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Further Analysis of the 2000, 2005, and 2011 Demographic and Health Surveys

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Table of Contents

Tables

Figures

Annexes

ACKNOWLEDGEMENTS

ABSTRACT

States that ratify the Convention on the Rights of the Child (CRC) agree that children have the right to survival, development, protection and participation and they agree that they will do all they can progressively to realize those rights. The Ethiopian state ratified the CRC in 1991. This child-focused deprivation analysis sheds light on child poverty in Ethiopia, measuring child deprivation by using a number of dimensions of survival and development. It presents how different dimensions other than income poverty affect child well-being by using indicators from the Ethiopian Demographic and Health Surveys (2000, 2005 and 2011) and matching those to the rights contained in the CRC. The study measures the levels of child deprivation for the under-five child population and assesses overall progress in child deprivation reduction in Ethiopia over the years 2000 to 2011. The analysis employs Multiple Overlapping Deprivation Analysis (MODA), a comprehensive approach to the multidimensional measurement of child deprivation built on previous approaches (i.e. the Bristol approach and the Alkire & Foster methodology, among others). Deprivation levels are first analysed for each of the survival and development dimensions separately, followed by a multiple deprivation analysis showing the intensity of deprivation and the distribution of deprivations among children, investigating how sectoral deprivations overlap, comparing the deprivation severity depending on children's geographic and socio-economic characteristics, and studying trends in the multidimensional deprivation ratios and changes in sub-group contribution to the national deprivation level over time. The results show that while the deprivation incidence has decreased significantly in almost all dimensions between 2000 and 2011, the joint distribution of deprivations reveals that the percentage of children experiencing several deprivations at a time has decreased only marginally. In 2011, almost all children (94 per cent) still suffered from at least two deprivations considered as a threat to their survival or development. The average deprivation intensity was very high, children on average experiencing 3.8 deprivations at a time. This, however, is slightly lower compared to 2000 when children were on average deprived in 4.5 out of all six dimensions analysed. The deprivation overlap analysis shows differences in the extent to which the analysed sectors overlap, and reveals that children do not suffer from the same combinations of deprivations across regions. The study reveals significant disparities in multidimensional child deprivation levels between rural and urban areas and among regions. The highest child deprivation rates in 2011 were in Afar, SNNPR, Oromiya and Somali regions, while the lowest were in Addis Ababa, Harari and Dire Dawa. The highest decrease in the child deprivation level since 2000 has occurred in Amhara, Tigray, and Beneshangul Gumuz. Overall, the study aims to encourage the integration of child-specific needs into national poverty reduction strategies.

1. INTRODUCTION

Children's wellbeing determines the future of a country. The extent to which children's claims to the enjoyment of their rights are fulfilled has a direct impact on the future pace with which all rights, not just children's rights, can be realised. According to UNICEF, "*Well managed and sustained investments in people, especially in children and the most disadvantaged, yield the greatest returns for poverty reduction. Countries cannot achieve sustained growth and shared prosperity without investing effectively in their people, above all their children. Inclusive economic growth and the development of human capacities depend upon each other*" (UNICEF, 2012, p.5).

Ethiopia has a population of 84 million of which 15.4 per cent are children under the age of five (CSA, 2011). The country has made steady economic progress since 2003. During 2011/12, Ethiopia's economy as measured by Gross Domestic Product (GDP) grew by 8.5 per cent. The growth registered in the fiscal year compares well with the average growth rate of Sub Saharan Africa which was 5.3 per cent for the same period. Ethiopia's growth rate is also higher than the average GDP growth rate of 7 per cent required to achieve MDGs' target of reducing poverty by half by 2014/15 (MOFED, 2012a). According to the Household Consumption and Expenditure Surveys (HCE), the percentage of Ethiopians living in poverty has declined from 38.7 per cent in 2004/2005 to 29.6 per cent in 2010/11(MOFED, 2012c). Poverty was measured based on consumption, with the poverty line equal to the cost of minimum necessary food and non-food goods. This approach to measuring poverty is a good predictor of households' and children's poverty, showing the households' ability to meet basic needs. To reveal whether and to what extent the basic needs are met and whether the available households' means are equally distributed to meet the needs of all household members including children, other data and analyses are needed.

Poverty reduction is one of the main agendas of the Government of Ethiopia, and a number of policies have been implemented in this regard over the past two decades. The Sustainable Development and Poverty Reduction Programme (SDPRP) (2002/03-2004/05) and Plan for Accelerated and Sustainable Development to End Poverty (PASDEP) (2005/06 to2009/10) have led to significant improvements in social and economic development. In addition a Growth and Transformational Plan (GTP) has been put in place for the period 2010/11 to 2014/15. In the GTP, in addition to sustaining the high economic growth rate, emphasis is given to improving the performance of various sectors through a more detailed sector by sector plan (MOFED, 2010). Two of the objectives of the GTP include maintaining at least an average real GDP growth rate of 11%, and attaining the MDGs in the social sectors by improving the quality of education and health services. To achieve these objectives, three among the seven GTP strategic pillars directly address the reduction of multidimensional poverty. The strategic pillars include: Sustaining rapid and equitable economic growth; enhancing expansion and quality of infrastructure development; and enhancing expansion and quality of social development. Ethiopia's firm commitment to achieve the MDGs is demonstrated by the fact of having included them as national development targets. According to the Ethiopia MDG Country Progress Report (MOFED, 2012b), the government is achieving broad-based social and economic development and is on track to achieve most of the MDGs. Ethiopia's Growth and Transformation Plan Annual Progress Report (MOFED, 2012a) states that achievements made in the agriculture, education, health, water, road, energy and telecommunication sectors have increasingly made social services and welfare accessible to more citizens including the poor. The following paragraphs briefly describe the progress made in reducing deprivation on a sector by sector basis through the development and implementation of various sector programmes.

The Government of Ethiopia has implemented a number of initiatives to increase access to potable water with considerable improvements at the national level, although with high disparities between urban and rural areas. The GTP aims to increase water supply coverage to 98 per cent at a national level by 2015

through the use of sustainable and feasible technologies, effective and efficient management of existing water schemes, and promotion of stakeholder participation (MOFED, 2010; MOWR, 2002). Based on the Water Sector Development Plan (2002-2016), a number of actions are being implemented in the urban and rural areas to improve access to water and sanitation requiring an estimated USD 2,086 million (of which 71 per cent is allocated to rural areas). The actions include use of hand-dug wells, spring development, shallow drilled wells, deep-drilled wells, stock ponds, birka, subsurface dams, water harvesting, conventional sewerage, pour-flush toilets, septic tanks, and other technologies. The expenditures are covered by central and regional governments, international donors, NGOs and communities (MOWR, 2002).

Sewerage coverage is low. Over the last decade it has been an increasing problem, especially in urban areas, because of the increasing size and density of the population. During the WSDP (2002-2016), a total of USD 30 million (1.1 per cent of the total budget) has been allocated for the development of urban sewerage.

The key challenges in the housing sector are the presence of large numbers of people living in low standard housing and not enough resources to increase the stock of better housing at a pace that will make up for the lost time when there was little investment in housing. The existing housing initiatives are mainly limited to urban areas. Ethiopia is in the process of introducing an urban policy for housing in order to narrow the gap between demand for and supply of housing in the urban areas. As part of the GTP, housing development initiatives have resulted in low cost housing being built for low and middle income households, focusing on urban areas (Addis Ababa) and reducing slum areas. Furthermore, during the implementation of the PASDEP, 213,000 houses have been built out of the total of 396,000 planned in various regions and city administrations (MOFED, 2010).

There have been four Health Sector Development Programmes (HSDP) since 1997, the last one of which (HSDP IV) began in 2010/11 and is set to run until 2014/15. Due to these programmes there have been continuous improvements in the demand, utilization and supply of health services. By 2010/11, the number of health posts had reached 14,416 compared with 76 health posts in 1996/97, there were 2,689 health centres compared with 243 in 1996/97, and there were 111 public hospitals compared with 87 in the same time period. The Health Extension Programme was launched in 2003, focusing on the provision of qualitative, promotive, preventive and selected curative health care services, with a special attention to mothers and children in the rural areas. By 2010/11, 33,819 health extension workers had been trained and deployed in 89 per cent of communities. Due to the improvements in the health service delivery during the PASDEP, prenatal and postnatal service coverage has increased by 17 and 15 percentage points respectively (FMOH, 2010). Between 2000 and 2011, under-five mortality rates declined from 166 per 1000 live births to 88 per 1000 live births (EDHS, 2011). HSDP IV gives particular attention to child health, maternal and new born care and stopping the spread of major diseases such as TB, HIV and malaria (FMOH, 2010).

For many years, Ethiopia has been experiencing food shortages and as a result has been one of the largest recipients of food aid in Africa. Consequently, in 2005 the government of Ethiopia introduced the Productive Safety Net Programme[1] with the support of donors as part of the Food Security Programme (FSP) with the major objectives of replacing emergency appeals with a standing safety net focusing on the provision of more reliable and timely support to chronically food insecure households, and increasing household productivity and asset accumulation to prevent households from being forced to sell their assets when they experience food shortage. This programme was introduced in four regions initially covering 260 woredas. During many years of implementation, 'the programme has modestly reduced food

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[1] Between 2005 and 2009 PSNP reached around 7.8 million people and operated with an annual budget of approximately USD 500 million making it the largest social protection programme in Sub-Saharan Africa.

insecurity, facilitated asset creation and protected households from price and drought shocks' (Sarah et al 2011). Building on past experiences, the government of Ethiopia has continued to implement similar programmes to the PSNP (called the Development Food Aid Programme) with multi-donor support in 318 woredas in 4 regions and 1 city administration.

The National Nutrition Programme (NNP) was introduced in 2008 and phase two was launched in 2013. Good results have been obtained in improving the nutritional status of children and women and increasing community involvement in managing nutrition interventions. Eleven million children under-five have received vitamin A supplementation and deworming, CMAM (community management of acute malnutrition) has been scaled-up to more than 10,000 health facilities, community based direct interventions have been scaled up to more than 500 woredas, and nutrition and HIV interventions have been scaled up to 400 health facilities. Zinc supplementation for diarrhoea has been included into the health extension programme's integrated community case management, and the salt iodization legal framework is being enforced. The second phase of the NNP, starting in 2013, aims to further reduce stunting and strengthen the national food fortification programme (NNP, 2013).

Even though good progress has been made in many areas, the country still needs to improve in certain sectors. The Ethiopia Demographic and Health Survey (EDHS, 2011) confirmed that major basic services are still inaccessible or limited in many places, with substantive regional disparities. For example, only 10 per cent of the births take place in health facilities; less than one-third of children under-five are immunized with DPT3 according to the EDHS[2]; and only eight per cent of households use improved toilet facilities. Less than five per cent of households have electricity in rural areas compared to 85 per cent of urban households, although this figure will certainly improve in the near future given the investments in rural electricity infrastructure currently being rolled out.

The Convention on the Rights of the Child (CRC, 1989) is the most widely ratified human rights convention, freely accepted and shared by almost all countries. The Convention constitutes a common reference against which progress can be assessed and results compared (Santos-Pais, 1999). The Ethiopian government has signed the CRC, committing itself to do whatever is possible to safeguard these children's rights. By ratifying the CRC the Ethiopian state agrees that children have the right to survival (the right to adequate food, clean water, health care, shelter, etc.), development (the right to education, leisure, cultural activity and information), protection (the right to be protected from all forms of abuse and exploitation), and participation (the right to freedom of expression, views, opinions; being heard; freedom of association; the right to birth registration).

This child-focused deprivation analysis sheds light on child poverty and deprivation in Ethiopia. It presents how different dimensions other than income poverty affect child well-being by using some of the EDHS indicators and by matching those to the rights contained in the CRC. It also shows trends in child deprivation between 2000 and 2011. The analysis generates information on how and where children in Ethiopia experience deprivation by using a multidimensional approach to its measurement with the aim to allowing policy makers to formulate structured policy responses to address children's deprivations, to facilitate a rights-based policy dialogue, and to stimulate further research.

This paper is structured as follows. The first section discusses the conceptual reasoning for the need to apply multidimensional deprivation analysis to the measurement of child poverty. This is followed by a section on the methodology applied for this study, and the results section which reports the findings of the empirical analysis and assesses overall progress in child deprivation reduction in Ethiopia over the years 2000-2011 using the EDHS data. The last section summarizes the findings with regards to changes of

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[2] The EDHS may have underestimated coverage as the 2012 EPI survey results indicate a higher coverage.

child well-being status over time and gives recommendations towards an integrated approach to addressing child deprivations.

2. LITERATURE REVIEW

As argued by Minujin (2012), children experience poverty differently from adults. If children grow up in poverty, they are more likely to be poor in adulthood as well. Poverty often manifests itself as a vicious circle that children are trapped in from their birth onwards (Roelen and Gassman, 2008). Based on her early childhood nutrition study in rural Ethiopia, Porter (2013) underlines the importance of investment in under-five children by presenting the evidence that falling behind during this critical period of childhood can lead to permanent effects on adult outcomes. *The Global Thematic Consultation on the Post-2015 Development Agenda: Addressing Inequalities* (UNICEF & UN Women, 2013) states that deficits in nutrition, health, education and social inclusion are mutually reinforcing, and that risks of enduring and damaging outcomes rise sharply as children's claims to multiple rights are not realised leading to more frequent and damaging adverse events. The extent of inequalities can thus be masked if indicators in each sector are analysed separately.

Similarly, the source and the extent of inequalities can be masked by focusing on one concept of poverty only. The reasons for which children are deprived of their rights vary greatly, ranging from income poverty in their families, to discrimination, disease, geographic location, lack of information, and lack of access to services, among others. Monetary poverty, either based on income or consumption, conceptualizes child poverty as children living in low-income families since low incomes are considered to have a strong link with the well-being of children. Its disadvantage, however, is that it is a one-dimensional measurement of poverty disregarding other dimensions (Roelen and Gassman, 2008). The measurement of child poverty has received increasing attention over the last decade, especially after the introduction of the Bristol approach that introduced a methodology for measuring multidimensional child poverty. The Bristol approach introduced a way to align child poverty measurement with child rights and to implement, insofar as data permits, indicators and cut offs for child poverty that reflect the definitions agreed in the World Summit for Social Development in Copenhagen[3] (Gordon et al 2003). Such an approach to measurement makes it suitable for monitoring certain children's rights according to the CRC.

Child poverty headcounts measure the number of poor children and provide a headcount rate of poverty. The drawback of headcounts is that they do not account for the intensity or severity of deprivation. The headcount ratio remains unchanged when children who are already poor become deprived in an additional dimension, or when their level of deprivation in a particular dimension deteriorates (Alkire and Roche 2011). Alkire and Roche (2011) argue that child poverty should not be assessed only according to the incidence of poverty, but also by the intensity of simultaneous deprivation that negatively affects poor children's lives.

The multidimensional poverty measure (Alkire and Foster 2007), used for the construction of the Multidimensional Poverty Index (Alkire and Santos 2010) and other influential work[4], is a composite of indices summarizing a broad range of information in a single measure, and can be used for comparative purposes. The main strength of this method is that not only the number of the deprived children, but also the intensity of their deprivation, is included in the measurement. The main weaknesses of the method are that it is more complex than a uni-dimensional measurement and that the results are not easy to interpret. Also, the results can vary depending on the authors' indicator choice and the number of deprivations used in the aggregation process (Ravallion 2011; Roche 2013).

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[3] "Absolute poverty is a condition characterized by severe deprivation of basic human needs, including food, safe drinking water, sanitation facilities, health, shelter, education and information" (UN 1995, Chapter II: 19).
[4] For case studies on how the Alkire Foster method of measuring multidimensional poverty has been applied in other projects, see OPHI's brochure 'Measuring Multidimensional Poverty: Insights from Around the World'http://www.ophi.org.uk/live-now-measuring-multidimensional-poverty-insights-from-around-the-world/.

UNICEF Office of Research together with the Division of Policy and Strategy have developed MODA (Multiple Overlapping Deprivation Analysis), a tool providing a comprehensive approach to the multidimensional aspects of child poverty and deprivation (De Neubourg et al 2012a). It builds on earlier studies related to multidimensional child poverty measurement incorporating the contributions of the aforementioned Bristol approach (Gordon et al 2003) and the work of OPHI – the Oxford Poverty and Human Development Initiative (Alkire and Foster 2007; Roche 2013), among others. A large set of tools is incorporated ranging from deprivation headcount rates by indicator and dimension (i.e., the sector or uni-dimensional analysis) to deprivation overlap analysis to multidimensional deprivation ratios. The approach places the child at the heart of the analysis by taking the child, rather than the household, as the unit of observation. The method recognises that children's needs differ depending on their age, thus focusing on children within their appropriate age-group rather than analysing the whole child population together. MODA's premise is that deprivation and monetary poverty analyses both contribute towards explaining children's status of well-being but are conceptually different and should thus be treated as two different fields of poverty. If the data source used for the analysis includes information on both households' monetary situation and variables showing children's basic needs' fulfilment, the overlap between the two fields can be studied.

Overall, the existing literature emphasizes that household's income alone, although a good predictor of child poverty, does not show whether and to what extent children's rights are realised (Minujin, 2012; Roelen et al 2011). The current practice points towards a need to apply a child-centred multidimensional approach when measuring child poverty, recognizing that children's needs are age-specific and multidimensional.

3. METHODOLOGY

3.1 Defining and Measuring Child Poverty

This analysis uses the MODA methodology (De Neubourg et al 2012a), adjusted to the data availability and the development context of Ethiopia. Child poverty is defined as children's deprivation in dimensions essential for their survival and development. The CRC has been used to define the dimensions, regarding deprivation in each of the selected dimensions as a non-fulfilment of the child's rights.

The study comprises the following approaches: The dashboard approach to have a comprehensive sector-by-sector analysis (i.e., analysis by each dimension separately); the deprivation count and distribution to measure how many deprivations each child suffers from and how these deprivations are distributed across the population; the overlap analysis to understand how the different sectoral deprivations overlap with each other; and the multidimensional headcount ratio, average intensity, and adjusted deprivation headcount ratio using the Alkire and Foster (2007) methodology to identify the multi-dimensionally deprived children and their deprivation intensity. All the aforementioned elements are calculated for various subgroups of the child population to identify the characteristics (i.e. the profile) of the most vulnerable children and to assist in informing group prioritization.

This study has a particular focus on the trend analysis over time studying the changes in deprivation levels and changes in sub-group contribution to deprivation with the aim of observing how children's deprivation intensity and profile have changed between 2000 and 2011.

3.2 Data, Unit of Analysis and Life-cycle Stages

This study uses Ethiopia Demographic and Health Surveys (EDHS) 2000, 2005 and 2011. The three surveys have been carried out using similar survey instruments, methodology, and questions that are comparable across the time periods, allowing for a trend analysis. The EDHS is representative at the national (urban and rural) and regional levels. While the EDHS sample corresponds to 14,072 households in 2000, 13,721 households in 2005, and 16,702 households in 2011, this analysis is based only on households with children below the age of five, so the actual sample analysed corresponds to 7,091 households in 2000, 6,845 households in 2005, and 8,026 households in 2011.

In line with the MODA approach, this analysis focuses on the child as the unit of analysis to make the child-specific needs visible. It also applies the life-cycle approach to acknowledge the heterogeneity of children's needs as deprivations differ depending on children's age. The inclusion of these two approaches allows the measurement of the situation of each child with regards to the dimensions that are relevant for child survival and development in a specific age-group. This study looks specifically at children below the age of five. Thus, a sample size of 10,103 children in 2000, 9,794 children in 2005 and 11,783 children in 2011 is used for the analysis.

3.3 Dimensions, Indicators, and Deprivation Thresholds

MODA uses international standards[5] as guiding principles in choosing the most relevant dimensions and indicators of child well-being. In addition, the selection process of indicators was shaped by the interests of major stakeholders (MOH, MoWCYA and UNICEF), global and national priorities (the MDGs and GTP), and data availability. As a result, six dimensions were selected for analysing deprivation among

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[5] The Convention on the Rights of the Child (CRC) (1989), the World Summit on Social Development (1995) and the Millennium Development Goals (2000) (De Neubourg et al 2012; UNICEF 2007).

children below the age of five: Nutrition, health, water, sanitation, housing, and information. Table 1 presents the indicators and thresholds applied to construct the dimensions.

Table 1 Dimensions, indicators and deprivation thresholds

Dimensions	Indicators	Deprivation Thresholds
Individual level indicators		
Nutrition	Wasting	Child's height for weight is below minus two standard deviations from the international median (WHO)
	Underweight	Child's weight for age is below minus two standard deviations from the international median (WHO)
Health	BCG immunization	Child aged 1-59 months has not received BCG vaccination[6]
	DPT 1 -3	Child aged 12-59 months has not received three DPT vaccines[7]
Household level indicators		
Water	Access to improved water source	Household's main source of drinking water is unimproved (WHO)
	Distance to water	Time needed to collect water (go, get water, and come back) is more than 30 minutes (WHO)
Sanitation	Access to improved sanitation	Household uses unimproved toilet facility (WHO)
Housing	Floor and roof material	Child lives in a house where both floor and roof are made of natural, non-permanent material (UN-HABITAT)
	Overcrowding	Household has on average more than four people per sleeping room (UN-HABITAT)
Information	Availability of information sources	Household has not reported having a TV or a radio, and the child's mother has not reported reading a newspaper at least on a weekly basis[8] (CRC Art. 17; MDG Target 18)

Annex 1 provides a detailed list of the international definitions used for selecting the indicators and thresholds, while Annex 2 lists the categories selected from EDHS 2000, 2005, and 2011 for the threshold construction for water, sanitation, and housing indicators.

3.4 Indicator Aggregation into Dimensions

For dimensions consisting of more than one indicator, the union approach is used as an aggregation method. This means that a child is identified as deprived in a dimension if deprived in one or the other, or both of the indicators selected for that dimension. This method is insensitive to the severity of deprivation in each dimension as the dimension value does not change depending on whether a child is deprived in one or two indicators belonging to the specific dimension. Indicators have been selected to show the status of deprivation in order to identify a non-realization of a child's rights in each of the dimensions. When there is more than one indicator per dimension, these indicators have been selected to complement each other in showing whether or not a child is deprived in a particular dimension. Indicator aggregation into one dimension is thus necessary to avoid deprivation double-weighting when two indicators explain

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[6] BCG vaccine is given at birth or during the first month after the birth of the child. Thus, a child's deprivation status in this indicator is measured if the child has reached one month of age or older.

[7] The three DPT vaccines are recommended to be given during the first year of a child's life (WHO, 2011, pp. 509-520). Thus, the deprivation status in DPT3 is measured starting from the age of one year.

[8] The intersection approach is used to aggregate the three variables. Any one of the three information sources is assumed to provide information for the household concerning children's needs.

the status of deprivation in the same overarching dimension of a child's rights. For example, a child is deprived in the nutrition dimension if he/she is underweight or wasted, or both. The union approach has been used to capture all children deprived in each dimension.

3.5   Weighting

Weights assigned to each dimension serve as an indication of the relative importance or value assigned to the different dimensions included in the analysis. In line with the MODA approach, no explicit weights have been assigned to dimensions when counting the deprivations each child suffers from, weighting each dimension equally. All the dimensions chosen for this analysis are assumed to be of equal importance since deprivations are understood as a non-realisation of one or more of the child's rights, derived from the CRC and other international standards.

3.6   Treatment of Missing Values

For the single deprivation analysis when calculating the deprivation headcount rates in each indicator and dimension, all the observations for which information on the particular indicator/dimension is not available, or for which this indicator/dimension is not relevant, are excluded from the equation, keeping only children to whom each indicator or dimension applies. For example, when calculating the deprivation headcount rate for the BCG immunization indicator, only children aged 1-59 months have been included in the equation. Also, all the observations with missing values in the indicator/dimension are dropped from the equation. Using the same example, for some of the children in the sample there is no information on whether they received a BCG vaccine, so these observations are not included when calculating the headcount rates for the BCG immunization indicator.

In the multidimensional deprivation analysis, the number of deprivations is counted per child, compared between sub-groups of children, and combined into multidimensional deprivation ratios. The sample size of each dimension thus must be the same to ensure comparability across dimensions. Therefore, children to whom a particular dimension does not refer are considered non-deprived in that dimension. For this study, this is the case only regarding the health dimension. Children under the age of one month cannot be considered deprived of access to BCG and DPT vaccines. Since these children are included in the multidimensional deprivation analysis, they are considered not deprived with regards to health, and are either deprived or non-deprived in the other five dimensions.

It may also be the case that some children in the sample have missing information on one or more of the dimensions. As long as a child has information on at least one of the dimensions analysed, this observation is kept in the multidimensional deprivation analysis. The observations with one or more missing values on dimensions are not dropped to keep all the other available information for these children. Children with missing information on a dimension are considered 'non-deprived' in that dimension. As a result, a high level of missing values will distort the results and may introduce a bias by underestimating the deprivation levels. To examine to what extent this treatment of missing values introduces a bias in the results, a sensitivity analysis has been performed, using two alternative treatments for missing values: (1) treating missing values as 'deprived' in the particular dimension; and (2) dropping observations from the analysis if an observation misses information on more than one dimension. The results are shown in Annex 5.

Annex 4 provides a detailed table showing the exact percentage of missing values per dimension for each of the three surveys used for the analysis. In EDHS 2000 and 2011, the percentage of missing values per dimension does not exceed 12%. In EDHS 2005, however, 57% of the sample has missing information in

the nutrition dimension.[9] While sector-by-sector analysis can be carried out, the multidimensional analysis using EDHS 2005 cannot be undertaken due to a high proportion of missing values.[10] As a result, all three EDHS surveys have been used for the single dimension trend analysis, while the multidimensional trend analysis is based only on EDHS 2000 and 2011 to avoid a bias in the results when comparing the different time periods.

3.7 Identification of Children's Deprivation Status

3.7.1 Deprivation status per indicator and dimension

The basis for this analysis is the identification of the deprivation status of each child per indicator and per dimension. The following matrix can be seen as the starting point:

	j_1	j_2	j_3	j_4	j_5	j_6
i_1	$I_{1,1,1}$ $I_{1,1,2}$	$I_{1,2,3}$ $I_{1,2,4}$	$I_{1,3,5}$ $I_{1,3,6}$	$I_{1,4,7}$	$I_{1,5,8}$ $I_{1,5,9}$	$I_{1,6,10}$
i_2	$I_{2,1,1}$ $I_{2,1,2}$	$I_{2,2,3}$ $I_{2,2,4}$	$I_{2,3,5}$ $I_{2,3,6}$	$I_{2,4,7}$	$I_{2,5,8}$ $I_{2,5,9}$	$I_{2,6,10}$
i_n	$I_{n,1,1}$ $I_{n,1,2}$	$I_{n,2,3}$ $I_{n,2,4}$	$I_{n,3,5}$ $I_{n,3,6}$	$I_{n,4,7}$	$I_{n,5,8}$ $I_{n5,9}$	$I_{n,6,10}$

Where: $i_1, i_2 …………i_n$– each child in the sample;
  $j_1, j_2…………j_6$ –six dimensions included in the analysis;
  $I_{1,1,1}, I_{1,1,2}……I_{1,6,10}$ – ten indicators forming the six dimensions, the first digit of the subscript indicating the individual, the second indicating the dimension, and the third referring to the indicator.

Firstly, each child is identified as deprived or non-deprived in each of the ten indicators ($I_{1,1,1}..I_{1,6,10}$). Child i is considered deprived in the specific indicator if the child's status in this indicator is below the threshold z, specified in Table 1. If the child is deprived, a value of 1 is assigned as the child's deprivation status for the relevant indicator (deprivation status $y_I =1$ if child i is deprived in the indicator I). If not deprived, 0 is assigned ($y_I = 0$ if child i is not deprived in the indicator I).

Let us assume the following deprivation status of each of the three children in the 10 indicators:

	j_1	j_2	j_3	j_4	j_5	j_6
i_1	0 0	1 0	0 0	0	0 0	1
i_2	0 0	0 0	0 1	1	. .	1
i_3	1 0	1 1	0 1	1	1 1	1

To determine each child's deprivation status y_j per dimension, the union approach is used if there is more than one indicator per dimension. For example, supposing that under the dimension j_1 we have two indicators ($I_{1,1,1}$ and $I_{1,1,2}$), a child is deprived in dimension j_1 if deprived either in $I_{1,1,1}$ or $I_{1,1,2}$ or both. Again, if the child is deprived, a value of 1 is assigned as the child's deprivation status for the relevant dimension ($y_j=1$ if child i is deprived in dimension j). If not deprived, 0 is assigned ($y_j = 0$ if child i is not deprived in dimension j). Using the example above, the following matrix presents the deprivation status of each child in the six dimensions:

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[9] The anthropometric information during the EDHS 2005 survey has only been gathered for a sub-sample of children below the age of five, measuring 43% of the total sample of children under-five.
[10] The results of the nutritional indicators are representative due of the survey's randomized selection of the sub-sample. This, however, is only true when calculating headcount ratios for each indicator separately as the observations with missing values can be excluded from the equation.

	j_1	j_2	j_3	j_4	j_5	j_6
i_1	0	1	0	0	0	1
i_2	0	0	1	1	.	1
i_3	1	1	1	1	1	1
q_j	1	2	2	2	1	3
n_j	3	3	3	3	2	3
h_j	33%	67%	67%	67%	50%	100%

For a single deprivation analysis, the deprivation headcount rate in each of the dimensions is calculated using the following formula:
$$h_i = \frac{q_j}{n_j}$$

where h_j = deprivation headcount rate in dimension j; q_j = number of children deprived in the dimension j; and n_j = the total number of children included in the analysis of each dimension j.

3.7.2 Number of deprivations experienced by each child

Having determined each child's deprivation status per dimension, the total number of dimensions each child is deprived in can be calculated using the following equation:

$$D_i = \sum_{j=1}^{d} y_j$$

where D_i – total number of dimensions each child i is deprived in; with $y_j = 1$ if child i is deprived in the dimension j; $y_j = 0$ if child i is not deprived in the dimension j.

Using the same example, the following matrix shows the total number of each child's deprivations:

	j_1	j_2	j_3	j_4	j_5	j_6	d	D_i
i_1	0	1	0	0	0	1	6	2
i_2	0	0	1	1	0	1	6	3
i_3	1	1	1	1	1	1	6	6

Counting the total number of deprivations of each child [11] allows carrying out a child-centred multidimensional analysis by identifying children with 0, 1, 2, 3, ...,d deprivations. Accumulating the number of deprived children for each number of deprivations will give an overview of the deprivation distribution by showing the percentage of the relevant child population experiencing no deprivations, one deprivation, two deprivations, and so forth. Calculating deprivation distribution for various sub-groups of children can give an insight into the differences in severity of child deprivations depending on children's characteristics. Profiling can help to identify the characteristics of those who have a low risk of being deprived and those who are deprived in multiple dimensions (De Neubourg et al, 2012a).

3.8 Overlap Analysis

Based on the MODA methodology (De Neubourg et al, 2012a), deprivation overlap analysis is carried out to study to what extent the different sectoral deprivations overlap and to show which types of deprivation children experience simultaneously. There are two ways in which this analysis is carried out. Firstly, each of the sectors is studied by looking at how many children are deprived only in the selected dimension and no other dimensions, and how many children are deprived in one to five other dimensions at the same time. This shows to what extent each of the deprivations is a unique problem among children requiring a

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[11] Note that child i_2 has missing information on dimension j_5. In the single dimension analysis this observation is not included in the equation, while in the multiple deprivation analysis this child is identified as 'non-deprived'.

single-sector response, and which deprivations occur together with other deprivations at the same time, pointing towards the need for an integrated approach to reducing deprivation intensity among children. Secondly, the deprivation overlap is studied by looking at three dimensions at a time, presented in a Venn-diagram to better visualise how the selected deprivations coincide. Children deprived in all three selected dimensions simultaneously are analysed further through profiling to identify the characteristics of the most vulnerable groups of children.

3.9 Identification of the Multidimensionally Deprived Children

3.9.1 Multidimensional child deprivation headcount ratio (H)

The multidimensional deprivation headcount measures the number of children deprived depending on the chosen cut-off point to identify the deprived. A child i is considered deprived if the number of dimensions in which he/she is deprived (D_i) is equal to or larger than the cut-off point K:

$$y_K = 1 \text{ if } D_i \geq K, \qquad\qquad\qquad y_K = 0 \text{ if } D_i < K$$

The multidimensional child deprivation headcount ratio is calculated as follows:

$$H = \frac{q_K}{n} \text{ , with } q_K = \sum_{i=1}^{n} y_K$$

Where,
q_K = number of children affected by at least K deprivations*;*
n = total number of children included in the analysis*;*
y_K = deprivation status of a child i depending on the cut-off point K*;*
D_i = number of deprivations each child i experiences*;*
K = cut-off point.

Note: if the cut-off point is larger than one, children whose total number of deprivations is below this cut-off are excluded from the calculation of the headcount ratio. Since every deprivation is seen as non-fulfilment of a child's rights, results using all of the cut-off points are calculated, including K=1.

3.9.2 Average deprivation intensity among the deprived (A)

To calculate the breadth of child deprivation among the multi-dimensionally deprived children, the Alkire and Foster (2007) methodology has been applied. The average intensity of multidimensional deprivation is the sum of all deprivations among children identified as deprived, as a share of the sum of all possible deprivations among the same group of children.

$$A = \frac{\sum_1^{q_K} c_K}{q_K \times d}, with c_k = D_i \times y_k$$

Where
q_K = number of children affected by at least K deprivations*;*
d = total number of dimensions considered per child;
c_K = number of deprivations each multi-dimensionally deprived child i experiences

As an example, if $K=2$ and the average intensity of deprivation $A = 50\%$, the children deprived in two to six dimensions ($d=6$) are on average deprived in 3 dimensions. The average number of deprivations per child takes into consideration the deprivations experienced by all children only when $K=1$. When the cut-off point is higher than one, the average intensity of deprivation is calculated using a smaller sample,

disregarding the deprivations experienced by children who also experience deprivation(s) but are not identified as multi-dimensionally deprived according to the cut-off point.

3.9.3 Adjusted multidimensional child deprivation headcount ratio (M_0)

Adjusted deprivation headcount ratio, M_0, is calculated based on the Alkire and Foster (2007) methodology. This ratio is applied to capture not only the number of the deprived children (H), but also their deprivation intensity (A).

The following two formulas can be used to calculate the adjusted deprivation headcount ratio:

$$M_0 = \frac{\sum_1^{q_K} c_K}{n * d} \text{ or } M_0 = H \times A$$

The reason why the deprivation headcount (H) alone is not sufficient to demonstrate children's deprivation level is because it does not show children's deprivation severity. As an example, let us assume that in both, region X and region Y, 50% of the children are deprived in two to six dimensions. However, children from region X are on average deprived in four dimensions, while children living in region Y experience two deprivations on average. Deprivation headcount alone would show that both regions have the same child deprivation rate. The deprivation intensity, however, shows that the deprived children in region X experience deprivation more severely compared to those living in region Y. M_0 is a composite ratio taking into consideration both, the number of multi-dimensionally deprived children and their average number of deprivations, assigning a higher value to region X (M_0=H×A=50%×67%=0.33) compared to region Y (M_0= H×A=50%×33%=0.17). This ratio allows the measurement of differences between children's deprivation severity depending on their characteristics and facilitates measuring changes over time.

3.9.4 Decomposition of M_0 by sub-group and dimension

As explained by Alkire and Foster (2007), the adjusted headcount ratio M_0 also satisfies the axiom on 'decomposability', as the overall deprivation levels are the sum of the weighted average of subgroup deprivation levels. The ability to decompose the national adjusted deprivation headcount into subgroups creates an understanding of the contribution of each of the subgroups to the national deprivation level. The following formula is used for calculating the composition of M_0:

$$\frac{M_{0_1}\left(\frac{n_1}{n}\right)}{M_0} + \frac{M_{0_2}\left(\frac{n_2}{n}\right)}{M_0} = 1$$

The adjusted headcount ratio M_0 can also be decomposed by dimension to estimate the contribution of each dimension to the overall deprivation in the country, in a specific region, or population group. The contribution of each dimension j to the total adjusted headcount ratio M_0 is defined as follows:

$$P_j = \frac{\sum_{i=1}^n (y_j * y_k)}{n * d * M_0}$$

Where
P_j = contribution of dimension j to the adjusted headcount ratio M_0
$\sum_{i=1}^n (y_j * y_k)$ = total number of children i deprived in dimension j while also being deprived multi-dimensionally according to the cut-off point K, *with:* $y_j=1$ if child i is deprived in dimension j; $y_j=0$ if child i is not deprived in dimension j; $y_k=1$ if child is multi-dimensionally deprived with $D_i \geq K$; and $y_k = 0$ if child is not multi-dimensionally deprived with $D_i < K$.

3.10 Profiling Variables

Profiling variables are chosen to indicate the child's geographic location and socio-economic characteristics to facilitate the identification of the deprived children. The deprivation incidence and intensity are calculated for the different sub-groups of children. Annex 6 lists all the profiling variables used for this study as well as their percentage share of the total population. Significance tests have been performed to check whether the differences in the subgroup results are significant.

In the absence of information on households' income or consumption to measure monetary poverty, the DHS has adopted a wealth index which is a weighted accumulation of household assets measuring household's relative economic status within a national context (Rutstein and Johnson 2004). Even though an analysis between wealth and deprivation would be very useful, in this case the comparison is problematic because the wealth index includes variables that have also been selected for constructing dimensions for this deprivation analysis. Thus, correlation between the wealth index and deprivation incidence would be partially endogenous and self-explanatory as the same components are present in both measures. For the purposes of this analysis, an asset index has been constructed as a substitute for the wealth index. The construction of this index is identical to that of the wealth index, except that the variables used for constructing the water, sanitation, and housing dimensions have not been included. Annex 3 lists all the variables included in the wealth index, showing which ones have been used for the asset index and which ones have been excluded. Since the importance of having certain assets differs depending on the place of residence, the asset index is constructed for rural and urban areas separately so the results using urban and rural asset indices are not comparable.

4. RESULTS

This section presents the results of multidimensional under-five child deprivation in 2000, 2005 and 2011. The first sub-section presents results derived from the single deprivation analysis showing changes in deprivation headcount ratios by indicator and dimension over time. This is shown at a national and regional level, as well as by children's individual characteristics. The second sub-section presents results from the multiple deprivation analysis, examining deprivation intensity and deprivation distribution, investigating how the different sectoral deprivations overlap, comparing different sub-groups of children to identify the characteristics of the most deprived, and studying trends in the total and sub-group multidimensional deprivation ratios over time.

SINGLE DEPRIVATION ANALYSIS

The single deprivation analysis contains findings of sector analyses evaluating children's well-being for one indicator and dimension at a time and observing trends between 2000, 2005, and 2011.

4.1 Deprivation incidence by dimension at a national and regional level

Overall, high deprivation rates are observed in all the dimensions analysed, ranging from 32% in nutrition to 87% in sanitation in 2011 (see Figure 1). The majority of children in Ethiopia have no access to the necessary health facilities and do not have access to a safe water source, sanitation facilities, and appropriate housing. The majority of children also live in households with no source of information from the media. Declining trends in deprivation were observed in all dimensions, except for water between 2005 and 2011, and sanitation between 2000 and 2011. At a national level, the differences in deprivation rates between 2000 and 2011 are statistically significant at a 99% level for all dimensions except sanitation. Regional disparities are large and vary from sector to sector (see Figure 2). The main results are presented below. See Annex 7 for trends at a national level and Annex 8 for trends at a regional level, showing differences in relative terms and statistical significance.

Figure 1 Deprivation headcount rates (%) by indicator and dimension among children under-five in Ethiopia, 2000, 2005, and 2011
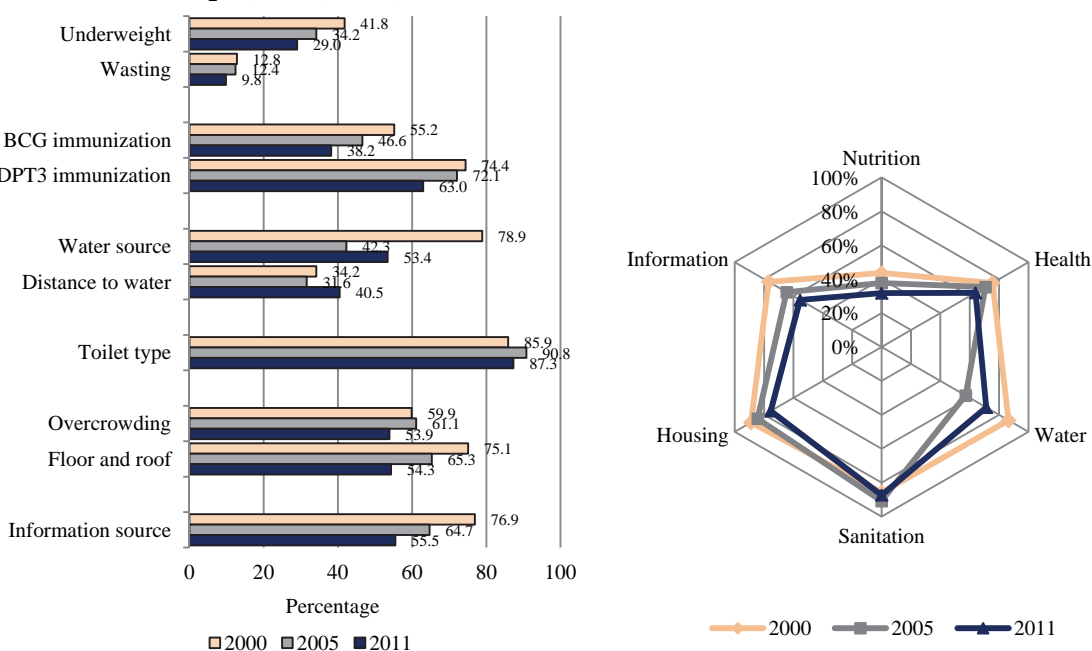
Figure 2 Deprivation headcount rates (%) by dimension and region, 2000 and 2011
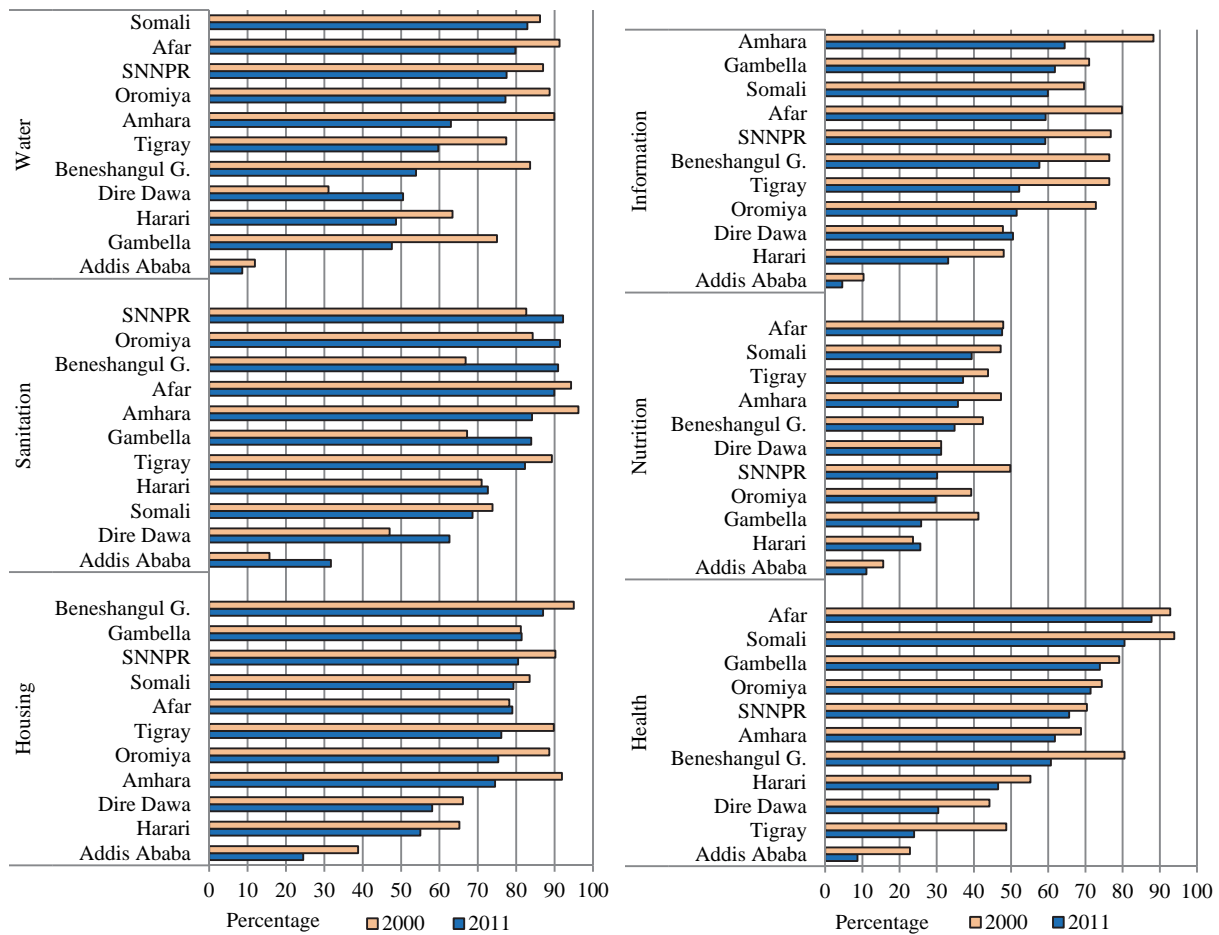
The regions are ranked from the largest to the smallest deprivation rate in each dimension, according to results in 2011.
See Annex 8 for trends at a regional level, showing differences in relative terms and statistical significance.
Note: The trends for Somali and Afar regions should be interpreted with caution as the sample of 2011 for these two regions is larger than that of 2000. In the 2000 EDHS, only three of the five zones of the Afar region (zones 1, 3, and 5) and only three of the nine zones in the Somali region (Shinile, Jijiga and Liben) were included. In the 2011EDHS, all five zones of the Afar region and six out of the nine zones of the Somali region (adding Afder, Gode and Warder) were covered.

The **Water** dimension shows a significant decrease in deprivation incidence since 2000, although more than two thirds of children still suffer from inadequate access to water. In 2000, the deprivation rate was 86%, while in 2005 and 2011 it was 57% and 71%, respectively. The deprivation decrease in the water dimension is due to a significant improvement in children's access to improved water sources where the deprivation incidence dropped by 32% in relative terms between 2000 and 2011. Nevertheless, the percentage of children with an unimproved water source was lower in 2005 compared to 2011. Regarding distance to the water source, the proportion of deprived children has increased since 2000. By 2011, 41% of children lived in households needing more than half an hour to reach the water source and return, while in 2000 and 2005 the headcount rate was 34% and 32%, respectively. At a regional level, in 2011 the deprivation rates in all the regions apart from Addis Ababa were above 45%. The highest percentage of children deprived of access to water was in Afar and Somali regions (80% and 83%), with no statistically significant changes observed since 2000. In Dire Dawa, the situation has worsened as the deprivation rate has increased from 31% in 2000 to 51% in 2011. In Beneshangul Gumuz, Amhara, Gambella, and Tigray, on the other hand, the deprivation rates have dropped significantly by 36, 30, 37, and 23 per cent in relative terms, respectively.

Sanitation is the only dimension out of a total of six dimensions where no statistically significant changes in the deprivation incidence have taken place between 2000 and 2011. The percentage of children deprived is strikingly high: 87% of children in 2011 were using unimproved toilet facilities.

Regional disparities regarding sanitation are significant, the percentage of deprived children in 2011 ranging from 63% in Dire Dawa to 92% in SNNPR among all regions except Addis Ababa which had a much smaller deprivation rate of 32%. The trend analysis shows that the situation has worsened significantly in Addis Ababa, Beneshangul Gumuz, Gambella, Oromiya, and SNNPR where the deprivation rates are considerably higher compared to 2000. Especially in Addis Ababa the percentage of deprived children has more than doubled from 16% in 2000 to 32% in 2011.

Housing deprivation incidence has reduced by 13 percentage points in absolute terms (a 15 per cent reduction in relative terms). While the overcrowding rate has decreased only marginally, there has been a continuous decline in the per cent of deprived children regarding the housing conditions (roof and floor) dropping from 75% in 2000 to 54% in 2011. However, the deprivation rate in housing is the second highest among the six dimensions after sanitation, with 76% of children living in inappropriate housing in 2011. Analysis at a regional level shows that in 2011, more than 80% of children in Beneshangul Gumuz, Gambella, and SNNPR were living in either overcrowded housing conditions or in houses with non-permanent roof and floor material, and in Somali and Afar the deprivation rate was 79%. Gambella, Somali and Afar have not shown any statistically significant changes in deprivation rates since 2000. At the same time, in Addis Ababa, Amhara, Tigray, Oromiya and SNNPR, the deprivation rates have decreased significantly over the ten years.

Access to information has continuously improved as the number of children living in families with no access to any of the three information sources (newspaper, radio or TV) has declined from 77% in 2000 to 56% in 2011. Regional disparities with regards to access to information are large, with the deprivation rates ranging from 33% in Harari to 64% in Amhara. Addis Ababa is an exception with a very low deprivation rate of 5% in 2011. The trend analysis shows a significant decrease in the deprivation rates in all regions except for Dire Dawa, Gambella and Somali.

Nutrition shows one of the highest deprivation decrease trends of -27 per cent in relative terms over the years. This is due to a significant drop in the percentage of underweight children (from 42% in 2000 to 29% in 2011). The percentage of children suffering from wasting reduced only marginally from 13% to 10% over the respective years. Overall, the deprivation rate in nutrition is still high, as 32% of children in 2011 are underweight, or wasted, or both.

At a regional level, the lowest deprivation rate in nutrition in 2011 was in Addis Ababa, where a significant deprivation reduction over time has taken place (from 16% in 2000 to 11% in 2011). In Afar, Somali, and Tigray regions, the percentage of children who are underweight and/or wasted was the highest (48%, 39% and 37% in 2011, respectively). In Somali and Tigray, deprivation rates since 2000 have dropped by 17 and 15 per cent in relative terms, while in Afar, Harari and Dire Dawa, no reduction in the wasting and/or underweight rates can be observed. In SNNPR and Gambella, the reduction in malnutrition rates was the highest compared to other regions, dropping from 50 to 30 per cent in SNNPR, and from 41 to 26 per cent in Gambella between 2000 and 2011.

Health care services are not accessible to the majority of children under-five: In 2011, 64% of the children had not received the necessary vaccinations crucial for their survival and development.[12] BCG and DPT vaccine coverage is used as a proxy to measure children's access and utilization of health services. Although some improvements can be observed, DPT coverage is very low as 63% of children

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[12] According to the National Immunization Coverage Survey (EHNRI, 2012), immunization coverage is higher compared to the EDHS 2011 results presented here. Although both surveys are nationally representative, the sample design and the time period are different so the results of these two surveys are not comparable.

between 12 and 59 months had not received the necessary three DPT vaccines in 2011. BCG coverage, on the other hand, has improved significantly as the percentage of children between 1 and 59 months without BCG vaccine dropped by 17 percentage points from 55% in 2000 to 38% in 2011. The regional variation in the lack of access to basic health services is large, ranging from 9% in Addis Ababa to 88% in Afar in 2011. Different trends can be observed with regards to changes over time. In Somali, Gambella, and Harari regions the deprivation rates are high (81%, 74%, and 47% in 2011, respectively) and no statistically significant decrease can be observed since 2000, while in Tigray, Dire Dawa, SNNPR and Beneshangul Gumuz a significant decline in deprivation rates has occurred.

4.2 Deprivation Incidence by Dimension According to Children's Background Characteristics

The analysis further investigates children's status in the various dimensions depending on their background characteristics. Results showing variations in dimensional deprivation levels for all sub-groups analysed can be found in Annex 9. The main findings are summarized below.

4.2.1 Deprivation headcount ratio by type of residence

Figure 3 shows the gap between urban and rural areas per dimension for the years 2000 and 2011. The percentage of deprived children in rural areas is significantly higher than in urban areas in every dimension analysed. In 2011 the largest gap was for water, housing and information dimensions (57, 40, and 41 percentage point difference, respectively). When compared to 2000, results show that disparities between rural and urban areas have decreased with regards to access to health and information. The gap has also decreased in sanitation, but this is due to a considerable deprivation increase among the urban population, while in rural areas the deprivation rate in sanitation has remained very high at more than 90%. Overall, for children living in rural areas slight improvements can be observed in all of the dimensions analysed except for sanitation. Among children living in urban areas, improvements in terms of deprivation reduction are particularly large with regards to nutrition, water, and housing, while the deprivation headcount in sanitation increased considerably, indicating that children's access to improved toilets has deteriorated.

Figure 3 **Deprivation headcount rates by dimension in rural and urban areas, 2000 and 2011**
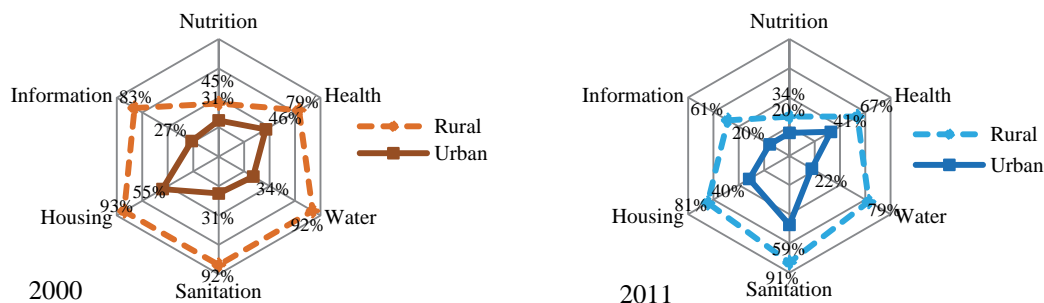
4.2.2 Deprivation headcount ratio by asset index

Figure 4 shows that for the children living in rural areas the relative wealth of their households does not determine their deprivation level. In nutrition, health, water and sanitation almost no differences in the deprivation rates can be observed between children belonging to the poorest 40% or the wealthiest 60% of the population living in rural areas. For those living in urban areas, on the contrary, deprivation rates change considerably depending on whether children belong to the poorest 40% or the wealthiest 60% of the urban population. For the composition of the asset index, see Annex 3.

Figure 4 Deprivation headcount rates by asset index in rural and urban areas, 2011

Poorest 40% in rural areas
Wealthiest 60% in rural areas

Poorest 40% in urban areas
Wealthiest 60% in urban areas
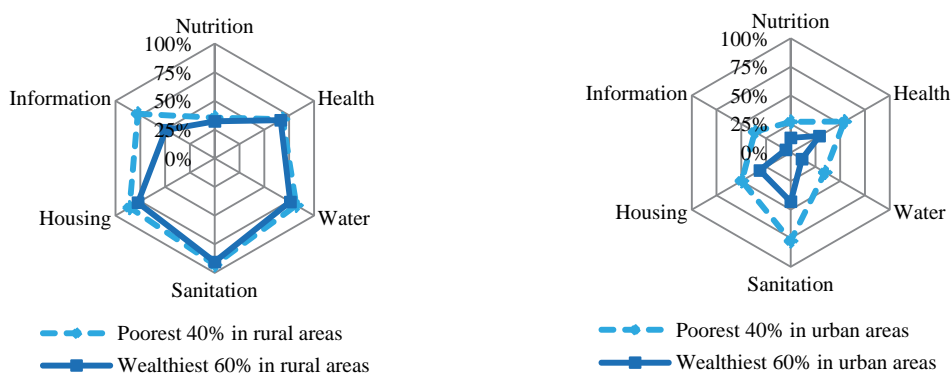
4.2.3 Deprivation headcount ratio by other background characteristics

The largest disparities in deprivation levels between the analysed sub-groups are among children living with mothers who received skilled birth attendance compared to those with an unskilled birth attendant[13], with significantly lower deprivation rates in all dimensions for the former group, especially information. A similar observation is made when comparing children whose mothers have secondary or higher education and those with no or only primary education[14].

Differences between children living in households with three or fewer children and those living with more than three children are statistically significant in housing, water, health, and sanitation dimensions (13, 9, 6, and 4 percentage point difference respectively), with higher deprivation rates among children living in larger families.

Among children living in households identified as meeting the minimum frequency and diversity of infant and young child feeding, 21% are underweight and/or wasted, while among those identified as having insufficient infant and young child feeding 30% are underweight and/or wasted. For all the other dimensions, except health, the difference in deprivation incidence between the two sub-groups is insignificant. Among the stunted children[15], deprivation rates are significantly higher in all dimensions; this is especially true in housing and information (9 and 8 percentage point difference), but is also true in health and sanitation (4 percentage point difference in deprivation rates). Among children who are not stunted, 14% are underweight and/or wasted, while for the stunted children this rate is 54%.

Children living in households that have experienced under-five child mortality in the 5 years before the survey have higher deprivation rates in housing, water, and sanitation (7,6, and 5 percentage point difference respectively), compared to households where no child under the age of five has died. Differences in nutritional outcome, access to health services, and information are statistically insignificant. Correlations between child mortality and inappropriate housing, sanitation and water should be further investigated.

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[13] The composition of children living with mothers who received unskilled birth attendance is the following: 7% live in urban and 93% in rural areas; 56% belong to the wealthiest three quintiles of households while the other 44% to the poorest two quintiles (according to the asset index calculated for rural and urban areas separately); 43% live in Oromiya, 22% in Amhara, 22% in SNNP, and 7% in Tigray.

[14] The composition of children with mothers with secondary or higher education is the following: 71% live in urban and 29% in rural areas; 83% belong to the wealthiest three quintiles of households while the other 17% to the poorest two, based on the asset index; 63% had a skilled birth attendant while the other 37% an unskilled attendant; 32% live in Oromiya, 18% in Amhara, 17% in Addis Ababa, 15% in SNNP, and 12% in Tigray.

[15] Stunting is used as a profiling variable as one of children's characteristics rather than one of the deprivation indicators. Stunting is not included in the analysis as a deprivation indicator because it is a long-term indicator and intersectoral, thus cannot be attributed to one particular dimension only (e.g., nutrition, water, housing, etc.).

The variation of deprivation rates depending on whether children live with their parents, whether they are orphans or whether they are adopted cannot be observed due to the small sample size, showing insignificant differences. See Annex 9 for results by sub-group with statistical significance testing.

MULTIPLE DEPRIVATION ANALYSIS

While in the previous section we looked at the different sectors separately and identified the number of children deprived in each of the dimensions, in this section we look at each child and identify the number of deprivations they experience. The multiple deprivation analysis examines how many and what combination of deprivations each child experiences simultaneously. It gives an insight in the various levels of deprivation distribution and severity among different groups of children. The following results are presented: The distribution of the number of deprivations experienced by children; the deprivation overlap and the profile of children deprived in several deprivations at a time; multidimensional deprivation ratios; the profile of the multi-dimensionally deprived; and the contribution of various sub-groups to the total adjusted deprivation headcount ratio. Trends between 2000 and 2011 are presented to measure Ethiopia's progress in child deprivation reduction over time.

4.3 Deprivation Distribution at a National Level

The total number of deprivations experienced by each child is counted to measure how deprivations are distributed over the child population and to examine the intensity of the overall child deprivation in Ethiopia. Figure 5 shows the deprivation distribution in 2000 and 2011, revealing that deprivation distribution has shifted towards a lower number of deprivations. This means that over the ten-year period children's deprivation intensity has decreased as proportionally there are fewer children who suffer from five and six deprivations at a time. In 2000, the majority of children (82%) were deprived in four, five, or six dimensions at a time, while by 2011; a lower proportion of 61% experienced such high intensity of deprivation. Nevertheless, the proportion of children who are not deprived in any of the dimensions analysed is still extremely low (only 2% of all children below five), having increased only by one percentage point over the 2000 to 2011 period. The majority of children (75%) experience three to five deprivations simultaneously.

Figure 5 Deprivation distribution among children below five in Ethiopia, 2000 and 2011
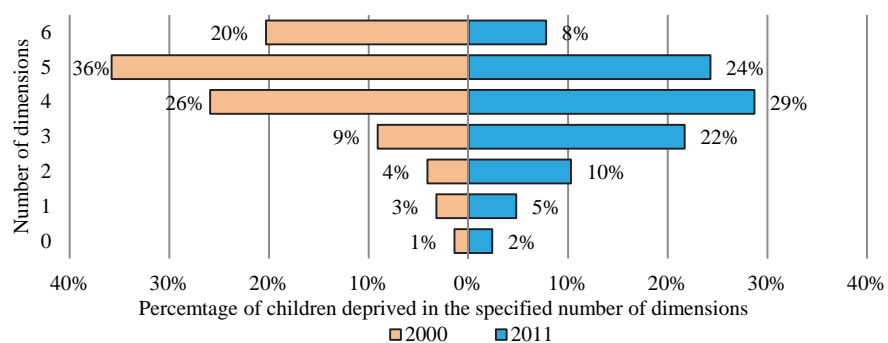
4.4 Deprivation Distribution According to Children's Background Characteristics

The analysis further investigates the deprivation distribution depending on the children's characteristics. The results showing variations for all sub-groups analysed can be found in Annex 12. The main findings are summarized below.

4.4.1 Deprivation distribution by mother's level of education

Figure 6 shows deprivation distribution among children by their mothers' level of education in 2000 and 2011. In both years, the deprivation distribution for children whose mothers have only primary or no education is skewed to a higher number of deprivations compared to children who have mothers with secondary or higher education. In other words, the higher the mothers' educational attainment, the lower the number of deprivations experienced by their children. Over the course of ten years, significant deprivation distribution variations are observed for children with mothers with secondary or higher education: The percentage of children experiencing four to six deprivations has dropped from 22% in 2000 to 9% by 2011, with 77% deprived in two or less dimensions.[16] On the contrary, while the deprivation intensity also decreased among children whose mothers have no or only primary education, most of them still suffer from a high number of deprivations and only 14% are deprived in one, two, or none of the dimensions analysed.[17]

Figure 6 Deprivation distribution by mother's level of education, 2000 and 2011
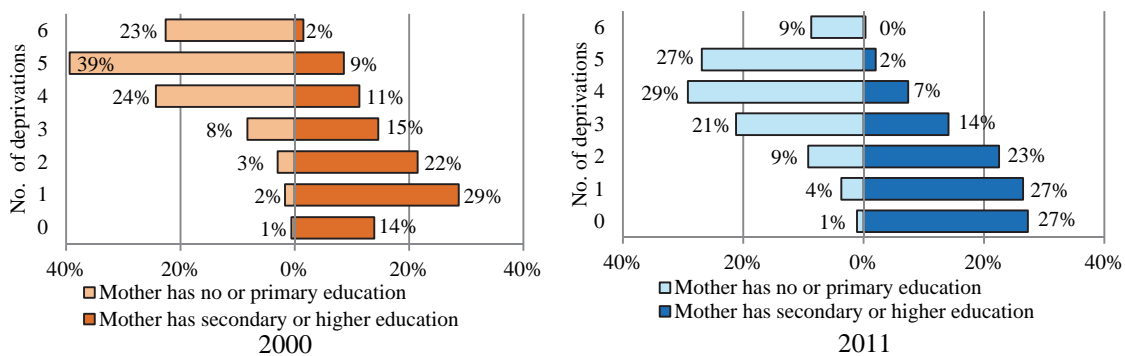
4.4.2 Deprivation distribution by place of residence and by asset index

Figure 7 shows that in rural areas, households' relative wealth does not determine children's deprivation severity. Belonging to the wealthiest 60% of the population in rural areas does not affect the deprivation distribution. Most children are deprived in three to five dimensions at a time, regardless of whether they belong to the poorest 40% or wealthiest 60% of the rural population based on the asset index. This indicates a widespread deprivation and limited service access and delivery. In urban areas, on the other hand, the deprivation distribution is very different depending on whether the child lives in poorer or

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[16] In 2011, the majority of the children with mothers with secondary or higher education were living in urban areas (71% in urban and 29% in rural areas), were from the wealthiest households (83% from the wealthiest three quintiles and 17% from the poorest two quintiles according to the asset index), and concentrated mainly in the following regions: Oromiya (32%), Amhara (18%), Addis Ababa (17%), SNNP (15%), and Tigray (12%).

[17] The composition of mothers by their educational attainment has changed over time. In both 2000 and 2011, 90% of all mothers of the children analysed had either no or only primary education. However, in 2000, 74% had no education while in 2011 the share of mothers with no education had dropped to 57%. At the same time, the percentage of mothers with primary education increased from 16% in 2000 to 33% in 2011. See Annex 6.

wealthier households. Among the children belonging to the poorest 40% of the urban population most are deprived in two to four dimensions at a time, while majority of the children from the wealthiest three quintiles are deprived in one or two dimensions at a time and 31 per cent are not deprived in any of the dimensions at all.

The trends show that the deprivation intensity has decreased slightly among children from both, rural and urban areas since 2000. Nevertheless, the level of disparity depending on the place of residence has remained the same. Also, no changes in the level of disparities depending on households' wealth for children from urban areas can be observed. In rural areas, a slight increase in differences between the wealthiest and poorest households can be observed, although the deprivation distribution in rural areas is still very similar regardless of the households' relative wealth.

Figure 7 Deprivation distribution by place of residence and asset index, 2011
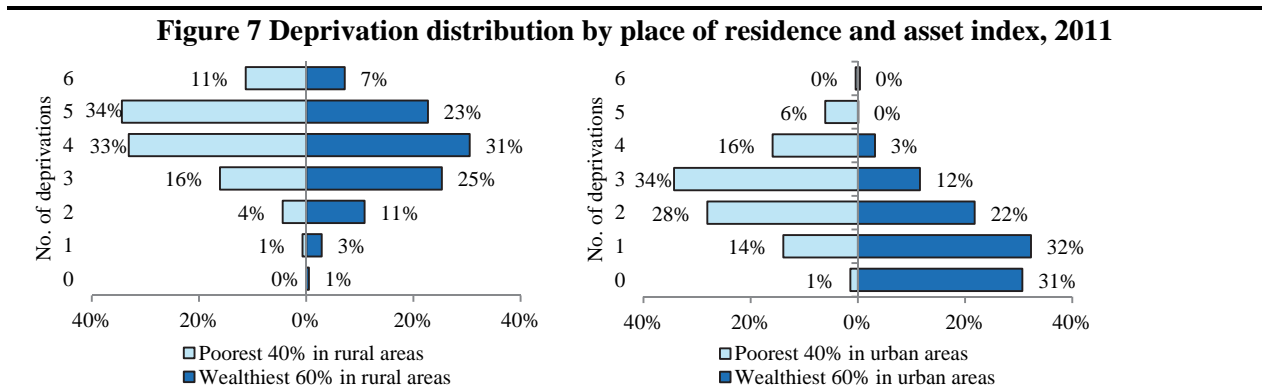
4.4.3 Deprivation distribution by other background characteristics

Other findings reveal that children from families with more children suffer from more deprivations at a time. In 2011, among children living in households with more than 3 children only 13% had two or less deprivations (the other 87% experienced 3-6 deprivations), while a much higher proportion of children from households with three or fewer children (23%) experienced two or less deprivations at a time. From all the children living with mothers who received skilled attendance at birth, 71% had 0-3 deprivations, while this was so only for 31% of all children living with mothers who received unskilled birth attendance.[18] Lastly, a higher proportion of children living in families where at least one child under the age of five has died experienced a higher deprivation intensity: 71% of all these children were deprived in 4-6 dimensions (the other 29% were deprived in 0-3 dimensions), compared to 63% among children living in families where no under-five child mortality could be observed.

4.5 Deprivation Overlap Analysis

This sub-section looks at which deprivations are experienced simultaneously among children and to what extent these deprivations overlap. Deprivation overlap analysis helps understanding of to what extent each of the sectoral deprivations can be seen as a unique problem with no or little overlap with other deprivations, and which deprivations coincide with the others the most. The triple-deprivation analysis examines the most common deprivation combinations children suffer from and the characteristics of children who experience several deprivations at a time. Analysis at a regional level was also performed and trends between 2000 and 2011 were observed.

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[18] In 2011, the majority of children with mothers who received unskilled birth attendance were living in rural areas (93% in rural and 7% in urban areas), were from the wealthiest households (56% from the wealthiest three quintiles and 44% from the poorest two quintiles according to the asset index), and concentrated mainly in the following regions: Oromiya (43%), Amhara (22%), SNNP (22%), and Tigray (7%).

4.5.1 Deprivation overlap for each dimension

Deprivation overlap analysis of each dimension with other dimensions shows the proportion of children deprived in one, two, or three to five other dimensions, as well as the percentage of children deprived in that particular dimension only. The results in Figure 8 demonstrate the deprivation incidence for each dimension at a national level, subdivided by the extent of overlap with other dimensions. Overall, the number of children deprived in four to six dimensions at a time (i.e., children deprived in a given dimension and deprived in 3-5 other dimensions) has decreased since 2000. However, the number of children deprived in only one and no other dimension has remained very low. In 2011, the percentage of children deprived only in any one of the specified dimensions and no other dimension ranges from 0.2% in nutrition to 2.3% in sanitation, while the percentage of children deprived in these dimensions ranges from 27% in nutrition to 87% in sanitation. The only sector where the number of children deprived in only that particular sector has increased over time is sanitation. Overall, the majority of children still suffer from several deprivations at a time, and none of the dimensions analysed can be seen as a unique problem that would not overlap with other sectors. This finding points at a need for an integrative approach to addressing the deprivations analysed.

Figure 8 Deprivation overlap for each dimension at a national level, 2000 and 2011
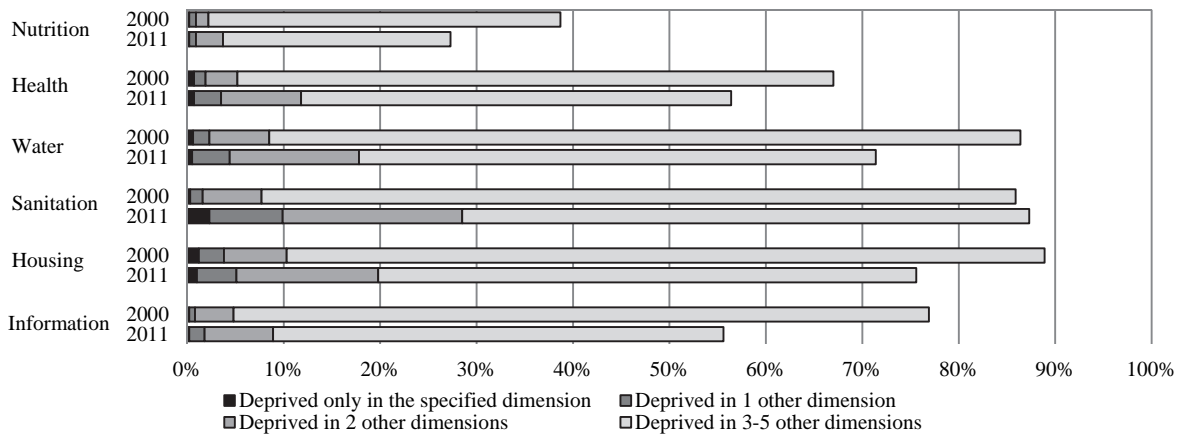
At a regional level, the extent to which deprivations overlap varies considerably, implying that different entry points for interventions may be needed in different regions. As an example, Figure 9 compares the extent to which deprivations overlap in Addis Ababa and Dire Dawa. In Addis Ababa, a relatively high proportion of children are deprived in only one and no other dimension at a time. In 2011, more than a half of all the children in Addis Ababa who were deprived in sanitation were not deprived in any of the other dimensions studied. Similarly, almost a half of those who were deprived in housing were not deprived in any other dimension. A higher deprivation overlap could be observed among children deprived of access to health care services. While 7 per cent of all the children in Addis Ababa were deprived of access to health care services, only 23 per cent of these children were not deprived in any other dimension, while the other 77 per cent also experienced other deprivations.

In Dire Dawa, a vast majority of children deprived in any one dimension were also deprived in three to five other dimensions. The percentage of single-dimensionally deprived children was low while the deprivation rates in each dimension were high. For example, while 58 per cent of the children were deprived in housing, 11% of these children were not deprived in any other dimension while the other 89% were deprived in one to five other dimensions. In nutrition, only 5% of all the underweight or wasted children did not suffer from any other deprivation, while 25% of those deprived in nutrition suffered from one or two other deprivations and 70% suffered from three to five other deprivations.

Figure 9 Deprivation overlap for each dimension in Addis Ababa and Dire Dawa, 2011

Addis Ababa

- Deprived only in the specified dimension
- Deprived in 1 other dimension
- Deprived in 2 other dimensions
- Deprived in 3-5 other dimensions

Dire Dawa

- Deprived only in the specified dimension
- Deprived in 1 other dimension
- Deprived in 2 other dimensions
- Deprived in 3-5 other dimensions
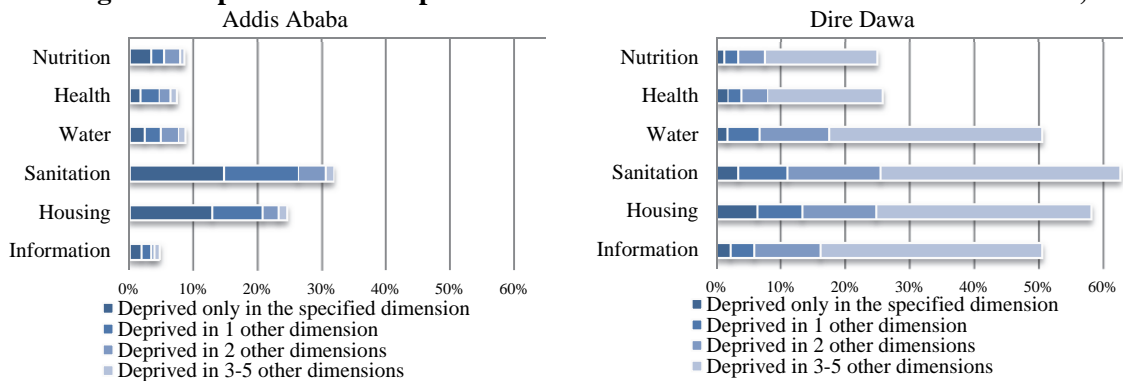
4.5.2 Deprivation overlap of three dimensions

As seen in Figure 10, the proportion of children deprived in any three dimensions has declined over the course of 10 years. All the combinations with water, sanitation, housing, information, and health dimensions show that the percentage of children suffering from any three of these deprivations ranged from 27 to 53 per cent in 2011. This is a significant drop compared to 2000 when deprivation in the same combinations of dimensions ranged from 50 to 74 per cent. Overlap of any dimension with nutrition is proportionally lower ranging from 12 to 20 per cent in 2011 as the deprivation rate in nutrition is lower than in the rest of the dimensions.

Figure 10 Deprivation headcount rates of children deprived in all three specified dimensions

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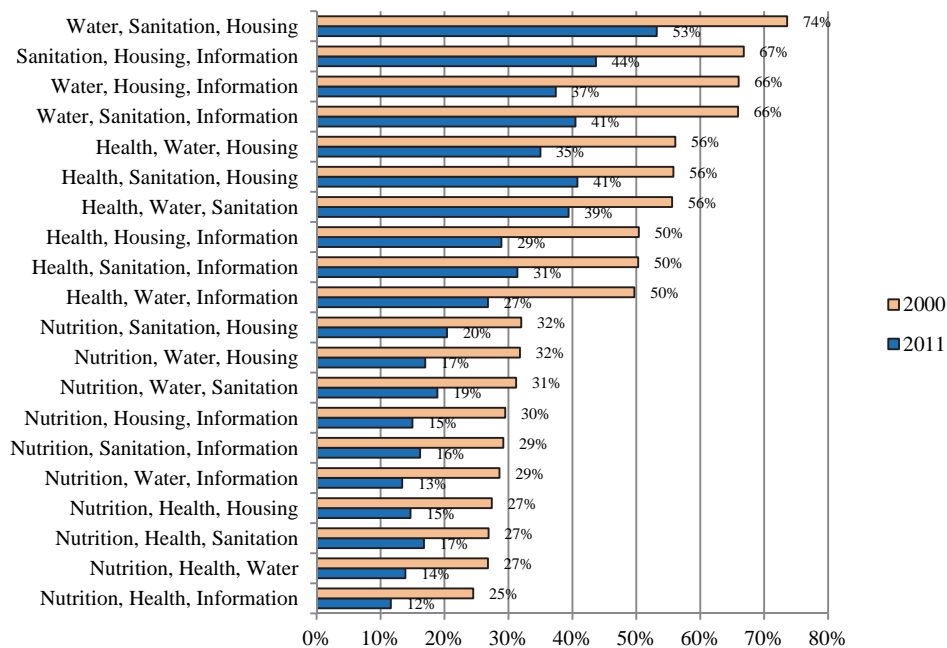
We further examine how these combinations of deprivations overlap with the help of Venn-diagrams for a better visualisation. To use as much child-level information as possible, the Venn-diagram presented below comprises nutrition, health and water dimensions, as nutrition and health dimensions are based on individual level data. The children experiencing all three deprivations at a time are given additional attention, looking at differences between regions and at the profiles of these children.

Deprivation overlap in nutrition, health and water

The results in figure 11 show that in 2011, only 12 per cent of all the children below the age of five did not suffer from any of the three deprivations analysed. While 28 per cent of all the children under-five were deprived in the nutrition dimension, only 3 per cent (11% of all the children deprived in nutrition) were deprived in nutrition only. This reveals that only about one tenth of all the underweight and/or wasted children were not deprived in the health and/or water dimensions. At the same time 14 per cent of all the children below the age of five in 2011 were deprived in nutrition, health and water simultaneously, which indicates that a half of all the underweight and/or wasted children also had not been immunized and did not have access to safe drinking water.

The results reconfirm the need for integrated approaches to address the multiple facets of children's deprivation. For instance, if a nutrition programme is put into place to address nutritional problems of those 28 per cent of children who are malnourished, most of these children (89%) also face other forms of deprivations, which means that although their nutritional status may be improved, they still suffer from a lack of immunization and no access to safe drinking water that are crucial to the realisation of their rights. Of course immunization and improved water quality are themselves key elements of a holistic approach to reducing malnutrition.

Figure 11 Overlap between nutrition, health and water, 2011
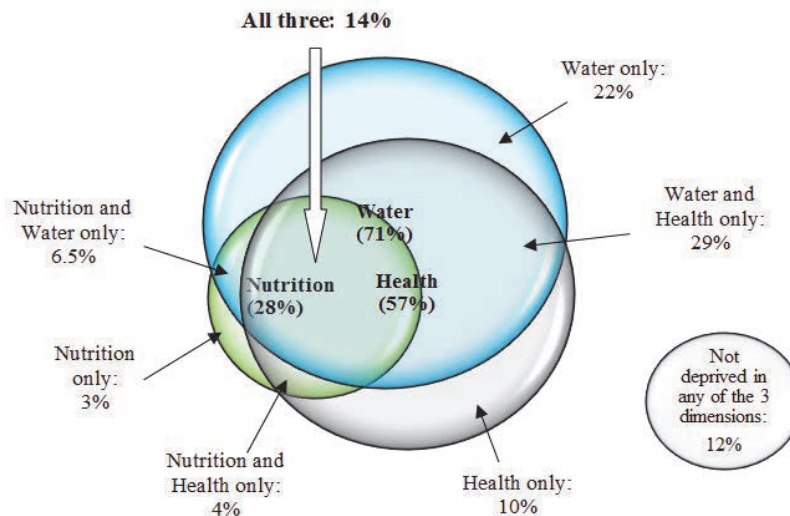
To enhance the precision of the identification of the deprived children, the headcount rates of children deprived in the aforementioned dimensions are calculated for different sub-groups separately, by region and by other children's characteristics. As an example, Figure 12 shows the extent to which children living in Tigray and in Amhara suffer from deprivation in nutrition, health, and water simultaneously. It can be seen, for instance, that the overlap of the nutrition and health deprivations is higher in Amhara compared to Tigray. In Tigray, less than one fifth of the malnourished children have not had access to basic health care services, while in Amhara more than a half (60%) of the wasted and/or underweight children had also not received basic health care services in 2011.

Figure 12 Overlap between nutrition, health and water in Tigray and Amhara, 2011

Tigray

Amhara
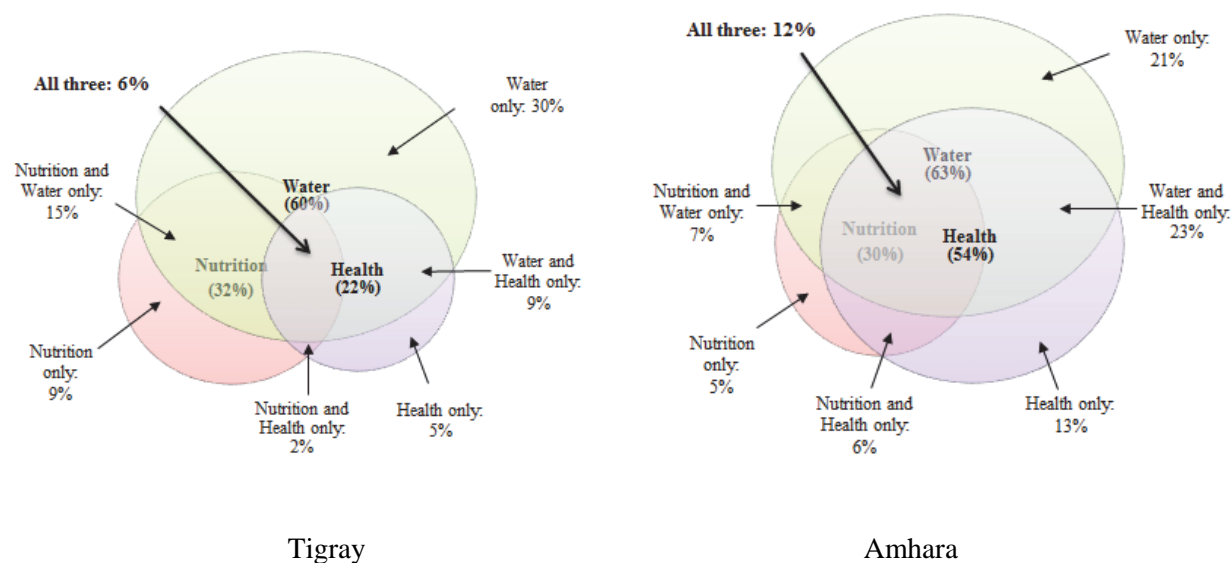
Overall, a high variation between the different regions can be observed in terms of the deprivation overlap. Table 2 shows that in 2011, while the national headcount ratio of children deprived in nutrition, health and water simultaneously was 14 per cent, a much higher percentage of children experienced these deprivations simultaneously in Afar, Somali and Oromiya regions (33, 21, and 16 per cent, respectively). The lowest percentage of children deprived in nutrition, health and water at a time was in Addis Ababa (0.3 per cent), Tigray (6 per cent), and Dire Dawa (6 per cent). Between 2000 and 2011, the deprivation rates of the overlap in nutrition, health and water have declined in most regions. In Beneshangul Gumuz, Gambella, Amhara, SNNPR, and Tigray, the relative decrease in deprivation incidence was more than 50 per cent. In Somali, Harari, Addis Ababa, and Dire Dawa, on the other hand, the difference between the two time periods is small and statistically insignificant.

Table 2 Deprivation overlap in nutrition, health and water at a national and regional level, 2000-2011

	Deprivation headcount 2000	Deprivation headcount 2011	Relative difference (%)	
National	26.8%	14.3%	-46.6%	***
Afar	38.6%	33.4%	-13.5%	
SNNPR	32.5%	14.0%	-56.9%	***
Amhara	29.6%	12.1%	-59.1%	***
Beneshangul Gumuz	29.1%	9.5%	-67.4%	***
Somali	28.6%	20.9%	-26.9%	
Gambella	26.4%	8.5%	-67.8%	***
Oromiya	25.1%	15.9%	-36.7%	***
Tigray	14.1%	5.9%	-58.2%	***
Dire Dawa	8.6%	6.1%	-29.1%	
Harari	7.2%	7.7%	6.9%	
Addis Ababa	0.0%	0.3%		

Deprivation overlap in nutrition, health and water by children's characteristics

As shown in Figure 13, the proportion of children deprived in all three dimensions is eight times higher in the rural areas compared to urban areas (16 per cent versus 2 per cent). The deprivation rates among children living in urban areas vary depending on the relative wealth of their households, while in rural areas this phenomenon is not observed. Also, no statistically significant differences in deprivation rates

can be observed depending on the number of children per household. There are large disparities between children of mothers with different educational attainment: Only 2 per cent of all the children whose mothers have secondary or higher education are deprived in nutrition, health and water, while among children whose mothers have no or primary education 15 per cent suffer from this combination of deprivations. Similar differences can be observed when comparing children living with mothers who had skilled attendance when giving birth and those with an unskilled attendant. See footnotes 13 and 14 for the composition of children who live with mothers who received unskilled birth attendance and mothers with secondary or higher education.

Figure 13 Percentage of children deprived in nutrition, health and water by sub-group, 2011
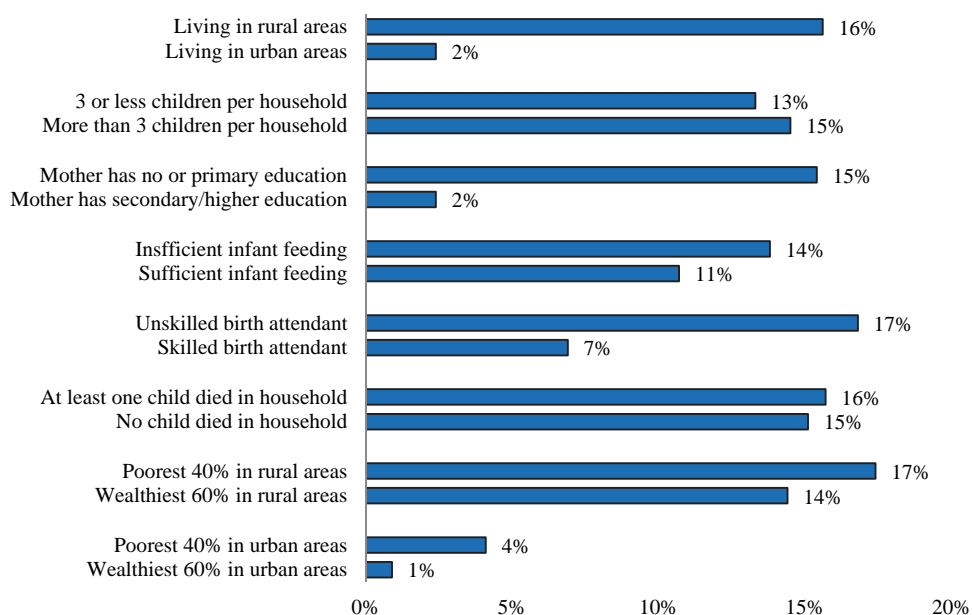
4.6 Identification of the Multidimensionally Deprived Children and their Deprivation Intensity

To report on aggregated multidimensional child deprivation, the following three deprivation ratios are used: The deprivation headcount ratio (H) showing the percentage of multidimensionally deprived children; the average deprivation intensity among the deprived (A) measuring the average number of deprivations that the multidimensionally deprived children experience to show the breadth of child deprivation; and the adjusted deprivation headcount ratio (M_0), which is a composite ratio composed of the headcount of the deprived children (H) adjusted by the average intensity of their deprivation (A). These were calculated using the Alkire and Foster (2007) method (see section 3.9 for the methodology and formulas). These measures are applied to underline the importance of considering both, the number of the poor children, and their deprivation intensity. It is clear that a child suffering from four deprivations at a time is in a more difficult situation than a child suffering from two at a time. Different policy responses might be necessary to alleviate children from poverty as they suffer from different levels of deprivation and may have different characteristics. The results of this study should give policy incentives to work towards not only reducing the number of poor children, but to reducing the intensity of deprivations from which they suffer.

4.6.1 Percentage of multidimensionally deprived children and changes over time

Figure 14 shows the multidimensional deprivation headcount in the years 2000 and 2011, as a percentage of children deprived in a number of dimensions that ranges from the selected cut-off to the maximum number of deprivations. In 2011, most children (98 per cent) were deprived in at least one dimension, 93 per cent in at least two dimensions, 82 per cent in at least three dimensions, 61 per cent in at least four dimensions and 32 per cent in at least five out of the six dimensions analysed. There has been progress towards decreasing deprivation incidence over the period of ten years; the larger the cut-off the greater the decline over years, suggesting that the deprivation intensity has also decreased.

Figure 14 Multidimensional deprivation headcount ratio (H) depending on the number of deprivations
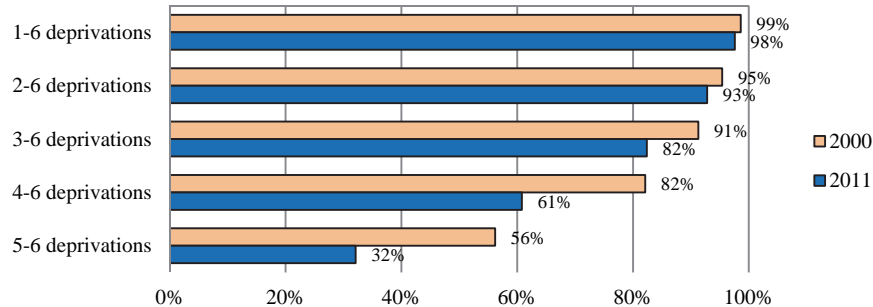
At a regional level, when focusing on those children who are deprived in two or more dimensions, the multidimensional deprivation headcount ratio does not show large disparities. As can be seen in Figure 15, in all regions apart from Addis Ababa, Dire Dawa and Harari, 90 to 95 per cent of the children in 2011 were deprived in two or more dimensions, with very small changes since 2000. A statistically significant decrease in the percentage of children deprived in two or more dimensions can be observed only in Afar and Amhara. See Annex 11 for the results of the significance testing.

Figure 15 Multidimensional deprivation ratio among children deprived in 2-6 dimensions by region
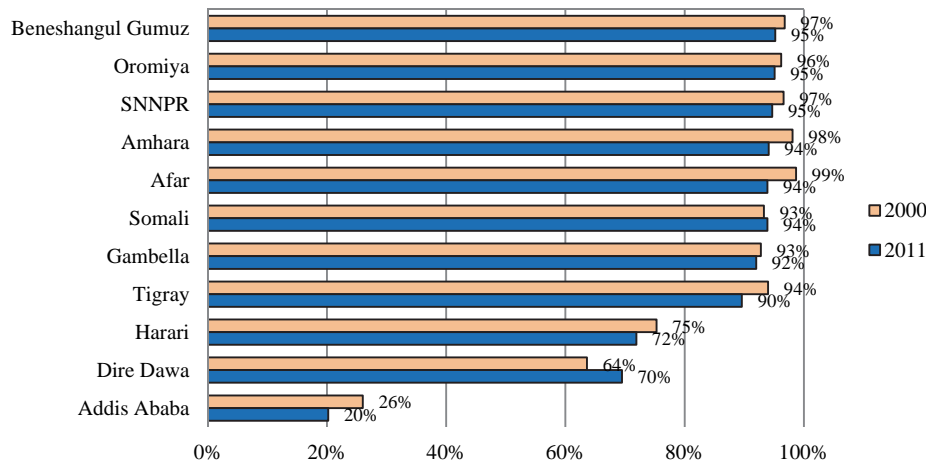
The regions are ranked according to results in 2011 from the largest to the smallest deprivation ratio in each region. Note: The trends for Somali and Afar regions should be interpreted with caution as the sample of 2011 for these two regions is larger than that of 2000. In the 2000 EDHS, only three of the five zones of the Afar region (zones 1, 3, and 5) and only three of the nine zones in the Somali region (Shinile, Jijiga and Liben) were included. In the 2011 EDHS, all five zones of the Afar region and six out of the nine zones of the Somali region (adding Afder, Gode and Warder) were covered.

4.6.2 Average deprivation intensity among deprived children and changes over time

As could be seen in sub-section 4.6.1, the multidimensional headcount ratio is a good indication of deprivation incidence, but it is not sensitive to the depth of multidimensional deprivation because it does not show the deprivation severity of the children identified as poor. When analysing child deprivation, it is important to be guided not only by the number of deprived children but also by the number of deprivations they suffer from.

Figure 16 shows the regional ranking according to the average intensity of deprivations from which children suffer, which is the average number of deprivations children experience simultaneously. All the children deprived in at least one out of a total of six dimensions are taken into consideration. At the top of the graph are the regions with the highest average deprivation intensity in 2011, while at the bottom are the regions where children on average suffer from fewer deprivations at a time. Results in 2000 are also shown to study progress in the reduction of deprivation severity over time.

At a national level, the deprivation intensity out of a maximum of 6 deprivations dropped from 4.5 deprivations on average experienced by children in 2000 to 3.8 deprivations in 2011. The average deprivation intensity, however, varies across regions. In 2011, the lowest average number of deprivations was observed in Addis Ababa where the deprived children experienced 1.5 deprivations on average. This is followed by Harari and Dire Dawa where on average children deprived in any one dimension experienced 3 deprivations at a time. The highest deprivation severity was in Afar, SNNPR, Somali, and Oromiya regions, where children who were deprived in at least one dimension were on average deprived in 4.3, 4.0, 3.9, and 3.9 deprivations, respectively.

A significant progress in the reduction of deprivation severity among children deprived in one or more dimensions can be observed in Amhara, Tigray, Oromiya, Beneshangul Gumuz, SNNPR, Harari, and Afar, with the average deprivation intensity dropping by 0.5-1 deprivation. In Amhara, although still very high, the average deprivation intensity has decreased the most, dropping from 4.8 to 3.8 deprivations experienced by children deprived in one or more dimensions. In Gambella, Somali, Dire Dawa and Addis Ababa, on the other hand, no statistically significant changes can be observed.

Figure 16 Average deprivation intensity (A) among children deprived in 1-6 dimensions by region
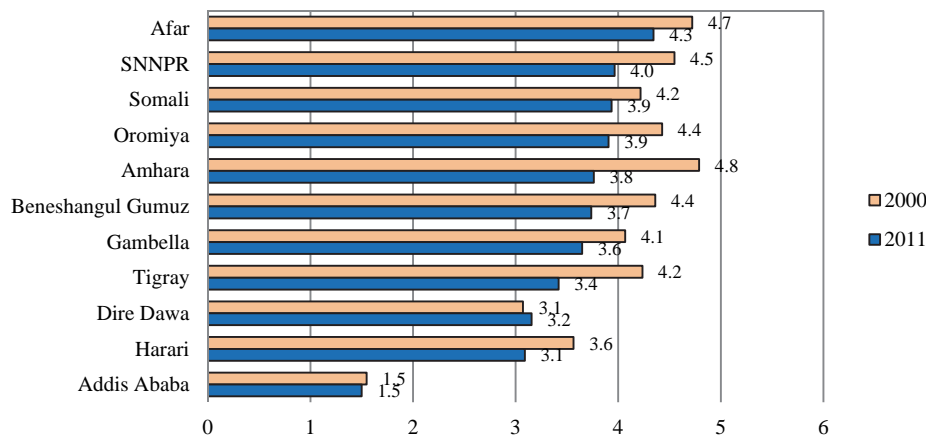
4.6.3 Assessment of overall progress in child deprivation reduction in Ethiopia over time

As can be seen from the previous sub-sections, it is important to consider both, the number of poor children, and their deprivation intensity. Child poverty reduction should be assessed not only in terms of reduction of the number of poor children, but also the reduction of the intensity of deprivations they suffer from. Accordingly, to access the overall progress in child poverty reduction in Ethiopia over time, the adjusted deprivation headcount ratio (M_0) is used, incorporating both, the number of the deprived children (section 4.6.1) and the number of deprivations they suffer from (section 4.6.2).

To enhance the identification of the multidimensionally deprived children, the deprivation ratio is calculated not only at a national level but also by region and by other sub-groups to see the variation in deprivation according to children's geographic and socio-economic characteristics. This is useful for identifying the most vulnerable children. The percentage contribution of each sub-group to the national value is also calculated to see which sub-groups of children contribute the most to the overall deprivation ratio. Furthermore, the adjusted deprivation headcount of each sub-group is decomposed into dimensions to see to what extent each sector contributes to the deprivation level of each group. Trends between 2000 and 2011 are investigated to assess changes of child deprivation level over time and to see in what ways the different groups of children have contributed to the overall changes.

Changes in national and regional child deprivation ratios

Changes over time are assessed based on the adjusted deprivation headcount ratio (M_0), defining children as multidimensionally deprived if they experience two or more deprivations at a time. Overall, the adjusted deprivation headcount ratio dropped by 16 per cent in relative terms between 2000 and 2011. This is due to a 3 per cent reduction in the number of the multidimensionally deprived children (deprivation headcount H dropped from 95% to 93%; see Figure 14), and a 14 per cent reduction in children's deprivation intensity (average deprivation number (A) experienced by the children deprived in two or more dimensions dropped from 4.6 to 4.0; see Annex 11).

According to Table 3 and Figure 17, child deprivation has not decreased evenly across the regions. While significant deprivation reduction can be observed in Amhara, Tigray, Beneshangul Gumuz, SNNPR and Oromiya where the relative change over the ten years ranges from -23 to -12 per cent, the rest of the regions have experienced a lower progress in terms of child deprivation reduction, especially Afar, Dire Dawa, Gambella, Harari and Somali regions[19], where the adjusted multidimensional deprivation ratio has not changed (at a significance level of 95%). In 2011, Afar region scores the worst (M_0=0.71), followed by SNNPR, Oromiya and Somali where the ratio (M_0) is 0.65, 0.64, and 0.64. The lowest deprivation ratios are in Addis Ababa, Harari and Dire Dawa.

To see to what extent the deprivation headcount ratio or the average deprivation intensity have contributed to the overall multidimensional deprivation measure M_0 for each region, see Annex 11.

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[19] Findings for Afar and Somali regions should be interpreted with care. See note under Table 3.

Table 3 Assessment of overall progress in child deprivation reduction at a national and regional level

	M_0 in 2000	M_0 in 2011	Relative change (%) 2000-2011	
National	0.73	0.61	-16%	***
Afar	0.78	0.71	-9%	*
SNNPR	0.75	0.65	-13%	***
Oromiya	0.73	0.64	-12%	***
Somali	0.68	0.64	-6%	
Amhara	0.79	0.61	-23%	***
Beneshangul Gumuz	0.72	0.61	-15%	***
Gambella	0.66	0.59	-11%	
Tigray	0.68	0.53	-22%	***
Dire Dawa	0.40	0.43	7%	
Harari	0.49	0.42	-14%	
Addis Ababa	0.10	0.08	-20%	

Note: *** statistically significant at 99% level, ** 95% level, * 90% level.
The trends for Somali and Afar regions should be interpreted with caution as the sample of 2011 for these two regions is larger than that of 2000 due to the increase of geographic coverage into more remote areas.

Figure 17 visualizes the results described above and presented in Table 3, indicating where multidimensional deprivation was concentrated at the regional level in 2000 and 2011. The darker colours in the maps represent higher levels of multidimensional child deprivation compared to other regions at that time.

Figure 17 Adjusted deprivation headcount ratio (M_0) among children deprived in 2-6 dimensions by region

| 2000 | 2011 |
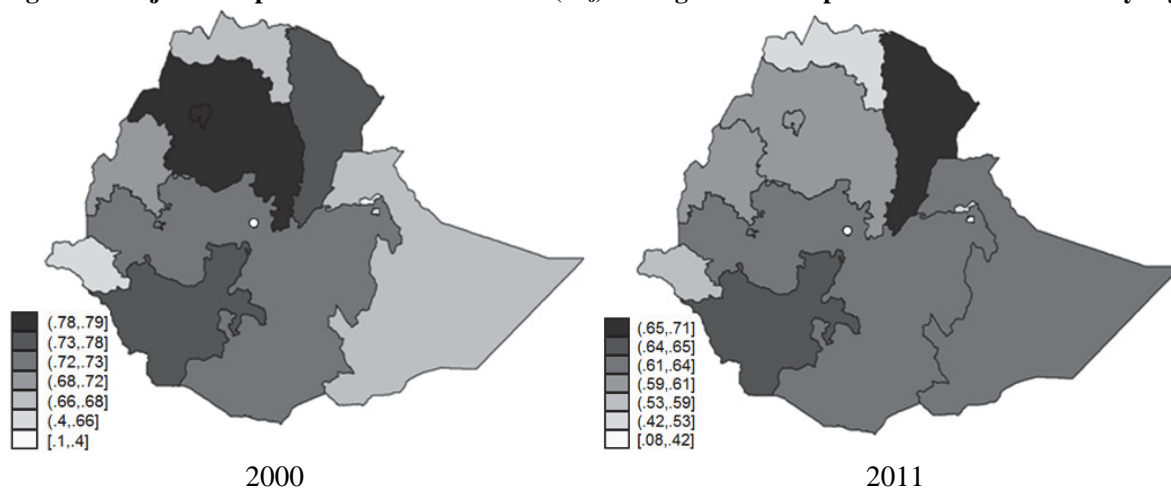
Note: M_0 is a composite ratio composed of the headcount of the children deprived in 2-6 dimensions (H) and the average intensity of their deprivation (A), calculated using the formula M_0 =H*A. The index ranges between 0 and 1, where 0 would show that none of the children analysed suffer from two or more deprivations, while 1 would show that all of the children analysed (100%) suffer from 2-6 deprivations, and that all these children experience six deprivations (i.e., 100% of all the possible deprivations) at a time.

Changes in the dimensional composition of the national and regional child deprivation ratios

Figure 18 shows the contribution share of each dimension to the total adjusted headcount ratio M_0 in 2000 and 2011. The main contributors to the total deprivation ratio are sanitation, water and housing deprivations, but information, health and nutrition also contribute significantly. At a national level, there have been some changes in terms of the composition of the deprivation ratio: The contribution share of the nutrition, information and water dimensions to the total deprivation ratio is lower in 2011 compared to that of 2000, while the contribution of deprivation in sanitation has increased over time.

Figure 18 Percentage contribution of each dimension to the national adjusted deprivation ratio (M_0) among children deprived in two to six dimensions
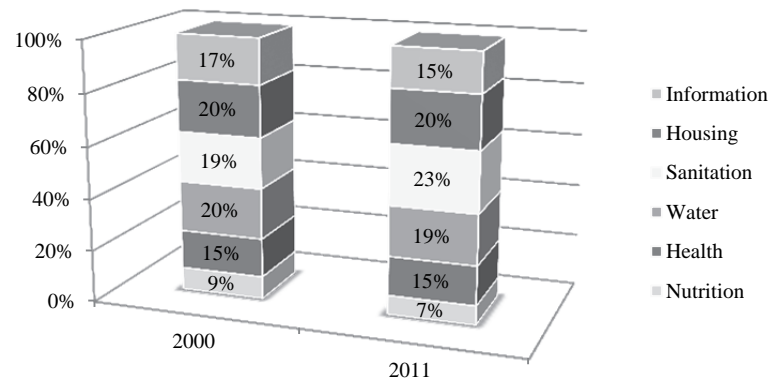
At the regional level, changes in the contribution share of each of the six dimensions to the total adjusted deprivation headcount ratio have followed a similar pattern to that of the national composition changes, although with some differences. For example, the contribution of deprivation in information has decreased the most in Addis Ababa, Afar, Harari, Oromiya and Tigray regions. In Addis Ababa, the most significant change in the dimensional contribution to the multidimensional deprivation ratio is regarding sanitation: In 2000, the contribution of deprivation from sanitation was 19% while in 2011 it had reached 35% as a share of the total adjusted deprivation headcount, indicating that in Addis Ababa the sanitation issues dominate proportionally to the other deprivations. In Beneshangul Gumuz, the contribution from sanitation and housing dimensions compared to the other deprivations has increased over time, while in Dire Dawa, the contribution from the water dimension has increased the most. In Harari, the health dimension in 2011 has a higher contribution share to the total deprivation level compared to 2000.

The focus of this section was the contribution of dimensions to the total adjusted deprivation headcount at a national and regional level. The single deprivation analysis in Section 4.1 can give further information on the changes in each of the dimensions at a regional level over time.

Changes in the contribution of each region to the national child deprivation ratio

Figure 19 shows the percentage contribution of each region to the national adjusted deprivation headcount ratio among children deprived in two to six dimensions. The three largest contributors are Oromiya, SNNPR and Amhara in both time periods. This is due to the following two reasons: The child population sizes are the largest in these three regions compared to the other regions in Ethiopia, and the deprivation levels are among the highest. The percentage contribution of Oromiya and SNNPR to the national child deprivation ratio has increased over the ten years, while the child population of these two regions as a share of the total child population has not changed much (see Annex 6 for the child population distribution over regions). This can be explained by the lower pace in which the deprivation headcount and intensity in these two regions have decreased in comparison to the other regions (see Table 3), and by the higher pace in which the child population has grown in the other regions. In the Amhara region, on the other hand, the contribution share to the total deprivation ratio in 2011 is considerably lower than in 2000. Again, this is because the child population in Amhara as a share of the total child population is smaller in 2011 compared to 2000 (see Annex 6), and because the deprivation headcount and intensity in Amhara have decreased significantly. The deprivation headcount has decreased by 4 per cent dropping from 98% to 94%, while intensity has decreased by 24 per cent, dropping from five to four deprivations experienced on average. The Tigray region has also experienced progress over time as the contribution share to the

national deprivation ratio has decreased while the child population size as a proportion of the total child population has not changed. The figure also shows that the contribution from Somali region to the total deprivation ratio has tripled, but this is mainly driven by a high child population growth rate in this region.

Figure 19 Percentage contribution of each region to the national adjusted deprivation ratio (M_0)
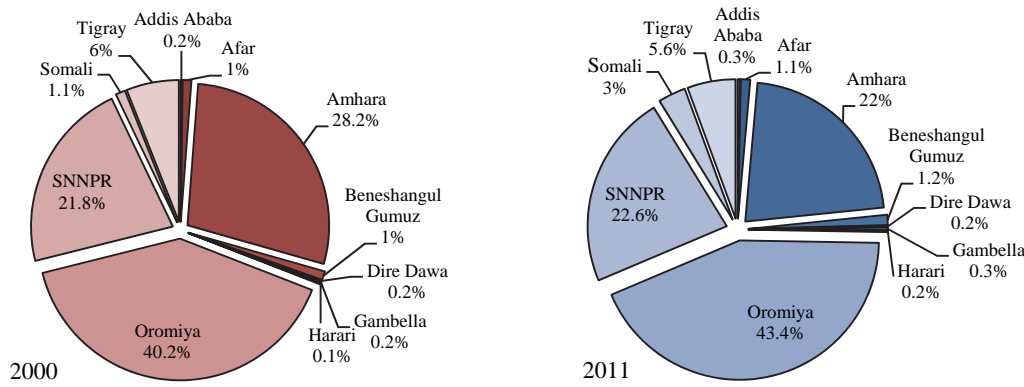
Changes in the adjusted deprivation headcount ratio (M_0) by other background characteristics

Adjusted deprivation headcount ratio (M_0) by type of residence

Figures 20 - 22 show the adjusted headcount ratio in 2000 and 2011 among children deprived in two to six dimensions by children's type of residence. Figure 20 shows that child deprivation is higher in rural areas compared to urban areas (2.5 times higher in 2000 and 2.4 times higher in 2011) pointing at the inequalities between children from urban and rural areas. Over time, deprivation in rural areas has decreased by 15 per cent while in urban areas only by 11 per cent in relative terms. When decomposing the national adjusted headcount ratio by type of residence (see Figure 21), it is clear that children from rural areas contribute most to the deprivation index. This is because the number of multidimensionally deprived children and their intensity of deprivation are higher in rural areas, and the population size in rural areas is larger compared to urban areas (87% vs. 13% of the total child population in 2011: See Annex 6 for the population distribution by year and sub-group).

Figure 20 Adjusted deprivation ratio (M_0) by area among children deprived in 2-6 dimensions

Rural areas
- 0.78 (2000)
- 0.66 (2011)

Urban areas
- 0.31 (2000)
- 0.28 (2011)

■ 2000
■ 2011
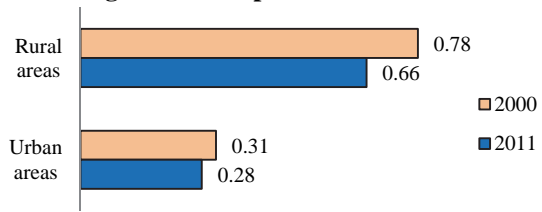
Figure 21 Percentage contribution of each area to the national adjusted deprivation ratio (M_0)

4%
96%
□ Rural areas ■ Urban areas
2000

6%
94%
■ Rural areas □ Urban areas
2011
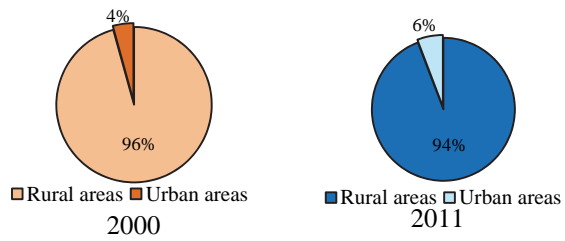
Decomposition of the adjusted headcount ratio by dimension (Figure 22) shows that in rural areas, the sanitation, water, and housing deprivations contribute the most, each contributing about twenty per cent to the total deprivation ratio of rural areas. No significant changes can be observed between 2000 and 2011. In urban areas, the three main sectors dominating the total deprivation ratio in 2000 were health, housing and water. By 2011, the sanitation contribution share to the urban deprivation ratio had increased considerably (almost doubled), while the contribution of the water dimension dropped due to a significant decrease in the deprivation rates in the water dimension. The health dimension in urban areas has a higher contribution in 2011 compared to 2000 due to a smaller decrease in the health deprivation rate over the years compared to the deprivation decrease in most other dimensions.

Figure 22 Percentage contribution of each dimension to the adjusted deprivation ratio (M_0) by area
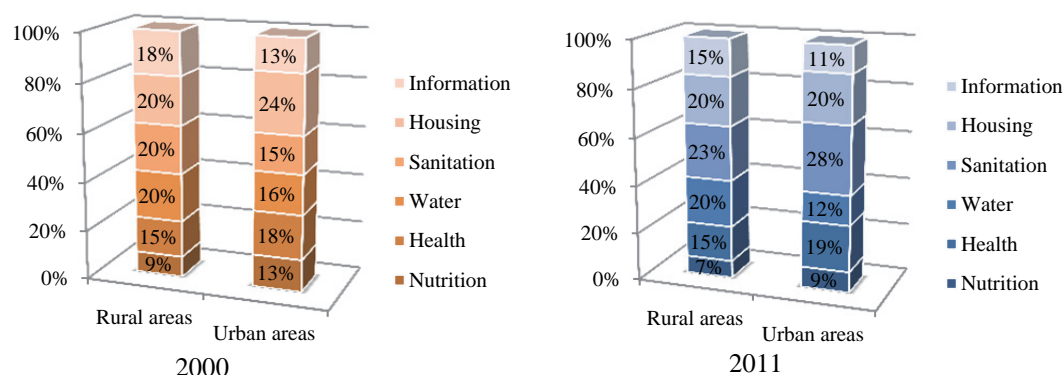
Adjusted deprivation headcount ratio (M_0) by other sub-groups

Figure 23 confirms the results found in the previous sections regarding disparities among children. The deprivation ratio for children living in urban areas differs significantly depending on the relative wealth of their households, while in rural areas the difference between wealthiest and poorest households regarding child deprivation is smaller. Also, differences in child deprivation ratios can be observed when comparing children living in households with three or less children and those in households with more than three children. Mothers' educational attainment shows large disparities: the child deprivation ratio is almost double for children whose mothers have only primary education when compared to those whose mothers have obtained secondary school education. Large disparities can also be observed when comparing children living with mothers who had a skilled attendant when giving birth and those without a skilled attendant, the latter group having a higher child deprivation ratio. As already observed, a vast majority (93%) of these children live in rural areas. Also, the stunted children have a significantly higher multidimensional deprivation ratio compared to the children who are not stunted. Lastly, the adjusted deprivation headcount is higher among children living in households where at least one child under-five has died over the last five years compared to those where no under-five child mortality has been observed (at a 90% significance level). All the other results are statistically significant at a 99% level except for infant feeding where no differences can be observed. See also Annex 13 for results. For more details about the composition of these sub-groups, see footnotes 13, 14, and 17, as well as Annex 6.

Figure 23 Adjusted deprivation ratio (M_0) by sub-group among children deprived in 2-6 dimensions
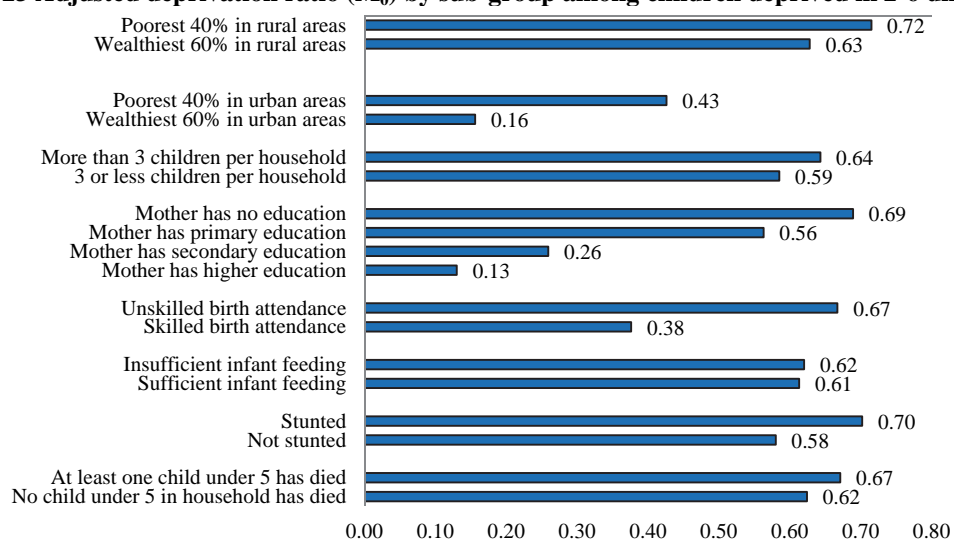
5. DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

States that ratify the Convention on the Rights of the Child agree that children have the right to survival, development, protection and participation and that they will do all they can progressively to realize those rights. The Ethiopian state ratified the CRC in 1991. This analysis measures child deprivation for the under-five child population in Ethiopia, using a number of dimensions that affect child well-being and correspond to the CRC rights. The dimensions are composed of indicators from the series of three Ethiopian Demographic and Health Surveys (EDHS 2000, 2005 and 2011). The analysis applies a child-centred multidimensional approach for measuring child poverty, recognizing that children's needs are age-specific and multidimensional. It has employed Multiple Overlapping Deprivation Analysis (MODA), a comprehensive approach to the multidimensional measurement of child poverty that builds on previous contributions comprising single deprivation analysis (deprivation ratios by sector) and multidimensional analysis (deprivation count and distribution, deprivation overlap analysis, and multidimensional deprivation ratios), emphasizing the benefits of using a combination of various approaches to complement the measurement of child poverty. Use of the data from the three EDHS' has also allowed the study of trends in the multidimensional deprivation ratios and changes in sub-group contribution to the national child deprivation level between 2000 and 2011.

The single deprivation analysis provides an analysis of each sector observing trends from 2000 to 2011. Results show that among all the children below the age of five in 2011, the percentage of deprived children in sanitation, water, and housing was more than 70 per cent, while 64 per cent were deprived in health and 32 per cent in nutrition. There has been a decline in deprivation rates since 2000 in all dimensions except sanitation. The decline ranges from 15 to 28 per cent in relative terms, with the highest deprivation drop in the percentage of children deprived in nutrition and information. Deprivation rates by sub-group show that children living in rural areas are significantly more deprived than urban children in all the dimensions analysed, especially in information, water, and housing. For children living in rural areas the relative wealth of their households does not determine their deprivation level. In contrast, in urban areas the deprivation levels vary considerably depending on whether the children belong to the poorest 40% or the wealthiest 60% of households. This reflects the gap between urban and rural areas in the supply of basic services. Also, children living in households that have experienced under-five child mortality over the last 5 years have higher deprivation rates in water, sanitation and housing, compared to households where no child under the age of five has died.

The percentage of children deprived in two or more out of a total of six dimensions has decreased only marginally. In 2011, almost all children (94 per cent) experienced at least two deprivations, and the majority of children experienced three, four, or five deprivations at a time. Over the past decade, the proportion of children with no deprivations has increased by only one percentage point; only 2 per cent of all children did not experience any of the six deprivations studied in 2011. The distribution of deprivations, however, varies considerably depending on children's background characteristics.
The overlap analysis reveals that the majority of children suffer from several deprivations at a time.

At a national level none of the dimensions analysed is a unique issue that does not have a great deal of overlap with other sectors. In 2011, the percentage of children deprived only in any one of the dimensions and not suffering from any other deprivation at a time ranged from 0.2% in nutrition to 2.3% in sanitation, while the percentage of children deprived in these dimensions ranged from 27% in nutrition to 87% in sanitation. At a regional level, on the other hand, the level of deprivation overlap varies considerably. As an example, the overlap of nutrition and health deprivations in Tigray and Amhara shows that while in both regions, the percentage of underweight and/or wasted children in 2011 was similar (32 and 30 per cent), the percentage of the malnourished children who were also deprived of access to basic health care services was three times higher in Amhara compared to Tigray.[20] The overlap analysis implies that regions might want to think about varying the degree of emphasis they give to different sectors, and that different entry points for interventions may be needed.

In this study, insights into child poverty are derived not only by counting the deprived but also by looking at their deprivation intensity. Even though the multidimensional deprivation rates did not decrease substantially, the deprivation intensity among the deprived has decreased over the ten years. In 2000, children were on average deprived in 4.5 out of the six dimensions analysed, while in 2011 children on average experienced 3.8 deprivations at a time. Regional ranking using the deprivation ratio and the adjusted deprivation ratio yielded different results. The differences are mainly due to the varying levels of deprivation intensity depending on the region children live in. For instance, based on the deprivation headcount ratio, Oromiya and Beneshangul Gumuz regions had the highest level of child deprivation (95 per cent of children experienced 2-6 deprivations), while when accounting also for the average deprivation intensity of the deprived, Afar had the highest level of child deprivation. This suggests that to understand child deprivation it is important to look not only at the percentage of deprived children but also at their deprivation intensity. Different actions might be necessary to alleviate children from poverty depending on their level of deprivation as they may have different characteristics. The results give incentives to work towards not only reducing the number of poor children, but to give an extra impetus to reduce the intensity of deprivations where they are greatest.

The study reveals significant disparities in multidimensional child deprivation levels between rural and urban areas and among regions. The adjusted deprivation ratio of children living in the rural areas is more than two times that of the adjusted deprivation ratio of urban areas, showing a significant inequality between rural and urban children. This multidimensional child deprivation analysis thus reveals larger disparities between rural and urban areas than shown by the HCE surveys.[21] At a regional level, the highest adjusted deprivation ratios are identified in Afar, SNNPR, Somali, and Oromiya regions, while

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[20] In 2011, the percentage of children deprived in both, nutrition and health, was 6% in Tigray and 18% in Amhara. Less than one fifth of the malnourished children in Tigray had not had access to basic health care services, while in Amhara more than a half (60%) of the malnourished children was also deprived in health.

[21] According to the HCE2010/11 survey, the proportion of the population below the monetary poverty line was 30.4% in rural areas and 25.7% in urban areas (MOFED, 2012c). Note that the results of the HCE survey are not comparable with this child deprivation analysis as the datasets, sample, and methods differ.

the lowest are in Addis Ababa, Harari and Dire Dawa.[22] Regional disparities are especially significant with regards to the deprivation intensity. In 2011, the lowest average number of deprivations was in Addis Ababa where the deprived children experienced 1.5 deprivations on average, followed by Harari and Dire Dawa, the two other regions dominated by urban areas, where children on average experienced three deprivations at a time. The highest deprivation intensity was experienced by children living in Afar, SNNPR, Somali, and Oromiya regions, where the deprived children experienced four deprivations on average.

The highest decrease in child deprivation (measured by the adjusted deprivation ratio M_0) since 2000 has occurred in Amhara, Tigray, and Beneshangul Gumuz, where the relative change of the multidimensional deprivation ratios over the ten years ranges between -23 and -15 per cent. In Dire Dawa, Gambella, and Harari regions, no statistically significant changes were observed between 2000 and 2011. Also Somali and Afar regions have not experienced any progress in terms of child deprivation reduction, although this observation may be influenced by differences in the survey coverage of these two regions[23]. Although not comparable, it is interesting to observe that the results based on the HCE surveys (MOFED, 2012c) show a substantial reduction of the monetary poverty index over time among the total population, while this study concludes that the reduction of the multidimensional deprivation ratio among children has not been substantial in most of the regions.[24]

When analysing the contribution share of each region to the national deprivation ratio based on the deprivation level and population size of the regions, the three largest contributors are Oromiya, SNNPR and Amhara regions. The percentage contribution of the first two regions has increased over the ten years while there has been a decline in the contribution of the Amhara region. The main factors for Amhara's contribution reduction to the national deprivation level are a relative decline of 23 per cent in the adjusted deprivation headcount ratio and the decline in child population as a share to the national child population. The study also shows disparities in deprivation rates and intensity based on other children's background characteristics, such as the number of children per household, mothers' education, households' wealth based on assets, and under-five child mortality in households.

Due to data limitations, only a small number of children's deprivations and children's background characteristics could be studied. For example, the situation of the most vulnerable groups of children (i.e., orphans, adopted children, and homeless children) could not be observed as these groups are not captured by the DHS surveys, or the sample size is too small for an in-depth analysis.

The results presented herein give pointers to the federal and regional governments regarding where they should invest more heavily if they want to accelerate progress towards the elimination of deprivations for children. As the degree of deprivation varies by region the results also give an indication of how regional budget allocations might vary by region.

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[22] Ranking based on MOFED's monetary poverty analysis using the HCE survey (considering the total population) gives the following results: in 2010/11, Harari had the lowest monetary poverty headcount index (11%) followed by Addis Ababa and Dire Dawa (28%), while the highest monetary poverty index was in Afar (36%), Somali (33%), Gambella (32%), and Tigray (32%) regions (MOFED, 2012c). Note that the results of the HCE survey are not comparable with this child deprivation analysis as the datasets, sample, and methods differ.

[23] The EDHS 2011 had a substantial increase of geographic coverage for the Afar and Somali regions compared to that of EDHS 2000, covering also the more rural largely pastoralist areas.

[24] Findings based on MOFED's monetary poverty analysis using the HCE surveys show that monetary poverty decreased by 33% at a national level (poverty headcount index was 44% in 1999/2000 and 29.6% in 2010/11), ranging from a relative decrease of 13% in Somali and 15% in Dire Dawa to 48% in Tigray and 57% in Harari (MOFED, 2012c). Results are not comparable as this deprivation analysis is based on the EDHS and refers only to children below age five, while the HCE surveys use a different methodology and refer to the total population.

The study also gives pointers for the draft child policy, strategy and plan of action. The strategy for implementing the policy could take cognisance of how multiple deprivations vary by region and by socio-economic characteristics, and make suggestions for how investments could vary from one region to the other with a view to reaching an overall national development strategy that takes into account more closely the current inequalities in the realisation of rights for children across the country. The results of this study should give policy incentives to work towards not only reducing the number of poor children, but to reducing the intensity of deprivations from which they suffer. We recommend studying in more depth how the different sectoral deprivations overlap by region and affect other sub-groups of children to assist in finding entry points to address several deprivations at a time.

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Annexes

Annex 1 International definitions applied for indicator and threshold choice

WATER
Access to improved water source
WHO: Improved water sources include household connections, public standpipes, boreholes, protected dug wells, protected springs, and rainwater collections. Unimproved water sources are unprotected wells, unprotected springs, vendor-provided water, bottled water (unless water for other uses is available from an improved source) and tanker truck-provided water'' (WHO & UNICEF, 2006)
Distance to water source
WHO: Reasonable access to water source is defined as the availability of at least 20 litres per person per day from a source within one km of the user's dwelling (WHO& UNICEF, 2006), or 30 minutes of total collection time (WHO, 2003)

SANITATION
Access to improved sanitation
WHO: Improved sanitation includes connection to public sewers, connection to septic systems, pour-flush latrines, simple pit latrines and ventilated improved pit latrines. Not considered as improved sanitation are: Service or bucket latrines (where excreta are manually removed), public latrines, and open latrines. (WHO& UNICEF, 2006)
MDG 7, Target 10: Access to improved sanitation refers to access to facilities, that hygienically separate human excreta from human, animal and insect contact. Facilities such as sewers or septic tanks, poor-flush latrines and simple pit or ventilated improved pit latrines are assumed to be adequate (UN MDG, 2003, p. 66)

HOUSING
Overcrowding
UN-HABITAT: Living with 4 or more people in one room increases the risk of loss of dignity, infectious diseases and domestic violence. Children's development may suffer through being unable to do homework in a quiet space, poor sleep, illness, abuse and violence (UN HABITAT, 2007)
Habitat Agenda Goals, Indicator 2: "Overcrowding is a key indicator measuring the adequacy of the basic human need for shelter. A house is considered to provide a sufficient living space if three or less people share the same room. Total number of rooms includes bedrooms, dining rooms, living rooms, studies, habitable attics, servants' room, kitchen and other separate spaces intended for dwelling purposes." (UN HABITAT, 2004, p. 12)
UN-HABITAT definition of crowding is adjusted by increasing the threshold from *"more than three"* to *"more than four"* people per room, since the available indicator in the EDHS data refers to sleeping rooms only.
Roof and floor material
WHO: Floor and roof are considered as crucial in the housing domain since they serve as a climate protection function: home is a shelter to protect from weather extremes such as heat and cold, but also wind and rain (WHO, 2010). *Habitat Agenda Goals, Indicator 1:* A housing structure is considered durable when certain strong building materials are used for roof, walls and floor. The definition of a 'durable' housing is that built on a non-hazardous location and having a structure permanent and adequate enough to protect its inhabitants from the extremes of climatic conditions such as rain, heat, cold, humidity (UN HABITAT, 2004, p.11)

INFORMATION
Availability of information sources
CRC, Article 17: "States Parties recognize the important function performed by the mass media and shall ensure that the child has access to information and material from a diversity of national and international sources, especially those aimed at the promotion of his or her social, spiritual and moral wellbeing and physical and mental health." (CRC, 1989)
MDG 8, Target 18: "In cooperation with the private sector, make available the benefits of new technologies, especially information and communications." (UN MDG, 2003, p. 90-91)
In this analysis, it is assumed that not having access to any source of information has a negative effect on the child's wellbeing. Newspapers, radio and TV serve as households' sources of information regarding health, nutrition, and wash initiatives, e.g., immunization, how to treat diarrhoea, hand washing benefits, where to get food supplements, prevention of illnesses, and so forth.

NUTRITIONAL OUTCOME
Weight for height
MDG 1, target 2: "Low weight for height or wasting defined as below minus 2 standard deviations from the median weight for height of the reference population; indicates a recent and severe process of weight loss, often associated with acute starvation or severe disease." (UN MDG, 2003)
Weight for age
WHO: Low child's height for weight or underweight is defined as below -2 standard deviations from the international median.

HEALTH COVERAGE
BCG immunization
The BCG (BacilleCalmetteGuerin) vaccine is the most effective vaccine in protecting from tuberculosis. Since the BCG vaccine is given at birth or during the first month after the birth, it can be used as a proxy to measure children's access to health care services.
DPT immunization
UNICEF, WHO: "Coverage levels for the diphtheria and tetanus toxoid with pertussis vaccine (DTP) are considered to be a good indicator of health system performance." (UNICEF & WHO, 2011)
WHO: "Coverage of DPT3 by 12 months of age serves as the primary indicator of an immunization program's performance. Coverage with routinely administered vaccines is used to measure program performance and population immunity, and is assessed as the percentage of children who have received the appropriate number of doses of a recommended vaccine during their first year of life." (WHO, 2011, pp. 509-520)

Source: Compiled by De Neubourg et al (2012b)

Annex 2 Water, sanitation, and housing indicator thresholds using EDHS 2000, 2005, and 2011

Water dimension: Access to improved water source

Year	Unimproved source	Improved source
2011	32 unprotected well; 42 unprotected spring; 43 river/lake/pond/stream/dam; 61 tanker truck; 62 cart with small tank; 71 bottled water if source of non-drinking water is unimproved (i.e. any of the above)	11 piped into dwelling; 12 piped to yard/plot; 13 public tap/standpipe; 21 borehole; 31protected well; 41 protected spring; 51 rainwater; 96 other; 71 bottled water if source of non-drinking water is improved (i.e. any of the above)
2005	21 unprotected well; 22 unprotected spring; 41 surface water (river/dam/lake/pond/stream/canal/irrigation channel); 61 tanker truck; 71 bottled water if source of non-drinking water is unimproved (i.e. any of the above)	11 piped in dwelling; 12 piped into compound; 13 piped outside compound; 31 tube well or borehole; 32 protected well; 33 protected spring; 51 rainwater; 71 bottled water if source of non-drinking water is improved (i.e. any of the above); 96 other
2000	21 open well; 22 open spring; 31 river; 32 pond/lake/dam	11 piped into dwelling; 12 piped into compound; 13 piped outside compound; 23 covered well; 24 covered spring; 41 rainwater; 96 other

Sanitation dimension: access to improved sanitation

Year	Unimproved toilet type	Improved toilet type
2011	14 flush to somewhere else; 23 pit latrine without slab/ open pit; 31 no facility/ bush/ field; 42 bucket toilet; 43 hanging toilet/hanging latrine	11flush toilet to piped sewer system; 12 flush to septic tank; 13 flush to pit latrine; 15 flush, don't know where; 21 ventilated improved pit latrine; 22 pit latrine with slab; 41 composting toilet; 96 other
2005	14 flush to somewhere else; 23 pit latrine without slab / open pit; 25 bucket toilet; 26 hanging toilet / hanging latrine; 31 no facility / bush / field	11 flush to piped sewer system; 12 flush to septic tank; 13 flush to pit latrine; 15 flush, don't know where; 21 ventilated improved pit latrine; 22 pit latrine with slab; 24 composting toilet; 96 other
2000	31 no facility, bush, field	11 Flush toilet; 21 traditional pit toilet ; 22 ventilated improved pit latrine

Housing dimension: roof and floor material

Year	Roof		Floor	
	Unimproved	Improved	Unimproved	Improved
2011	11 no roof; 12 thatch/ leaf/ mud	21 rustic mat/plastic sheets; 22 reed/bamboo; 23 wood planks; 24 cardboard; 31 corrugated iron/metal; 32 wood; 33 asbestos/cement fiber; 34 cement/concrete; 35 roofing shingles; 96 other	11 earth/sand; 12 dung	21 wood planks; 22 palm, bamboo; 31 parquet or polished wood; 32 vinyl or asphalt strips; 33 ceramic tiles; 34 cement; 35 carpet; 96 other
2005	11 thatch/ leaf	21 rustic mat / plastic sheets; 22 reed / bamboo; 23 wood planks; 31 corrugated iron; 32 wood; 33 calamine / cement fiber; 35 cement / concrete; 36 roofing shingles; 96 other	11 earth/sand; 12 dung	21wood planks; 22 reed / bamboo; 31parquet or polished wood; 32 vinyl; 33 ceramic tiles; 34cement / bricks; 35 carpet; 96 other
2000	21 wood and mud; 22 thatch	23 reed or bamboo; 24 plastic sheet; 25; 31 corrugated iron; 32 cement or concrete; 96 other	11 earth, sand; 12 dung	21 wood planks; 22 reed, bamboo; 31 parquet or polished wood; 32 vinyl sheets, tiles; 33 cement; 34 cement tiles, brick; 35 carpet; 96 other

Annex 3 Composition of the asset index, based on the wealth index

Variables from the wealth index that are used for constructing the asset index	Variables used for the wealth index but not for the asset index
Electricity; radio, television; bicycle; motorcycle/scooter; car/truck; telephone; electric mitad; kerosene lamp/pressure lamp; bed/table; crop land; cattle/camels; horse/ mule/donkey; sheep/goats; and the categories for cooking fuel.	Number of members per sleeping room; all the categories for drinking water source; all the categories for toilet type; all the categories for principal floor type in dwelling; all the categories for roof type; if household works own or family's agric. land; own house (n/a for EDHS 2005 & 2011); cash crops (n/a for EDHS 2005 & 2011).

Annex 4 Data availability: percentage of missing values per indicator and dimension

Dimensions	Indicators	EDHS 2000	EDHS 2005	EDHS 2011
Nutrition	Weight for age (underweight)	11.5%	56.8%	13.9%
	Weight for height (wasting)	13.6%	59.2%	15.7%
	Dimension level	11.4%	56.8%	13.9%
Health	DPT immunization (12-59 months)	12.8%	11.4%	13.6%
	BCG immunization (1-59 months)	10.6%	9.2%	11.0%
	Dimension level (1-59 months)	10.5%	9.1%	11.0%
Information	Availability of information devices	0.0%	0.0%	0.0%
	Dimension level	0.0%	0.0%	0.0%
Water	Access to improved water source	0.0%	0.0%	0.1%
	Distance to water source	2.1%	0.0%	0.0%
	Dimension level	0.0%	0.0%	0.0%
Sanitation	Access to improved sanitation	0.0%	0.0%	0.0%
	Dimension level	0.0%	0.0%	0.0%
Housing	Overcrowding	0.1%	0.8%	0.2%
	Roof & floor material	0.0%	0.1%	0.0%
	Dimension level	0.0%	0.0%	0.0%

Note: Calculations are based on the sample of children aged 0-59 months, unless otherwise indicated.

Annex 5 Sensitivity analysis regarding the treatment of missing values

EDHS 2000	No. of dimensions children are deprived in	Original: missing dimension as "non-deprived"	Re-define missing dimension as "deprived"	Drop children with more than 1 missing dimension
Deprivation headcount ratio (H, %)	1-6	98.6	98.9	98.7
	2-6	95.4	96.1	95.6
	3-6	91.3	92.6	92.0
	4-6	82.1	85.1	84.1
	5-6	56.2	65.4	62.7
Average intensity across the deprived (A, %)	1-6	75.0	78.5	77.0
	2-6	77.0	80.3	78.9
	3-6	79.0	82.1	80.7
	4-6	82.2	84.9	83.6
	5-6	89.4	90.4	89.4
Adjusted deprivation headcount ratio (M_0)	1-6	0.74	0.78	0.76
	2-6	0.73	0.77	0.75
	3-6	0.72	0.76	0.74
	4-6	0.68	0.72	0.70
	5-6	0.50	0.59	0.56
Sample size		10103	10103	9016

EDHS 2011	No. of dimensions children are deprived in	Original: missing dimension as "non-deprived"	Re-define missing dimension as "deprived"	Drop children with more than 1 missing dimension
Deprivation headcount ratio (H, %)	1-6	98.1	98.6	98.3
	2-6	93.9	95.2	94.3
	3-6	84.0	87.1	85.5
	4-6	62.4	68.9	65.6
	5-6	33.0	41.8	37.0
Average intensity across the deprived (A, %)	1-6	64.5	68.3	66.1
	2-6	66.6	70.2	68.2
	3-6	70.5	73.6	71.8
	4-6	77.6	79.8	78.4
	5-6	87.4	88.4	87.4
Adjusted deprivation headcount ratio (M_0)	1-6	0.63	0.67	0.65
	2-6	0.63	0.67	0.64
	3-6	0.59	0.64	0.61
	4-6	0.48	0.55	0.51
	5-6	0.29	0.37	0.32
Sample size		11783	11783	10310

Annex 6 Classification and distribution of children's background characteristics

Profiling variables	Sub-groups	EDHS 2000	EDHS 2011
Area	Living in rural area	90%	87%
	Living in urban area	10%	13%
Gender of household head	Female	13%	15%
	Male	87%	85%
Women's power in spending decisions (1)	Woman makes no spending decisions	1%	3%
	Woman makes spending decisions	21%	25%
	Missing values	78%	72%
Infant and young child feeding (0-23 months) (2)	Sufficient infant feeding	-	31%
	Insufficient infant feeding	-	69%
Under-5 child mortality in household	At least one child under 5 in the household has died over last 5 years	14%	8%
	No child under 5 in the household has died over last five years	79%	84%
	Missing values	8%	8%
Number of children under 18 per household	Three or less children per household	52%	49%
	More than three children per household	48%	51%
Child's height for age (stunting) (3)	Not stunted	37%	47%
	Stunted	49%	37%
	Missing values	14%	16%
Birth attendance (4)	Skilled birth attendance	9%	11%
	Unskilled birth attendance	81%	78%
	Missing values	10%	11%
Asset index in urban areas	Poorest 40% in urban areas	46%	47%
	Wealthiest 60% in urban areas	53%	53%
Asset index in rural areas	Poorest 40% in rural areas	43%	40%
	Wealthiest 60% in rural areas	57%	59%
Mother's education	Mother has no education	74%	57%
	Mother has primary education	16%	33%
	Mother has secondary education	5%	3%
	Mother has higher education	0%	2%
	Missing values	5%	6%
Child living with parents or not	Living with at least one parent	96%	97%
	Not living with parents	4%	3%
	Orphan	0%	0%
Relationship to the household head	Son or daughter	90%	90%
	Adopted or foster child	1%	0%
	Grandchild	7%	8%
	Missing values	2%	2%

Regions	Addis Ababa	1.5%	2.0%
	Afar	1.0%	1.0%
	Amhara	26.2%	22.1%
	BeneshangulGumuz	1.0%	1.2%
	DireDawa	0.3%	0.3%
	Gambella	0.2%	0.3%
	Harari	0.2%	0.3%
	Oromiya	40.6%	41.9%
	SNNPR	21.3%	21.5%
	Somali	1.2%	3.0%
	Tigray	6.5%	6.5%

Note: distribution is calculated based on the sample of children aged 0-59 months, unless otherwise indicated; missing values are 0% unless otherwise indicated.

(1)The category "Woman makes spending decisions" includes children living with women who decide alone or together with their husband/partner on how to spend money. The other category includes children living with women whose husband or partner or someone else decides on how to spend money.

(2) Insufficient infant and young child feeding: child under 6 months not exclusively breastfed; child between 6-23 months living in a household where children between 6-23 months are not provided with the minimum dietary diversity or minimum meal frequency in the last 24 hours (WHO, 2008).

(3)Child's height for age is calculated using the WHO standards (2006): a child is stunted if his/her height for age is below minus two standard deviations from the international median.

(4)Skilled birth attendance: doctor; nurse/midwife; other health personnel; unskilled birth attendance: health extension worker; trained/untrained traditional birth attendant; voluntary community health worker; relative/friend; no one.

Annex 7 Changes in the national deprivation headcount rates by indicator and dimension, 2000-2011

	Deprivation headcount 2000	Deprivation headcount 2011	Relative difference (%) 2000-2011	
Underweight	42%	29%	-31%	***
Wasting	13%	10%	-23%	***
Nutrition	*44%*	*32%*	*-27%*	***
BCG immunization	55%	38%	-31%	***
DPT3 immunization	74%	63%	-15%	***
Health	*76%*	*64%*	*-15%*	***
Water source	79%	53%	-32%	***
Distance to water	34%	41%	18%	**
Water	*86%*	*71%*	*-17%*	***
Toilet type/Sanitation	*86%*	*87%*	*2%*	
Overcrowding	60%	54%	-10%	***
Floor and roof	75%	54%	-28%	***
Housing	*89%*	*76%*	*-15%*	***
Information	*77%*	*56%*	*-28%*	***

Source: Own calculations based on the EDHS 2000 and 2011.Note: *** statistically significant at 99% level, ** statistically significant at 95% level, * statistically significant at 90% level; calculated using the two-sample t-test hypothesis for the difference between the two time periods, taking into account the complex sample design of the surveys.

Annex 8 Changes in the deprivation headcount rates by dimension at a regional level, 2000-2011

Regions	Deprivation headcount (%) 2000	Deprivation headcount (%) 2011	Relative change (%) 2000-2011		Deprivation headcount (%) 2000	Deprivation headcount (%) 2011	Relative change (%) 2000-2011	
		Nutrition				Health		
Addis Ababa	15.6	11.1	-29%	**	11.9	8.7	-27%	
Afar	47.9	47.6	-1%		96.7	87.8	-9%	***
Amhara	47.3	35.7	-25%	***	75.6	61.8	-18%	***
Beneshangul Gumuz	42.4	34.8	-18%	*	83	60.7	-27%	***
Dire Dawa	31.2	31.2	0%		46.7	30.4	-35%	**
Gambella	41.2	25.8	-37%	***	82.7	73.9	-11%	
Harari	23.6	25.6	8%		44.3	46.5	5%	
Oromiya	39.3	29.7	-24%	***	79.5	71.4	-10%	**
SNNPR	49.8	30.1	-40%	***	82.6	65.6	-21%	***
Somali	47.2	39.4	-17%	*	74.5	80.5	8%	
Tigray	43.8	37.1	-15%	**	41.9	23.9	-43%	***
		Water				Sanitation		
Addis Ababa	11.9	8.6	-28%		15.7	31.7	102%	***
Afar	91.3	79.8	-13%		94.3	89.9	-5%	
Amhara	89.9	63	-30%	***	96.2	84.1	-13%	***
Beneshangul Gumuz	83.6	53.9	-36%	***	66.8	90.9	36%	***
Dire Dawa	31.1	50.5	62%	*	47	62.6	33%	
Gambella	75	47.6	-37%	***	67.2	83.9	25%	***
Harari	63.4	48.7	-23%		71	72.6	2%	
Oromiya	88.7	77.2	-13%	***	84.3	91.4	8%	**
SNNPR	87	77.5	-11%	**	82.6	92.2	12%	***
Somali	86.2	82.9	-4%		73.8	68.6	-7%	
Tigray	77.4	59.7	-23%	**	89.3	82.3	-8%	
		Housing				Information		
Addis Ababa	38.8	24.5	-37%	***	10.3	4.6	-55%	**
Afar	78.2	79	1%		79.8	59.3	-26%	***
Amhara	91.9	74.5	-19%	***	88.3	64.4	-27%	***
Beneshangul Gumuz	95	87	-8%	**	76.4	57.6	-25%	***
Dire Dawa	66.1	58.1	-12%		47.8	50.5	6%	
Gambella	81.2	81.4	0%		71	61.8	-13%	
Harari	65.2	55	-16%		48	33.1	-31%	**
Oromiya	88.6	75.3	-15%	***	72.8	51.5	-29%	***
SNNPR	90.2	80.5	-11%	***	76.8	59.2	-23%	***
Somali	83.5	79.3	-5%		69.6	59.9	-14%	
Tigray	89.8	76.1	-15%	***	76.4	52.2	-32%	***

Source: Own calculations based on the EDHS 2000 and 2011. Note: *** statistically significant at 99% level, ** statistically significant at 95% level, * statistically significant at 90% level; calculated using the two-sample t-test hypothesis for the difference between the two time periods, taking into account the complex sample design of the surveys.

The trends for Somali and Afar regions should be interpreted with caution as the sample of 2011 for these two regions is larger than that of 2000. In the 2000 EDHS, only three of the five zones of the Afar region (zones 1, 3, and 5) and only three of the nine zones in the Somali region (Shinile, Jijiga and Liben) were included. In the 2011 EDHS, all five zones of the Afar region and six out of the nine zones of the Somali region (adding Afder, Gode and Warder) were covered.

Annex 9 Deprivation headcount rates by dimension according to children's characteristics, 2011

		Nutrition	Health	Water	Sanitation	Housing	Information
Area	Rural	34%	67%	79%	91%	81%	61%
	Urban	20%	41%	22%	59%	40%	20%
		***	***	***	***	***	***
Number of children below 18 in household	Three or less children	31%	61%	67%	85%	69%	57%
	More than three children	32%	67%	76%	89%	82%	55%
			***	***	***	***	
Gender of household head	Male as household head	32%	64%	72%	88%	76%	55%
	Female as household head	30%	63%	68%	86%	71%	59%
				*		**	*
Mother's education	No education	34%	70%	77%	91%	82%	68%
	Primary education	30%	58%	69%	86%	71%	40%
	Secondary education	17%	36%	29%	57%	39%	6%
	Higher education	9%	30%	12%	39%	24%	1%
		***	***	***	***	***	***
Women's power in spending decisions	No spending decisions	29%	71%	66%	90%	75%	56%
	Make spending decisions	31%	60%	67%	87%	74%	46%
			**				**
Infant and young child feeding practices	Insufficient infant feeding	30%	58%	71%	87%	75%	57%
	Sufficient infant feeding	21%	68%	73%	87%	76%	53%
		***	***				
Skilled birth attendance	Unskilled birth attendance	33%	67%	76%	90%	79%	59%
	Skilled birth attendance	20%	44%	39%	66%	50%	28%
		***	***	***	***	***	***
Under-five child mortality in household	At least one child has died	33%	67%	77%	92%	82%	60%
	No child under 5 has died	32%	64%	71%	87%	75%	55%
				*	**	**	
Asset index in rural areas	Poorest 40% in rural areas	35%	68%	82%	93%	86%	78%
	Wealthiest 60% in rural areas	32%	66%	76%	90%	77%	49%
		*		***	**	***	***
Asset index in urban areas	Poorest 40% in urban areas	27%	54%	35%	77%	50%	36%
	Wealthiest 60% in urban areas	13%	29%	11%	43%	31%	5%
		***	***	***	***	***	***
Child's height for age (stunting)	Not stunted	14%	62%	70%	86%	72%	52%
	Stunted	54%	66%	73%	90%	81%	60%
		***	***	*	***	***	***

Note: *** statistically significant at 99% level, ** statistically significant at 95% level, * statistically significant at 90% level

Annex 10 Changes in multidimensional deprivation ratios (H, A, and M$_0$)

Number of deprivations experienced	Deprivation headcount (H, %)				Average deprivation intensity (A)				Adjusted deprivation headcount (M)			
	2000	2011	Relative change (%) 2000-2011		2000	2011	Relative change (%) 2000-2011		2000	2011	Relative change (%) 2000-2011	
1-6	99%	98%	-1%	**	4.5	3.8	-15%	***	0.74	0.62	-16%	***
2-6	95%	93%	-3%	**	4.6	4.0	-14%	***	0.73	0.61	-16%	***
3-6	91%	82%	-10%	***	4.7	4.2	-11%	***	0.72	0.58	-20%	***
4-6	82%	61%	-26%	***	4.9	4.7	-6%	***	0.68	0.47	-30%	***
5-6	56%	32%	-43%	***	5.4	5.2	-2%	***	0.50	0.28	-44%	***

Annex 11 Changes in multidimensional deprivation ratios for children deprived in 2-6 dimensions

Regions	Deprivation headcount (H, %)			Average deprivation intensity (A)			Adjusted deprivation headcount (M)		
	2000	2011	Relative change (%) 2000-2011	2000	2011	Relative change (%) 2000-2011	2000	2011	Relative change (%) 2000-2011
National	95%	93%	-3%**	4.6	4.0	-14%***	0.73	0.61	-16%***
Addis Ababa	26.0%	20.2%	-22%	2.4	2.4	2%	0.10	0.08	-20%
Afar	98.7%	93.9%	-5%**	4.7	4.5	-5%	0.78	0.71	-9%*
Amhara	98.1%	94.1%	-4%**	4.8	3.9	-20%***	0.79	0.61	-23%***
Beneshangul G.	96.8%	95.2%	-2%	4.5	3.8	-14%***	0.72	0.61	-15%***
Dire Dawa	63.6%	69.5%	9%	3.7	3.7	-1%	0.40	0.43	7%
Gambella	92.8%	92.0%	-1%	4.3	3.8	-11%**	0.66	0.59	-11%
Harari	75.3%	71.9%	-5%	3.9	3.5	-10%**	0.49	0.42	-14%
Oromiya	96.2%	95.1%	-1%	4.5	4.0	-12%***	0.73	0.64	-12%***
SNNPR	96.6%	94.7%	-2%	4.7	4.1	-12%***	0.75	0.65	-13%***
Somali	93.3%	93.9%	1%	4.4	4.1	-7%	0.68	0.64	-6%
Tigray	94.0%	89.6%	-5%	4.3	3.6	-18%***	0.68	0.53	-22%***

Note: *** statistically significant at 99% level, ** statistically significant at 95% level, * statistically significant at 90% level

Annex 12 Deprivation distribution according to children's characteristics, 2011

		Number of dimensions children are deprived in						
		0	1	2	3	4	5	6
National		2%	5%	10%	22%	29%	24%	8%
Area	Rural	0%	2%	8%	22%	32%	27%	9%
	Urban	17%	24%	25%	22%	9%	3%	0%
No. of children under 18 per household	Three or less children	4%	7%	12%	21%	27%	22%	8%
	More than three children	1%	3%	9%	23%	31%	26%	8%
Gender of household head	Male	2%	5%	10%	22%	28%	25%	8%
	Female	4%	7%	11%	20%	31%	21%	8%
Mother's education	No or primary education	1%	4%	9%	21%	29%	27%	9%
	Secondary or higher	27%	27%	23%	14%	7%	2%	0%
Women's power in spending decisions	No spending decisions	2%	4%	9%	18%	36%	23%	8%
	Make spending decisions	3%	7%	11%	23%	26%	22%	8%
Infant and young child feeding practices	Insufficient infant feeding	3%	5%	10%	20%	27%	27%	8%
	Sufficient infant feeding	3%	5%	9%	21%	30%	27%	6%
Skilled birth attendance	Unskilled birth attendance	0%	2%	9%	20%	30%	30%	10%
	Skilled birth attendance	15%	20%	15%	21%	17%	9%	3%
Under-5 child mortality in household	At least one child has died	1%	3%	6%	19%	30%	32%	9%
	No child under 5 has died	2%	5%	10%	21%	28%	26%	9%
Asset index in rural areas	Poorest 40%: rural areas	0%	1%	4%	16%	33%	34%	11%
	Wealthiest 60%: rural areas	1%	3%	11%	25%	31%	23%	7%
Asset index in urban areas	Poorest 40%: urban areas	1%	14%	28%	34%	16%	6%	0%
	Wealthiest 60%: urban areas	31%	32%	22%	12%	3%	0%	0%
Child's height for age (stunting)	Not stunted	3%	6%	12%	23%	29%	24%	4%
	Stunted	1%	2%	7%	17%	26%	32%	16%

Annex 13 Multidimensional deprivation ratio (M_0) in 2000 and 2011 by background characteristics

Sub-groups		2000					2011				
		Number of dimensions children are deprived in									
		1-6	2-6	3-6	4-6	5-6	1-6	2-6	3-6	4-6	5-6
National		0.74	0.73	0.72	0.68	0.50	0.62	0.61	0.58	0.47	0.28
Regions	Addis Ababa	0.17	0.10	0.04	0.02	n/a	0.14	0.08	0.03	0.01	0.01
	Afar	0.78	0.78	0.77	0.72	0.57	0.72	0.71	0.69	0.63	0.46
	Amhara	0.79	0.79	0.79	0.76	0.60	0.62	0.61	0.57	0.45	0.27
	Beneshangul Gumuz	0.73	0.72	0.69	0.63	0.47	0.62	0.61	0.57	0.45	0.25
	Dire Dawa	0.43	0.40	0.35	0.27	0.18	0.45	0.43	0.38	0.29	0.17
	Gambella	0.67	0.66	0.64	0.56	0.38	0.60	0.59	0.55	0.43	0.21
	Harari	0.51	0.49	0.46	0.39	0.21	0.45	0.42	0.37	0.27	0.12
	Oromiya	0.73	0.73	0.71	0.66	0.48	0.64	0.64	0.60	0.50	0.30
	SNNPR	0.76	0.75	0.74	0.69	0.52	0.65	0.65	0.62	0.52	0.31
	Somali	0.69	0.68	0.66	0.59	0.44	0.65	0.64	0.60	0.50	0.32
	Tigray	0.69	0.68	0.66	0.61	0.36	0.54	0.53	0.47	0.33	0.17
Area	Rural	0.78	0.78	0.78	0.73	0.55	0.67	0.66	0.64	0.53	0.32
	Urban	0.36	0.31	0.24	0.16	0.08	0.32	0.28	0.20	0.09	0.03
No. of children under 18 per household	Three or less children	0.73	0.72	0.71	0.66	0.48	0.60	0.59	0.55	0.44	0.26
	More than three children	0.75	0.75	0.74	0.69	0.52	0.65	0.64	0.61	0.50	0.30
Gender of household head	Male	0.75	0.74	0.73	0.69	0.51	0.63	0.62	0.59	0.48	0.29
	Female	0.69	0.68	0.66	0.61	0.43	0.60	0.59	0.55	0.45	0.25
Mother's education	No education	0.80	0.79	0.79	0.75	0.60	0.69	0.69	0.67	0.58	0.37
	Primary	0.66	0.65	0.63	0.55	0.36	0.57	0.56	0.52	0.39	0.21
	Secondary	0.36	0.31	0.24	0.16	0.09	0.30	0.26	0.19	0.09	0.03
	Higher	0.22	0.16	0.15	0.13	n/a	0.19	0.13	0.05	0.02	0.01
Infant and young child feeding practices	Insufficient infant feeding	n/a	n/a	n/a	n/a	n/a	0.63	0.62	0.59	0.49	0.31
	Sufficient infant feeding	n/a	n/a	n/a	n/a	n/a	0.62	0.61	0.58	0.48	0.28
Skilled birth attendance	Unskilled birth attendance	0.79	0.78	0.78	0.74	0.59	0.67	0.67	0.64	0.54	0.34
	Skilled birth attendance	0.51	0.48	0.44	0.37	0.25	0.41	0.38	0.33	0.22	0.11
Under-5 child mortality in household	At least one child has died	0.77	0.77	0.76	0.73	0.54	0.68	0.67	0.65	0.56	0.36
	No child under 5 has died	0.75	0.75	0.73	0.69	0.54	0.63	0.62	0.59	0.49	0.30
Asset index in rural areas	Poorest 40%	0.80	0.80	0.79	0.76	0.59	0.72	0.72	0.70	0.62	0.40
	Wealthiest 60%	0.77	0.77	0.76	0.72	0.52	0.63	0.63	0.59	0.47	0.26
Asset index in urban areas	Poorest 40%	0.50	0.48	0.42	0.29	0.15	0.45	0.43	0.33	0.16	0.06
	Wealthiest 60%	0.23	0.17	0.08	0.04	0.01	0.21	0.16	0.08	0.03	0.00
Child's height for age (stunting)	Stunted	0.81	0.81	0.80	0.77	0.65	0.71	0.70	0.68	0.60	0.42
	Not stunted	0.69	0.69	0.67	0.62	0.44	0.59	0.58	0.54	0.43	0.23