is 1.32 acres).

However, the second requirement for the education indicator is that all children between 6 and 16 years of age are attending school. This is in line with the mentioned MDG. On the one hand, it is more demanding than the target, in that children are required to be in school even at an older age than what primary education demands. On the other hand, it is not excessively demanding since children are not required to be in the school grade corresponding to their age (even if a 16 year old was in primary school, the household would satisfy the requirement). A household with no-literate member and with children between 6 and 16 years of age that are not attending school is considered to be *education deprived*, and so are all its household members.

The following two dimensions are directly related to the seventh MDG: *Ensure Environmental Sustainability*. Increasing the access to electricity (especially in rural areas) is one of the key objectives within this goal, since it will not only improve the living conditions of the rural population but it will also reduce the proportion of population using solid fuels improving the quality of the air. Bhutan would like to achieve "electricity for all" by 2020 and it is working steadily towards this goal. A household with no access to electricity is considered to be *electricity deprived*, and so are all its members. Access to safe drinking water is another key objective within this goal and Bhutan has progressed significantly in increasing this access. However, there are areas in which more progress can still be made, so this dimension was selected as one to be considered for multidimensional poverty measurement. A household with no access to either a pipe in dwelling, a neighbour's pipe, a public outdoor tap or a protected well, is considered to be *water deprived*, and so are all its members.

It is worth mentioning that within the goal to ensure environmental sustainability, increasing the access to safe sanitation is also considered. However, Bhutan has progressed tremendously in extending the access to improved sanitation, that only 3.6% of the population is deprived in this dimension. Therefore, it was decided not to include it among the dimensions of the multidimensional poverty measure to be estimated.

Finally, the number of people per room in the household is also considered. Although this is not included as a target in any of the 8 Goals of Bhutan, it is a commonly used socio-economic assessment indicator, since it provides a measure of housing quality. It is mentioned as an indicator in the 2003 Indicators for Monitoring the Millennium Development Goals. It can be related to Goal 7, since dwelling's overcrowding can promote different type of diseases and it does not contribute to a sustainable environment. A household with 3 or more people per room is considered to be *room deprived*, and so are all its members. The number of rooms excludes kitchens, bathrooms, toilets and balconies. The use of 3 or more people is quite standard in different countries.

Table 1: Selected dimensions, deprivation cut-off values and weights

Dimension	**Deprivation Cutoff value**
Rural and Urban Areas	
Related to MDG 1: Eradicate Extreme Poverty and Hunger	
Income	Have monthly per capita income of Nu 1096.94 pc p/month (Bhutan Poverty Line)
Related to MDG 2: Achieve Universal Primary Education	
Education	At least one literate household member and all children between 6 and 16 are going to school.
Related to MDG 7: Ensure Environmental Sustainability	
Access to Electricity	Access to electricity
Access to Drinking Water	Access to drinking water (either pipe in dwelling, neighbour's pipe, public outdoor tap or protected well)
Room Availability	Less than 3 people per room
Rural Areas Only: Two additional MDG1-related dimensions are considered	
Access to Roads	Access to either a feeder or a tarred road in 30

	minutes or less (by any means of transport).
Land Ownership	Own at least 1 acre of land of any kind. (Land is the sum of wet land, dry land, orchard and tsheri (swidden cultivation land)).

Clearly, the list of dimensions is not intended to be exhaustive. There are another four MDGs that Bhutan is trying to accomplish, and within all the eight goals there are many other indicators which could be considered. However, there are two difficulties. In the first place, not all goals and targets are applicable to obtain a multidimensional poverty estimate from micro-data that is relevant for the whole population. For example, even when *Improving Maternal Health* (Goal 5) is a goal of utmost importance, indicators that account for these issues at the household level would only have meaning for households with pregnant or recently pregnant women. Secondly, even when indicators on some of the other goals, such as *Reducing Child Mortality* (Goal 4), or *Combating HIV/AIDS, Malaria and Other Diseases* (Goal 6) could be included, the BLSS does not provide information on these issues. Goal 3 of *Promoting Gender Equality and Empowering Women* is also a fundamental one, but it is centred on a specific part of the population. Finally, the targets included in Goal 8 of *Developing a Global Partnership for Development* (such as telephone density or computers in use) might not be necessarily associated with poverty, especially in a country that is in the first stages of modernisation.

All the selected dimensions refer to material-conditions. However, there are basis to argue that other non-material conditions should also be included in the measurement of multidimensional poverty as it is suggested by the capability approach. The Oxford Poverty and Human Development Initiative (OPHI), at the University of Oxford, has identified five *missing dimensions* of poverty, namely: the quality of employment, empowerment, physical safety, the ability to go about without a shame and psychological and subjective wellbeing (Alkire, 2007). Unfortunately data on any of these dimensions is not available in the BLSS, so indicators related to these dimensions can not be included in the estimations of this paper. Most of these data are available in this GNH Survey but the period of survey and respondents are not compatible with the BLSS data set. On the other hand, GNH Survey does not include questions on a few requisite data like water and sanitation. However, Bhutan is planning to incorporate questions on these issues in poverty surveys in the near future. This will eventually allow broadening and enriching the present analysis.

In any case, given Bhutan's interest in non-traditional dimensions and in a holistic approach to the measurement of well-being, the main purpose of this paper is an illustrative one: to demonstrate the methodology and its potential both for multidimensional poverty measurement as well as for budget allocation. A different list of dimensions could be used eventually.

Provided that four out of the seven selected indicators are dichotomous variables, only the multidimensional Headcount Ratio H and M_0 are estimated. These two measures are estimated for both urban and rural areas considering the five dimensions applicable to both areas: income, education, room availability, electricity and water. The two measures H and M_0 are also estimated only for rural areas considering all the seven dimensions.

3.4 Weighting

The selection of dimensions to be included is not the only controversial task when measuring multidimensional poverty. Defining the weights to give to each dimension is another difficult issue since it implicitly entails value judgements (Decanq and Lugo, 2008). In this paper, two groups of estimations were performed for each measure. One of them uses equal weights, assigning a value of one to each dimension. This can be thought as a benchmark, since it implicitly assumes that all dimensions are equally important.

The second group of estimates uses a set of weights derived from the 2007 Gross National Happiness Survey (GNHS). One of the questions of this survey, which had a sample size of 950 people, required the respondent to rank his/her sources of happiness. The question was an open one, so that the respondent could mention any source of happiness that was important for him/her. Answers were then grouped and categorised. Interestingly, the seven dimensions selected in this paper are among the dimensions ranked in the ten first places.[7] The percentage of people that placed each of the selected dimensions at some point in the ranking was re-scaled so as to add up to the total number of dimensions used, obtaining the weights listed in Table 2.

Table 2: Weights derived from the Gross National Happiness Survey

Dimension	**% of responses by 950 respondents who mentioned it as a source of happiness**	**Derived Weight For the urban & rural estimates**	**Derived Weight For the urban & rural estimates**
Income	41%	2.0	2.0
Education	27%	1.3	1.3
Room Availability	14%	0.7	0.7
Electricity	16%	0.8	0.8
Water	4%	0.2	0.2
Access to Roads	27%	-	1.3
Land Ownership	15%	-	0.7

[7] The list of 'sources of happiness' derived from this question of the GNHS, ranked in order of their preference reads: financial security, transportation, education, good health, family relationships, agricultural productivity, electricity, basic needs (food, clothing, shelter, cleaning drinking water), land, housing, good governance, health infrastructure and facilities, faith and spiritual practices, community relationship, job, national security, communication facilities, environment, sports and travelling.

	5	7

Note: Room Availability was not listed itself as a source of happiness, but 'Housing' was, so the percentage of people mentioning this was used to derive this weight. Access to roads was listed within 'Transportation'.

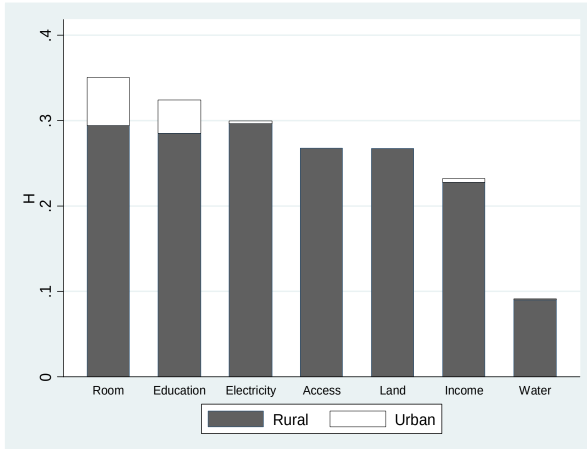
4. Estimation results

4.1 Aggregate deprivation by dimension

Figure 1 presents the estimated Headcount in each dimension, ranked from highest to lowest. It also shows the contribution to the overall deprivation in each of them done by rural and urban areas. Note that, by definition, all the deprivation in access to roads and land ownership corresponds to rural areas.

From this graph, it can be seen that while 23% of the population do not earn enough income to afford the basic needs basket, the incidence of deprivation in all the other dimensions except for water is higher. In particular, 35% of the population in Bhutan live in a household with 3 or more people per room, 32% live in a household where either no-one is literate or there are children in school age not going to school and 30% do not have access to electricity. Only 9% do not have access to drinking water. Virtually all the deprived population in electricity, income and water live in rural areas. Most of the population deprived in room and education also live in rural areas, although it is worth noting that 12% of all the deprived in room and 15% of all the deprived in education live in urban areas, suggesting that improvement in these two dimensions is also needed in urban areas. Among people living in rural areas, 26.7% do not have access either to a tarred or to a feeder room within 30 minutes, and the same percentage owns less than one acre of land.

Figure 1: Head Count Ratio in each Dimension Rural and Urban Contributions



These figures provide a first basis for priorities within the selected dimensions in terms of policy design. They also suggest that deprivation is mainly a rural phenomenon, where 74% of the population in Bhutan live. This provides a strong reason to focus deprivation-reducing efforts in these areas.

4.2 Aggregate multidimensional poverty estimates

4.2.1 Rural and urban estimates with five dimensions

Table 3 presents the estimates of the Multidimensional Headcount Ratio (*H*) and the Adjusted Headcount Ratio for both urban and rural areas using the five dimensions applicable to both, for different values of *k*, using equal weights and the weights derived from the GNHS.

It should be noted that the meaning of each *k*-value in the estimates using the GNHS weights differs from the meaning when equal weights are used. With equal weights k=1 requires for someone to be considered multidimensionally poor to be deprived in at least one of the five dimensions, which can be any of them. With GNHS weights, k=1 implies requiring being deprived in at least a dimension or a combination of dimensions which weights add to 1. For example, someone deprived only in safe water is not considered to be multidimensionally poor with k=1, neither is considered someone deprived only in room or in electricity. However, someone deprived only in income or only in education is considered multidimensionally poor with k=1, as well as someone deprived both in water and electricity, electricity and room or electricity and water, for example. The H and M_0 measures using GNHS weights were estimated for all possible values of k, which range from 0.2 to 5, and not only the entire values from 1 to 5. For simplicity and comparison purposes Table 3 presents the estimates only for the same five values of k for which the measures using equal weights were estimated.

Clearly, both with equal weights and GNHS weights, the multidimensional poverty estimates decrease as k increases. With equal weights, estimates indicate that 64% of the population is deprived in one or more of any the five dimensions, and -on average- they are deprived in 2 dimensions, so that the Adjusted Headcount Ratio M_0 is 0.26. Analogously, 37% of the population in rural and urban areas is deprived in two or more of the five dimensions, and on average, they are deprived in 2.7 dimensions, so that the Adjusted Headcount Ratio is 0.20. The percentage of people deprived in 3 or more dimensions is 20%, with M_0 being 0.14 and people being deprived on average in 3.5 dimensions. The estimates are smaller for k=4 and finally only 1.4% of the population is deprived in all the five dimensions. The estimates using GNHS weights are smaller for k=1 to k=3, which is a consequence of the lower importance given to some of the dimensions such as people per room, electricity and water, so that combinations of these deprivations are equivalent to being deprived only in income or only in education. With k=4, H and M_0 with GNHS weights are slightly higher than with equal weights because people deprived in a combination of three dimensions (such as income, education and room) are considered multidimensionally poor (since their weights add up to 4) but are not considered multidimensionally poor with k=4 in the equal weighting system. Obviously, when it is required to be deprived in all 5 dimensions to be considered multidimensionally poor, all estimates coincide and are indeed very low.

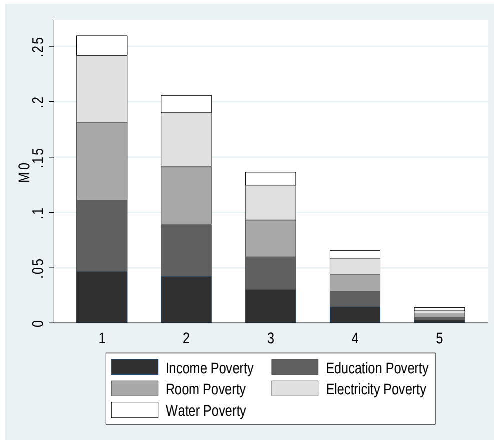
Table 3: Multidimensional Headcount Ratio (H) and Adjusted Headcount Ratio (M_0) in rural and urban areas - Different k values -Equal weights and GNHS weights
Five Dimensions considered

K	Equal Weights			GNHS Weights		
	H	**M_0**	**Average Deprivation**	**H**	**M_0**	**Average Deprivation**
1	0.64	0.26	2.0	0.48	0.23	2.4
2	0.37	0.20	2.7	0.34	0.19	2.8
3	0.20	0.14	3.5	0.17	0.12	3.5
4	0.08	0.06	3.75	0.11	0.08	3.6
5	0.014	0.014	5	0.014	0.014	5

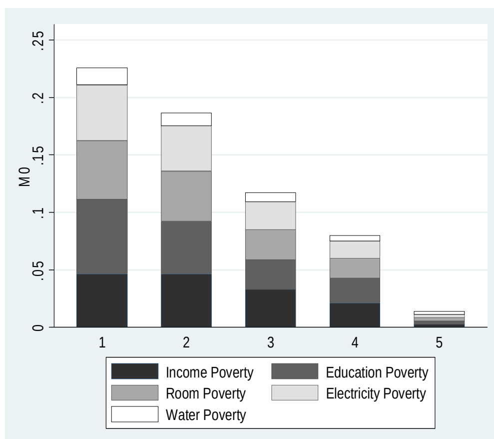
The multidimensional poverty incidence (H) estimates can be related to the one-dimensional (income) poverty incidence, which is 23%. One should always present the estimates for the different k-values. However, if one had to choose a value to define policy, k=2 might be a reasonable intermediate cutoff which focused the attention on a set of people narrow enough so as to ensure that they are indeed multidimensionally deprived, and broader enough so as to include people that, even if not deprived in a high number of dimensions, they still experience deprivation in several relevant ones.

A natural question is how does deprivation in each dimension contributes to the overall multidimensional poverty. This can be analysed breaking down M_0 by the dimensions, which is precisely one of the advantages of this measure. Figure 2 presents this decomposition in the form of a bar graph for each k value with each of the weighting systems.

Figure 2: Multidimensional Adjusted Headcount Ratio (M_0) in rural and urban areas
Different k – Contributions by each of the five dimensions



(a) Equal Weights

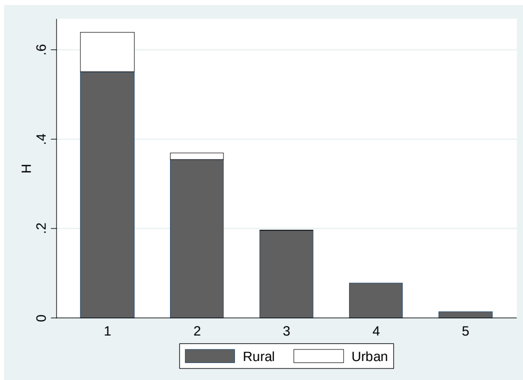


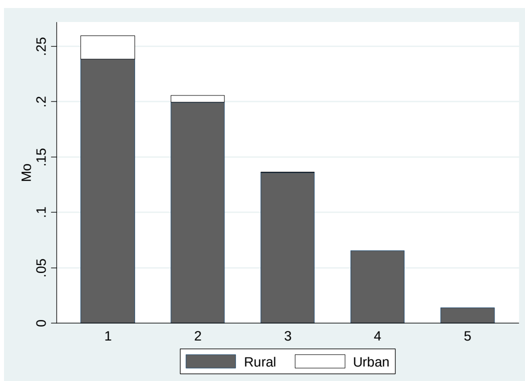
(b) GNHS Weights

In the figure it can be seen that income, education, room and electricity have roughly similar contributions to overall M_0 for k=1 to k=4 in both weighting systems, whereas water is clearly the dimension with the smallest contribution. Within the four dimensions with similar contributions, when equal weights are used and k=1, room is the one with the highest contribution (27%), followed by education (25%), electricity (23%) and income (18%). Poverty in water contributes with only 7%. When k=2, the ranking of contributions is similar, except that electricity has a slightly higher contribution than education (23% *vs.* 22%). When k=3 and k=4, the ranking order is room, electricity, income, education and water. It is interesting to note that when the GNHS weights are used, the rankings of the contributions differ from the case of equal weights. With k=1, deprivation in education gives the highest contribution (29%), followed by room (23%), electricity (21.5%), income (20.5%) and water (6%). With k=2, the ranking is income (25%), education (24.5%), room (23.5%), electricity (21%) and water (6%). With k=3 and k=4, the rankings are the same, except that with k=3, education switches the place with room. The fact that education ranks first with k=1, and income ranks first in the other cases, is reflecting the higher weight given to these two dimensions when GNHS weights are used. Overall, and by definition, as k approaches the maximum k value, the structure of contributions by each dimension approaches to an *equal*-contribution. When k=5, each dimension contributes with 20%.

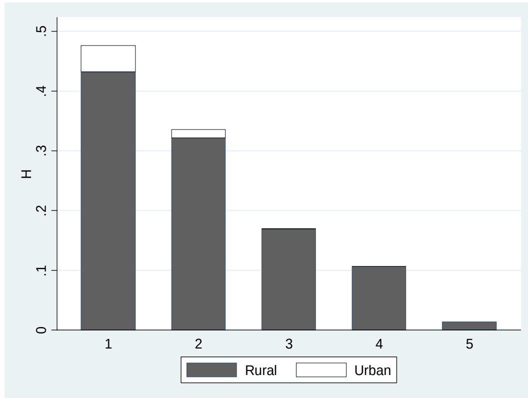
Another interesting decomposition of the aggregate multidimensional poverty measures is between rural and urban areas. Figure 3 presents the estimates of H and M_0 contained in table 3 with the corresponding contributions of rural and urban areas. These are consistent with what was suggested in Graph 1. Only in the case of k=1 does the urban areas have some contribution to overall H and M_0, which is 14% to overall H with equal weights and 9% with GNHS weights, and it is 8% to overall M_0 with equal weights and 5% with GNHS weights. These results reinforce previous results from the 2004 and 2007 *Poverty Analysis Reports*, which had identified income poverty as a predominantly rural phenomenon. The estimates in this paper suggest that multidimensional poverty is also fundamentally a rural problem.

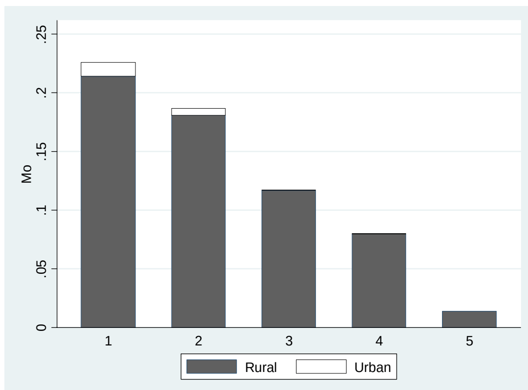
Figure 3: Multidimensional Poverty Headcount Ratio and Adjusted Headcount Ratio
Different k – Rural and Urban Contributions





(a) Equal Weights





(b) GNHS Weights

4.2.2 Rural estimates with seven dimensions

Given that multidimensional poverty is virtually all concentrated in rural areas, it is worth estimating *H* and M_0 only for these areas, expanding the set of dimensions to also include deprivation in access to roads and land ownership. These results are presented in table 4, both using equal weights and GNHS weights, for different values of *k*. The same comment given when explaining table 3 on the meaning of the *k*-cutoff with GNHS weights applies here.

Table 4: Multidimensional Headcount Ratio (H) and Adjusted Headcount Ratio (M_0) in rural areas only - Different k values - Equal weights and GNHS weights
Seven Dimensions considered

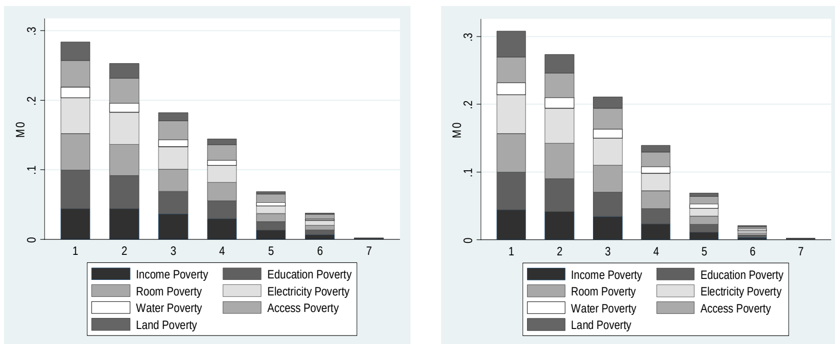
	Equal Weights			**GNHS Weights**		
K	**H**	**M_0**	**Average Deprivation**	**H**	**M_0**	**Average Deprivation**
1	0.84	0.31	2.6	0.68	0.28	2.9
2	0.60	0.27	3.1	0.54	0.25	3.2
3	0.38	0.21	3.9	0.32	0.18	3.9
4	0.21	0.14	4.6	0.24	0.14	4.1
5	0.09	0.07	5.4	0.09	0.07	5.4
6	0.024	0.021	6.1	0.05	0.04	5.6
7	0.002	0.002	7	0.002	0.002	7

Table 4 shows higher estimates than before both because these refer only to rural areas, where multidimensional poverty is higher, and because a higher number of dimensions are being considered. Using equal weights, estimates suggest that 84% of the population in rural areas is deprived in at least one of the seven considered dimensions, being deprived on average in 2.6 dimensions giving a M_0 value of 0.31. 60% are deprived in two or more, 38% in three or more and 21% in four or more, increasing the average deprivation among these groups and reducing M_0 correspondingly. Using GNHS weights, the multidimensional poverty estimates in the rural areas are lower for k=1 to k=3 than the ones obtained with equal weights for similar reasons to the ones explained in table 3. Note that starting with k=5, estimates both using equal weights and GNHS weights decrease significantly and are only 0.2% for k=7. This suggests that a k cutoff value of 5 or higher is extremely demanding for estimating multidimensional poverty in the rural areas of Bhutan.

The Income Poverty Headcount Ratio is 30.9% in the rural areas of Bhutan, which can be compared with the Multidimensional Poverty Headcount Ratios for the different k values and the two weighting systems. Analogous to the analysis for both urban and rural areas, even when estimates for the different *k* values must be considered, a cutoff value of *k*=3 might be a good option for monitoring multidimensional poverty in the rural areas.

As in the case of the overall estimates, it is worth analysing the decomposition of overall M_0 in rural areas among the seven dimensions. The results of this decomposition are presented in figure 4.

Figure 4: Multidimensional Adjusted Headcount Ratio (M_0) in rural areas only
Different k – Contributions by each of the seven dimensions



(a) Equal Weights (b) GNHS Weights

In the figure it can be seen that for all *k* and for the two weighting systems, poverty in electricity, education, room and income are among the highest contributors to overall poverty in rural areas, coinciding with the contributions analysed for both rural and urban areas. These are followed in all cases by deprivation in access to roads, deprivation in land ownership and, finally, water. This means that the two additional dimensions considered in rural areas do not affect significantly the ranking of the other deprivations; rather, they are placed after the mentioned four and before water.

Within the four dimensions with the highest contributions, when equal weights are used and k=1, electricity ranks first (contributing with 18.7% to overall poverty), then room (with 18.5%), education (17.9%) and income (14.3%). Poverty in access and land contributes in both cases with 12.4%, and water with 5.7%. When k=2 and k=3, room poverty ranks first, and it is followed by electricity, education, income, access, land and water. And when k=4, income switches positions with education. For higher values of k, the four main contributors have more and more equal contributions. As it happened with estimates for both rural and urban areas, when the GNHS weights are used, education and income tend to have higher contributions to overall poverty relative to electricity and room because of the higher importance attributed to these two dimensions.

4.3 Overlapping and correlation between dimensions

The typical argument to focus poverty analysis exclusively on income is that income is highly correlated with achievements in other dimensions, such as education. If this was the case, by targeting the income-poor, one would be targeting the deprived in other dimensions. However, this does not seem to be the case of Bhutan.

A first simple exercise is to analyse the Spearman correlation between any pair of variables. Table 5 (a) presents this coefficient between deprivations in the different pairs of dimensions used to estimate multidimensional poverty in both rural and urban areas, using the total sample. Table 5 (b) presents the same, but for all pairs of dimensions used for the estimations only in rural areas.

Table 5: Spearman correlation coefficients between deprivations

(a) Rural and Urban Areas-Five Dimensions

	Income Deprived	Education Deprived	Room Deprived	Electricity Deprived	Water Deprived
Income Deprived	1				
Education Deprived	0.24	1			
Room Deprived	0.36	0.17	1		
Electricity Deprived	0.30	0.22	0.25	1	
Water Deprived	0.14	0.14	0.11	0.22	1

(b) Rural Areas Only- Seven Dimensions

	Income Deprived	Education Deprived	Room Deprived	Electricity Deprived	Water Deprived	Access Deprived	Land Deprived
Income Deprived	1						
Education Deprived	0.21	1					
Room Deprived	0.36	0.16	1				
Electricity Deprived	0.22	0.16	0.23	1			
Water Deprived	0.09	0.11	0.09	0.17	1		
Access Deprived	0.22	0.14	0.20	0.36	0.22	1	
Land Deprived	-0.09	-0.03	0.01	-0.08	-0.015	-0.08	1

In both tables it can be seen that any pair of deprivations has a high correlation coefficient, and even though deprivation in income is the one with higher correlations with the others, it never exceeds 0.36. This suggests that a multidimensional analysis is indeed important: a policy targeted to the income poor might not reach other segments of the population deprived in other dimensions.

A second exercise consists of analysing whether there is overlap between the group of poor identified with the multidimensional approach and the group of poor identified with the traditional income approach. Ruggeri-Laderchi, Saith and Stewart (2003) present empirical evidence of significant lack of overlap in the identification by the monetary and the capability approach for the case of India and Peru. Similar evidence is found in the case of Bhutan.

Table 6 (Panels a and b) present the percentage of population that is income non-poor but multidimensionally poor, and the percentage of the population that is income poor but multidimensionally non-poor, for the different k values in the estimates of rural and urban areas using equal weights and GNHS weights. Similar tables can be constructed for the estimates of rural areas only. By definition, the percentage of the income non-poor that are multidimensionally poor decreases as k increases, being zero when $k=d$, since all the multidimensionally poor in that case are deprived in every considered dimension, including income. For the same reason, the percentage of income poor that are not multidimensionally poor increases as k increases. It goes from 0 when $k=1$, since in that case all the income deprived are considered multidimensionally poor, to a percentage close to the aggregate income Headcount Ratio when $k=d$, since in that case only the few income deprived that are also deprived in all the other dimensions are considered multidimensionally poor.

This suggests that, if one would want to reach the multidimensionally poor by using the income poor as a 'proxy' variable there would always be some non-depreciable error: either a group that is only income poor but not multidimensionally poor would be included, which would be a Type-I error, or a part of the multidimensionally poor would be excluded for not being income poor, which would be a Type-II error. If one considers the minimum possible *k* value to be the relevant to identify the multidimensionally poor, using an income approach in that case minimises the Type-II error but maximises Type-I error. On the other hand, if one considers that *k=d,* is the relevant deprivation cutoff to identify the multidimensionally poor, using an income approach minimises Type-I error but maximises Type-II error. For *k*-values in the middle of the extremes, there is some combination of each error type when an income approach is used.

Table 6: Lack of overlap between Income and Multidimensional Poverty

(a) Rural and urban areas, five dimensions, equal weights

% of Population	**k=1**	**k=2**	**k=3**	**k=4**	**k=5**
Income Non-Poor but Multidimensionally Poor	40.7%	15.8%	4.6%	0.5%	0%
Income Poor but Multidimensionally Non-Poor	0%	2.1%	8.1%	15.9%	21.8%

(b) Rural and urban areas, five dimensions, GNHS weights

% of Population	**k=1**	**k=2**	**k=3**	**k=4**	**k=5**
Income Non-Poor but Multidimensionally Poor	24.4%	10.4%	0.54%	0%	0%
Income Poor but Multidimensionally Non-Poor	0%	0%	6.7%	12.5%	21.8%

4.4 Analysis at the district level

Given that the 2007 BLSS is representative at the district level, the multidimensional poverty measures *H* and M_0 were estimated for each district. Table 7 presents these estimates for both rural and urban areas of each district, using five dimensions, with *k*=2, using the GNHS weights. It also presents the income Headcount Ratio in each district. Two type of analysis can be done at the district level. On the one hand, it is interesting to analyse the estimates of each measure in each district, which are presented in columns (2), (6) and (10) for Income *H*, Multidimensional *H* and M_0 correspondingly. Districts can be ranked according to the estimate in each measure, which is done in descending order in columns (3), (7) and (11), and then rankings can be compared. Column (14) presents the difference in the rank order obtained by each district when ranked by Income *H* and when ranked by M_0.

On the other hand, provided that the three measures can be decomposed by population subgroups, it is worth analysing the contribution of each district to the aggregate estimate of each measure. This is obtained weighting the measure estimate in each district by the district's population share, such that: $C_s^P = [(100n_s / n)P_s / P]$, where C_s^P is the contribution of district *s* (with $s = 1,.....,20$) to the aggregate poverty measure *P*, P_s is the poverty estimate in district *s*, and $(100n_s / n)$ is the population share of district *s*. The population share of each district is presented in column (1) of the table and the contribution of each district to the aggregate Income *H*, Multidimensional *H* and M_0 estimates are presented in columns (4), (8) and (12) correspondingly. Districts can be ranked according to their contribution to each of the aggregate measures. These rankings are done in columns (5), (9) and (13), and again, changes in the rankings can be analysed. In particular, column (15) presents the difference in the rank order obtained by each district when ranked by their contribution to Income *H* and when ranked by their contribution to M_0.

Regarding the first type of analysis, one interesting point to note is that the districts having the lowest estimates of Income *H* are not necessarily the ones having the lowest estimates of multidimensional *H* and M_0. Looking at column (14), it can be seen that although the change in the rank order of the districts when moving from Income *H* to M_0 is not striking, there are some interesting cases, such as the districts of Gasa and Tsirang. Note that when ranked in descending order by Income *H*, the district of Gasa ranks in the 18th place, since its income *H* is one of the lowest (only 4% of the population is income poor), and the district of Tsirang ranks in the 15th place (with only 14% of the population being income poor). However, when ranked by M_0, Gasa is ranked in the 8th place, that is, it climbs 10 places in the ranking because its M_0 estimate is 0.25, whereas Tsirang ranks in the 10th place, with an M_0 estimate of 0.22, climbing 5 places in the ranking.

Table 7: Income and Multidimensional Headcount Ratio and Multidimensional Adjusted Headcount Ratio (M_0) decomposed by districts Urban and Rural Areas- Five dimensions considered, k=2, GNHS weights

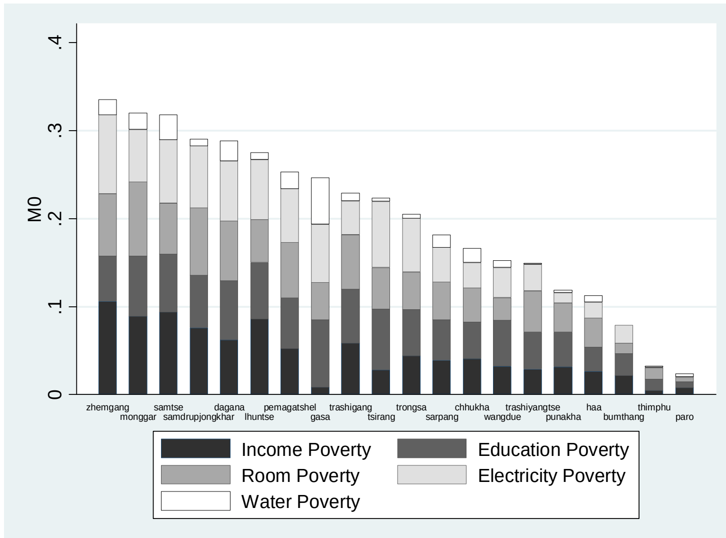
District	Pop. Share (%) (1)	Income H (2)	Desc. Rank Order Inc. H (3)	Contri. Overall Income H (%) (4)	Desc. Rank Order Contrib to Inc. H (5)	Multi. H (k=2) (6)	Desc. Rank Order Inc. H (7)	Contrib. Overall Multi. H (k=2) (%) (8)	Desc. Rank Order Contrib to Inc. H (9)	M0 (k=2) (10)	Desc. Rank Order M_0 (11)	Contrib. Overall M_0 (k=2) (%) (12)	Desc. Rank Order Contrib. to M_0 (13)	Diff. b/w. Rank Order in Inc. H and M_0 (3)-(11) =(14)	Diff. b/w Rank Order in Contrib. Inc. H and M_0 (5)-(13) =(15)
Zhemgang	3.11	0.53	1	7.09	6	0.58	1	5.42	1	0.33	1	5.59	7	0	-1
Samtse	8.85	0.47	2	17.84	1	0.55	2	14.44	2	0.32	3	15.08	1	-1	0
Mongar	6.06	0.44	3	11.61	2	0.54	3	9.82	3	0.32	2	10.40	2	1	0
Lhuntse	2.49	0.43	4	4.62	8	0.53	4	3.96	4	0.27	6	3.67	11	-2	-3
S/Jongkhar	5.55	0.38	5	9.08	5	0.49	5	8.02	5	0.29	4	8.63	5	1	0
Dagana	3.00	0.31	6	4.02	10	0.50	6	4.45	6	0.29	5	4.63	10	1	0
Trashingang	7.58	0.29	7	9.56	3	0.43	7	9.74	7	0.23	9	9.30	4	-2	-1
Pemagatshel	3.76	0.26	8	4.24	9	0.44	8	4.97	8	0.25	7	5.09	8	1	1
Trongsa	2.32	0.22	9	2.21	13	0.37	9	2.56	9	0.20	11	2.54	14	-2	-1
Chukha	10.74	0.20	10	9.38	4	0.29	10	9.20	10	0.17	13	9.55	3	-3	1
Sarpang	6.38	0.19	11	5.35	7	0.31	11	5.84	11	0.18	12	6.21	6	-1	1
Punakha	4.03	0.16	12	2.71	11	0.26	12	3.16	12	0.12	14	2.56	9	-2	2
Wangdue	5.70	0.16	13	3.89	12	0.31	13	5.29	13	0.15	16	4.66	13	-3	-1
T/Yangtse	2.89	0.14	14	1.79	15	0.29	14	2.49	14	0.15	15	2.32	16	-1	-1
Tsirang	3.01	0.14	15	1.80	14	0.38	15	3.45	15	0.22	10	3.61	12	5	2
Haa	1.99	0.13	16	1.13	18	0.20	16	1.17	16	0.11	17	1.20	17	-1	1
Bumthang	2.55	0.11	17	1.20	17	0.18	17	1.35	17	0.08	18	1.07	18	-1	-1
Gasa	0.60	0.04	18	0.11	20	0.38	18	0.68	18	0.25	8	0.79	19	10	1

Paro	5.63	0.04	19	0.96	19	0.05	19	0.84	19	0.02	20	0.71	20	-1	-1
Thimphu	13.77	0.02	20	1.42	16	0.08	20	3.15	20	0.03	19	2.38	15	1	1
Bhutan	100%	0.23		100%		0.34		100%		0.19		100%			

The explanation for this sort of change in the relative positions of these two districts can be found in figure 5, where the 20 districts have been ranked from highest to lowest by the M_0 estimates. The bar for each district also presents the composition of multidimensional poverty by each of the dimensions. There, it can be seen that in the case of Gasa only a very small fraction of the multidimensional poverty in this district is explained by income. However, even if not highly deprived in income, significant parts of the population in this district are deprived in the other considered dimensions. Deprivation in education accounts for 31% of the overall multidimensional poverty estimate, deprivation in electricity accounts for 27%, deprivation in drinking water accounts for 21.4% and deprivation in room accounts for 17% of M_0. The high levels of deprivation in the other dimensions relative to the income deprivation explain the big change between the ranking by income H and by M_0. Moreover, it is a paradox that given Bhutan's achievement in terms of access to drinking water (such that only 9% of the population in the country is deprived in this dimension), being Gasa one of the richest districts in income terms, it is the one that has the highest deprivation in access to water. Something similar happens with Tsirang, in which the deprivation in education, room and electricity accounts for most part of the M_0 estimate. On the contrary, in most of the other districts, deprivation in income accounts for a very significant part of overall multidimensional poverty, which explains why they do not have such striking changes in the rank order when moving from Income H to M_0. However, this does not mean that deprivation in income would suffice for a comprehensive poverty analysis since these districts are highly deprived in the other considered dimensions, suggesting that they have coupled disadvantages, which makes them particularly vulnerable. Similar conclusions are obtained when the analysis is performed on the estimate results of the rural areas only.

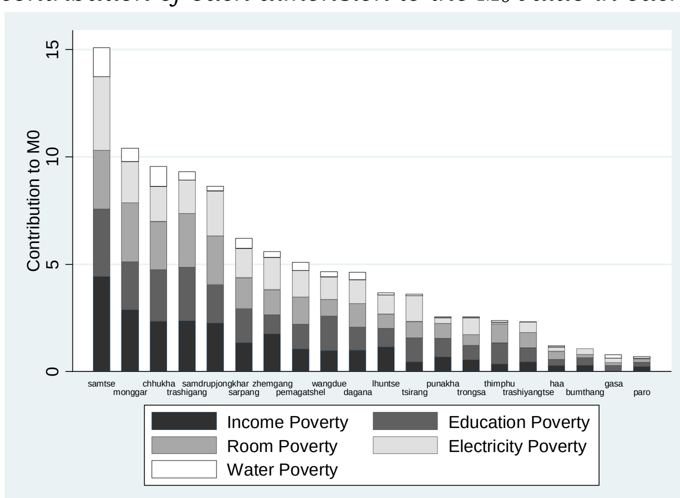
Figure 5: Composition of the Adjusted Headcount Ratio (M_0) in each Bhutanese district

Rural and urban areas – Five Dimensions – k=2 – GNHS weights

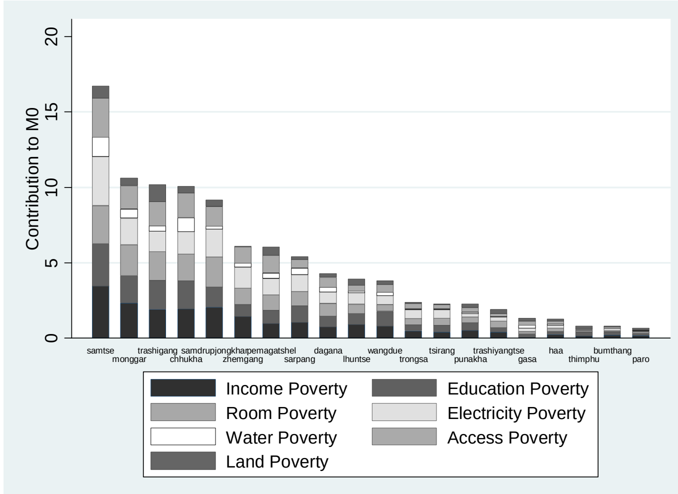


In terms of policy design, the second type of analysis seems particularly important. When governments are faced to the difficult task of assigning public budget among the different districts in order to reduce poverty, it is necessary to consider the contribution of each district to the aggregate poverty estimate, that is, it is necessary to weight district-level estimates by their population share. Figure 6 summarises two type of relevant information for policy purposes. In the first place, it presents the contribution of each district to overall M_0, given by the height of each bar. In the second place, the figure also presents, within each district, the contribution of deprivation in each dimension to overall M_0 in the district. Panel (a) is referred to estimates in both rural and urban areas, using five dimensions, *k*=2, and GNHS weights; panel (b) is referred to estimates in rural areas only, using seven dimensions, *k*=3, and GNHS weights. In Panel (a) it can be seen that Samtse, Mongar, Chukha, Trashigang and Samdrup Jongkhar are the districts with the highest contribution to aggregate M_0. Note that Gasa is one of the districts with the lowest contribution to aggregate M_0 despite it is one with the highest estimates of M_0. This is because its population share is below 1%. Within the districts with the highest contribution to aggregate M_0, improving income conditions, extending the access to electricity, guaranteeing that children in school age attend to school and that at least one household member becomes literate, and improving housing conditions to reduce overcrowding seem to be the most urgent needs. Extending even further the access to drinking water comes at a second place. It is worth noting that improvements in the mentioned dimensions should also be priorities even among the districts with lower contributions to aggregate M_0. Similar conclusions can be drawn from the rural estimates of Panel (b), with the addition that access to roads is a also key dimension that should be added to priorities in the case of rural areas, whereas land ownership comes -together with access to drinking water- seems to be less relevant.

Figure 6: Contribution to overall M_0 by each district and contribution of each dimension to the M_0 value in each district



(a) Rural and urban areas – Five Dimensions – k=2 – GNHS weights



(b) Rural areas only – Seven Dimensions – k=3 – GNHS weights

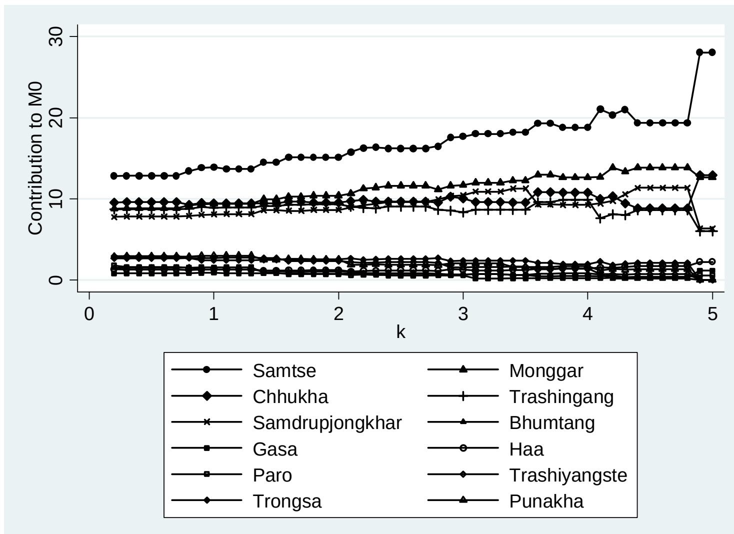
Clearly, the ranking of the districts by their estimates of M_0 (as the one presented in Figure 5) as well as by their contribution to aggregate M_0 (as the ones presented in Figure 6) are subject to the selected value of k, the weighting system, the chosen dimensions and the deprivation cutoffs.

Figure 7 plots the contribution of two groups of districts for the different k values in the rural and urban estimates (with five dimensions) when GNHS weights are used.[8] One group is composed by the districts of Samtse, Mongar, Chukha, Trashigang and Samdrup Jongkhar. These districts have the highest contributions across all the different k values. Among them, Samtse always has a higher contribution, while the ranking of the other four changes with k, as it can be seen by the lines crossing with each other. The other group is composed by the districts of Paro, Gasa, Bhumtang, Haa,

[8] When GNHS weights are used, the minimum k value is 0.2. Then it is increased in 0.1 until its maximum level, which is 5 in the case of the estimates for both rural and urban areas (since 5 dimensions are considered). That gives 49 different possible k cutoff values.

Trashiyaste, Trongsa and Punakha. These are at the other extreme, always having the lowest contributions to the aggregate M_0 estimate. Within this group, the ranking changes with the *k* value. In the middle of these two groups lie the contributions of the other districts: Dagana, Lhuntse, Pemagatshel, Sarpang, Thimphu, Tsirang, Wangdue and Zhemgang. This type of analysis can facilitate assigning priorities of public budget distribution among districts.

Figure 7: Contribution to overall M_0 by each district for different k values
Rural and urban areas – Five Dimensions – GNHS weights



5. Concluding remarks

This paper has estimated multidimensional poverty in Bhutan using a recently developed methodology by Alkire and Foster (2007). The selection of dimensions was based on the Millennium Development Goals that are applicable for estimations of poverty at the household level and for which the BLSS provides data. For the case of both urban and rural areas five dimensions were selected: income (access to the basic basket), education (at least one literate person in the household and all children attending school), number of people per room (less than three), access to electricity and access to drinking water. Estimations for rural areas included two additional dimensions: access to roads (in 30 minutes or less) and land ownership (at least one acre). In each case, two alternative weighting structures were applied: one using equal weights and one using weights derived from the ranking of 'sources of happiness' identified through the Gross National Happiness Survey.

Estimates suggest that 37% of the population in both rural and urban areas is deprived in two or more of the five considered dimensions, and 20% are deprived in three or more. When these Headcount Ratios are adjusted by the average deprivation, the M_0 estimates are 0.20 and 0.14 correspondingly. If the dimensions are weighted using the ranking of sources of happiness obtained from the Gross National Happiness Survey, the estimates of the Headcount Ratio and the Adjusted Headcount Ratio are slightly lower for these values of k. The results also indicate that multidimensional poverty is mainly a rural phenomenon, although urban areas present non-depreciable levels of deprivation in room availability and education. In the rural areas of Bhutan, poverty in education, electricity, room availability, income and access to roads, contribute in similar shares to overall multidimensional poverty, while poverty in land ownership has a relatively smaller contribution, being poverty in water the smallest one. When the aggregate multidimensional poverty estimate is decomposed by districts, it is found that Samtse, Mongar, Chukha, Trashingang and Samdrup Jongkhar are the ones with the highest contribution to overall multidimensional poverty.

The paper is innovative not only in that it changes the focus from the traditional unidimensional perspective of poverty, centred on income, to a broader multidimensional one, but it also provides with a methodology that is potentially useful for allocating the budget among the districts and within them, among the different dimensions. The property of Alkire and Foster's (2007) M_0 measure of being decomposable in population subgroups and suitable for breaking it down into dimensions is what makes it suitable for such purpose.

Clearly, other dimensions could be incorporated and alternative deprivation cutoff values could be considered in the analysis. In any case, Bhutan constitutes a striking example of how significant and fast progress can be made towards development when goals are clearly set and policies specifically designed to fulfil them. The proposed methodology could prove to be a useful instrument to monitor such progress.

References

Alkire, S. (2007). "The Missing Dimensions of Poverty Data: Introduction to the Special Issue." *Oxford Development Studies* 35: 347-359.

Alkire, S. and J. E. Foster (2007). "Counting and Multidimensional Poverty Measurement." OPHI Working Paper Series No. 07, OPHI.

Anand, S. and S. Sen (1997). "Concepts of Human Development and Poverty: A Multidimensional Perspective." Human Development Papers. New York: UNDP.

Atkinson, A. and F. Bourguignon (1982). "The Comparison of Multidimensional Distribution of Economic Status." *The Review of Economic Studies*, 49:183-201.

Basu, K. and J. E. Foster (1998). "On Measuring Literacy." *Economic Journal*, 108: 1733-749.

Blackorby, C. and D. Donaldson (1980). "Ethical Indices for the Measurement of Poverty." Econometrica 48: 1053-1060.

Bourguignon, F. and S. Chakravarty (2003). "The Measurement of Multidimensional Poverty." *Journal of Economic Inequality*, 1, 25-19.

Chakravarty, S. (1983). "A New Index of Poverty." *Mathematical Social Sciences*, 6: 307-13.

Decancq, K. and M. A. Lugo (2008). "Setting Weights in Multidimensional Indices of Well-Being." http://www.ophi.org.uk/pubs/W1.Decancq-Lugo.pdf.pdf

Foster, J. E. and A. Shorrocks (1991). "Subgroup Consistent Poverty Indices." *Econometrica,* 59: 687-709.

Foster, J.E., J. Greer and E. Thorbecke (1984). "A Class of Decomposable Poverty Indices", *Econometrica*, 52: 761-6.

National Statistics Bureau (2004). *Poverty Analysis Report* 2004.

_______ (2007). *Poverty Analysis Report* 2007.

_______ (2000-2006). *National Accounts Statistics.*

Office of the Census Commissioner (2005). *Population and Housing Census of Bhutan* 2005.

Royal Government of Bhutan (2005). *Millennium Development Goals Progress Report* 2005.

Rugeri Laderchi, C., R. Saith and F. Stewart (2003). "Does it Matter that We Do Not Agree on the Definition of Poverty? A Comparison of Four Approaches." *Oxford Development Studies* 31,: 244-274.

Sen, A. (1976). "Poverty: An Ordinal Approach to Measurement." *Econometrica,* 44: 219-231.

_______ (1985). *Commodities and Capabilities.* Amsterdam: North-Holland.

_______ (1990). "Development as Capability Expansion" in K.G. a. J. KNIGHT (ed.) *Human Development and the International Development Strategy for the 1990s*. London: Mc. Millan.

_______ (1999). *Development as Freedom.* Oxford University Press.

Tsui, K. (2002). "Multidimensional Poverty Indices." *Social Choice and Welfare*, 19: 69-93.

United Nations Development Program (2003). *Indicators for Monitoring Millennium Development Goals.* New York.

Watts, H. W. (1969). "An Economic Definition of Poverty" in Moynihan, D. P. (ed.) *On Understanding Poverty.* New York: Basic Books.

Annex

Table A.1: Sample size by district and by rural and urban areas

District	Rural	Urban	Total	Weighted sample
Bumthang	1051	286	1337	16,033
Chukha	2930	2088	5018	67,606
Dagana	1362	104	1466	18,867
Gasa	1076	48	1124	3749
Haa	1079	138	1217	12,511
Lhuntse	1206	81	1287	15,705
Mongar	2529	436	2965	38,187
Paro	2615	175	2790	35,475
Pemagatshel	1649	184	1833	23,646
Punakha	1879	134	2013	25,346
Samdrup Jongkhar	2027	679	2706	34,940
Samtse	3490	717	4207	55,727
Sarpang	2119	802	2921	40,182
Thimphu	662	5482	6144	86,717
Trashingang	3301	388	3689	47,704
Trashi Yangtse	1274	175	1449	18,216
Trongsa	1097	176	1273	14,585
Tsirang	1385	121	1506	18,970
Wangdue	2223	564	2787	35,890
Zhemgang	1257	176	1433	19,606
Bhutan	**36,211**	**12,954**	**49,165**	**629,662**