Multidimensional Poverty in Botswana: Leaving No One Behind

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ABSTRACT

The Leave No One Behind (LNOB) principle is at the core of the 2030 Agenda for sustainable development. It acknowledges that poverty is multidimensional and that it should be examined at the individual level. Notwithstanding this, poverty measurement remains heavily premised on monetary measurement and household-level multidimensional poverty measurement. However, monetary as well as household-level multidimensional poverty measures are likely to produce a biased assessment of individual poverty leading to an underestimation of the poverty levels of society. Using Botswana as a case study, the broad purpose of this thesis is to measure and analyse poverty in accordance with the LNOB principle. The objectives of my thesis are to (i) construct an individual-level multidimensional poverty measure for Botswana; (ii) examine multidimensional poverty profiles and inequality among the multidimensional poor; (iii) investigate poverty mismatch and overlaps between monetary and multidimensional poverty measures; (iv) examine targeting performance of social assistance programmes in reaching their intended beneficiaries; and (v) provide policy implications for using multidimensional poverty measure.

The thesis utilised the 2015/16 Botswana multi-topic household survey (BMTHS) collected by Statistics Botswana. The results reveal that an estimated 46.2 per cent of individuals are considered multidimensionally poor based on individual-level analysis compared to 36.5 per cent when using household-level analysis. The results also reveal that monetary and multidimensional poverty measures are distinct constructs and identify different people as poor. Concerning targeting by implementation, results reveal high inclusion and exclusion errors. Regarding the targeting performance by design, the results reveal high under-coverage rates regardless of the poverty method used. However, results show higher leakage rates for the monetary measure than the multidimensional measure. These findings have policy implications. How poverty is measured reflects how it is understood, and this can significantly influence which policies should be implemented to address it.

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DECLARATION

I hereby declare that this thesis has not been and will not be submitted in whole or in part to another University for the award of any other degree.

Signature:……

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DEDICATION

To the loving memory of my beloved mother

Rebecca Mokompane
(1949 - 2010)

I wish you were here to celebrate this achievement with me. I can imagine the smile on your face from your heavenly abode

LIST OF ACRONYMS

ADB	Asian Development Bank
AF	Alkire-Foster
AIDS	Acquired Immunodeficiency Syndrome
ALDEP	Arable Lands Development Programme
ARAP	Accelerated Rainfed Arable Programme
AUC	African Union Commission
BIDPA	Botswana Institute for Development Policy Analysis
BMI	Body Mass Index
BMTHS	Botswana Multi-Topic Household Survey
BNA	Basic Needs Approach
BOMPM	Botswana Official Monetary Poverty Measure
BPC	Botswana Power Corporation
BPEPS	Botswana Poverty Eradication Policy and Strategy
CCDF	Complementary Cumulative Distribution Function
CHBC	Community Home-Based Care
CRC	Convention on the Rights of the Child
CRPD	Convention on the Rights of Persons with Disabilities
CSI	Coping Strategy Index
CSO	Central Statistics Office
CTT	Classical Test Theory
DPP	Destitute Persons Programme
EA	Enumeration Area
EEC	European Economic Commission
EER	Exclusion Error Rate
ELCSA	Latin American and Caribbean Food Security Scale
EU	European Union
FAO	Food Agriculture Organisation
FCS	Food Consumption Score
FGT	Foster Greer Thorbecke
FIES	Food Insecurity Experience Scale
GDP	Gross Domestic Product
HDDS	Household Dietary Diversity Score
HDI	Human Development Index
HFIAP	Household Food Insecurity Access Prevalence
HFIAS	Household Food Insecurity Access Scale
HFIASS	Household Food Insecurity Access Scale Score
HHS	Household Hunger Scale
HIV	Human Immunodeficiency Virus
HLP	High-Level Panel
HRC	Human Rights Council
ICC	Item Characteristic Curve
ICT	Information and Communications Technology
IER	Inclusion Error Rate

IRT	Item Response Theory
ISPAAD	Integrated Support Programme for Arable Agriculture Development
LBDRP	Labour-Based Drought Relief Programme
LIMID	Livestock Management and Infrastructure Development
LNOB	Leave No One Behind
MCA	Multiple Correspondence Analysis
MDGs	Millennium Development Goals
MFED	Ministry of Finance and Economic Development
MLG	Ministry of Local Government
MoA	Ministry of Agriculture
MoAFS	Ministry of Agriculture and Food Security
MODA	Multiple Overlapping Deprivation Analysis
MoH	Ministry of Health
MPI	Multidimensional Poverty Index
MYESC	Ministry of Youth, Empowerment Sports and Culture
NDP	National Development Plan
NSP	Needy Student Package
NSPR	National Strategy for Poverty Reduction
OAP	Old Age Pension
OCP	Orphan Care Programme
OECD	Organisation for Economic Co-operation and Development
PCA	Principal Component Analysis
PDL	Poverty Datum Line
PEP	Poverty Eradication Programme
PPA	Participatory Poverty Assessments
PPS	Probability Proportional to Size
PWD	Persons with Disability
RADP	Remote Area Development Programme
rCSI	Reduced Coping Strategy Index
RIDS	Rural Income Distribution Survey
SAFS	Self Assessed Measure of Food Security
SB	Statistics Botswana
SDGs	Sustainable Development Goals
SE	Social Exclusion
SSA	Sub-Saharan Africa
SSU	Secondary Sampling Units
SWB	Subjective Wellbeing
UDHR	Universal Declaration of Human Rights
UN	United Nations
UNDP	United Nations Development Programme
UNESC	United Nations Economic and Social Council
UNOHCHR	United Nations Office of High Commissioner for Human Rights
UNICEF	United Nations International Children’s Emergency Fund
UR	Under-coverage Rate

USAID	United States Agency for International Development
VDC	Village Development Committee
WHO	World Health Organization
WWII	World War II Veterans Allowance
YDF	Youth Development Fund
YFF	Young Farmers Fund

CHAPTER 1: INTRODUCTION AND RATIONALE

1.1. Introduction

Poverty is multidimensional in nature, and hence its operationalisation needs measures or indices that capture and combine the various dimensions in an adequate manner that leave no one behind. The multidimensional nature of poverty has been widely recognised, not only by scholars or researchers but also by international organisations like the World Bank and the United Nations. Both the World Bank (2001) and the United Nations Development Programme (UNDP) (2010) agree that one indicator alone cannot capture the multiple aspects that constitute poverty. Scholars from different disciplines observed that concepts like poverty and deprivation have profound multidimensional manifestations, and corresponding evaluations should consider multiple dimensions of human living such as income, education, health, housing, food, assets and access to clean water. The multidimensional approach gained substantial momentum from seminal studies on the standard of living (Townsend, 1974), the basic needs approach (Streeten, 1977, 1979, 1984; Streeten et al., 1981), subjective well-being (van Praag & Ferrer-i-Carbonell, 2008), the capability approach (Sen, 1985a, 1985b, 1993, 1999) and social exclusion (Gordon et al., 2000; Levitas et al., 2007; Atkinson et al., 2010).

The measurement of poverty has been under scrutiny from both academics and policymakers. For many years the monetary approach using income or consumption/expenditure has been used as a proxy to measure poverty. However, there was great concern regarding the limitation and insufficiency of monetary poverty measures to capture the multiple and overlapping deprivations experienced by the poor (Sen, 1992). Monetary deprivation is one of the important dimensions of poverty but does not proxy other non-income dimensions (Alkire et al., 2017a). Therefore, to understand poverty, it is necessary to consider deprivation simultaneously in its multiple dimensions (Betti et al., 2015).

The worldwide adoption of the United Nation's Sustainable Development Goals (SDGs) in 2015, also known as the 2030 Agenda for Sustainable Development, has reinforced interest in multidimensional poverty measures (UN, 2015, 2016a). The SDGs are framed around ending absolute poverty (Alkire et al., 2015a) and recognising that poverty has

many forms and dimensions (UN, 2015). SDG 1 calls to 'end poverty in all its forms everywhere' (UN, 2015: p15). Specifically, target 1.2 of SDG 1 states that: 'by 2030, reduce at least half the proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions' (UN, 2015: p15) to leave no one behind. The Africa Agenda 2063 (henceforth Agenda 2063) also recognises poverty as one of the main challenges for Africa that needs to be eradicated (African Union Commission [AUC], 2015).[1]

Multidimensional poverty measures capture the complexity of poverty and offer a robust tool to help the government design specific policies to better target resources to those areas with specific needs. Therefore, multidimensional poverty measures are important for better policy efficiency and are vital to the achievement of the SDGs (UN, 2015). Accordingly, policies to fight poverty must also be integrated and multi-sectoral (UN, 2015). The SDGs are also premised on the concept of 'leave no one behind' (LNOB), highlighting that the fight against poverty should include everyone. It follows that policies aiming to support the fight against poverty should be supported by approaches to poverty measurement that capture its multidimensional nature and serve the notion of LNOB. Despite the rapid expansion of multidimensional poverty measurement in the last decade, conceptual and empirical linkages between the LNOB principle and multidimensional poverty measurement remain unexplored.

The LNOB principle has emerged as a central theme of the 2030 Agenda of Sustainable Development (Fukuda-Parr & Hegstad, 2018; UN, 2015) and relates closely to three important dimensions of the 2030 Agenda: poverty, inclusiveness, and inequality (UN, 2016a). The LNOB principle is seen as a central cross-cutting focus of the entire agenda, and achieving its target means all 17 SDGs goals must be met. This is spelt out in the 2030 Agenda, which states: 'As we embark on this great collective journey, we pledge that no one will be left behind. Recognising that the dignity of the human person is fundamental, we wish to see the Goals and targets met for all nations and peoples and for all segments of society. And we will endeavour to reach the furthest behind first'. (UN,

[1] Agenda 2063, adopted in 2013, is a long-term development vision entitled "The Africa We Want – The Agenda 2063". Agenda 2063 is a locally developed plan for transforming the African continent for the next fifty years (2013-2063). The Agenda contains seven aspirations and 20 goals, 39 priority areas, and 256 targets (AUC, 2015).

2015: p15). The LNOB principle sets a new transformative standard, recognising the need to move to multidimensional poverty assessment. The LNOB principle is also recognised by Agenda 2063 (AUC, 2015).

1.2. Case study context

Botswana, a landlocked country with about 2 million inhabitants, has pursued poverty reduction since independence in 1966. As a result, the country has witnessed rapid GDP growth for most of its post-independence period (Lekobane & Seleka, 2017). The country has transitioned from the poorest country at independence to the current "upper middle income" status in four decades. Botswana's economy has grown rapidly during the 1966-2008 period, with a real GDP average growth rate of 8.7 per cent per annum, making Botswana one of the fastest-growing economies (MFDP, 2010). Such impressive economic growth performance was primarily propelled by the mining sector, which has accounted for the largest shares of GDP, exports and government revenue. However, the real GDP growth rate has declined, estimated at 3 per cent in 2019 (SB, 2020). The growth was followed by declining monetary poverty from 59 per cent in 1985/86 to 47 per cent, 30.6 per cent, 19.3 per cent and 16.3 per cent in 1993/94, 2002/03, 2009/10 and 2015/16, respectively (SB, 2013a, 2018). Similarly, the proportion of people living in extreme poverty (below one dollar a day) (currently $1.90) has also been declining over time, from 23.4 per cent, 6.4 per cent and 5.8 per cent in 2002/3, 2009/10 and 2015/16 (respectively) (SB, 2018). Impressive as they are, these figures do not tell the entire story of the country's poverty situation.

Despite the significant progress in monetary poverty, Botswana has not had an equally impressive record on other key indicators such as unemployment, especially amongst the youth, rising inequalities, increasing HIV/AIDS prevalence rates, and child malnutrition. Inequality, measured by the Gini coefficient, has increased from 0.495 in 2009/10 to 0.522 in 2015/16 (SB, 2018). Unemployment rates, especially amongst the youth, continue to pose a serious challenge. The youth (aged 15-35 years) unemployment rate stood at 25.2 per cent in 2015/16, much higher than the average national rate of 17.7 per cent in the same period (SB, 2018). The unemployment rate rose steadily from 10.2 per cent in 1981 to 17.7 per cent in 2015, and it has been consistently higher for females (SB, 2016), partially explaining the higher prevalence of poverty among females than males.

Although infant and child mortality rates have dropped considerably in the last four decades (SB, 2016), HIV/AIDS infection rates continue to increase over time. Between 2008 and 2013, HIV/AIDS prevalence rate increased from 17.6 per cent to 18.5 per cent (SB, 2014).[2] Similarly, malnutrition and maternal mortality rates remain at high levels. Chronic malnutrition (stunting) and wasting stood at 30 per cent and 11.6 per cent in 2013, while the maternal mortality rate was 147 per 100,000 live births in 2012 (SB, 2016). With respect to education, Botswana's net enrolment rate in primary education increased from 90 per cent in 2003 to 96.9 per cent in 2017 (SB, 2021). Botswana's enrolment rates have been consistently below those of other upper-middle-income countries, such as Algeria, Mauritius, Namibia and South Africa (World Bank, 2015). In 2015, GNI per capita in purchasing power parity terms stood at $14,663, placing the country at rank 107 out of the world's 228 economies. This ranking is an indication that Botswana has not been successful in transforming national wealth into improvements in the well-being of its citizens.

1.3. Purpose of the thesis

The broad purpose of this thesis is to measure and analyse poverty in accordance with the LNOB principle using an individual-level multidimensional poverty measure. This thesis utilises the 2015/16 Botswana multi-topic household survey (BMTHS) collected by Statistics Botswana (SB). To the best of my knowledge, this thesis is the first to offer a conceptual and empirical exploration of linkages between LNOB and multidimensional poverty in Botswana and to analyse multidimensional poverty in Botswana at the national level. In Botswana, poverty is and has been almost exclusively measured using the monetary approach. The first attempt to measure multidimensional poverty in Botswana was in 2015 by UNICEF (de Neubourg et al., 2015). However, the study only focused on multidimensional child poverty using multiple overlapping deprivation analysis (MODA). Notably, the MODA approach does not advocate for the construction of the composite index. Its primary focus is more on overlap analysis than aggregating it into a composite index. However, during the process of writing this thesis, Botswana was included in the global MPI report, and the first global MPI estimate for Botswana was included in the 2020 Human development report. This led to the country's pilot national

[2] Botswana has the fourth highest HIV prevalence in the world, after South Africa, Lesotho and Eswatini.

study in 2021 (Republic of Botswana, 2021). However, the global MPI and pilot national estimates are based on household-level multidimensional poverty. This thesis assesses individual-level country-specific multidimensional poverty at the national level.

Therefore, the objectives of my thesis are to (i) construct an individual-level multidimensional poverty measure for Botswana in accordance with the LNOB principle; (ii) examine multidimensional poverty profiles and inequality among the multidimensional poor; (iii) investigate poverty mismatch and overlaps between monetary and multidimensional poverty measures; (iv) examine targeting performance of social assistance programmes in reaching their intended beneficiaries; and (v) provide policy implications for using a multidimensional poverty measure.

The overarching question of this thesis is: *How to measure and analyse poverty in accordance with the LNOB principle*? This question is further broken down into specific sub-questions as follows:

- *Who are those left behind or at risk of being left behind, and where do they live?*
- *What is the situation of multidimensional child poverty in Botswana, and who are those children at risk of being left behind?*
- *What are the factors contributing to poverty mismatch and overlaps between the official monetary and multidimensional poverty measures?*
- *Do social protection programmes reach those left behind*?

In answering these questions, this thesis contributes to the conceptual and methodological aspects of the study of multidimensional poverty. First, by constructing the nationally relevant and context-specific individual-level multidimensional poverty index for Botswana, this thesis makes a novel contribution to the multidimensional measurement of poverty in Botswana. Second, this thesis is timely, as it may serve as a baseline to track the progress of the implementation of the SDGs, especially the LNOB commitment and the Botswana Poverty Eradication Policy and Strategy (BPEPS), National Development Plan (NDP) 11 and Vision 2036. Third, by analysing poverty across different groups, this thesis contributes to the disaggregation of poverty statistics, which is vital for the LNOB principle. Fourth, the multidimensional individual-level poverty measure developed in this thesis offers a robust tool to help policymakers to implement nationally appropriate

specific social protection programmes to better target resources to those left behind. Last, this thesis provides policy implications of using the multidimensional approach. In sum, this thesis contributes toward a deeper understanding of poverty from a multidimensional perspective by providing a more comprehensive and better-focussed assessment of poverty and providing policy implications of using the multidimensional approach.

1.4. Structure of the thesis

The thesis is organised as follows. The next chapter (Chapter 2) presents brief literature on concepts, measurements and definitions of poverty. The chapter discusses the relative and absolute concepts of poverty. Also, the chapter presents literature on monetary and multidimensional poverty measures.

Chapter 3 presents the conceptual and theoretical framework. Specifically, the chapter deals with the operationalisation of the capability approach, especially the selection of dimensions.

Chapter 4 discusses the data sources and methodology approach used in this thesis. Specifically, the chapter discusses data sources, data preparation and cleaning, and a description of key variables used. Also, the chapter discusses the methodology and econometric regression models used in this thesis.

Chapter 5 answers the overarching research question: *How to measure and analyse poverty in accordance with the LNOB principle*? In answering this question, the chapter deals with the construction of an individual-level and country-specific multidimensional poverty measure. Specifically, the chapter addresses the unit of analysis, selection of dimensions, deprivation indicators and their respective cut-offs. Also, the chapter deals with the weighting of dimensions and tests the robustness of the index. This chapter constitutes the first attempt in Botswana and the African region to estimate the individual-level multidimensional poverty index for the whole population in line with SDG 1.2. Also, the chapter contributes to the limited literature globally concerning the use of an individual-level multidimensional poverty measure.

Chapter 6 presents multidimensional poverty profiles and inequality among the multidimensionally poor. The chapter seeks to answer the following questions: *Who are*

those left behind or at risk of being left behind, and where do they live? This chapter extends the analysis in Chapter 5 by disaggregating multidimensional poverty in Botswana by individual characteristics, household-level variables, economic variables, and geographical variables. It then analyses inequality among the multidimensionally poor and concludes by identifying the correlates of multidimensional poverty. This chapter makes a novel contribution to a deepened understanding of multidimensional poverty by providing multidimensional poverty profiles by different subgroups of the population in accordance with SDG 1.2.

Chapter 7 aims to develop a child-centred, individual-level and composite measure that offers nationally relevant and context-specific insights into the magnitude and depth of multidimensional child poverty in Botswana. In particular, it did so through the lens of LNOB by zooming in on demographic, economic and geographical characteristics associated with greater vulnerability or marginalisation. Specifically, this chapter answers the following research question: *What is the situation of multidimensional child poverty in Botswana, and who are those children at risk of being left behind*? This sub-question extends the analysis in chapter 6 by focusing only on children.

Chapter 8 provides an in-depth analysis by examining the poverty mismatch and overlap between monetary poverty and individual-level multidimensional poverty. This chapter addresses the following research question: *What are the factors contributing to poverty mismatch between the official monetary and multidimensional poverty measures*? This chapter contributes to the literature on poverty mismatch and overlap in Botswana and Sub-Saharan Africa (SSA) and adds to the debates on poverty mismatches globally.

Chapter 9 investigates targeting performance and effectiveness of social protection programmes in reaching their intended beneficiaries and whether they reach those left behind. In doing so, this chapter attempts to answer the following questions: *Do social protection programmes reach those left behind*? This chapter makes an original contribution by assessing the targeting performance of several social assistance programmes in Botswana by (a) the specific programme eligibility criteria, (b) the monetary poverty indicators, and (c) the multidimensional poverty index. Last, Chapter 10 presents the summary of findings, policy implications, academic contributions, limitations and future research.

CHAPTER 2: CONCEPTS, DEFINITIONS AND MEASURES OF POVERTY: A REVIEW OF LITERATURE

2.1. Introduction

Poverty is not a modern-day phenomenon; it has been in existence for centuries and continues to exist in all countries (UNDP & OPHI, 2020). The measurement of poverty originated in the United Kingdom in the 17th century (Deeming, 2010). Sir Gregory King, in his unpublished work from the 1690s, presented a family budget profile of England in 1688. This was followed by the hypothetical budget carried by Massie (1758) and the unpublished work of Sir Frederic Eden in 1797, who examined the wages of labourers and costs of food vis-à-vis work conditions in Britain (Carney, 1992). Extensive surveys by Charles Booth (1892, 1894) on pauperism in London and Seebohm Rowntree (1901) on the situation of households in York followed.[3] Following these, Weisbrod (1965) engaged in an extensive survey of estimating the nutritional requirements (consumption levels) for an individual in the United States. These earlier studies used the income threshold to measure poverty.

Rowntree (1901) established his primary poverty threshold in the United Kingdom as the income required to purchase mere physical necessities. In the United States, the first official poverty estimation at the national level was during the 1960s (Fisher, 1997). The famous declaration of the 'war on poverty' by President Lyndon B. Johnson in 1964 and subsequent political initiatives led to the adoption of Mollie Orshansky's poverty threshold as a working definition for statistical planning in the United States (Orshansky, 1965). The poverty thresholds are used in the United States as a measure of the income that a household must not exceed to be counted as poor (Fisher, 1997). Since the 1960s, poverty thresholds have been established in many countries. The World Bank has adopted an international threshold of $1.90 a day to capture extreme poverty in most developing countries (Wagle, 2002). Social indicators have also been used to establish poverty thresholds (see Townsend, 1979; Mack & Lansley, 1985; Gordon & Pantazis, 1997).

[3] For an extensive review of the history of poverty measurements in the United Kingdom see Deeming (2010).

The concept of poverty has evolved over time. In the mid-1970s, the International Labour Organization (ILO) conceptualised poverty not just as lack of income but also as a lack of access to health, education, and basic social services deemed necessary for survival (Mabughi & Selim, 2006). The 1980s saw new ideas added to the concept of poverty, such as Robert Chambers' work on powerlessness and isolation, which helped inspire greater attention to participation (Chambers, 1983). Also, Sen's capability approach (Sen, 1985a, 1987) conceptualised poverty in terms of lack of capabilities to function in society. The 1990s saw further development regarding the conceptualisation of poverty more towards the concept of well-being and failure of social entitlements (Mabughi & Selim, 2006). The UNDP, inspired by Sen, developed the concept of human poverty within the scope of human development (UNDP, 1997). This led to the conceptualisation and adoption of multidimensional poverty measurement in the mid-2000s.

This chapter presents brief literature on concepts, measures and definitions of poverty. The chapter is structured as follows. Section 2.2 presents a brief history of poverty studies in Botswana, followed by Section 2.3 presenting literature on absolute and relative concepts of poverty. Section 2.4 presents the monetary poverty measure, while Section 2.5 presents literature on the multidimensional poverty measure. Last, Section 2.6 presents the conclusion.

2.2. A brief history of poverty studies in Botswana

Poverty measurement in Botswana started in the early 1970s and mainly focused on monetary poverty. The 1974/75 Rural Income Distribution Survey (RIDS) collected by Central Statistics Office (CSO) [now Statistics Botswana] led to the first study of poverty in Botswana (CSO, 1976a). The survey collected information on household income from a sample of households in rural areas. Rural households were classified by income relative to basic requirements based on the rural 'Poverty Datum Line' (PDL) developed by CSO. The PDL was perceived as the basic minimum need for a decent standard of living among lower-income households in the rural areas of Botswana. The second survey followed in 1976, covering only four main towns and used the same methodology as 1974/75 RIDS (CSO, 1976b). CSO conducted the third poverty study in 1989 following 1985/86 Household Income and Expenditure Survey (HIES), which covered urban and rural areas and divided them into six regions to allow regional comparisons (CSO, 1988). These first three poverty studies used per capita income to derive headcount ratios.

The fourth poverty study was conducted in 1996 following the 1993/94 HIES release (CSO, 1996). BIDPA computed the PDL and poverty profiling for the fourth poverty study (BIDPA, 1997). BIDPA used consumption to calculate the PDL due to concerns that income is more susceptible to under-reporting. The fifth poverty study was published in 2008 following the 2002/03 HIES release. The 2002/03 HIES provided up-to-date information on household incomes and expenditures with the main aim of updating the PDL (CSO, 2008).

The sixth study followed the 2009/10 Botswana core welfare indicator survey (BCWIS) release (SB, 2013a). The 2009/10 BCWIS marked a shift in poverty data and analysis. The 2009/10 BCWIS included modules on non-income indicators, thus paving the way for the first attempt at multidimensional poverty measurement in Botswana. In addition, 2009/10 BCWIS introduced the subjective measure of poverty to capture the household's experiences and assessment of their poverty status relative to other households in the same communities (SB, 2013a). The seventh poverty study was released in 2018 using the 2015/16 BMTHS. The survey extended the 2009/10 BCWIS and used the same methodology to compute the PDL.

The first multidimensional study used the 2009/10 BCWIS and was published in 2015 by UNICEF, focusing on multidimensional child poverty (de Neubourg et al., 2015). The 2015/16 BMTHS led to Botswana's first inclusion in the global MPI report (UNDP & OPHI, 2020), thereby providing the first national population-wide estimates of multidimensional poverty. However, Botswana is yet to develop its own country-specific MPI. Recently, the Office of the President released a national pilot MPI for Botswana. The national pilot MPI includes four dimensions (education, health, social inclusion and living standards) (Republic of Botswana, 2021). The pilot study used the same dimensions of the global MPI with an addition of the social inclusion dimension and used the household as the unit of analysis. This study, therefore, provides the first attempt in Botswana to develop individual-level multidimensional poverty at the national level.

2.3. Absolute and relative concepts of poverty

Traditionally, poverty has been defined as a lack of income and has been associated with the study of personal income (Berenger & Celestini, 2006). As indicated in the

introduction, the concept of poverty and how it is measured has evolved over time. Poverty can be conceptualised as an absolute or relative concept. However, whether poverty should be measured using an absolute or a relative approach remains an age-old question (Foster, 1998) and still remains a long debate in economics in poverty measurement (Ravallion, 1992; Atkinson, 1998). Sen (1983, 1985c) argued that using an absolute approach to poverty is related to capability. He claimed that absolute deprivation in terms of a person's capabilities results from a relative deprivation in terms of commodities, incomes and resources. Townsend (1985) disputed this notion saying that conceptions of poverty as 'absolute' were inappropriate and misleading. These different views have led to various researchers and organisations conceptualising and defining poverty differently. I discuss these two concepts in this section.

In absolute poverty, people are considered poor when they are deprived of economic resources or incomes that are required to meet their basic needs, such as food, shelter, and clothing (Ravallion, 1998; Wagle, 2002). Absolute poverty is also defined in terms of deprivations. An international agreement at the Copenhagen World Summit on Social Development in 1995 committed to eradicating 'absolute' and reducing 'overall' poverty. Here absolute poverty was defined as 'a condition characterised by severe deprivation of basic human needs, including food, safe drinking water, sanitation facilities, health, shelter, education and information. It depends not only on income but also on access to services' (UN, 1995: p57). Overall poverty takes various forms, including 'lack of income and productive resources to ensure sustainable livelihoods; hunger and malnutrition; ill health; limited or lack of access to education and other basic needs; increased morbidity and mortality from illness; homelessness and inadequate housing; unsafe environments and social discrimination and exclusion' (UN, 1995: p57).

The World Bank also defined absolute poverty in terms of deprivation as 'pronounced deprivation in well-being and comprised many dimensions. It includes low incomes and the inability to acquire the basic goods and services necessary for survival with dignity. Poverty also encompasses low levels of health and education, poor access to clean water and sanitation, inadequate physical security, lack of voice, and insufficient capacity and opportunity to better one's life' (World Bank, 2001). Similarly, the Organisation for Economic Co-operation and Development (OECD) stated, 'poverty encompasses different dimensions of deprivation that relate to human capabilities including

consumption and food security, health, education, rights, voice, security, dignity and decent work' (OECD, 2001). The UNDP introduced the concept of human poverty, defined as deprivation of essential capabilities such as long and healthy life, knowledge, economic resources and community participation (UNDP, 1997).

The United Nation's Economic and Social Council (UNESC) described absolute poverty in the context of human rights. They defined it as a denial of choices and opportunities, a violation of human dignity. It means a lack of capacity to participate effectively in society. It means not having enough to feed and clothe a family, not having a school or clinic to go to, not having the land to grow one's food or a job to earn one's living, not having access to credit. It means insecurity, powerlessness and exclusion of individuals, households and communities. It means susceptibility to violence, which often implies living in marginal or fragile environments without access to clean water or sanitation (UN, 1998). The UNDP also addresses the issue of absolute poverty as a denial of human rights from a human development perspective and defines poverty as 'the denial of opportunities and choices most basic to human development – to lead a long healthy creative life and to enjoy a decent standard of living, freedom, dignity, self-esteem and the respect of others' (UNDP, 1997).

In relative poverty, people are considered poor in relation to the normative economic status of other members of society. People are considered to be in relative poverty when they cannot meet a minimum level of living standards compared to others in society (Wagle, 2002; UNDP, 2010). According to Ravallion (1992), relative poverty means being unable to afford to meet the minimum needs that are deemed reasonable by the standards of the society in question. Rowntree (1901), in the early 20th century, defined families whose total earnings are insufficient to obtain the minimum necessaries for the maintenance of merely physical efficiency as being in primary poverty. Peter Townsend defined poverty in terms of the concept of relative deprivation. 'Individuals, families and groups in the population can be said to be in poverty when they lack the resources to obtain the types of diet, participate in the activities and have the living conditions and amenities which are customary, or at least widely encouraged or approved, in the society to which they belong' (Townsend, 1979: p31). The Joseph Rowntree Foundation modified Rowntree and Townsend's definitions and defined poverty as the situation where 'a person's resources (mainly their material resources) are not sufficient to meet

minimum needs (including social participation)' (Goulden & D'Arcy, 2014: p3). This current definition captures both the absolute and relative features of poverty.

The European Commission explicitly adopted a relative poverty measure. According to the European Commission, people are said to be living in poverty if their income and resources are so inadequate as to preclude them from having a standard of living considered acceptable in the society in which they live. Because of their poverty, they may experience multiple disadvantages through unemployment, low income, poor housing, inadequate health care and barriers to lifelong learning, culture, sport and recreation (European Commission, 2004). The European Economic Commission (EEC) (1985) defined the poor as persons, families, and groups of persons whose resources (material, cultural and social) are so limited as to exclude them from the minimum acceptable way of life in the Member State in which they live. These definitions capture the relative aspect of poverty.

2.4. Monetary measure of poverty

The *monetary measure*[4] is the oldest and most commonly used approach with a strong theoretical basis (Ruggeri-Laderchi et al., 2003; Maltzahn & Durrheim, 2007). For the monetary approach, poverty is conceptualised as an economic deprivation usually measured by income or consumption. The consumption approach, usually proxied by expenditure, is a direct measure of poverty (Ringen, 1988). Consumption is mostly used because it is more stable over time, and it reflects, to a certain extent, the household's long-run resources rather than mere current income (Cutillo et al., 2020). Income, on the other hand, is an indirect measure of monetary poverty (Ringen, 1988). Scott (2002) indicated that the rationale behind using income as a measure of poverty was based on the thinking that income can be used to satisfy and fulfil basic human needs.

The traditional monetary approach to poverty measurement follows the *welfarist*[5] perspective. In measuring poverty, welfare is conceptualised in terms of *utility*, measured

[4] The term 'monetary' is used to mean income or consumption measures. Henceforth, we use the term monetary to mean either income or consumption.

[5] The *welfarist* perspective takes utilitarian approach to conceptualise welfare in the form of *utility* obtained from consumption of commodities and services. However, the use of income alone as an indicator of poverty has been severely criticised and is a major concern for the measurement of poverty because the relationship between income and *utility* is of ordinal nature and income is just one of the many variables determining overall utility (Sen, 1979; Zheng, 1997).

using income or consumption, and then compared with a specified poverty line defined in terms of income or consumption/expenditure, representing a minimal level of welfare deemed necessary to avoid poverty (Ravallion, 1992). People are then identified as poor if their income or consumption/expenditure falls below the specified poverty line.[6] The poverty index is then expressed in terms of headcount ratio or the percentage of poor people in the population. This captures the absolute concept of poverty. Where a household income is below a certain percentage of the median household income, that household is in relative poverty. However, using the monetary measure of poverty alone as a proxy for non-income dimensions of poverty has not escaped criticism (Tsui, 2002). There has been a growing consensus regarding the insufficiency and limitation of monetary poverty measures (Sen, 1992; Alkire & Santos, 2014). Sen (1982, 1983) referred to this as a narrow definition of poverty.

The monetary measure is not comprehensive enough to capture all aspects of human wellbeing, which is the ultimate ends to be measured and evaluated and cannot be expressed entirely in monetary terms (Ringen, 1988). This measure alone does not tell the whole story of human suffering because poverty is not only about one's inability to spend on essential goods and services (Hanandita & Tampubolon, 2016). Poverty is a complex phenomenon with multidimensional manifestation, and the monetary approach is inadequate to capture such multiplicity (Atkinson, 2003). It significantly misidentifies deprivations in other dimensions (Alkire, 2008). This criticism has been chiefly captured in the writings of Sen (1976), who stressed that when taking poverty evaluations, 'we must look at impoverished lives, not just depleted wallets' (Sen, 2000: p3).

Affordable quality services, such as water, health, and education, are frequently not provided through the market (Tsui, 2002; Callan et al., 1993; Bourguignon & Chakravarty, 2003; Alkire & Santos, 2014). Having an income above the poverty line does not guarantee that other needs like education or health have been met. A person's health status cannot be reduced to the amount of money (Kim, 2016). The monetary approach follows an indirect approach to measuring welfare and, therefore, cannot

[6] Another monetary poverty measure commonly used is the international poverty line set at $1.90 per day 2011 purchasing power parity (PPP) by World Bank. The international poverty line is the threshold that determines whether someone is living in extreme poverty. The PPP allows for cross-country comparisons (Jolliffe & Prydz, 2015).

represent the standard of living of a family or individual (Ringen, 1988). This method (indirect) does not take into account the intra-household allocation of resources/income (Alkire & Santos, 2014).

Having sufficient income by individuals or households does not necessarily mean they will spend it to meet their basic needs (Thorbecke, 2008). Financial resources' availability does not always guarantee access to consumer goods and services (Popova & Pishniak, 2017). The ability to convert a given amount of income into certain functionings varies across age, gender, health, location, climate, and conditions such as disability; that is, people's conversion factors differ (Sen, 1979). The monetary poverty measure is not robust for international comparisons as it depends on the value and methods to construct poverty lines (Blackburn, 1998).

2.5. Multidimensional measure of poverty

Following the recognition of the insufficiency and limitation of the traditional monetary measure of poverty, poverty research has shifted the emphasis to a multidimensional approach (Chakravarty & Lugo, 2016), especially after the seminal works of Townsend (1979) and Sen (1985a). The significant shift in the conceptualisation and measurement of poverty and view of poverty from a multidimensional perspective has been primarily influenced by Sen's seminal work on poverty, famines, entitlements, and deprivations (Sen, 1976). The multidimensional perspective conceptualises notions like the standard of living or the quality of life as multidimensional (Townsend, 1979; Streeten et al., 1981; Mack & Lansley, 1985; Sen, 1985a, 1992). It measures poverty in terms of multidimensional deprivations (including monetary and non-monetary dimensions). Different concepts have been employed to study multidimensional poverty. These include the capability approach (Sen, 1979, 1985a, 1985b, 1992), material deprivation and social exclusion (Townsend, 1979; Mack & Lansley, 1985; Levitas et al., 2007), the basic needs approach (Streeten et al., 1981; Streeten, 1984), subjective wellbeing approach (van Praag & Ferrer-i-Carbonell, 2008), the human rights-based approach (Sengupta, 2010; Burchardt & Vizard, 2011) and participatory poverty assessments (Narayan et al., 2000). Below a brief discussion of the different approaches is presented.

2.5.1. Capability approach

The conceptual understanding of poverty as a multidimensional phenomenon gained momentum influenced by the capability approach (Sen, 1979, 1985a, 1985b, 1992). The capability approach offers a multidimensional perspective of poverty (Dang, 2014) and provides a broad, rich, and intrinsically complex perspective for describing the multifaceted nature of poverty (Martinetti, 2000). This approach comprises two core concepts: *functionings* and *capabilities*. Functionings refer to the various things a person succeeds in 'doing or being', such as participating in the life of society, being healthy, and so forth (Sen, 1992; Hick, 2014). In contrast, capabilities refer to a person's real or substantive freedom to achieve such functionings (Sen, 1992: p75).

Sen suggests that there is a need to consider functionings and, ultimately, capabilities, which are better representations of wellbeing than just utility because capabilities can be strictly related to (1) the inherent characteristics of people, (2) environmental circumstances, and (3) the conversion process from the resources to wellbeing (Martinetti, 2000). Sen (1985a) concluded that capability (the freedom of choice of functionings) should be the final information basis for wellbeing (Comim, 2001). He defined poverty as the lack of capabilities to function in a given society (Sen, 1985a). Capabilities, therefore, stand for a certain level of available functionings and, in turn, indicate wellbeing and quality of life. In this way, poverty is then defined as a restricted set of essential capabilities needed to pursue whatever one has reason to value in life. This way, the approach places freedom of choice at the core of any poverty analysis (Rippin, 2016).

Several researchers used the capability approach in the empirical application of the measurement of poverty. Different scholars have discussed these various theoretical and empirical aspects of the operationalisation of the capability approach (Comim, 2001; Kuklys, 2005; Alkire, 2008).[7] The theoretical premise of the capability approach has been extensively applied in the empirical literature on multidimensional poverty (Anand & Sen, 1997; Stiglitz et al., 2009; Qizilbash, 2002; Kuklys, 2005; Alkire & Foster, 2011a, 2011b). The United Nations Development Programme (UNDP) measure of the Human Development Index (HDI) (UNDP, 1990-2014) and the Multidimensional Poverty Index

[7] For a formal presentation of the capability approach, see Kuklys (2005) and Lancaster (1996) for a detailed elaboration.

(MPI) (OPHI, 2010-2015) both used the theoretical foundations of the capability approach to measuring multidimensional poverty. The multidimensional premises of poverty measurement have also been included in the SDGs, where the aim is to eradicate poverty in all its forms in order to leave no one behind (UNDP, 2016).

2.5.2. Material and social deprivation

Townsend (1979) developed the concept of deprivation based on the relative theory of poverty. Townsend (1979, 1987) made distinctions between deprivation and poverty and argued that deprivation is as important a concept as poverty. These two concepts are closely linked. Poverty is seen as a lack or denial of command of resources over time, and deprivation is its consequence (Townsend, 1979, 1987; Gordon, 2006). Therefore, people can experience one or more forms of deprivation without necessarily being in poverty (Townsend, 1987).

Townsend (1979) classified deprivation into two forms: material and social deprivation. Townsend made it clear that these two deprivation concepts are equally important. However, the material deprivation concept has highly developed in the empirical literature (Townsend, 1987). Townsend (1979: p38) argued that 'people's needs, even for food, are conditioned by the society to which they belong', thus defining material deprivation as the inability to live a decent life. The Organisation for Economic Co-operation and Development (OECD) and the European Union (EU) have adopted this concept. The OECD defines material deprivation as the inability for individuals or households to afford consumption goods and activities typical in a society at a given point in time, irrespective of people's preferences concerning these items (OECD, 2007). On the other hand, social deprivation is concerned with a lack of access to ordinary social customs, activities and relationships (Townsend, 1987).

Townsend and Gordon (1989) developed a deprivation index based on the Greater London survey in the 1980s (Gordon et al., 2000). Gordon and Pantazis (1997) and Gordon (1995) also extended the work of Townsend. The socially perceived necessities approach involves 'ordinary' people (poor and non-poor) in defining poverty; 'poverty is treated as an enforced lack (that is, due to insufficient resources) of items that the population has identified as essential for an acceptable standard of living; and the focus is explicitly multidimensional' (Barnes & Wright, 2012: p137). First, a long list of items

thought to be potential necessities was created. Next, a representative sample of the public (poor and non-poor) was asked to identify items from the list they thought were necessities that no household or family should be without in society. Then they were asked which items they actually had and which they wanted but could not afford. Items defined as necessities by more than 50 per cent of the population from the list but lacked because of a shortage of money were then used to determine deprivation. Finally, a poverty threshold was calculated (Gordon et al., 2000).

2.5.3. Social exclusion

The concept of social exclusion (SE) does not have the purpose of identifying the poor (Wagle, 2008). However, SE is conceived as a complex and multidimensional concept (Gordon et al., 2000; Levitas et al., 2007). It extends beyond Townsend's concept of relative deprivation and places emphasis on non-material aspects (Saunders & Wong, 2009). SE has opened its way through the literature on poverty, mainly motivated by the European policy agenda, and it is interlinked with the concept of material deprivation (European Foundation, 1995). Although SE is a widely used term, there is no consensus on its exact definition (Levitas, 2006). SE is defined as 'the lack of access to the kinds of social relations, social customs and activities in which the great majority of people in the society engage' (Gordon et al., 2000: p73). SE involves 'the lack (or denial) of resources, rights, goods and services, and the inability to participate in the normal relationships and activities available to most people in a society, whether in economic, social, cultural or political arenas' (Levitas et al., 2007: p25). SE can also be considered as a process through which individuals or groups are wholly or partially excluded from full participation in the society in which they live (European Foundation, 1995).

The EU defined SE as the situation of people either at risk of poverty or severely materially deprived or living in a household with a very low work intensity (EUROSTAT, 2015). SE is also linked to human development and capabilities, and it involves deficiencies in several dimensions associated with 'full citizenship': paid work and income, education, housing, health care, legal assistance, accessibility of public provisions (Jehoel-Gijsbers & Vrooman, 2007). Devicienti and Poggi (2011) derived six major indicators of SE for the case of Italy, not having an adequate house, not being healthy or able to work, not living in a clean or safe environment, not meeting basic needs fulfilment, not reaching a certain quality of life and inability to having social

relationships. Labonté et al. (2011) conducted a review of literature on SE frameworks and indicators. They identified nine domains that capture SE processes: employment and work, income and economic resources, material resources, education and skills, health, housing, social resources, community resources, and personal safety.

2.5.4. The basic needs approach

The basic needs approach (BNA) emerged at the end of the 1970s, following the limitations and insufficiency of the monetary measurement of poverty. The BNA advocates for the inclusion of fundamental social indicators to account for those neglected dimensions of poverty. The proponents of BNA suggested that a comprehensive evaluation of human development should include information on satisfaction levels in terms of basic needs (Streeten et al., 1981; Streeten, 1979, 1984; Beccaria & Minujín, 1985). Streeten et al. (1981: p25) defined basic needs in terms of 'minimum specified quantities of such things as food, clothing, shelter, water and sanitation that are necessary to prevent ill health, undernourishment, and the like' (see also Alkire & Santos, 2014). The approach focuses on the basic resources that should be available for every individual in society. The main basis of the BNA stems both from the view that 'raising incomes alone is insufficient in view of the inefficiencies in the consumption patterns of the poor and the lack of availability of essential goods and services' (Hicks & Streeten, 1979: p570).

2.5.5. The subjective well-being approach

The *Leiden school*[8] of thought suggested evaluating subjective welfare based on the perceptions of deprived individuals (van Praag & Ferrer-i-Carbonell, 2008). The subjective well-being (SWB) approach understands well-being as the experience people have of well-being (Rojas, 2007) and how they think and feel about their quality of life (McGregor 2007). The SWB refers to the well-being as declared by the person, a self-reported measure of well-being (Rojas, 2007). The SWB has two aspects: on the one hand, people's perceptions of their (material, social, and human) positions, and on the other hand, cultural values, ideologies, and beliefs (White, 2010). This approach has been used by both psychologists (Kahneman et al., 1999; Hills & Argyle, 2002), sociologists

[8] The Leiden approach (or school) originated at Leiden University in the Netherlands by van Praag, Kapteyn, Wansbeek, Hagenaars, Van der Sar, Plug, and Frijters in the early 1970s.

(Veenhoven, 1988), and recently has been widely used by economists (Rojas, 2007; van Praag & Ferrer-i-Carbonell, 2008; Clark, 2009), to mention but a few.

2.5.6. The human rights-based approach

International agencies such as the United Nations Office of the High Commissioner for Human Rights (UNOHCHR) and the UN have begun to consider how human rights concerns can be best incorporated into strategies for development and poverty eradication (Osmani, 2005). Since 1989, the Human Rights Council (HRC) has discussed extreme poverty as a major source of deprivation, affecting all human rights (Sengupta, 2010). The UNOHCHR developed a set of guiding principles on extreme poverty and human rights adopted by the HRC in 2012 (UN, 2012). Extreme poverty is defined as the combination of income poverty, human development poverty and social exclusion (Sengupta, 2010; UN, 2012). The Committee on Economic, Social and Cultural Rights defined poverty as a human condition characterised by the sustained or chronic deprivation of the resources, capabilities, choices, security and power necessary for the enjoyment of an adequate standard of living and other civil, cultural, economic, political and social rights (UN, 2001, 2012). The human rights-based approach perceives poverty as a multidimensional phenomenon that encompasses a lack of both income and the basic capabilities to live in dignity (UN, 2012). The human rights-based approach is also linked to SE, conceptualised as a lack of enforceable rights (Burchardt et al., 2002). Approaches to poverty as a violation of human rights are articulated in the UN's agenda. Many human rights violations are both a cause and a consequence of poverty (UN, 2012).

A human rights-based approach to poverty adds a distinct value to anti-poverty strategies, making them more effective (Sengupta, 2010). The human rights-based approach defines poverty as a denial of human rights (Osmani, 2005). In this case, poverty can be best seen through the lens of the capability approach. Burchardt and Vizard (2011) contended that it is possible to operationalise the capability approach on the basis of human rights. The LNOB principle of the 2030 Agenda for Sustainable Development is compatible with a rights-based approach to development, and most of the SDGs capture human rights. Those left behind are denied economic and social rights, including rights to education, health, a decent standard of living, food, to mention but a few (Klasen & Fleurbaey, 2018), and these rights have a direct and immediate bearing upon poverty eradication (UN, 2001).

2.5.7. Participatory poverty assessment

All the conceptual frameworks summarised in this chapter, except for the SWB, focus on understanding poverty from researchers and academics. Chambers (2007: p142) names participatory poverty assessment the 'ivory tower' concept of poverty. It is vital to understand poverty levels, how poverty occurs, why it persists, and how it can be eradicated to develop effective and appropriate strategies and policies for poverty eradication (Narayan et al., 2000; Robb, 2000). Participatory poverty assessments (PPA) were started by the World Bank in the early 1990s to link the policy agenda with the ground realities of the poor (Narayan et al., 2000) and were mainly used in African countries. PPAs complement traditional household surveys that collect quantitative data with qualitative data, thereby helping understand better the results of household surveys by capturing the experiences of the poor themselves. Since the year 2000, the World Bank has led an extensive application of participatory research in the field of poverty, transforming PPAs into a comparative study.

The Asian Development Bank (ADB) defined PPA as a qualitative social research approach designed to determine what perceptions the poor have toward poverty, the issues that concern them and how they would like to see these issues resolved (ADB, 2001: p5). The PPA research method gives the poor, marginalised, and excluded a voice in policymaking (Robb, 2000). While the most important stakeholders involved in the research process are poor men and women, PPA can also include decision-makers from all levels of government, civil society, and the local elite in order to take into account different interests and perspectives and increase local capacity and commitment to follow-up action (Robb, 2000; Norton et al., 2001). Notwithstanding this, PPA has been criticised for being expensive and time-consuming since they require a larger sample of interviews to include a broad range of views, which will cause PPAs to be extremely expensive.

2.6. Conclusions

This chapter has provided a brief review of the literature on the concepts and measures of poverty. Poverty is one of the oldest concepts that describe human suffering. There is no single definition that best describes poverty, and also, no single measure is best suited to

measure poverty. Poverty can be measured using monetary or multidimensional approaches. Many countries have extensively used monetary measures to capture poverty. However, the unidimensional monetary measure has been criticised for its failure to capture the multidimensional manifestations of poverty. Multidimensional poverty measure has been adopted to address this limitation of the monetary measure. Townsend (1979) advocates for a relative approach arguing that if poverty is relative cross-nationally, then it is also relative to time and place. Sen (1985c) argues that poverty can be seen as relative in the dimension of income but absolute in the realm of capabilities. By calling for ending poverty in all its forms for everyone and according to national definitions, SDG 1.2 acknowledges that poverty is both multidimensional and relative (Pomati & Nandy, 2020). Most indicators used in this thesis are relative than absolute. So, the concepts of relative and absolute poverty are considered simultaneously.

Besides the absolute/relative concepts of poverty, several concepts have also been employed to study poverty from a multidimensional perspective. These include the capability approach, material deprivation and social exclusion, basic needs approach, subjective wellbeing approach, a human rights-based approach and participatory poverty assessments. The BNA advocates for a comprehensive evaluation of human development that includes information on satisfaction levels in terms of basic human needs. The SWB suggested an evaluation of subjective welfare based on the perceptions of the deprived individuals. The PPA captures the experiences of the poor themselves to include the voices of the poor in poverty measurements. The concept of material deprivation is based on the relative theory of poverty and is conceptualised as the inability to live a decent life. It emphasises resources (means). The material deprivation concept was extended to capture social exclusion and placed emphasis on non-material aspects. However, while SE is often seen as complementing the concept of poverty, it remains unclear whether SE is an outcome or a process (Hick, 2012). Most of the indicators under these approaches are often classified in the ‘means’ category.

The capability approach offers a framework for poverty analysis that places capabilities (ends) over resources (means) and adopts a multidimensional perspective. The capability approach provides a broader perspective than these other approaches in terms of dimensionality, and thus it possesses a considerably firmer conceptual foundation (Hick, 2012). The biggest advantage of the capability approach is that it provides an outcome-

based and individualistic evaluation of individual wellbeing. The capability approach emphasises people's abilities and opportunities to enjoy long, healthy lives, be literate, and participate freely in their society.

In this thesis, I use a mixed approach to conceptualise poverty. I adopt the human rights framework, capability approach and LNOB principle to underpin my definition of multidimensional poverty. Both the human rights framework and capability approach point to the many facets of poverty and are linked to the denial of basic economic and social rights. The capability approach offers a strong conceptual foundation for linking human rights and poverty (Osmani, 2005; Burchardt & Vizard, 2011). The capability approach emphasises the role of individual freedom as the basis for the ethical evaluation of human rights (Sen, 2005). This is in line with the LNOB principle, which is premised on the human rights-based approach and emphasises the special focus that must be placed on the most vulnerable and marginalised in society (UN, 2015). Operationalising the capability approach based on human rights provides valuable and disaggregated data to support policy-making decisions, thus helping to identify the different vulnerable groups in society to leave no one behind.

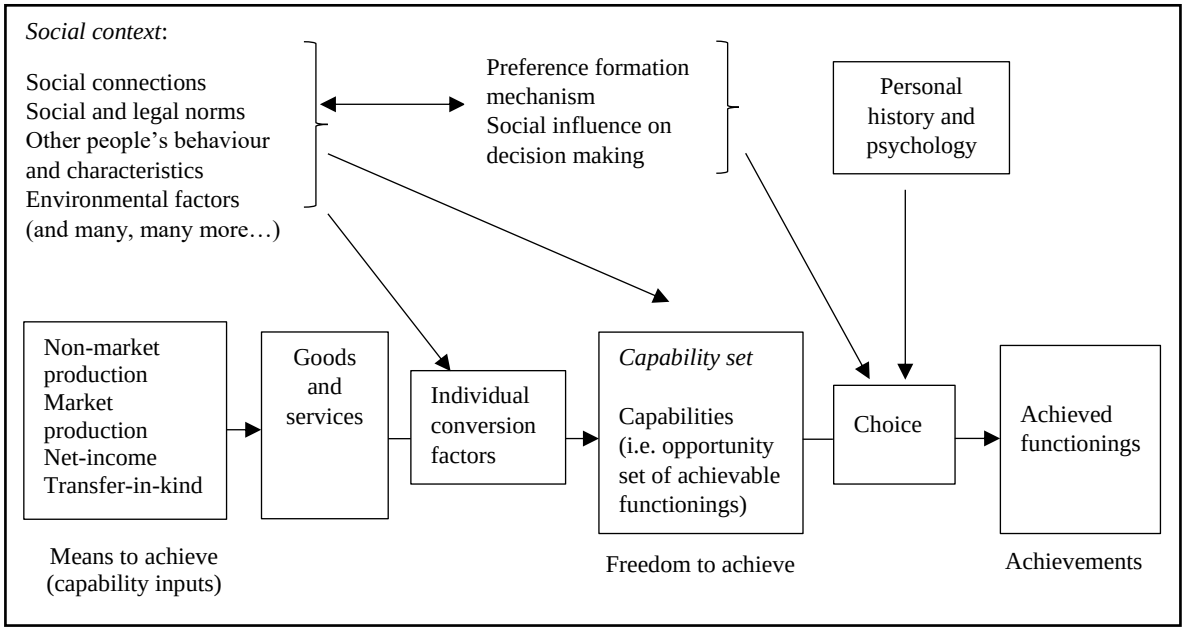
CHAPTER 3: OPERATIONALISING THE CAPABILITY APPROACH

3.1. Introduction

As mentioned in the previous chapter (Chapter 2), this thesis operationalises the capability approach and provides a normative framework for the evaluation of multidimensional poverty. The capability approach provides a comprehensive theoretical construct for measuring poverty as a multidimensional concept and in accordance with the LNOB principle. This is in line with the LNOB principle, is premised on a human rights-based approach, and acknowledges the multidimensional nature of poverty (UN, 2015). The LNOB principle aims to address two related concerns: ending poverty in all its forms and reducing inequalities among both individuals and groups (UN, 2015; Stuart & Samman, 2017; Klasen & Fleurbaey, 2018). The LNOB principle emphasises the assessment of poverty at the individual level (Klasen & Fleurbaey, 2018). In line with the LNOB principle, the capability approach advocates for an individualistic evaluation of multidimensional poverty where the (observable) set of individual functionings constitute the basic metric of evaluation of individual deprivation, and the evaluation of capabilities incorporates the notion of freedom of choice in the process of evaluation (Sen, 1985a, 1992).

The capability approach advocates for an evaluation at the capability space and emphasises the capabilities a person has, irrespective of whether they choose to exercise these or not (Hick, 2016). Capabilities refer to the set of real choices that a person has to lead the life he/she wants to lead or the life she has reason to value (Krishnakumar & Ballon, 2008; Krishnakumar & Chávez-Juárez, 2016). This opportunity set is determined by several conversion factors, including the individual's personal, economic, social, political, environmental and institutional circumstances (Sen, 1985a, 1987, 1999; Krishnakumar & Ballon, 2008). Functionings focus on achievements – a set of things the person manages to do or to be ('doings or beings') (Basu & Lopez-Calva, 2011). Therefore, the capability set represents the opportunity set of achievable functionings (see Figure 3.1 for illustration).

Figure 3. 1: Representation of the capability approach



Source: Robeyns (2005)

Measuring capabilities has proved to be a major challenge for the operationalisation of the capability approach (Krishnakumar & Chávez-Juárez, 2016). Capturing what people are able to do (their "capabilities") is potentially problematic (Sen, 2009) because of the challenges people have in knowing what they are capable of (Gasper, 2007). Capabilities are not easy to observe, and information on capabilities is rarely available in conventional nationally representative data. On the other hand, functionings are easier to observe and measure than capabilities in an empirical setup (Sen, 1992). Also, available household survey data can provide relevant information on what people can do (their "functionings"). A majority of empirical applications operationalised the concept of the capability approach in the functioning space (e.g., Martinetti, 2000; Alkire & Santos, 2014; Suppa, 2018). Therefore, considering the constraints in terms of available data and the limitations for the direct measurement of capabilities, I operationalise the capability approach in the functioning space to measure multidimensional poverty. For example, it is difficult to measure the education capability 'to be educated'. In contrast, information capturing functionings such as 'being able to read and write' (literacy) or 'being in school' (enrolment) are available. Each dimension selected and used in this thesis represents an important functioning and includes multiple functioning components relevant to the functioning dimension.

In the functioning space, the capability approach takes into consideration the resources available to an individual and several personal, social, and environmental factors that influence the individual ability to convert those resources into various functionings (Sen, 1985a, 1999). The conversion factors consist of demographic characteristics of individuals, such as an individual's age, gender, disability, and citizenship, as personal conversion factors. Household characteristics (family type, sex and age of household head, employment status and the highest level of education of household head, household income) capture the household's socio-economic status and represent social conversion factors. In addition, administrative districts and regional variables are used to represent the environmental conversion factor. In line with the LNOB principle, individuals at the intersection of these factors are at the risk of being left behind. The importance of data disaggregation is also in line with international human rights monitoring (Burchardt & Vizard, 2011).

In operationalising the capability approach, I made several decisions, including the unit of analysis, the selection of functioning dimensions and indicators, the weighting scheme, the poverty cut-off, and the aggregation method. This chapter (Chapter 3) explicitly addresses the issue of the selection of dimensions using the capability approach. A detailed discussion of the final list of dimensions and their respective indicators is presented in Chapter 5. Also, Chapter 5 entails an empirical application and operationalisation of the capability approach within the human rights-based approach and in the context of Botswana.

The chapter is organised as follows. Section 3.2 presents a brief overview of approaches to selecting dimensions, and Section 3.3 presents a brief overview of key studies that generated a list of dimensions. In section 3.4, I present the selected dimensions and their rationale for inclusion, while section 3.5 presents conclusions.

3.2. Approaches to selecting dimensions

The operationalisation of the capability approach is still a matter of discussion, and the selection of relevant dimensions remains a debatable issue (Alkire, 2002, 2008; Nussbaum, 2000, 2003; Robeyns, 2003; Kuklys, 2005). The literature on the capability approach discussed several approaches commonly used in an empirical operationalisation of the approach. Several researchers (e.g., Nussbaum, 2000, 2003; Kuklys, 2005)

emphasise the importance of generating a list of dimensions to operationalise the capability approach (Burchi et al., 2014). Sen (1993, 2004) has argued against having a pre-determined list. He advocates for a deliberate exercise that depends on the specific purpose of the study and the local context for the selection of relevant capabilities (Burchi et al., 2014).

Robeyns (2003) also argued against a fixed universal list of dimensions and was the first to suggest a set of guidelines to select relevant dimensions. She suggested the following criteria. First, the elements of the list of dimensions should be explicitly formulated, open for discussion and properly justified and defended. Second, the methodology used for selection should be justified and discussed in the context of measurement. Third, the list of dimensions should be drawn in at least two stages, based on which the researcher should start with the ideal, theory-based list. Only at a later stage move to a feasible one based on data and resource availability. Finally, the definitive list should be exhaustive and not capable of further reduction (Robeyns, 2003).

Alkire (2008) also argued against a single authoritative list and advocated for a contextual selection of dimensions. Alkire (2008) explored the conceptual issues of selecting dimensions within the capability approach and identified five different approaches: *existing data*, *normative assumptions*, *public consensus*, *ongoing deliberative participatory process* and *empirical evidence* regarding people's values.

Existing data is a data-driven approach, and it involves identifying data that have the requisite technical features and relate to the issue(s) of the study. The selection is based on existing data conventionally used to measure multidimensional poverty, which fits the current measurement context (Alkire, 2008). This method can be used in conjunction with another method.

Normative assumptions involve making assumptions regarding what people should value based on the researcher's views or drawing on various social, psychological or philosophical theories (Robeyns, 2003; Alkire, 2008; Burchi et al., 2018). Examples of this approach are Maslow's (1948) pyramid of needs, Nussbaum's (2000) list of ten central capabilities, which she considered as 'central requirements of a life with dignity and Alkire and Black's (1997) list of capabilities based on 'practical reasoning theory of

development'. This method can be used when the researcher has a clear view of the relevant dimensions (Alkire, 2008).

The *public consensus* approach uses a set of dimensions that has generated some consensus and critical public discussion as the basis for generating comparable data across time and space (Alkire, 2008). The list has already gained legitimacy in the academic and policy domains. Some examples include the MDGs, SDGs and the Universal Declaration of Human Rights (UDHR). The advantage of this approach is that it does not require the collection of further qualitative or quantitative information. The resulting list of dimensions has the advantage of having been agreed upon by many countries. However, international processes may lose track of important national level dimensions (Burchi et al., 2018).

The MDGs and SDGs are the two examples of global agendas that heavily relied on the participation of different actors (international organisations, governments, and civil society, among others) in deriving their list of targets and indicators. Human development and poverty eradication became fundamental to the MDG framework. The MDG 1 target of halving extreme income poverty is an excellent example of achieving political commitment from different actors. However, the MDGs were criticised for missing goals for reducing inequality within and between countries (Fukuda-Parr, 2010) and missing focus on the 'poorest of the poor', masked by national averages or aggregated information (Brikci & Holder, 2011). Nonetheless, the MDGs have played an important part in global agreement that the goals to fight poverty should continue beyond 2015, leading to the introduction of the SDGs.

The SDGs build on the MDGs (Pogge & Sengupta, 2016) and offer a new perspective to assess the progress of societies. The SDGs mark a shift from the MDGs and emphasise the interconnected environmental, social and economic aspects of development (Sachs, 2012). Even though both MDGs and SDGs placed poverty at the top of the development agenda, the SDGs acknowledge that poverty is multidimensional. SDG 1.2 calls to 'end poverty in all its forms everywhere' (UN, 2015: p15). The SDGs' call for disaggregated data by ethnicity, disability status, gender, age, geographical location, and so on is in line with the capability approach. The SDGs and the capability approach have interconnectedness across dimensions at their core. The SDGs, especially SDG 1.2, are

concerned with ‘leaving no one behind’, while the capability approach sees each person as an end. Unlike the MDGs, the SDGs are much more inclusive and integrated (Le Blanc, 2015). Both the SDGs and capability poverty are multidimensional and people-centred concepts.

The *participatory approach* involves the use of participatory exercises among various stakeholders (Alkire, 2008). These include focus group discussions and other participatory techniques to draw out people’s considered values (Alkire, 2008) and ensure an in-depth public consultation (Burchi et al., 2018). An example of this approach is the comprehensive study by Narayan et al. (2000), covering more than 60,000 respondents from 50 countries. However, the weakness of this approach is that its implementation at the national level can be very complex and costly, and its outcomes may pose some serious bias due to power and educational inequalities among participants (Burchi et al., 2018).

The *empirical evidence* approach is based on evidence from seminal multidisciplinary empirical studies. This method analyses data on people’s values, beliefs, or behaviours to construct a set of dimensions that seem to represent their values. However, the weakness of this method is that surveys may not include relevant populations (the poor) since dimensions are selected on the basis of expert analyses of people’s values from empirical data (Alkire, 2008).

Each of the approaches taken individually has relevant flaws, and to reduce their weakness, researchers, in most cases, use these approaches in combination (Alkire, 2008). For example, some researchers mixed PPA with normative assumptions, where a researcher identifies an initial list as a starting point for a participatory exercise (Biggeri & Libanora, 2011). Mitra et al. (2013a) employed a mixed-method approach involving public consensus and a participatory approach in their study.

3.3. Overview of key studies

This section focused on large studies and approaches that developed a generic list of dimensions across countries that have been tested and applied in the empirical literature. Specifically, I relied on *normative assumptions* (Nussbaum, 2000, 2003), *public consensus* (Stiglitz et al., 2009; Alkire & Foster, 2011a, 2011b; Alkire & Santos, 2014;

UNDP, 1990-2005) and *participatory approaches* (Narayan et al., 2000). A review of the relevant literature of some empirical studies employing the capability approach using nationally representative data was also undertaken. Table 3.1 summarises some of the key studies that are mainly used to generate the list of dimensions. These studies, heavily influenced by Sen (1985a, 1993), operationalised the capability approach and suggested a useful list of dimensions of poverty. Even though these studies have diverse backgrounds and rationale, they have considerable conceptual overlap.

Normative theories: This approach draws inspiration from multiple disciplines of academics and is concerned with 'what constitutes a good life'. I reviewed the list that has received substantial debates and discussions in the context of the capability approach derived by Nussbaum (2000, 2003). Nussbaum (2000, 2003), drawing heavily from the work of Aristotle, proposed a list of ten philosophically derived capabilities that include *life*; *bodily health*; *bodily integrity*; *senses, imagination and thought*; *emotions*; *practical reason*; *affiliation*; *other species*; *play*; and *control over one's environment*.

Public consensus: For this approach, I reviewed studies by expert groups. The need for multidimensional measures of poverty has long been acknowledged and discussed at the policy level. The formation of several expert committees followed such acknowledgement at national and international levels. I draw the list from three expert committee studies (i) the UNDP (1990-2005) human development reports on the human development index (HDI) ; (ii) the Oxford Poverty and Human Development Initiative (OPHI) on multidimensional poverty index (MPI) which UNDP currently uses; (iii) The Stiglitz-Sen-Fitoussi Commission report. These studies have achieved legitimacy in the academic and policy domains.

Since 1990, UNDP has adopted the capability approach in its annual Human Development Reports (HDR) to report the countries' HDI (UNDP, 1990-2005).[9] The HDI was developed by Anand and Sen (1997) to analyse human development and human poverty. It uses three dimensions: *life expectancy*, *education* (measured by adult literacy and educational enrolments), and *adjusted GDP per capita*, which serves as a proxy for the material aspects of functioning wellbeing. In addition, the Human Poverty Index

[9] The HDI is an index between 0 and 1, whereby a country that would have the highest average achievement on each functionings would score 1.

(HPI) was derived from the capability approach, and poverty has been measured directly through it since 1997 (UNDP, 1997). This served as a massive contribution to the framework of multidimensional poverty measurement and analysis, which is the current tool used in the HDR for assessing poverty (Alkire & Foster, 2011a; Alkire et al., 2015b).

In 2010, UNDP adopted the Multidimensional Poverty Index (MPI), developed by researchers in the Oxford Poverty & Human Development Initiative (OPHI) in collaboration with UNDP (OPHI, 2010-2015) to replace the HPI.[10] The MPI measures multidimensional poverty as an aggregation of poverty features along three dimensions: *health* (measured in terms of nutrition and child mortality), *education* (measured in terms of years of schooling and school attendance), and *living standard* (measured in terms of water, electricity, sanitation, floor, and assets) (Alkire & Foster, 2011a, 2011b; Alkire & Santos, 2014).

The Stiglitz-Sen-Fitoussi Commission (also known as Sarkozy Commission) listed the following as key dimensions: *material living standards* (income, consumption and wealth), *health*, *education*, *personal activities including work*, *political voice and governance*, s*ocial connections and relationships*, *environment* (present and future conditions), and *insecurity*, of an economic as well as a physical nature (Stiglitz et al., 2009).

Participatory approach: Sen (2004) strongly advocated for public participation in the evaluative exercise of the capability approach. The argument is that the selection of dimensions should incorporate opinions from the poor, thus, removing selection biases that might creep in from normative judgments of experts or general researchers. Narayan et al. (2000) summarised the following list of wellbeing dimensions complied from 81 PPA reports conducted by the World Bank in the 1990s that consulted 60,000 respondents from 50 countries. The dimensions included *material well-being*, *physical well-being*, *social well-being*, *security*, *freedom of choice action*, and *psychological well-being*. Table 3.1 presents the summary of all the studies mentioned, clearly showing the dimensions and their associated indicators.

[10] The HDR published by UNDP include the global MPI since 2010, which replaced the Human Poverty Index (HPI), which had been reported since 1997 (Anand & Sen, 1997). Different scholars in different countries have used the measure. For a detailed empirical application, see Alkire et al. (2015b).

Table 3.1: Summary of key studies used to derive the proposed list of dimensions

Key studies (year)	Dimensions	Indicators
1. Public consensus		
Stiglitz et al. (2009)	1. Material living standards	1. income; 2. consumption; 3. food; 4. shelter
	2. Health	5. pertinent aspects of healthy living; 6. diseases and disabilities; 7. access to health services
	3. Education	8. basic education; 9. continuous schooling; 10. professional development.
	4. Personal activities	11. paid work; 12. unpaid domestic work; 13. rights and opportunities at the workplace; 14. lifelong learning; 15. leisure
	5. Political voice and governance	16. right to vote; 17. access to public services and welfare schemes; 18. participation in political exercises and governance
	6. Social connections and relationships	19. friendships; 20. relationships; 21. social acceptance; 22. participation in society without discrimination
	7. Environmental conditions	23. living in a clean and pollution-free environment; 24. access to water and sanitation
	8. Insecurity, of an economic as well as physical nature	25. physical; 26. mental; 27. social; 28. religious; 29. political integrity; 30. unemployment; 31. disability; 32. illness; 33. retirement; recession
Alkire and Santos (2014)	1. Health	1. nutrition; 2. child mortality
	2. Education	3. years of schooling; 4. School attendance
	3. Living standard	5. drinking water; 6. sanitation; 7. electricity; 8. cooking fuel; 8. housing; 10. assets
UNDP (1990-2005)	1. Long and healthy life	1.life expectancy at birth
	2. Education	2. child enrolments; 3. adult years of schooling
	3. Standard of living	3. GNI per capita (PPP $)
2. Normative assumptions		
Nussbaum (2003)	1. Life	1. being able to live a normal life.
	2. Bodily health	2. being able to have good health; 3. being adequately nourished; 4. being adequately sheltered
	3. Bodily integrity	5. being secure; 6. being able to move freely; 7. having opportunities for sexual liberty
	4. Senses, imagination and thought	8. being able to use the senses, to imagine, think and reason; 9. being able to use imagination and thought; 10. being able to use one's mind in ways protected by guarantees of freedom of expression; 11. being able to have pleasurable experiences and to avoid non-beneficial pain
	5. Emotions	12. being able to have attachment to things and people outside ourselves; 13. to love those who love and care for us; 14. to express feelings of love, gratitude, grieve, hatred, and anger
	6. Practical reason	15. being able to form a conception of the good and to engage in critical reflection about planning one's life.

	7. Affiliation	16. being able to live with and towards others; 17. being able to be treated with dignity and without discrimination
	8. Other species	17. living in harmony with other species in one's environment.
	9. Play	18. being able to laugh, play, to enjoy recreational activities.
	10. Control over one's environment	19. being able to participate effectively in political choices; 20. having the right to political participation and protection of free speech and association; 21. enjoying equal rights and opportunities in holding properties; 22. having the right to seek employment on an equal basis with others; 23. having the freedom from unwarranted search and seizure
3. Participatory approaches		
Narayan et al. (2000)	1. Material wellbeing	1. having enough food; 2. having assets; 3. having work
	2. Physical wellbeing	4. being in good health; 5. appearing in public; 6. having a good physical environment
	3. Social wellbeing	7. having family; 8. self-respect and dignity; 9. social relationships
	4. Security	10. civil peace; 11. safe and secure environment; 13. personal physical security; 14. Security in old age; 15. lawfulness and access to justice; 16. confidence in the future
	5. Freedom of choice and action	17. enjoying human rights, the right to justice; 18. freedom of expression and action
	6. Psychological wellbeing	19. enjoying peace of mind; 20. being happy; 21. harmony in personal, social, and religious life

Source: Alkire and Santos (2014); Narayan et al. (2000); Nussbaum (2003); Stiglitz et al. (2009); UNDP (1990-2005)

3.4. Selected list of functioning dimensions

Motivated by normative theories and expert studies, I developed a list of functioning dimensions and indicators for the Botswana context. In addition, I reviewed the literature of some empirical studies employing the capability approach using nationally representative data (e.g., Klasen, 2000; Qizilbash & Clark, 2005; Wagle, 2008; Alkire et al., 2015b). In addition, the functioning dimensions are included for their intrinsic and instrumental significance (Klasen, 2000). Also, the study relied on Botswana's policy commitments and development priorities such as Vision 2036, NDP 11, the BPEPS and the SDGs to ensure that the measure is contextually relevant. Finally, data availability is considered.

Based on these different studies, I developed a summarised list of functioning dimensions and indicators presented in Table 3.2. The table presents the list of functioning dimensions, the deprivation they capture and the rationale behind their inclusion based on key studies. For example, education and health are explicitly considered key constituents all the list considered and are therefore included in the list. As can be seen from Table 3.2, each functioning dimension is derived from more than one approach. For example, material, health, housing and living conditions, food security, employment, social, and freedom and personal dimensions are derived from all three approaches. This shows the overlapping across the three approaches used. I use a unified approach in developing the list. This list forms the basis for selecting functioning dimensions because it is not constructed for any particular evaluative purpose and can be applied in different contexts.

To assess the validity of the selected list developed in Table 3.2, I made a preliminary assessment of the selected functioning dimensions by comparing the contents of the selected list with similar lists reported in key empirical studies employing the capability approach. Substantial overlapping in terms of functioning dimensions between my selected list and key studies operationalising the capability approach in the empirical literature exists. For example, the selected list covers all of the indicators and dimensions of the global MPI (Alkire & Santos, 2014) except child mortality and the dimensions proposed in the MODA child poverty study for Botswana (de Neubourg et al., 2015). In addition, the list covers all dimensions of key studies employing the capability approach

within a country context (e.g., Klasen, 2000; Kuklys, 2005). Such overlapping puts my selected list on a solid foundation.

Each functioning dimension from the selected list is carefully scrutinised in the context of Botswana and is subsequently passed through the test of availability of information on the functioning components from the 2015/16 BMTHS data. The 2015/16 BMTHS data form the informational basis and thus play a vital role in developing the final list. Chapter 4 of this thesis presents a brief description of the 2015/16 BMTHS data. Chapter 5 of this thesis presents a detailed discussion of the final list of the functioning dimensions.

Table 3.2: The selected list of functioning dimensions based on different approaches

Dimensions	Captures deprivation in terms of…	Rationale for inclusion	Source	Approach
1. Material	assets	material living standards	Stiglitz et al. (2009)	Public consensus
		material wellbeing	Narayan et al. (2000)	Participatory approach
		living standard	Alkire and Santos (2014)	Public consensus
2. Health	access to medical help	health	Stiglitz et al. (2009)	Public consensus
	being healthy	life	Nussbaum (2000, 2003)	Normative assumptions
	having health insurance	physical wellbeing	Narayan et al. (2000)	Participatory approach
		health	Alkire and Santos (2014)	Public consensus
3. Education	enrolment	education	Stiglitz et al. (2009)	Public consensus
	educational attainment	senses, imagination, and thought	Nussbaum (2000, 2003)	Normative assumptions
	literacy	education	Alkire and Santos (2014)	Public consensus
4. Housing and living conditions	housing condition	material living standards	Stiglitz et al. (2009)	Public consensus
	housing space	bodily health	Nussbaum (2000, 2003)	Normative assumptions
	construction material	material wellbeing	Narayan et al. (2000)	Participatory approach
	access to amenities	living standard	Alkire and Santos (2014)	Public consensus
5. Food security	food access	life	Nussbaum (2000, 2003)	Normative assumptions
	food utilisation (nutrition)	bodily health	Nussbaum (2000, 2003)	Normative assumptions
	food availability	material living standard	Stiglitz et al. (2009)	Public consensus
	food stability	material wellbeing	Narayan et al. (2000)	Participatory approach
		health (nutrition)	Alkire and Santos (2014)	Public consensus
6. Security	safety from crime and violence	bodily integrity	Nussbaum (2000, 2003)	Normative assumptions
	freedom of movement	other species	Nussbaum (2000, 2003)	Normative assumptions
		security	Narayan et al. (2000)	Participatory approach
7. Environmental	pollution-free environment	environmental	Stiglitz et al. (2009)	Public consensus
	pollution from material adversities	physical wellbeing	Narayan et al. (2000)	Participatory approach
8. Employment	meaningful (decent) employment	personal activities	Stiglitz et al. (2009)	Public consensus

	conducive working conditions	work and play	Nussbaum (2000, 2003)	Normative assumptions
	adequate leisure	material wellbeing	Narayan et al. (2000)	Participatory approach
9. Social	relationship and friendship	social connections	Stiglitz et al. (2009)	Public consensus
	participation in social events	friendship	Nussbaum (2000, 2003)	Normative assumptions
	protection against discrimination	affiliation	Nussbaum (2000, 2003)	Normative assumptions
		social wellbeing	Narayan et al. (2000)	Participatory approach
10. Freedom and personal	freedom of expression, choice and action	Social connections	Stiglitz et al. (2009)	Public consensus
	living in harmony with others	other species	Nussbaum (2000, 2003)	Normative assumptions
		psychological wellbeing	Narayan et al. (2000)	Participatory approach
		freedom of choice and action	Narayan et al. (2000)	Participatory approach

Source: Author derived from Alkire and Santos (2014); Narayan et al. (2000); Nussbaum (2000, 2003); Stiglitz et al. (2009)

3.5. Conclusions

This chapter discusses the operationalisation of the capability approach in multidimensional poverty assessment. Following other studies that operationalised capability approach in an empirical setup, this thesis adopted the functioning space. The evaluation in the functioning space deals with actual (observable) states of 'being and doing' of an individual. Functionings are easier to observe and measure than capabilities in an empirical setup (Sen, 1992). Also, relevant information to capture such functionings is readily available in most survey data. The capability approach takes into account personal, social, economic and environmental factors. This is in line with the LNOB principle, which is premised on the human rights-based approach and emphasises on data disaggregation to identify and profile those left behind (UNDP, 2018). Data disaggregation helps us to identify drivers/causes of being left behind. Operationalising the LNOB principle within the capability approach helps us to focus on each specific dimension of poverty. In addition, an LNOB assessment of different dimensions of poverty may yield insights into the causes of deprivation and how these vary by different subgroups of the population, with implications for the design and targeting of policy (Samman et al., 2021).

One of the key issues in the operationalisation of the capability approach is the selection of dimensions. Empirical literature demonstrated that there is no single approach best suited to operationalise the capability approach. Most studies operationalising the capability approach in the empirical literature have used a combination of more than one approach. In this chapter, key studies based on normative assumptions, public consensus and participatory approaches were used to select dimensions. I followed Robeyns (2003) and selected the dimensions in more than two stages. I started with key studies to generate the list of dimensions and their associated indicators and provided each method used to generate the list. From this list, I generated the ideal-feasible list providing the rationale for the inclusion of each dimension. The final list is passed through data availability in Chapter 5. Thus, the selection is reasoned, transparent, open to modification, and subjected to public debate (see Sen, 2004).

CHAPTER 4: DATA SOURCES AND METHODOLOGY

4.1. Introduction

This chapter discusses the data sources and methodology used in this thesis. Section 4.2 discusses data sources, including a discussion on data preparation and cleaning. The section also includes a description of the key variables used. The methodology used is presented in section 4.3, and section 4.4 presents the econometric regression models used. Section 4.5 presents my positionality statement, and section 4.6 presents ethical approval. Section 4.7 conclusions.

4.2. Data sources

The thesis utilises the 2015/16 Botswana multi-topic household survey (2015/16 BMTHS hereafter) conducted by Statistics Botswana (SB). This survey is a cross-sectional and nationally representative survey, allowing for disaggregation by demographic characteristics, economic variables and administrative districts. The survey aims to provide a comprehensive set of indicators designed to produce multidimensional welfare indicators at both household- and individual-level to allow for enriched and in-depth analyses. The 2015/16 BMTHS collected socio-economic information on sixteen (16) topical modules covering a sample of households across districts and sub-districts. The topical modules are designed to gather specific in-depth information. These modules include (but are not limited to) demographic characteristics, household expenditure and consumption, labour force, health, education, sources of income and social protection, self-assessed well-being and food insecurity, services within villages/community, housing, utilities, durable goods and livestock ownership, and anthropometric measurements (children under 18 years) (SB, 2018).

The dataset contains information from 24,720 individuals from 7,060 households surveyed in 2015/16. After applying sample weights, this resulted in an estimated 589,909 households and an estimated national population of 2,073,675 individuals (SB, 2018). The 2015/16 BMTHS individual population is comparable to the 2016 projected population of 2,219,736 estimated by SB (SB, 2015). The survey employed a two-stage stratified probability sample design. The first stage was the selection of primary sampling units (PSUs), which were

enumeration areas (EAs) using Probability Proportional to Size (PPS), where the measure of size is the number of households in an EA as defined in the 2011 Population and Housing Census. The second stage was the selection of occupied households within the selected EAs. A list of identified occupied households formed the basis of secondary sampling units (SSUs). Thus, the number of occupied households in each selected EA served as a sampling frame for that EA (SB, 2018). Stratification was made based on the twenty-six (26) census districts, which are heterogeneous and are aligned to administrative districts. The districts were further grouped into three strata: cities/ towns, urban villages, and rural areas (SB, 2018). Table 4.1 below summarises the dataset used.

Table 4.1: Sample distribution of the data

	Sample	Population
Households	7,060	589,909
Individuals	24,720	2,073,675

Source: SB (2018); Author computed.

4.2.1. Preparation and cleaning of the dataset

The Botswana Institute for Development Policy Analysis (BIDPA) officially requested the 2015/16 BMTHS dataset on behalf of researchers for research and academic purposes. The initial dataset only included information aggregated at the household level. The dataset did not include a lot of topical modules needed to construct deprivation indicators. I made a follow-up request to Statistics Botswana to obtain specific topical modules such as individual demographic characteristics, sources of income and social protection, self-assessed well-being and food insecurity, and anthropometric measurements. The information contained in the datasets is anonymised.

After obtaining all the needed topical modules, I followed a very rigorous and transparent data cleaning process. First, a descriptive analysis of the distribution and outliers of the key variables using the raw data from Statistics Botswana was undertaken. Second, I then compared my summary results with those contained in the reports by Statistics Botswana. Third, in cases where discrepancies were noted, I notified Statistics Botswana to seek clarity. I exchanged emails with the Poverty manager (Statistics Botswana) discussing issues relating to discrepancies and in cases where the results did not make practical sense. Fourth, in cases

of serious gaps, we cross-checked if the data I obtained from Statistics Botswana is similar to the final dataset used by Statistics Botswana. In cases they are different, I requested a more updated dataset. I followed this process meticulously in each module before I could use variables to compute indicators.[11]

After data cleaning, I merged the different modules into the main dataset used to compute the poverty datum line (PDL). The household datasets are then merged with the individual datasets. Individual sample units are treated as the units of observation and include relevant variables that provide information at the individual level. The merged datasets were then imported into the STATA format to facilitate the computation of indicators and analysis.

4.2.2. Description of key variables

In this section, I present a description of the key variables and how they were derived. I divided the selected variables into three main categories: demographic, economic and geographic variables.

4.2.2.1. Demographic variables

I capture the demographic information using six categorical variables: gender, age, marital status of household head, household size, citizenship and disability. The description of the demographic variables (individuals and household characteristics) is provided below.

Gender: Gender has been recognised as a critical factor in Botswana in the formulation and implementation of policies and programs or intervention strategies (Lesetedi, 2018) and has been mainstreamed into most policies and programmes targeting poverty (Monyeki, 2013). During NDP 11, gender analysis and gender equality centred planning will be promoted to inform gender-responsive and rights-based policies (MFED, 2016). According to Vision 2036, Botswana will be a society where all men and women have equal opportunities to actively participate in economic, social and political development (Republic of Botswana, 2016). I use the *sex* variable as a proxy for gender. The *sex* variable is a categorical variable with two categories: male and female, taking values 1 and 2, respectively. In 2015/16, males

[11] A detailed description of how I derived each deprivation indicator is presented in section 4.5.

accounted for 47.1 per cent of the total population compared to 52.9 per cent of their female counterparts (SB, 2018). These results are consistent with the 2011 population and housing censuses, where females accounted for 51.2 per cent, and males accounted for the remaining 48.8 per cent (SB, 2013b).

Age: The *age* variable is a continuous variable ranging from 0 to 98 years. I derived the age group variable and divided it into four categories: below 18 years, 18 to 35 years, 36 to 64 years, and 65 years and above, to represent children, youth, adults and older persons, respectively. The classification of age groups is adapted to the Botswana context. First, an age threshold for children (0-17 years) is set according to the legal definition of a child as per the Botswana Children's Act, 2009 (Republic of Botswana, 2009). Second, the age threshold of 35 years is set to separate the youth from children and adults as per the 2010 Revised National Youth Policy (Republic of Botswana, 2010). Finally, the threshold of 65 years is set to separate older persons from adults.

Data show that children (0-17 years) accounted for the largest share of the population, recording 39.5 per cent in 2015/16, while the youth accounted for 31 per cent during the same period (SB, 2018). The results indicate that Botswana has a youthful population, with children and youth accounting for 70.5 per cent. These results are consistent with the 2011 population and housing census, where children and youth accounted for 71.6 per cent (SB, 2013b). Botswana aspires to have made substantial investments in its youthful population to reap demographic rewards (Republic of Botswana, 2016). According to NDP 11, vocational training will be elevated to a level where it can cater for industry-relevant skills for the youth for employment (MFED, 2016). Adults accounted for 24.2 per cent, while older persons recorded 5.3 per cent. Data from the 2011 population and housing census show that older persons accounted for 5.6 per cent (SB, 2013b). According to Vision 2036, older persons (65 years and above) will have equal access to economic opportunities enjoyed by all (Republic of Botswana, 2016).

Marital status: The marital status of the household head is used as a proxy for the family structure, and it has six categories: married couple, cohabiting couple, divorced, separated,

widowed and never married. Marriage in Botswana is fundamental as it defines the household family structure. The institution of marriage plays a pivotal role in children's upbringing and provides a safe, secure and enabling environment for children to grow to reach their full potential (Republic of Botswana, 2016). It is central to household, community and socio-economic stability and is where values such as *Botho*[12] are taught (Republic of Botswana, 2016). Therefore, it is imperative to disaggregate data by marital status of the household head to identify those left out.

Household size: The household size variable is a continuous variable counting the number of household members. I derived a categorical variable (household size groups) and grouped it into three categories: 1-3 members, 4-6 members and more than seven members. In 2015/16, 30.4 per cent, 38.5 per cent and 31.1 per cent of the population resided in households with 1 to 3, 4 to 6 and more than seven members, respectively. The household size averaged 3.50 in 2015/16 (SB, 2018).

Citizenship: The derived citizenship variable has two categories: citizen and non-citizen. The non-citizen population accounted for only 3.3 per cent. According to the 2011 population and housing census, non-citizens accounted for 5.5 per cent (SB, 2013b).

Disability: Disability is considered a personal characteristic that should be considered in assessing poverty (Mitra, 2006) and is also a critical variable in the SDG agenda, especially LNOB. The SDG agenda calls for data to be disaggregated by disability variable (UN, 2015). In Botswana, disability is recognised, and the position that disability issues should be seen in terms of social inclusion is emphasised in both Botswana's Vision 2036 and NDP 11.[13] The *disability* variable has six categories explaining each type of disability: difficulty in seeing,

[12] According to Vision 2016, *Botho* describes a well-rounded character, well-mannered, courteous and disciplined, who realises his/her full potential either as an individual and/or as part of the community to which he/she belongs (Republic of Botswana, 2016: 11).

[13] Vision 2036 highlights the importance of the social inclusion of people with disability as a national objective and it clearly states that people living with disabilities will have equal access to services and socio-economic opportunities (Republic of Botswana, 2016). NDP 11on the other hand defines the provision of essential support services to people with disability as a national priority.

hearing, walking, remembering, communicating, and self-care (use of hands).[14] First, the six categories were recoded into independent dummy variables to explain each type of disability. A person reporting any difficulty in any of the six options was defined as disabled in that category. The indicators were then merged into a single domain to determine the disability status of an individual. An individual is identified as living with a disability if he/she reported any difficulty in at least one of the six indicators. The proportion of persons with disabilities is estimated at 2.8 per cent in 2015/16 (SB, 2018). The figure is consistent with the 2011 population and housing census results, where the percentage of persons with disabilities was 2.9 per cent (SB, 2013b).

4.2.2.2. Economic variables

Quintiles: An interesting policy question is how multidimensional deprivations vary across income groups. Data disaggregated by quintile/deciles and economic activities are included in identifying those left behind (UN, 2013). Therefore, to capture the inequalities across different dimensions, such as education and health, I will undertake a quintile analysis[15] to show how deprivation levels vary with income.

Economic activity: To capture economic activity, I use the employment status of the household head. I derive five categorical variables: unemployed, paid employment, self-employment, working on own farm and working as an unpaid family helper.[16] In 2015/16, 39.9 per cent of the population resided in households headed by unemployed persons (note that this figure is not the same as the unemployment rate). The unemployment rate is

[14] Since 2001, a worldwide effort has been made to collect internationally comparable disability data through the UN's Washington City Group on Disability Statistics (Madans, 2011). The questions are framed in line with UN's Statistical Office recommendation for a shortlist and an extended list of questions to measure disability consistently worldwide. The shortlist includes six questions- five capturing functional limitation (limitations in seeing, hearing, walking or climbing steps, concentrating, and communicating) and one of self-care (limitation in showering or dressing) (Mitra, 2013).

[15] An income quintile is a measure of neighbourhood socioeconomic status that divides the population into 5 income groups in such a way approximately 20 per cent of the population is in each group. The first quintile represents the 20 per cent of poorest populations while the fifth quintile represents 20 per cent of the population with highest income (richest). The quintile groups are calculated based on per capita household consumption. I divided total household consumption by household size to derive per capita household consumption.

[16] *Ipelegeng*, a public works programme, was included on the 2015/16 BMTHS to capture employment status. However, I did not include it under paid employment since it is not a fulltime employment. Individuals enrolled in *Ipelegeng* are considered unemployed.

estimated at 17.7 per cent based on the 2015/16 BMTHS. About 32.2 per cent resided in households whose heads are engaged in paid employment in 2015/16, followed by 10.9, 6.8 and 6.2 per cent in families headed by those engaged in self-employment, own farm and unpaid family helper, respectively (SB, 2018).

4.2.2.3. Geographic variables

Geographic information is used as a proxy for the environmental conversion factors in the capability approach. Geography plays an essential role in the LNOB principle because people are left behind when denied social and economic opportunities based on their place of residence. Therefore, geography reveals a person's access to opportunities (UNDP, 2018). It is crucial to dig below national averages to uncover who is being left behind. For example, Botswana's national monetary poverty rate is estimated at 16.3 per cent. However, geographical disaggregation depicts a heterogeneous picture, with poverty rates ranging from 5 per cent in Sowa Town district to 50.6 per cent in Kweneng West district (SB, 2018).

Two categorical variables are used to capture geographical information. First, the region (strata) is divided into three categories (cities and towns, urban villages, and rural areas); and second, the district variable is comprised of 26 heterogeneous census districts (SB, 2018). Population distribution is becoming more concentrated in urban areas than in rural areas. Urban villages recorded the highest share of 43.9 per cent, followed by rural areas with 34.9 per cent and cities/towns with 21.1 per cent (SB, 2018).

4.3. Methodology used for analysis

Several approaches have been proposed and applied in the empirical literature on multidimensional poverty measurement (see Alkire et al., 2015b). These approaches include axiomatic approaches (Tsui, 2002; Bourguignon & Chakravarty, 2003; Alkire & Foster, 2011a, 2011b; Chakravarty & D'Ambrosio, 2013), statistical approaches, including factor analysis (Lelli, 2001), principal component analysis (Klasen, 2000), multiple correspondence analysis (Kuklys, 2005; Krishnakumar, 2008), fuzzy set approach (Cerioli & Zani, 1990; Cheli & Lemmi, 1995; Belhadji & Limam, 2012; Betti et al., 2015), dashboards (Alkire et al., 2011; Ravallion, 1996, 2011), Venn diagrams (Roelen et al., 2009; Alkire & Seth, 2013;

Atkinson et al., 2010; Ferreira & Lugo, 2013), composite indices (Morris, 1978; Anand & Sen, 1994, 1997), and dominance approach (Duclos et al., 2006).[17]

Dashboards and composite indices do not reflect the joint distribution of deprivations. Venn diagrams, dashboards, statistical and dominance approaches do not produce a single aggregate index to assess poverty. Only the axiomatic and fuzzy set approaches reflect the joint distribution of the poor, identify the poor and produce a single aggregate poverty index. However, the main weakness of the fuzzy set approach relates to the use of ordinal data. The indicator variables used in this thesis are ordinal. Also, fuzzy set measures may not satisfy other properties usually considered key: focus, weak transfer, and, in some cases, subgroup decomposability. The axiomatic approach also has some limitations. Despite the limitations, axiomatic approaches offer a strong tool for measuring multidimensional poverty, with the advantages outweighing the potential drawbacks (see Alkire et al., 2015b).

For multidimensional poverty measurement, the axiomatic approach is chosen. Axiomatic measures present several opportune features. They comply with the two necessary steps of poverty measurement: identifying the poor and aggregating the information into a single headline figure (Alkire et al., 2015b). In addition, axiomatic measures include measures that only apply when indicators are cardinal or ordinal. For unidimensional analysis, a dashboard approach is used to assess the level of deprivation in indicators separately.

Specifically, this thesis employs the axiomatic counting methodology developed by Alkire and Foster (2011a) (henceforth AF) to estimate individual-level multidimensional poverty.[18] The AF methodology was chosen over other methods for a number of technical and practical reasons (Alkire et al., 2015b). First, this method can identify all poverty measures: headcount ratio, intensity, MPI (adjusted head count ratio) and inequality (Alkire & Foster, 2011a). Second, being an axiomatic family of measures, this method satisfies a number of desirable properties, including the axioms of population subgroup decomposability and dimension breakdown (Chen et al., 2019), which is useful for policymakers when developing

[17] For a detailed discussion of these different approaches see Alkire et al. (2015b).
[18] For a detailed outline of the methodology and discussion in aggregation approaches see Alkire et al. (2015b). Chapter 5 of the book discusses the methodology in detail.

interventions and targeted policies (Alkire & Apablaza, 2016). Third, from a practical perspective, the AF method uses the intuitive counting approach to identify the poor and explicitly assess the simultaneous or joint distribution of deprivations experienced by the poor people in a set of indicators (Alkire & Foster, 2011a). It allows for examining the composition of poverty in different subgroups (socio-demographic and location), indicators and dimensions required by the LNOB principle. Third, the AF method, especially the adjusted headcount ratio, is particularly applicable in my case due to its ability to use ordinal or binary data. All deprivation indicators are categorised as dummy variables. Fourth, this method is chosen for its methodological robustness, intuitive characteristics, and growing popularity in the field (Alkire et al., 2015b; Abeje et al., 2020). Fifth, the AF method is simple, flexible and clear (Silber, 2011; Thorbecke, 2011). Last, in line with this thesis, the most desirable part of the AF method is that it can be adapted to different contexts and purposes. Different dimensions and indicators can be selected depending on the purpose at hand (Abeje et al., 2020). This, coupled with the technical and practical advantages of the AF method, makes it an attractive option to inform policy.

To examine the level of inequality among the multidimensionally poor, the inequality measure proposed by Alkire and Seth (2014a) is employed. The inequality measure is based on the adjusted headcount ratio, which is a part of the AF method. This measure helps to reveal pockets of high intensities that might otherwise be missed by poverty measures, thereby ensuring that no one is left behind (Alkire & Seth, 2014b).

4.3.1. The AF methodology

Before describing the identification and the aggregation steps of the AF methodology, the achievements of all *n* persons within a society in all *d* indicators, summarised by an $n \times d$-dimensional matrix $\boldsymbol{X} = [x_{ij}]$, where x_{ij} is a set of achievement indicators for the person *i* $(i = 1, \cdots, n)$ in indicator j $(j = 1, \cdots, d)$ are considered. Thus, row *i* of $\boldsymbol{X}$ represents the achievement vector of person *i*, summarising the person's achievements in all d indicators, and its *j*th column contains the achievements of all *n* persons in indicator *j*. The AF methodology uses a two-step 'dual cut-off' process to identify the poor (Alkire & Foster, 2011b).

The first cut-off process is linked to deprivation cut-offs for each indicator, x_i and is denoted by z_j represented by a vector $z = (z_1, z_2 \cdots, z_d)$ where *d* represents the number of indicators. Any person *i* is deprived in any indicator *j* if her achievement falls below the deprivation cut-off z_j (or $x_{ij} < z_j$) for indicator *j*. From the $\boldsymbol{X}$ matrix and *z* vector, a matrix of deprivation $g^0[g_{ij}^0]$ is obtained such that $g_{ij}^0 = 1$ if $x_{ij} < z_j$ and $g_{ij}^0 = 0$ if $x_{ij} > z_j$ for all $j = 1, \cdots, d$ and $i = 1, \cdots, n$. Next, let $w = (w_1, w_2 \cdots, w_d)$ be the vector of indicators' weights. The weight attached to indicator *j* is denoted by w_j such that $(w_j > 0)$. These weights sum to 1, that is, $\sum_{j=1}^{d} w_j = 1$ and $w_j \in [0,1]$. Then, the deprivation score c_i is computed for each person *i*, such that $c_i = \sum_{j=1}^{d} w_j g_{ij}^0$. If an individual is not deprived in any indicator $c_i = 0$, and if an individual is deprived in all indicators $c_i = 1$. The vector of deprivations for all individuals is given by $c = (c_1, c_2 \cdots, c_n)$.

The second step involves choosing a poverty cut-off point, *k*, using the deprivation profiles in all indicators to identify the multidimensionally poor.[19] The choice of *k* is such that $1 \leq k \leq d$.[20] The poverty cut-off is implemented by using the method of identification ρ_k. A person *i* is identified as multidimensionally poor using a poverty cut-off *k*, such that $c_i \geq k$. Algebraically, $\rho_k(x_i; z) = 1$ if $c_i \geq k$, and $\rho_k(x_i; z) = 0$ otherwise. Based on empirical evidence and guided by the BPEPS, this thesis uses a cut-off of 33.33 per cent (*k*=0.333). The BPEPS defines the multidimensionally poor as those deprived in at least 33.33 per cent of the deprivation score and those deprived in more than 50 per cent as severe multidimensionally poor. The choice of *k*=0.333 means one is multidimensionally poor if deprived in two full dimensions or more. In addition, I assess if the index is robust for different poverty cut-offs (*k* values) using the complementary cumulative distribution function (CCDF) and changes in weighting structure (*w*). From the deprivation matrix $g^0[g_{ij}^0]$, a censored deprivation matrix $g^0(k)$ is constructed by multiplying each element in

[19] The choice of *k* can be made normatively, either based on previous studies or what the society would consider reasonable. It can also be chosen to reflect the country's policy goal (Mushongera et al., 2017).
[20] *k* represents the share of weighted deprivations that a person must experience to be considered multidimensionally poor. That is, in order to be identified as multidimensionally poor, a person's deprivation score must be equal to or larger than the poverty cut-off ($c_i \geq k$).

g^0 by the identification function $\rho_k(x_i; z)$: $g_{ij}^0(k) = \rho_k(x_i; z)$: $g_{ij}^0 \times \rho_k(x_i; z)$ for all i and all j. A censored deprivation score vector for all individuals is then obtained from the original deprivation score vector: $c(k) = c \times \rho_k(x_i; z)$. Let $c(k) = \sum_{j=1}^{d} w_j g_{ij}^0(k)$ be the censored deprivation score of individual *i*; by definition $c_i(k) = c_i$, if $c_i \geq k$ and $c_i(k) = 0$, if $c_i < k$ (Alkire & Santos, 2014).[21] Then, $c(k) = [c_1(k), c_2(k) \cdots, c_n(k)]$.

The AF methodology proposes a family of multidimensional poverty measures M_α that is based on the Foster, Greer, and Thorbecke (FGT) class of poverty measures (Foster et al., 1984) to solve the problem of aggregation. This thesis uses the first measure of this family; the adjusted headcount ratio is denoted by M_0 and contains both multidimensional headcount ratios (*H*) and the average deprivation scores, capturing the intensity of poverty (*A*) (Alkire et al., 2015b). Algebraically, M_0 is computed as:

$$M_0 = H \times A = \frac{q}{n} \times \frac{1}{q} \sum_{i=1}^{q} c_i\,(k) = \frac{1}{n} \sum_{i=1}^{n} c_i\,(k) \qquad (4.1)$$

This thesis uses M_0 to estimate individual-level multidimensional poverty in Botswana. The advantages of this measure are based on its two key properties: the 'population subgroup decomposability', which allows for examining subgroup contributions to all poverty, and the breakdown property by an indicator which makes it possible to find out the contribution of each indicator to the overall poverty.

4.3.2. The Inequality methodology

Inequality is one of the key priorities of the SDG agenda (UN, 2015). However, inequality has been neglected in the study of multidimensional poverty, as evidenced by few studies assessing inequality in the empirical literature (e.g., Hanandita & Tampubolon, 2016; Espinoza-Delgado & Klasen, 2018). Therefore, in line with LNOB, this thesis examines inequality among the multidimensionally poor and adds to the limited literature. Using

[21] The censoring step retains the deprivation scores of those who are identified as poor and replaces the deprivation scores of those who are not identified as poor ($c_i < k$) by 0 (Alkire et al., 2015b).

inequality measure provides value addition to the information provided by the adjusted headcount ratio (M_0). The thesis employs a separate decomposable inequality measure (I_q) proposed by Alkire and Seth (2014a). This proposed measure is based on a positive-multiple variance to overcome the obstacles stemming mainly from the use of non-cardinal indicator variables in the construction of M_0 (Alkire & Seth, 2014a; Hanandita & Tampubolon, 2016).

To assess inequality among the multidimensionally poor, and following Alkire and Seth (2014a), I suppose that the deprivation scores are ordered in descending order, and the first q persons are identified as poor. The elements are taken from the censored deprivation score vector $y = [c_1(k), c_2(k) \cdots, c_q(k)]$. I choose vector y such that it contains only the deprivation scores of the poor $(t = q)$. The average of all elements in y then is the intensity of poverty which for q persons is $\mu(y) = A$. I can then denote the inequality measure that reflects inequality in multiple deprivations only among the multidimensionally poor by I_q , which can be expressed as:

$$I_q = \frac{\tilde{\beta}}{q} \sum_{i=1}^{q} [c_i(k) - A]^2 \tag{4.2}$$

where q denotes the number of the multidimensionally poor, $c_i(k)$ is the deprivation score among the poor, A is the intensity of poverty, and $\tilde{\beta}$ is the normalisation factor that must be chosen such that $I_q = [0,1]$ (Alkire & Seth, 2014a), representing the properties of any standard inequality (Hanandita & Tampubolon, 2016). Following Alkire and Seth (2014a), $\tilde{\beta}$ equals the inverse of $\frac{1}{4}\{max[c_i(k)] - min[c_i(k)]\}^2$.[22] Therefore, $\beta = 4$ in equation 4.2. This measure (I_q) helps to reveal pockets of high intensities that might otherwise be missed by poverty measures, thereby helping to ensure that no one is left behind (Alkire & Seth, 2014b). In the SDGs, this is captured by SDG 10, which aims to reduce inequality within and

[22] That is, 'the maximum possible value that variance takes is one fourth of the range of the deprivation score vector, which is attained when half of the population have the lowest scores and the other half have the highest deprivation scores' (Alkire & Seth, 2014a: 16).

among countries (UN, 2015). Inequality is a problem of inclusion, and LNOB can be viewed as a tool for addressing inequality (Fukuda-Parr & Hegstad, 2018).

When using ordinal data, the AF measure is insensitive to inequality among the poor (Silber & Yalonetzky, 2014). Therefore, I also estimate the Correlation-Sensitive Poverty Index (CSPI) proposed by Rippin (2013, 2016, 2017), which is an inequality-sensitive multidimensional poverty index (Espinoza-Delgado & Klasen, 2018; Burchi et al., 2021). The CSPI takes into account the inequality among the multidimensionally poor and uses the union approach to identify the multidimensionally poor individuals (Rippin, 2013, 2016, 2017; Espinoza-Delgado & Klasen, 2018; Burchi et al., 2021). Therefore, the CSPI is simply the squared sum of weighted deprivations suffered by the multidimensionally poor individuals divided by the maximum possible number of weighted deprivations. It is computed as follows:

$$CSPI = \frac{1}{n}\sum_{i=1}^{n}\sum_{j=1}^{d}\left(w_j g_{ij}^{0}(k)\right)^2 \qquad (4.3)$$

The CSPI can be broken down into poverty prevalence, intensity, and inequality (Jenkins & Lambert, 1997; Espinoza-Delgado & Klasen, 2018; Burchi et al., 2021).

4.3.3. Botswana official monetary poverty measure

This thesis uses the Botswana official monetary poverty measure (BOMPM) to operationalise the monetary approach. The BOMPM is based on consumption expenditure (SB, 2018), and the assessment is carried out by Statistics Botswana. The measurement of BOMPM relies on the absolute poverty line grounded in a nutritionally based food basket, supplemented by the allowance for non-food needs (World Bank, 2015). Statistics Botswana provides a clear account of the method used to estimate the PDL. The computation of the PDL is based on the cost of a basket of goods and services considered necessary to meet household members' basic needs (SB, 2018). The PDL is associated with the individual and household composition, considering household sizes, individual gender, age, and region (SB, 2018).

Five components are used to calculate the PDL: food, clothing, personal items, household goods and shelter; and the cost of each of the five components of the PDL basket was calculated considering household size, individuals' gender and age, and region (SB, 2018). Each of the five components' poverty lines is added to obtain each household's poverty line. The poverty line for each household is compared with the reported total consumption. If a household's total consumption falls below the corresponding poverty line, then the household and every individual in that household is considered poor (SB, 2018). The official poverty measure is reported as a headcount ratio or a percentage of the poor people in the population. It is computed using the FGT (1984) proposed class of poverty measures out of practical demand for a decomposable poverty measure. Their measure is defined as

$$P_{\alpha}(y;z) = \frac{1}{n}\sum_{i=1}^{q}\left(1 - \frac{y_i}{z_i}\right)^{\alpha} \tag{4.4}$$

where z is the PDL, n is the total number of people, q is the number of poor (those from households with consumption expenditure levels below z), y_i is the consumption expenditure of each household i, q is the number of poor persons and $\alpha_i \geq 0$ is a 'poverty aversion' parameter. The higher the value of α, the greater the weight placed on the poorest individuals. When $\alpha = 0$, equation 4.4 reduces to the headcount ratio, which captures the proportion of the population below the poverty line (z).

4.4. Modelling determinants of multidimensional poverty

This thesis adopts two approaches to model the determinants of multidimensional poverty in Botswana. The first approach involves estimating a logit regression to make inferences about poverty status. The logit model has been used to measure the determinants of the probability of being multidimensionally poor (e.g., Qi & Wu, 2016; Espinoza-Delgado & Klasen, 2018). The dependent variable is specified as a binary variable taking a value of 1 if the individual is considered multidimensionally poor and 0 if the individual is non-poor. In such cases where the dependent variable is a dummy variable, binary choice models such as logit models should be applied. The logit model is specified as:

$$ln\left[\frac{p_i}{1-p_i}\right] = x_i'\beta + \varepsilon_i \quad (4.5)$$

where the subscript $i = 1, \cdots, N$ represents the number of observations, p_i is the probability that the *i*th individual is considered multidimensionally poor household is poor, x_i is a vector of independent variables, β represents a vector of unknown parameters, and ε_i is a disturbance error term. The independent variables include individual characteristics, household-level variables, economic variables and geographical variables. These selected variables are commonly used in the literature as key determinants of poverty (e.g., Grootaert, 1997; Qi & Wu, 2016; Lekobane & Seleka, 2017). The independent variables have also been selected on the grounds of 'restraining' any 'possible' endogeneity issue that may arise in the construction of the multidimensional poverty index (Alkire et al., 2015b). Also, variables such as age, gender, ethnicity, race, locality and disability are associated with the probability of being left behind (UN, 2016a, 2016b). The parameters of the logit model are estimated by the maximum likelihood method (ML).

Despite the popularity of this approach, it has been criticised for leading to the loss of information from collapsing data (deprivation scores) into a binary variable since all non-poor individuals are treated alike as censored data (Datt & Jolliffe, 2005). Therefore, the second approach involves using the Tobit model (Tobin, 1958) for econometric estimation. Specifically, the censored regression model, a generalisation of the standard Tobit model, is employed to assess the correlates of multidimensional poverty. The Tobit model is used to detect the relationship between the non-negative dependent and independent variable(s) for truncated data. The dependent variable is the deprivation score c_i for multidimensional poverty, which is truncated in our regression. The dependent variable can be either left-censored, right-censored, or both left-censored and right-censored, where the lower and/or upper limit of the dependent variable can be any number. The deprivation score, c_i, ranges

from 0 (left-censored) to 1 (right-censored).[23] Thus, to generate more accurate regression results, a two limit Tobit model was used:

$$y_i^* = x_i'\beta + \varepsilon_i \tag{4.6}$$

$$y_i = \begin{cases} 0, & if\ y_i^* \leq 0 \\ y_i^*, & if\ 0 < y_i^* < 1 \\ 1, & if\ y_i^* \geq 1 \end{cases} \tag{4.7}$$

where the subscript $i = 1, \cdots, n$ represents the number of observations, y_i^* is an unobserved (latent) dependent variable dual-censored at lower limit 0 and upper limit 1, y_i is the distributed dependent variable, x_i is a vector of independent variables, β represents a vector of unknown parameters, and ε_i is a disturbance error term. Any truncated observation can be presented by $c_i = \{i: y^* \leq 0 \cap y^* \geq 1\}$. The censored Tobit model is estimated using the ML method to examine the statistical significance of parameters of socioeconomic variables.

In addition, the quantile regression model (Koenker & Bassett, 1978) is used to allow the analysis of the effect of poverty determinants in the different quantiles in the distribution of the dependent variable, thus showing the full picture of the relationships between variables (Habyarimana et al., 2015; Garza-Rodriguez et al., 2021). Then, the differential effects of the determinants of poverty across its spectrum can be compared (Peng et al., 2019). The quantile regression model is a natural extension of the OLS regression model (Hao & Naiman, 2007).[24] To explain the quantile regression model methodology, first, the OLS regression model is specified (Leeds, 2014). The OLS regression model is expressed as follows:

$$y_i = x_i'\beta + \varepsilon_i \tag{4.8}$$

[23] When c_i=0, this indicates no deprivation in any indicator and when c_i=1, this indicates deprivation in all indicators.

[24] The quantile regression model estimates the coefficients by minimising the weighted sum of absolute residuals of the estimation.

for $i = 1, \cdots, n$, y_i is the deprivation scores, x_i is a vector of independent variables, β represents a vector of unknown parameters to be estimated, and ε_i is a disturbance error term. To obtain the parameters in equation 4.8, the method of minimisation of squared errors is employed:

$$min \sum_i (y_i - x_i'\beta)^2 \tag{4.9}$$

The quantile regression model is expressed as follows:

$$y_i = x_i'\beta^\tau + \varepsilon_i^\tau \tag{4.10}$$

where τ represents the quantile and $0 < \tau < 1$, for $i = 1, \cdots, n$. The quantile estimator is more efficient than the OLS estimator when errors are not normally distributed; thus, it is a robust method (Cameron & Trivedi, 2005).

4.5. Positionality statement

I have needed to place my researcher self in perspective. This research hit me closer to home in more ways than one. Several aspects of my personal lived, and professional experiences are particularly relevant in this thesis. From a personal perspective, I am a middle-aged family man, father and Christian. This research is conducted in Botswana, where I was born and raised. Specifically, I should mention that I was born in a rural village (Sesung) in Kweneng West District (one of the poorest districts in Botswana), where I attended my primary and junior secondary schools. I further attained both my undergraduate and postgraduate degrees from the University of Botswana and later worked in Botswana for 17 years. I am conversant with the traditions and local languages of Botswana.

I have experienced the brunt of poverty most of my childhood life, raised by a single, unemployed and widowed mother, going to school hungry and barefooted, attending classes under a tree, which was also a reality for many other children in the same cohort. Having experienced life on both sides of the fence, I place myself as an insider researcher. As a

Christian, I sorely believe the government has a great responsibility to protect the poor from being destroyed by their own poverty by providing sustainable and inclusive means to improve their livelihoods. The progress of a country should be gauged by improvements in the ordinary lives of its citizens. It, therefore, makes no economic sense for a country to thrive being a high-income-country status when its citizens are experiencing severe poverty situations. A country should strike a balance between economic and human development.

Regarding my professional experience, I am a Statistician by training and currently working as a research fellow for BIDPA - a think tank research institute for the Botswana government. I conduct research and policy analysis on poverty, social protection, inequality, and social policy. I have over thirteen (13) years of experience working in the research environment focusing on poverty analysis. As a researcher, I also conduct participatory research with people living in poverty and those benefiting from government social assistance programmes. My view that poverty is a multidimensional concept and should be examined from an individual level comes equally from my practical experiences and my view as a researcher on poverty. I believe that how poverty is conceptualised and measured significantly influences the policies adopted and implemented by governments to eradicate poverty.

I, therefore, position myself as an insider researcher who has intimate knowledge of the study area. I approach this research from a practical perspective based on both lived and professional experiences, and this will be an added advantage concerning the analysis and interpretation of the results. The result of holding this position is that I naturally tend toward both practitioner's viewpoint and lived experiences when developing and thinking about my current research. This is an advantageous position in many ways because I represent both the practical and lived experiences of poverty in Botswana. I am aware of the potential bias this may cause and will, therefore, will take proper precautionary measures to avoid any bias and conflict of interest. I engaged in a self-reflexive exercise at various stages of the analysis of data analysis. Therefore, I must make anyone who reads my thesis aware of my position in order that they know the lens through which the thesis was conceptualised and analysed.

4.6. Ethical approval

Ethical and management of ethical risks are fundamental requirements to be considered in all research. The University of Sussex's research ethics committee reviewed the proposal of this thesis for approval to ensure that it complies with the research ethics policy. This thesis relied on secondary quantitative survey data collected by Statistics Botswana. BIDPA officially requested the 2015/16 BMTHS dataset on behalf of researchers for research and academic purposes. The dataset is anonymised; it does not contain information on individuals, such as names or contact details. I obtained ethical approval from the University of Sussex to undertake this research and have included the approval certificate (see Figure A4.1 in the appendix).

4.7. Conclusions

This thesis relies purely on secondary quantitative data. The data used for analysis is cross-sectional, covering all administrative districts in Botswana, thus allowing for an in-depth analysis. Also, the dataset is detailed and has many modules to be used. The thesis also employs several methods, from descriptive analysis to econometric analysis, thus providing in-depth, rich analysis. However, some limitations do exist. For example, the lack of longitudinal data limits the study to investigate longitudinal changes in multidimensional poverty and examine changes in associated dimensions. Therefore, this thesis is unable to analyse poverty dynamics, tracking individuals exiting or entering poverty and the impact of social protection over time.

CHAPTER 5: CONSTRUCTING AN INDIVIDUAL LEVEL MULTIDIMENSIONAL POVERTY INDEX FOR BOTSWANA[25]

5.1. Introduction

In developing a multidimensional poverty index, several decisions need to be made relating to the data to be used, the unit of analysis, selection of dimensions, indicators and poverty cut-offs, weighting schemes and the poverty method to be applied. This chapter attempts to discuss and address the issues mentioned above. Even though these issues have been addressed in the empirical literature, the issue of the unit of analysis has not received the much-needed attention, and most empirical studies use the household as the unit of analysis for multidimensional poverty measurement (Angulo et al., 2016; Ervin et al., 2018).

Only three studies have attempted to estimate individual-level multidimensional poverty for the whole population using the Alkire and Foster methodology, to the best of my knowledge. The first study was done by Franco-Correa (2014) for the case of Chile, Colombia, Ecuador, and Peru. Espinoza-Delgado and Klasen (2018) did the case of Nicaragua, and Klasen and Lahoti (2020) examined the case of India. However, these studies did not provide an in-depth analysis of poverty levels by different socio-demographic characteristics of the population. For example, Espinoza-Delgado and Klasen (2018) considered analysis by gender and age only, while Franco-Correa (2014) examined multidimensional poverty across age groups.

The objectives of this chapter are to develop an individual-level and country-specific multidimensional poverty measure and to provide a multidimensional poverty estimate for Botswana. In so doing, this chapter addresses the overarching research question: *How to measure poverty in accordance with the LNOB principle*? The chapter utilises the 2015/16 BMTHS dataset collected by Statistics Botswana. The chapter employs the Alkire and Foster (2011a) methodology for aggregation. The results reveal that using the household as a unit

[25] The combination of this chapter and the following chapter 6 was published as an IDS working paper [Lekobane, K. R. (2020). *Leaving no one behind: An individual-level approach to measuring multidimensional poverty in Botswana.* IDS Working paper 539. Brighton: Institute of Development Studies (IDS)]. The chapter was also presented at the Development Studies Association (DSA) Annual Conference, held in Birmingham, United Kingdom, 17th - 19th June 2020. The chapter is published in *Social Indicators Research* journal.

of analysis underestimates the poverty levels of society. An estimated 46.2 per cent of individuals are considered multidimensionally poor based on individual-level analysis.[26] This figure is higher than the household-level estimate of 36.5 per cent. Similarly, the results show that, on average, the multidimensionally poor are deprived in 47.4 per cent of the deprivation indicators under consideration.

This chapter adds to the literature on multidimensional poverty in several ways. First, this chapter constitutes the first attempt in Botswana and the African region to estimate the individual-level multidimensional poverty index for the whole population in line with SDG 1.2. Second, this chapter offers the first empirical attempt to estimate nationally relevant and context-specific individual-level multidimensional poverty for Botswana. Third, the chapter contributes to the limited literature globally concerning the use of an individual-level multidimensional poverty measure. Fourth, this chapter will set the basis for further discussions and stimulate debates regarding adopting the individual-based multidimensional poverty measure.

The chapter is structured as follows: Section 5.2 discusses the unit of analysis, followed by Section 5.3 discussing the proposed dimensions, deprivation indicators and cut-offs. Section 5.4 presents the discussion on the weighting of dimensions, and Section 5.5 presents correlation analysis between deprivation indicators. Section 5.6 presents validity and reliability tests. Results and discussions are presented in Section 5.7, while Section 5.8 presents a robustness analysis. Last, Section 5.8 presents conclusions and policy implications.

[26] The global MPI estimate is for Botswana is 17.2 per cent. However, this estimate is not comparable to the national estimate of 46.2 per cent in this thesis. First, the number of dimensions and indicators are different. The global MPI was created using three dimensions and ten indicators. In this thesis, I used seven dimensions and twenty-four indicators. Second, the unit of analysis in the global MPI is household. In this thesis, I develop an individual-level national MPI that reflects Botswana's context using individuals as the unit of analysis.

5.2. Unit of analysis

This section deals with the selection of the unit of analysis in multidimensional poverty assessments, which is a critical issue in poverty analysis. Most empirical studies on multidimensional poverty measurement have used the household as a unit of analysis (Franco-Correa, 2014; Bessell, 2015; Pogge & Wisor, 2016; Rogan, 2016; Espinoza-Delgado & Klasen, 2018; Klasen & Lahoti, 2020). Using the household as a unit of analysis means that if the household is multidimensionally poor, all members of the same household are considered poor (Angulo et al., 2016; Ervin et al., 2018; Espinoza-Delgado & Klasen, 2018). This assumption implies that resources are equally shared and that any household members' deprivations are simultaneously assumed by all household members (Haddad & Kanbur, 1990).

Using the household as a unit of analysis is based on the following reasons. First, it makes the multidimensional poverty measure comparable to the official monetary poverty measure (Angulo et al., 2016; Ervin et al., 2018). Second, most deprivation indicators are defined at the household level (e.g., housing and living conditions, access to clean water and sanitation, among others). Third, the targeting of most poverty interventions is at the households. However, even though most empirical studies used the household as a unit of analysis, it has not escaped criticism.

First, the 'household' means different things to different people in different countries, and defining it can be tricky and complex (Bolt & Bird, 2003). The most widely used definition of a household is by the UN, which defines a household as a group of people who live and eat together (Bolt & Bird, 2003: p10). However, this definition may be problematic since individuals residing in the same household may have different living arrangements making it difficult to differentiate traditional households from other ones (Franco-Correa, 2014).[27]

Second, household measures are unable to capture possible intrahousehold inequalities in resource allocation (Vijaya et al., 2014; Alkire & Fang, 2019) and to distinguish individual poverty within the household (Alkire & Fang, 2019). Children and women are more likely to

[27] For example, in cases where one household member lives temporarily in two different households.

receive an unequal share of the resources or opportunities (Rodríguez, 2016; Klasen & Lahoti, 2020), indicating that resource allocation within households is uneven (Haddad et al., 1997). Individuals' needs and preferences vary across age (Osberg & Sharpe, 2014) and gender (Vijaya et al., 2014; Pogge & Wisor, 2016).

Third, and in addition to the stated above, using the household as a unit of analysis hides individuals' circumstances within households because it implicitly assumes the equal distribution of poverty among household members. However, this is usually not the case since poverty is an individual characteristic (Deaton, 1997). Using the household as a unit of analysis leads to underestimating levels of poverty in society (Haddad & Kanbur, 1990) because intrahousehold inequalities conceal deprived individuals within non-poor households (Brown et al., 2017), and this may, in turn, lead to biased assessments of social policies and targeting (Rodríguez, 2016). Deprivations that affect one household member do not necessarily affect all other household members.

Considering these limitations and in line with the LNOB principle (UN, 2015), the analysis performed in this chapter adopts the individual as the unit of analysis. In other words, this chapter measures and analyses poverty using a multidimensional poverty measure that captures individual deprivations to identify those left behind. Previous studies that considered individuals as a unit of analysis in multidimensional poverty measures are mainly focused on children (Roelen et al., 2010; Roche, 2013; Roelen & Camfield, 2013; Trani & Cannings, 2013; Roelen, 2014, 2017, 2018; García & Ritterbusch, 2015; Leu et al., 2016; Rodríguez, 2016; Pinilla-Roncancio & Silva, 2018; Qi & Wu, 2019). Other studies that developed an individual-level multidimensional poverty measure focused on some sections of the population, such as women (Bastos et al., 2009; Alkire et al., 2013; Batana, 2013) and adults (Mitra et al., 2013a; Agbodji et al., 2015; Bessell, 2015; Vijaya et al., 2014; Hanandita & Tampubolon, 2016; Pogge & Wisor, 2016; Rogan, 2016; Chen et al., 2019).

Studies that assessed individual-based multidimensional poverty across the entire population using the individual as a unit of analysis are scarce (Franco-Correa, 2014; Espinoza-Delgado & Klasen, 2018; Klasen & Lahoti, 2020). The scarcity of such studies could be a result of the

unavailability of individual-level data. Another reason could be associated with the conceptual and empirical challenges in constructing individual deprivations (Vijaya et al., 2014; Klasen & Lahoti, 2020).

The individual-level analysis allows for data disaggregation by demographic characteristics required by the LNOB principle to identify those left behind. The individual centred approach eases policy-making exercises because it considers individual deprivations (Franco-Correa, 2014), which will help highlight priorities for particular groups in specific places to ensure no one is left behind. However, in cases where indicators cannot be defined and identified at the individual level (e.g., housing and living conditions, access to clean water and sanitation, among others), it is assumed that all the members of the household share the same deprivations. However, this has the potential to make part of the measure liable to the same shortcomings mentioned earlier. For example, this may lead to the underestimation of inequality in the access and use of household-specific public goods and assets (Klasen & Lahoti, 2020). However, the selected household-level indicators are included for their intrinsic and instrumental significance (Klasen, 2000; Sen, 1999).

5.3. Proposed functioning dimensions, deprivation indicators and cut-offs

Following other studies dealing with multidimensional poverty measures (Alkire & Foster, 2011a, 2011b; Kuklys, 2005; Alkire et al., 2015b), this chapter employs the theoretical premises of the capability approach to operationalise the LNOB principle (Sen, 1985a, 1999).[28] The LNOB is critical to the SDGs and is people-centred with a focus on human rights (de Man, 2019). In conjunction with the normative approach and human rights-based approach, the capability approach informed the choice of the functioning dimensions and indicators (Alkire, 2002). The decision was also informed by Botswana's policy commitments and development priorities such as Vision 2036, NDP 11, BPEPS and the, Agenda 2063 and the SDGs to ensure that the measure is contextually relevant. Finally, we

[28] For a formal presentation of the capability approach, see Kuklys (2005) and Lancaster (1996) for a detailed elaboration. Several researchers used the capability approach in the empirical application of the measurement of poverty and different scholars have discussed these various theoretical and empirical aspects of the operationalisation of the capability approach (Alkire, 2008; Kukyls, 2005).

considered data availability. Chapter 3 presents a section dealing with the operationalisation of the capability approach.

From a list of dimensions in Table 3.2 (Chapter 3), I selected seven dimensions based on the availability of information on the 2015/16 BMTHS. Information on the remaining dimensions, environment, employment (adequate leisure), social, and freedom and personal, were missing. As a result, the following seven functioning dimensions are included in the multidimensional poverty measure: (i) *Assets*, (ii) *Housing and living conditions*, (iii) *Water and sanitation*, (iv) *Food security*, (v) *Health*, vi) *Education*, and (vii) *Security*. The selected functioning dimensions cover most of the indicators and dimensions of the global MPI (Alkire & Santos, 2014) and the dimensions proposed in the MODA child poverty study for Botswana (de Neubourg et al., 2015).[29] In addition, the indicators used cover most of the SDGs linked to the human rights-related capabilities (de Man, 2019) and most of the rights in the 2012 UNOHCHR guidelines and the UDHR document. Table 5.1 (presented at the end of this section) discusses the proposed dimensions, deprivations indicators, and the deprivation cut-offs, identification levels and groups for which the indicators are applicable.[30] Proposed dimensions and the corresponding deprivation indicators are described below.

5.3.1. Asset dimension

This dimension measures deprivations related to the possession of household assets. This dimension provides insights into the household economic activity and reflects both past and future income-generating opportunities. In reference to the capability approach, assets are closely connected with the ends (functionings) they facilitate (Alkire & Santos, 2014). For instance, having a car or van constitutes a functioning of 'being able to transport oneself'. Possession of durable goods is essential to perform everyday-life activities, and lacking certain goods can be understood as a manifestation of poverty (Townsend, 1979). However,

[29] Key stakeholders decided the MODA dimensions during a workshop organised by BIDPA in Botswana given a country context and subject to data availability (de Neubourg et al., 2015). The dimensions included nutrition, health, education, housing, water, sanitation. I included all indicators used in MODA and 9 of the 10 indicators used in the global MPI.

[30] Age groups 0-4 and 5-17 have 20 indicators each while age groups 5-14 and 18 years and above have 19 indicators each. In total there are 24 indicators considered for the construction of the index.

the use of asset indicators has proven to be both conceptually and empirically challenging in the construction of individual deprivations (Vijaya et al., 2014; Klasen & Lahoti, 2020) as assets are shared and used across households. In conceptualising this dimension, household assets are assumed to be jointly owned and accessible equally to everyone within the household (Klasen & Lahoti, 2020). Four deprivation indicators are considered in this dimension.

The first deprivation indicator (*information*) assesses household deprivation in terms of access to information and communication technologies (ICTs). Article 19 of the UDHR recognises access to information and communication as a fundamental human right (UN, 1948). Also, SDG 16 recognises the importance of the right to information (UN, 2015). In addition, Agenda 2063 commits to providing access to reliable and affordable ICT by 2063. Access to ICT has generally been viewed as critical in society today largely because of the potential opportunities, including access to health, education, career, access to government services and increased community participation. For example, in Uganda, the use of mobile phones by farmers increased market participation (Muto & Yamano, 2009). In Botswana, most people use mobile phones as banking instruments to transfer money to their families. The government of Botswana, through radio and television, provides awareness about government programmes. According to Vision 2036, Botswana aspires for its people to enjoy equal access to information (Republic of Botswana, 2016). The individuals residing in a household which does not own at least one of the following: radio, television, telephone (landline), mobile phone or personal computer/laptop are considered deprived in the *information* indicator.

The second deprivation indicator (*durable goods*) captures the lack of possession of durable household goods. Household durable assets are integral to the functioning and attainment of well-being (Lerman & McKernan, 2008). Durable assets play an important role in improving people's livelihood and helping them move out of poverty (McKay, 2009). It enhances income generation activities. For example, in the case of the informal sector, ownership of durable goods such as a sewing machine, stove or refrigerator may constitute business assets, thereby enhancing income-generating activities (Deere et al., 2012). Individuals residing in

a household which does not own at least two of the following: refrigerator/freezer, electric/gas stove, microwave, air conditioner, washing machine, sewing machine, grinding machine and wheelbarrow are considered deprived.

The third deprivation indicator (*transport*) assesses household transport deprivation measured in terms of possession of automobiles or other transportation assets. Transport is a vital pre-condition for accessing health care, especially in remote areas, accessing education and providing safety from crime. In the 2030 Agenda for Sustainable Development, transport-related targets are included in eight out of the seventeen SDGs (SDGs 2, 3, 6, 7, 9, 11, 12, 13). Lack of transport negatively impacts other social issues such as access to health or education in cases where the facilities are far (Allendorf, 2007). In addition, transport enhances one's ability to participate in social life (Rippin, 2016). The longer time one takes to travel also impacts negatively on people's opportunity for income-generating activities. Individuals residing in a household that does not own at least one of the following: van/truck/bakkie or car, tractor, donkey cart, bicycle and motorcycle are considered deprived.

The fourth indicator captures homeownership (*tenure*). Article 17 of the UDHR states that everyone has the right to own property (UN, 1948). The right to property is a standalone right separate from the right to adequate housing. Similarly, SDG 1.4 recognises that everyone should have equal rights to economic resources, including ownership and control over land (UN, 2015). Land ownership is considered a source of livelihood and is central to economic rights. The Agenda 2063 recognises land ownership as a basic human right (AUC, 2015). In Botswana, homeownership is understood beyond economic benefits and is an essential asset for families. It extends to social relations, as it confers status and prestige within one's community, enhancing one's social participation (without shame). Therefore, home ownership is included as an asset indicator. In reference to the capability approach, homeownership is essential because it indicates a crucial functioning of 'security or protection' (Blank, 2008; Doyal & Gough, 1991). Housing ownership also reflects household income-generating opportunities in terms of generating rent, especially in urban areas. Individuals residing in a household that does not own the housing unit they live in are considered deprived.

5.3.2. Housing and living conditions dimension

The 1948 UDHR and the 1966 International Covenant on Economic, Social and Cultural Rights recognise adequate housing as part of the right to an adequate standard of living (UN, 1948; UNOHCHR & UN-HABITAT, 2009). The issue of housing is also captured in the 2030 SDG Agenda for Sustainable Development. Target 11.2 aims to ensure adequate, safe, and affordable housing and basic services by 2030 (UN, 2015). Agenda 2063 commits to providing access to affordable and decent housing to all sustainable human settlements (AUC, 2015). The BPEPS emphasised shelter poverty (Republic of Botswana, 2018). The National Housing Policy of 2000 aims to meet the shelter needs of the population and to provide decent and affordable housing for all within the context of a safe and sanitary environment.[31]

This dimension captures deprivations relating to housing and living conditions (quality and overcrowding) and access to basic amenities to capture the functioning of 'being well-sheltered' (Nussbaum, 2003). People have the right to the basic shelter that enables them to live a dignified life. In line with the capability approach, six deprivation indicators are considered for this dimension: *overcrowding*, *cooking fuel*, *electricity*, *floor material*, *roof material* and *wall material*. These indicators capture whether the housing is adequate. That is, if it guarantees physical safety or provides adequate space and protection against the cold, dampness, heat, rain, wind, and other threats to health and structural hazards for its occupants (UNOHCHR & UN-HABITAT, 2009). Therefore, this dimension includes indicators that capture the quality of housing.

Overcrowding captures the living space per sleeping room measured by the number of household members per sleeping room. It is defined based on international standards of three persons per room, motivated by the UN-HABITAT criteria. Overcrowding is a good

[31] The policy intends to channel more resources to the provision of both rural and urban housing for low-income groups. One of the main objectives of the National Housing Policy of 2000 is to promote housing as an instrument for economic empowerment and poverty alleviation. This has resulted in the introduction of the following programmes: The Destitute Housing programme, Remote Areas Housing Scheme, Presidential Housing Appeal Programme and Poverty Alleviation and Housing scheme.

indicator of persistent poverty (Mushongera et al., 2017), and it affects individuals' well-being and does not positively contribute to a healthy environment (Espinoza-Delgado & Klasen, 2018). Individuals living in overcrowded households often suffer from poor health conditions and educational outcomes (Leventhal & Newman, 2010; Lund et al., 2011). Crowded living conditions increase the likelihood of contracting airborne diseases and respiratory infections (Graham, 1990; Baker et al., 2000; Wanyeki et al., 2006) and can increase the risk of infant mortality (Cage & Foster, 2002). This deprivation indicator takes into account household composition and children's age.[32] Individuals residing in a household with more than three persons per sleeping room are considered deprived.

The *cooking fuel* indicator is also included for its intrinsic and instrumental significance (Klasen, 2000). It captures whether household members use dirty fuel[33] that may cause high air pollution levels or may be harmful to their health. Evidence shows that indoor air pollution from dirty fuel significantly impacts individuals' respiratory health (Duflo et al., 2008; Kaplan, 2010), especially women responsible for cooking (Duflo et al., 2008). Individuals residing in households using the following source of fuel: biogas, wood, paraffin, cow-dung, coal, charcoal, and crop waste or having no source of fuel for cooking are considered deprived.

Electricity is used to capture household connectivity to the Botswana Power Corporation (BPC) grid. Both the cooking fuel and electricity indicators are captured by SDG 7 (target 7.1), which aims to ensure universal access to affordable, reliable, sustainable, and modern energy for all by 2030 (UN, 2015). Agenda 2063 also recognises energy as a key commodity for African households (AUC, 2015). Individuals residing in a household not connected to the BPC grid (not connected with electricity) are considered deprived.

[32] In Botswana it was agreed by key stakeholders during a workshop organised by BIDPA to decide on the MODA dimensions that children aged less than 5 should be given a weight of 0.5. Therefore, the indicator is calculated as: overcrowding = (number of children below 5 years*0.5 + number of household members aged 5 years and above*1)/number of rooms (de Neubourg et al., 2015). This was done to account for the housing standard condition in Botswana. Children especially infants do sleep with their parents in the same room. For example, a family of 4 made of a single mother and three children aged 4, 2 and 6 months, respectively, sleeping in the same room is considered non-deprived using the threshold of three persons per room.
[33] Dirty fuel includes use of firewood, paraffin, biogas, coal, charcoal, cow-dung and crop waste.

The material used in the construction of the housing unit reflects the quality of housing. According to Krieger and Higgins (2002), there is a body of evidence associating housing quality with morbidity from infectious diseases, chronic illnesses, injuries, poor nutrition, and mental disorders. For example, asbestos used as wall material can cause mesothelioma and lung cancer (Landrigan, 1998). Concerning floor material, old, dirty carpeting and mud floors are associated with dust, allergens, and toxic chemicals (Vaughan & Platts-Mills, 200). People living in poor housing conditions are less likely to invite guests into their homes, leading to social isolation (Krieger & Higgins, 2002). The quality of housing directly affects the well-being of individuals (Klasen, 2000).

The extent of shelter poverty in Botswana should be viewed beyond just the number of housing units built and assess issues relating to the quality of housing structure using indicators such as the *roof*, *floor*, and *wall* material. Individuals residing in a shelter with the main material of the floor made of the following: mud, mud dung, brick/stones, or any other material apart from cement, floor tiles, or wood or has no flooring material are considered deprived. Concerning roof material, individuals residing in a housing unit with the main material of the roof made of the following: thatch/straw, asbestos, or any other material apart from slate, roof tiles, corrugated iron/zinc/tin, concrete are considered deprived. Lastly, concerning wall material, individuals residing in a housing unit with the main material of the wall made of the following: mud bricks/blocks, mud and poles/ cow dung/ thatch/ reeds, poles and reeds, corrugated iron/zinc/tin, asbestos, wood, stone and other/mixed materials are considered deprived.

5.3.3. Water and sanitation dimension

The United Nations General Assembly and the Human Rights Council recognise both access to water and sanitation access as a standalone human right (UN, 2010; UN & WHO, 2010). This means that ensuring access to water and sanitation is a legal obligation and that everyone is entitled to water and sanitation, which is available, accessible, affordable, acceptable and safe (UN, 2015). In addition, the water and sanitation dimension is reflected in SDG 6, which calls to ensure the availability and sustainable management of water and sanitation for all (UN, 2015). Water and sanitation are also recognised by Agenda 2063 as important

dimensions (AUC, 2015). In line with the capability approach, safe drinking water and sanitation are central to living a life of dignity and upholding human rights. Like household and living conditions, water and sanitation are also of considerable instrumental and intrinsic significance (Klasen, 2000). Therefore, water and sanitation are treated as a standalone dimension. These two indicators are linked to health. Lack of access to safe drinking water and adequate sanitation profoundly impacts individuals' health (UN, 2003). For example, lack of access to clean drinking water and adequate sanitation is linked to higher morbidity and infant and child mortality (Trani & Cannings, 2013). Water and sanitation are publicly provided (public goods) and accessible equally within the household (Klasen & Lahoti, 2020).

The indicator *water supply* seeks to capture individual deprivation in terms of both access to safe drinking water inside the household and the duration (time) to collect safe drinking water if it is fetched outside the yard, either from a public source or sourced from neighbours. According to the UN and WHO (2010), the time taken to collect water should not exceed 30 minutes. This indicator captures both access and quality of water. Everyone has the right to water services that are physically accessible within or near the household (UN, 2010). Individuals residing in a household that uses unimproved water source including tanker, well, borehole, river/stream, dam/pan, rainwater, spring water, or if it takes at least 30 minutes to fetch water from a communal tap are considered deprived in this indicator.

The *toilet facility* captures the sanitation deprivation indicator. This indicator captures the functioning of being able to overcome a felt stigma of open defecation given the commodity of a private toilet (Barrington et al., 2017). Individuals residing in a household using an unimproved toilet facility (pit latrine) or who have no toilet facility are considered deprived. Those using the communal flush toilet, communal VIP, communal pit latrine or neighbours' toilet are also considered deprived.

5.3.4. Food security dimension

Article 25 of the UDHR recognises the right of all people to adequate food (UN, 1948). The right to food is a human right that protects an individual's access to sufficient, safe and

nutritious food (Tura, 2019). In addition, the issue of hunger and food insecurity features prominently in the 2030 Agenda. It is reflected in SDG 2 (target 2.1), which states that 'By 2030, end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round' (UN, 2015: p15). Also, Agenda 2063 commits to the complete elimination of hunger and food insecurity in Africa by 2063 (AUC, 2015). Food insecurity is a complex, multidimensional concept (Vaitla et al., 2017) and approaches to measure it needs to reflect this. The Food and Agriculture Organisation (FAO) emphasises the multidimensionality of food security (FAO, 2002).[34] There are four major dimensions of food security: food availability, food access, food stability and food utilisation (FAO, 1996). The right to food concept also requires these four essential components (Tura, 2019).

There is no single measure that adequately captures the complexity of food security (Maxwell et al., 2014). Two different approaches (direct and indirect) measure food security (Sam et al., 2019).[35] In this chapter, food insecurity is measured based on two indicators: food access and food utilisation. These two are chosen based on data availability. The 2015/16 BMTHS do not have variables to capture food availability and food stability, hence their exclusion in deriving the food insecurity dimension.[36] Several approaches are employed to measure food access. These approaches include the Coping Strategy Index (CSI); Reduced Coping Strategy Index (rCSI); Household Food Insecurity Access Scale (HFIAS); Household Hunger Scale (HHS); Food Consumption Score (FCS); Household Dietary Diversity Score (HDDS), and Self-assessed Measure of Food Security (SAFS) (Maxwell et al., 2013, 2014). The choice of each depends on the information available. This chapter adopts the HFIAS methodology in

[34] The definition of food security states that, 'food security exists when all people, at all times, have physical, social and economic access to sufficient and nutritious food that meets their dietary needs and food preferences for an active and healthy life' (FAO, 2002).

[35] Some of the widely used indirect approaches include estimation of calories available per capita at national level used by FAO; household income and expenditure surveys; individual's dietary measures; anthropometry (Bashir & Schilizzi, 2013).

[36] Sam et al. (2019) defined food availability as the availability of sufficient quantities of food of appropriate quality, supplied through domestic production or imports. On the other hand, Shah and Dulal (2015) defined food in relation to ensuring enough food availability for those households that are at high risk of temporarily or permanently losing access to the resources needed to consume adequate food due to income shocks, lack of enough 'reserves' for adequate consumption, or both. Data for these two indicators is not captured by the 2015/16 BMTHS and are therefore excluded from the food insecurity dimension.

developing the household food insecurity access indicator (Coates et al., 2007).[37] The HFIAS captures household behaviours signifying three domains of food insecurity; insufficient quality, insufficient quantity, as well as anxiety and uncertainty over household insecure access or food supply (Coates et al., 2007).[38]

The *food access* indicator captures the functioning of 'being free from hunger' (Drèze & Sen, 1989; Burchi & De Muro, 2016), and it is derived using information from topical module 7 of the 2015/16 BMTHS (self-assessed well-being and food insufficiency). The module comprises nine questions that evaluate the food insecurity experienced in several grades of severity with a recall period of 30 days (SB, 2018). Statistics Botswana adapted the questions from the HFIAS USAID FANTA project (Coates et al., 2007; Deitchler et al., 2011). The information obtained from HFIAS assesses the prevalence of household food insecurity (access) (Coates et al., 2007) which is useful for geographic targeting (Ballard et al., 2013) and to assess changes in the household food insecurity situation over time (Coates et al., 2007; Deitchler et al., 2011).

The questions ask people (household heads) directly about the quality and quantity of food they eat due to limited money or other resources to obtain food (SB, 2018). Based on these nine questions, two main indicators are created: The Household Food Insecurity Access Scale Score (HFIASS) and the Household Food Insecurity Access Prevalence (HFIAP).[39] The HFIASS is a continuous measure of the degree of food (access) insecurity, ranging from 0 to 27; the higher the score, the greater the household members' food (access) insecurity. On the

[37] The HFIAS is one of the four experience-based food insecurity scales included in Data4Diets. The other three measures are the Household Hunger Scale (HHS) (Ballard et al., 2011; Deitchler et al., 2010), the Latin American and Caribbean Food Security Scale (ELCSA) (Ballard et al., 2013), and the Food Insecurity Experience Scale (FIES) (Ballard et al., 2013). The HFIAS provided the foundation for the development of these three measures.

[38] The HFIAS evaluates food insecurity severity using nine generic occurrence questions and nine follow-up frequency occurrence questions to determine how often the condition occurred. If the response is a "no" for the generic occurrence question, then the follow-up frequency of occurrence questions is skipped. These questions represent three domains of the household food insecurity access: (i) anxiety and uncertainty about the household food supply, captured by the first question; (ii) insufficient quality, relating to variety and preferences of the type of food, is captured by questions two to four; as well as (iii) insufficient quantity of food intake and its physical consequences captured by questions five to nine (Coates et al., 2007; Deitchler et al., 2010).

[39] A total of four HFIAS indicators can be computed. The other two are household food insecurity access-related conditions and household food insecurity access-related domains.

other hand, the HFIAP categorises households into four levels of household food insecurity: food secure, mildly, moderately and severely food insecure (Coates et al., 2007).[40] An individual is defined as deprived in terms of food access if he/she resides in a household that is either moderately or severely food insecure based on HFIAP. It would have been ideal to have data on food security at the individual level to capture the unequal distribution of resources within the household (Pinilla-Roncancio et al., 2020). However, information on household food security access is only available at the household level.

The second indicator is *nutrition* and goes beyond the '*access*' indicator and captures food utilisation.[41] This indicator captures the functioning of 'being well-nourished' (Sen, 1992). It is derived using the anthropometric measure, child undernourishment, based on WHO methodology (WHO, 2006; Alkire & Santos, 2014). This indicator determines the nutritional status of an individual (FAO, 1996). It indicates a functioning failure associated with life-long effects in terms of cognitive and physical development in the case of children (Alkire & Santos, 2014). The *nutrition* indicator is derived using children's information from the Anthropometric measurements' topical module. Ideally, it is desirable to include information on nutritional status for everyone. However, information on this indicator is available only for children. According to this indicator, a child aged 0-4 is considered deprived in any of the three nutrition indicators (weight-for-age or height-for-age or weight-for-height) if his/her *z*-score is below minus two standard deviations from the median of the reference population. For children aged 5-17, a child is considered deprived in nutrition if his/her BMI

[40] The algorithm used to compute household food insecurity access prevalence categories is based on Coates et al. (2007). (i) *food secure*: if a household experiences none of the conditions, or just experiences worry, but rarely is considered food secure; (ii) *mildly food insecure*: if a household worries about not having enough food sometimes or often, and/or is unable to eat preferred foods, and/or eats a more monotonous diet than desired and/or some foods considered undesirable, but only rarely. But it does not cut back on quantity nor experience any of three most severe conditions is considered mildly food insecure. (iii) *moderately food insecure*: if a household sacrifices quality more frequently, by eating a monotonous diet or undesirable foods sometimes or often, and/or has started to cut back on quantity by reducing the size of meals or number of meals, rarely or sometimes is considered moderately food insecure. (iii) *severely food insecure*: if a household is cutting back on meal size or number of meals often, and/or experiences any of the three most severe conditions (running out of food, going to bed hungry, or going a whole day and night without eating), even as infrequently as rarely. In other words, any household that experiences one of these three conditions even once in the last four weeks (30 days) is considered severely food insecure (Coates et al., 2007: 19-20).

[41] According to Timmer (2000) food utilisation consists of sufficient diet, clean water, sanitation, and health care to reach a state of nutritional well-being. It is the way the body makes the most of various nutrients in the body (Swindale & Bilinski, 2006).

z-score is below minus two standard deviations from the median of the reference population (WHO, 2006; Alkire & Santos, 2014).[42]

5.3.5. Health dimension

The 1948 UDHR recognises health as a human right (UN, 1948). In addition, several international treaties, such as the 1989 Convention on the Rights of the Child and the 1966 International Covenant on Economic, Social and Cultural Rights, have recognised health as a human right (see UN & WHO, 2008). The health dimension is also reflected in SDG 3 (target 3.8) of the 2030 Agenda of Sustainable Development, which aims to achieve universal health coverage, including financial risk protection, access to quality essential health care services and access to safe, effective, quality and affordable essential medicines and vaccines for all (UN, 2015). The Agenda 2063 also considers health as one of the important dimensions (AUC, 2015). Vision 2036 and NDP 11 both reiterate Botswana's long-standing recognition of the importance of its population's health status. Vision 2036 recognises good health and wellness as fundamental human rights and necessary conditions for development (Republic of Botswana, 2016). NDP 11 calls for the critical appraisal of the quality of health services to improve health outcomes (MFED, 2016). Therefore, health is considered a central capability (Sen, 2000; Nussbaum, 2003), and it is included for its intrinsic as well as instrumental value (Klasen, 2000; Alkire & Santos, 2014). The health dimension captures deprivations related to access and quality of the nearest health facility and chronic illness.

The first indicator is *the condition of the nearest health facility* capturing the perceived quality of the nearest health facility and problems associated with the health facility. The right to health entails that all services, goods and facilities must be available, accessible, acceptable and of good quality (UN & WHO, 2008). Individuals are considered deprived if the perceived quality of the nearest health facility they use is poor or fair and has the

[42] The algorithm provided by WHO Child Growth Standards was used to estimate the *z*-scores of child nutrition indicators. These anthropometric measures for young children, even though are related, capture different deprivations. For example, height-for-age (HAZ) captures stunting, which is a long-term nutritional deprivation, weight-for-height (WHZ) captures wasting, which is a symptom of acute undernutrition, and weight-for-age (WAZ) captures underweight (WHO, 2006; WHO & UNICEF, 2010). BMI is computed as: $BMI=weight/(height/100)^2$ and applies only to children aged 5-17. Therefore even though BMI captures underweight, it is not comparable to WAZ, which captures underweight for children aged 0-4.

following problems. In essence, the facility; is too far, is not clean or in poor condition, has few trained professional staff, has staff frequently absent, has lack of drugs, does not offer all services, and has limited opening hours.

The second indicator is *chronic illness* and captures the functioning of 'being healthy'. The inclusion of the chronic illness indicator variable into a multidimensional poverty index is not new and has been used previously in other studies (Santos, 2013; Hanandita & Tampubolon, 2016). It is linked to other important functionings (Sen, 1997). For example, chronic illness may reduce the ability to be educated, thus limiting employment opportunities (Callander et al., 2013; Rippin, 2016). Chronic illness is a significant public health and social welfare issue (Salway et al., 2007). Prolonged chronic illness can utterly impoverish people (Chambers, 1983) and can lead to loss of income (due to inability to work). People with chronic illness are often restricted in what they can do (inability to do any kind of work) (Beatty & Fothergill, 2005; Jayathilaka et al., 2020). Individuals suffering from a chronic illness that prevents them from working, being active or going to school are considered deprived in this indicator.[43]

5.3.6. Education dimension

According to Article 26 of the UDHR, education is a right to which all human beings are entitled (UN, 1948). This means that, as a human right, education should be guaranteed to everyone. In the SDGs, education has a stand-alone goal, SDG 4, which calls for ensuring inclusive and equitable quality education and promoting lifelong learning opportunities for all. Specifically, target 4.1 states that 'By 2030, ensure that all boys and girls complete free, equitable and quality primary and secondary education leading to relevant and effective learning outcomes' (UN, 2015: p15). Similarly, Agenda 2063 commits to expanding universal access to quality early childhood, primary and secondary education (AUC, 2015). Therefore, education plays a vital role in achieving Botswana's national development aspirations and priorities, including Agenda 2063 and the SDGs. The country recognises the

[43] Some of the chronic illnesses listed by Statistics Botswana include among others; HIV/AIDS, tuberculosis, anaemia, cancer, malaria (SB, 2018) which coincides directly with SDG 3 (target 3.3) which aims to end the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water borne diseases and other communicable diseases by 2030 (UN, 2015).

importance and contribution of education to other development goals, such as inequality reduction, gender inequality, poverty eradication, employment, and economic growth. According to Vision 2036, Botswana aspires to have an enlightened society with relevant quality education that is outcome-based (Republic of Botswana, 2016). NDP 11 emphasises access to quality education, starting from early childhood learning to tertiary education (MFED, 2016).

Education, like health, has intrinsic and instrumental value (Klasen, 2000). It captures human capital and is vital for enhancing capabilities (Saito, 2003), and to be educated is a valuable achievement (Espinoza-Delgado & Klasen, 2018). Education enhances one's well-being, such as the likelihood of employment, future income, self-confidence and the ability to social interaction (Rippin, 2016). Therefore, not being educated constitutes capability deprivation (Sen, 2000). The education dimension is captured using three deprivation indicators.[44]

The first indicator refers to *child enrolment* and captures children of school-going age's exposure to the learning environment (enrolled in school). In Botswana, child enrolment is mandatory at six years and includes ten years of basic free education. The ten years include seven years of primary (6 to 12 years) and three years of junior secondary (13 to 15 years). Two years of senior secondary (16 to 17 years) form part of 12 years of basic education. Therefore, any child in the schooling going age 5-17, who is currently not enrolled, is considered deprived. The second indicator, *school attainment*, captures years of education attained by adults aged 18 and above. This indicator captures the functioning of 'being educated'. Any adult who has attained less than nine years of schooling is considered deprived of school attainment.[45] The third indicator is *literacy,* and it captures individuals' ability to read and write ('being able to read and write'). Any individual aged 15 years and above who cannot read and write is considered deprived in terms of literacy.

[44] The three deprivation indicators are captured by targets 4.1, 4.2 and 4.6 in the 2030 SDG agenda document.
[45] A threshold of 9 years corresponds with the number of years of basic education. The basic education was initially 9 years before it was changed to 10 years. I used the threshold of 9 years since most adults went through the 9 years basic education. I constructed years of schooling using highest educational level achieved and the highest grade obtained in that level.

5.3.7. Security dimension

Article 3 of the UDHR recognises that everyone has the right to life, liberty and security (UN, 1948). So, the concepts of security and human rights are often closely linked. In the SDGs, this dimension is reflected in SDG 16, target 16.1, which aims to significantly reduce all forms of violence and related deaths rates everywhere (UN, 2015). In addition, Agenda 2063 recognises security and aspires for a peaceful and safe Africa, where there shall be safe and peaceful spaces for individuals, families and communities (AUC, 2015). This dimension is measured using two indicators (*safety* and *crime*). This *safety* indicator captures the functioning of 'being able to move freely from place to place' (Nussbaum, 2005). That is, to live a safe life free from crime and violence. Feeling unsafe diminishes numerous valuable capabilities (Nussbaum, 2005). The *crime* indicator is directly linked to the functioning of 'being secure against crime or violence' (see Nussbaum, 2000, 2003).

The *safety* indicator is a subjective measure and assesses the household's perceived safety from crime and violence. Individuals residing in a household whose head reported feeling unsafe from crime and violence are considered deprived. The second indicator, *crime*, is an objective measure of security and ascertains whether individuals have been victims of violence or crime in the past 12 months. Any individual residing in a household with at least one member involved in violence is considered deprived. These indicators are identified at the household level due to the unavailability of information at the individual level.

Table 5.1: List of proposed dimensions and deprivation indicators[†]

Dimension	Indicator	Indicator Definition	Deprivation cut-off (an individual is deprived if …)	Level	Group
1. Asset	Information	Captures lack of access to information and communication by household members	he/she resides in a household which does not own at least one of the following: TV, radio, PC/laptop, telephone (landline), mobile.	HH	All
	Durable goods	Captures the lack of durable assets used within the house	he/she resides in a household that does not own at least two of the following: refrigerator, washing machine, electric/gas stove, microwave, air conditioner, wheelbarrow, sewing machine, grinding machine.	HH	All
	Transport	Captures lack of ownership of automobiles (van/bakkie/truck or car)	he/she resides in a household which does not own an automobile, including a van/bakkie/truck, car, tractor, donkey cart, motorcycle, bicycle	HH	All
	Land tenure	Captures land ownership or possession of land and housing in which the housing unit is built.	he/she resides in a household that does not own the land where the housing unit is built.	HH	All
2. Housing and living conditions	Overcrowding	Captures the shortage of living space based on the number of rooms and persons in the household	he/she resides in a household with more than three people per sleeping room (excluding the kitchen, bathroom, and garage).	HH	All
	Cooking fuel	Captures the source of fuel for cooking used by households	he/she resides in a household that uses the following source of fuel: Biogas, wood, paraffin, cow-dung, coal, charcoal, and crop waste OR has no source of cooking fuel at all.	HH	All
	Floor material	Assesses the quality of the main material of the floor	he/she resides in a housing unit with the main material of floor made of the following: mud, mud dung, brick/stones, none, or any other material apart from cement, floor tiles, or wood.	HH	All
	Roof material	Assesses the quality of the main material of the roof	he/she resides in a housing unit with the main material of the roof is made of the following: thatch/straw, asbestos, or any other material apart from slate, roof tiles, corrugated iron/zinc/tin, concrete.	HH	All
	Wall material	Assesses the quality of the main material of the outside wall.	he/she resides in a housing unit with the main material of the outside wall is made of the following: mud bricks/blocks, mud and poles/ cow dung/ thatch/ reeds, poles and reeds, corrugated iron/zinc/tin, asbestos, wood, stone, other/mixed materials.	HH	All

	Electricity	Assess household connectivity to the national grid	he/she resides in a household that is not connected to the BPC grid.	HH	All
3. Water and sanitation	Water supply	Assesses lack of access to safe drinking water source	he/she resides in a household that uses unimproved water source: bowser/tanker, well, borehole, river/stream, dam/pan, rainwater, spring water, OR if it takes at least 30 minutes to fetch water from a communal tap.	HH	All
	Toilet facility	Measures lack of access to basic and safe sanitation facility in the household	he/she resides in a household that uses an unimproved toilet facility: pit latrine, communal flush toilet, communal VIP, communal pit latrine, communal neighbours' toilet OR has no toilet facility.	HH	All
4. Food security	Food insecurity access (HFIAP)	Assesses household's lack of access to sufficient quantity and quality food.	he/she resides in a household categorised as moderately food insecure or severely food insecure based on the HFIAP measure.	HH	All
	Weight-for-age (WAZ)	Assesses children's nutrition status.	he/she is a child who is malnourished. That is, if his/her *z*-score of weight-for-age is below minus two standard deviations from the median of the reference population.	IND	0-4 years
	Height-for-height (HAZ)	Assesses children's chronic nutrition status (stunting)	he/she is a child who is stunted. That is, if his/her *z*-score of height-for-age is below minus two standard deviations from the median of the reference population.	IND	0-4 years
	Weight-for-height (WHZ)	Assesses children's nutrition status in terms of wasting.	he/she is a child who is wasted. That is, if his/her *z*-score of weight-for-height is below minus two standard deviations from the median of the reference population.	IND	0-4 years
	Body Mass Index (BMI)	Assesses children's nutrition status based on BMI.	he/she is a child aged between 5 and 17 with a BMI z-score below minus two standard deviations from the median of the reference population.	IND	5-17 years
5. Health	Health facility	Assesses the perceived quality of the nearest health facility.	the perceived quality of the nearest health facility he/she uses is poor and has the following problems: the facility is too far, the facility is not clean or in poor condition, few trained professional staff, staff frequently absent, lack of drugs, does not offer all services, limited opening hours.	IND	All
	Chronic illness	Assess individuals' health status.	he/she has a long-term chronic illness that prevents them from working, being active or going to school.	IND	All

6. Education	Child school attendance	Quantifies the enrolment of individuals in the education system	he/she is a child aged 6-17 and is currently not enrolled in school. Those who completed compulsory basic education before 17 years are considered non-deprived.	IND	5-17 years
	Schooling achievement	Measures the number of years schooling	he/she is an adult aged 18 and above and has less than nine years of education.	IND	Above 18 years
	Literacy	Measures the ability of an individual to read and write	he/she is an adult aged 15 years and above, and he/she cannot read and write	IND	Above 15 years
7. Security	Safety	Assess the perceived safety of household from crime and violence	he/she feels not safe from crime and violence.	HH	All
	Crime	Ascertains whether the household member has been a victim of violence or crime in the past 12 months.	he/she resides in a household that has at least one member who has been a victim of violence or crime in the past 12 months	HH	All

Source: Developed by the author. †HH stands for household, IND stands for the individual, Y indicates data availability for the indicator, and N indicates data unavailability. Level means the identification level.

5.4. Weighting of dimensions

The next crucial step in constructing a multidimensional measure (after selecting the dimensions, deprivation indicators and their respective cut-offs) is the choice of weights for dimensions and indicators (Alkire et al., 2015a). This is a challenging exercise (Decancq & Lugo, 2013) since there is no specific procedure for setting weights in a multidimensional measure of poverty (Angulo et al., 2016). Different approaches are proposed in the literature, and these include normative judgements, reliance on empirical studies, participatory process, expert opinions, or inferential analyses using survey data (Alkire & Santos, 2014; Decancq & Lugo, 2013). Decancq and Lugo (2013) classified these different weighting schemes into three main categories: *normative, data-driven* and *hybrid*.[46] Below a brief discussion of each of the approaches is presented. Finally, the conclusion of this sub-section specifies and provides justification for the final choice of the weighting scheme used.

5.4.1. Normative approach

The normative approach consists of four types of weighting schemes: *equal weights*, *arbitrary weights*, *expert opinion weights* and *price-based weights* (Decancq & Lugo, 2013).[47] This approach is based on normative judgement (Alkire & Santos, 2014) and does not depend on the distribution of achievement vectors (Decancq & Lugo, 2013). *Equal weighting* is the most common and widely used approach for weighting in multidimensional poverty measurements (e.g., Alkire & Foster, 2011a, 2011b; Alkire et al., 2015a; Angulo et al., 2016; Ervin et al., 2018). This approach is mainly used due to its simplicity or the recognition that all indicators are equally important since they are roughly equal in intrinsic value (Alkire & Santos, 2014). The advantages of this weighting scheme are that it eases the interpretation of the index for policy (Alkire & Santos, 2014; Atkinson et al., 2002) and is more transparent and allows comparisons over time (Battiston et al., 2013). However, despite its popularity and convenience (Alkire & Foster, 2011a, 2011b), the equal weighting scheme has not escaped criticism. First, the equal weighting scheme has been criticised for not conveying a realistic image (Mikulić et al., 2015). Second, equal weighting is not adequately justified (Greco et al., 2018). Third, Greco et al. (2019) criticised the equal weighting scheme for missing the point of

[46] For a detailed discussion of these three approaches see Decancq and Lugo (2013).
[47] Decancq and Lugo (2013) conflated equal and arbitrary weights into a single weighting scheme and concluded that normative approach has three types of weighting scheme.

differentiating between essential and less important indicators by treating them all equally. Fourth, Paruolo et al. (2013) argued that the equal weighting scheme is not based on a proper theoretical and methodological framework but is chosen due to its simplicity.

The second weighting scheme under the normative approach is the *arbitrary weight* with unequal weights. Under this scheme, more weights are assigned to dimensions deemed highly important by researchers or policymakers (Decancq & Lugo, 2013). The weakness of this weighting scheme is that determining the relative importance of the different dimensions is not always transparent.

The third weighting scheme under the normative approach is the *expert opinion weight* based on the opinions of several experts or informed persons (Decancq & Lugo, 2013) to provide a more systematic representation of the diversity of expert judgement (Mascherini & Hoskins, 2008). There are two typical methods to elicit views from experts: *budget allocation* and the *analytical hierarchy process*. In the *budget allocation* approach, experts are asked to distribute a budget of '*n*' points to several indicators or dimensions based on their relative importance. Then an average of their choices is used (Jesinghaus, 1997). In the *analytical hierarchy process*, all members of the decision-makers (representative group) undertake a pairwise comparison among dimensions. These comparisons result in a comparison matrix from which the relative weights can be calculated using the eigenvalue technique (Nardo et al., 2005). Since only experts or informed persons are selected under this weighting scheme, the weights may be under-representation of the total population being analysed. Thus, there is a possibility of a bias in selecting experts, leading to a skewed weighting scheme (Decancq & Lugo, 2013).

Lastly, under the normative approach, there is the *price-based weighting* scheme suggested by Srinivasan (1994). This approach is not very popular in the multidimensional poverty indices. Some attempts to use this weighting scheme in the multidimensional poverty measure have been made by Becker et al. (2005) and Fleurbaey and Gaulier (2009). However, Foster and Sen (1997) argued that even if implicit prices can be obtained, they are not constructed for the task of multidimensional poverty measurement and are therefore inappropriate.

5.4.2. Data-driven approach

To address the shortcomings of the normative approach, some researchers rely on data-driven approaches that assign different weights to deprivation indicators and dimensions of poverty (Decancq & Lugo, 2013). Data-driven approaches include *frequency-based weights*, *statistical weights*, and *most-favourable weights* (Decancq & Lugo, 2013). These weighting schemes rely solely on the distribution of achievement vectors in a dataset.

The first weighting scheme under the data-driven approach is the *frequency-based* weighting scheme which is determined as a function of the distribution of the achievement levels in that dimension. In multidimensional poverty measurement, a less frequent deprivation is given a higher weight.[48] The advantage of this weighting scheme is that it is robust against the inclusion of dimensions that are only relevant to a small minority of the population (Decancq & Lugo, 2013). However, in an empirical application, Brandolini (2007) found that the results based on frequency-based are unstable. The second weighting scheme under the data-driven approach is the *statistical weights*. This weighting scheme employs two broad sets of statistical approaches: *descriptive* and *explanatory models*, to select the most appropriate weighting scheme (Krishnakumar & Nadar, 2008). The *descriptive* approach relies on multivariate statistical methods to describe and summarise data (Decancq & Lugo, 2013). The most commonly used is the Principal Component Analysis (PCA) (Klasen, 2000).[49] First, the set of initial indicators is transformed into an equal number of mutually uncorrelated linear combinations of indicators to drive weights. Second, the proportion of the variance explained by each of these linear combinations is computed. Third, weights can then be either obtained from a linear combination that explains the largest proportion of the variance or by using a weighted average of all the linear combinations. PCA assigns more weight to intercorrelated indicators (Catalán, 2019).

On the other hand, the *explanatory* approach assumes that some observed variables (indicators) are dependent on a certain number of unobserved latent variables, called

[48] In the multidimensional poverty measurement, the frequency of deprivation in a dimension is inversely related to the weight of that dimension (Deutsch & Silber, 2005).

[49] Another approach similar to PCA is multiple correspondence analysis (MCA). However, MCA applies a singular value decomposition instead of eigenvectors decomposition used by PCA. In a multidimensional poverty measure, Njong and Ningaye (2008) used both PCA and MCA and found that PCA estimates show lower poverty levels than those obtained from MCA.

factors (Krishnakumar & Nadar, 2008). Factor analysis is the simplest *explanatory* approach, imposing that the observed indicators are, in fact, different manifestations of the same latent variable (Noble et al., 2006). More sophisticated techniques of factor analysis have been used in the empirical application to construct multidimensional poverty indices following Sen's (1993, 2000) capability approach.[50]

However, these multivariate statistical approaches have not been without drawbacks. First, it is usually hard to interpret the obtained linear combination of indicators (Srinivasan, 1994). Second, correlations do not necessarily present the real influence of the indicators on multidimensional poverty (Nardo et al., 2005). Third, assigning higher weights to highly intercorrelated indicators may potentially under-represent other important indicators (Mazziotta & Pareto, 2019) since essential multidimensional deprivation indicators are not strongly related (Somarriba & Pena, 2009). Last, statistical weights resulted in a loss in transparency, and spatial and temporal comparability (Pasha, 2017), making the approach less attractive as a method to inform policymakers (de Kruijk & Rutten, 2007).

The third weighting scheme under the data-driven approach is the *most favourable weight*. The weights are individual-specific, allocating the highest weights to those dimensions on which individuals perform best. To avoid a case in which a single dimension is assigned all weights, one must impose constraints on the weights by specifying lower bounds. However, this approach has been criticised for the following drawbacks. First, it is difficult to make comparisons of multidimensional poverty levels since each individual has a unique weighting scheme. Second, this approach lacks transparency since the obtained results depend on the exact formulation of the constraints chosen by the researcher (such as lower bounds of the weights). Third, using this weighting scheme does not guarantee a reasonable trade-off between the dimensions (Decancq & Lugo, 2013).

[50] These techniques include multiple indicator and multiple causes models (MIMIC) and structural equation models (SEM) (Di Tommaso, 2007; Kuklys, 2005; Krishnakumar, 2007; krishnakumar & Ballon, 2008).

5.4.3. Hybrid approach

The hybrid approach combines both normative and data-driven approaches. It uses information on the value judgements together with information on the actual distribution of the achievement vectors (Decancq & Lugo, 2013) to partially compensate for the shortcomings of the two weighting schemes (Catalán, 2019) discussed earlier. They include the *stated preference weights* and *hedonic weights* (Decancq & Lugo, 2013).

The *stated preference weights* are based directly on the opinions of a representative group of individuals in society. In multidimensional poverty analysis, selected respondents are asked to rank their relative importance in determining the overall standard of living (de Kruijk & Rutten, 2007). For each individual, the weight for a dimension is calculated as a function of the total number of dimensions and the specific ranking of that dimension. In an ideal world, the choice of weights would be guided by this weighting scheme since it captures what the poor think of being poor, what dimensions matter the most, and what trade-offs the poor assign between dimensions (Hanandita & Tampubolon, 2016). Unfortunately, the *stated preference weighting* scheme has not been widely used because, in most datasets, questions to derive individual valuations are not available.

The second weighting scheme under the hybrid approach is the *hedonic weights* (Decancq & Lugo, 2013). This weighting scheme is regression-based, aiming at retrieving information about the implicit valuation of deprivation by an individual through information about self-reported happiness or life satisfaction (see, for example, Nardo et al., 2005). The weights can be derived from a (usually) regression of life satisfaction (Y^i) on a set of variables (x^i) representing different dimensions of multidimensional poverty. The weights can be obtained from the estimated coefficients (α_j) from the regression model of Y^i.[51] The results obtained can be controlled or cleaned for some variables that affect the subjective satisfaction levels without affecting the computed multidimensional poverty measure.

[51] The regression model is specified as $Y^i = \alpha_1 I_1(x_1^i) + \cdots + \alpha_m I_m(x_m^i) + \varepsilon^i$ where εi captures individual factors that may influence the individual valuation of life satisfaction Y^i (see Schokkaert (2007) for a detailed elaboration). Regression techniques allows for the sophistication of this model. For example, one can use a multinomial model, considering the ordinal nature of the self-reported life satisfaction instead of a standard linear model (see, Ferrer-i Carbonell & Frijters, 2004).

Notwithstanding this, the regression-based weights generally have the following shortcomings. First, when included dimensions are highly correlated, the estimated coefficients of α_j will be estimated in an imprecise way. This may lead to multicollinearity, which might hamper the interpretation of estimated coefficients. Second, in case of large standard errors, this will lead to most dimensions being statistically insignificant, which is problematic if the researcher chooses whether to include the dimensions depending on the level of significance (Decancq & Lugo, 2013).

5.4.4. The final choice of the weighting scheme

In conclusion, from the literature review, it is clear that the selection of weights is a necessary but challenging exercise. The relative values of different dimensions may be obtained in many different ways. The final approach adopted needs to be defended and justified. The applicability of differential weighting is much more complex, and the fact that optimal weights are unknown makes any information introduced to the index to be far from perfect (Catalán, 2019). Differential weights also make comparability over time to be complex. In this light, the data-driven and hybrid approaches cannot be used in this chapter. The final choice of weights is based on a normative approach and uses the *equal weighting scheme* across dimensions. The decision is based on the following key issues.

First, this chapter aims to compute a multidimensional poverty index according to the LNOB principle and according to the national context and to track the progress of the 2030 Agenda for Sustainable Development, the NDP 11, Vision 2036 and the BPEPS. It is, therefore, imperative to take into consideration both policy priorities and societal priorities. Based on normative decisions, each dimension used in this chapter reflects their equal importance as constituents of multidimensional poverty and is considered roughly equal in intrinsic value. Similarly, the LNOB principle is premised on the human rights-based approach. Therefore, operationalising LNOB means applying a human rights-based approach to multidimensional analysis. These rights are perceived to be equally important.

Second, comparability over time. Since this chapter will also serve as a baseline for tracking progress over time to assess if those left behind make progress, the equal weighting scheme is appropriate. Sen (1996) proposed that the weights should be explicit and transparent to allow for crucial comparison and must be robust to a plausible range

of weights. Hopkins (1999) concluded that since it is impossible to agree on weights, the most straightforward arrangement of equal weighting is the best. Atkinson et al. (2002) recommend that dimensions should be chosen such that weights can be equal.

Third, since this chapter also aims to provide some policy implications and advice, the equal weighting scheme has the advantage of easing the interpretation of the index for policy. Therefore, this chapter adopts an equally weighting scheme across dimensions and equal nested weights within dimensions for each indicator (Alkire & Santos, 2014; Angulo et al., 2016; Ervin et al., 2018). However, the weights across indicators will depend on the number of applicable indicators for specific individual age groups since the unit of analysis is individuals. For example, concerning the food security dimension, the nutrition indicators apply to different age groups of children (three indicators for children under five years and one indicator applies to children aged 5 to 17), which means weights across indicators will differ. Table A5.4 in the appendix presents the weighting structure across the age groups.

5.5. Association between deprivation indicators

Before computing the aggregate MPI, it is important to check for associations between indicators. I used tetrachoric correlation instead of the conventional Pearson's correlation since multidimensional poverty indicators are dichotomous (deprived/non-deprived) (Agresti, 2010).[52] Table 5.2 presents the tetrachoric correlation coefficients between the deprivation indicators. Overall, the results show that most deprivation indicators are weakly correlated. For example, the correlation between education indicators and other indicators is comparatively low. Similarly, health deprivation indicators are weakly related to other indicators. The same is observed for security deprivation indicators and nutrition deprivation indicators. Water and sanitation, as expected, show a moderate correlation with housing and living conditions indicators. Housing and living conditions indicators show mixed results, with most indicators exhibiting weak to moderate correlations, except for electricity showing a strong correlation with durable goods and

[52] Tetrachoric correlations assume that latent normally distributed continuous variables are underlying the observed binary variables and estimate the correlation between the latent continuous variables (Agresti, 2010).

cooking fuel. Quality of housing condition indicators (roof, floor, and wall), as expected, are strongly strong correlated (exhibiting correlations between 0.916 and 0.959).

Except for the correlation between electricity and cooking fuel (and durable goods), correlations between housing quality indicators (wall, roof and floor) and correlations between education indicators (enrolment, schooling and literacy), the majority of deprivation indicators recorded correlation coefficients below 0.8, implying multicollinearity does not appear to be a major concern. The Pearson's correlation coefficients are presented in Table A5.6 in the appendix and, as expected, showed lower and weak correlations compared to tetrachoric correlation coefficients. The generally weak correlation between deprivation indicators justifies a more holistic approach to the measurement of multidimensional poverty (Espinoza-Delgado & Klasen, 2018).

Table 5.2: Spearman's rank correlation coefficients between deprivation indicators 2015/16†

	DG	TR	LD	OC	CF	FL	RF	WL	EL	WR	TF	FA	WZ	HZ	WH	BM	HF	CI	EN	LT	SC	SF	CR
IF	.690***	.487***	-.121***	.384***	.499***	.446***	.413***	.417***	.652***	.324***	.470***	.350***	.147***	.070**	.056	.061**	-.003	-.027**	.174***	.259***	.186***	.026**	-.096***
DG	1	.627***	-.198***	.505***	.709***	.749***	.612***	.649***	.867***	.554***	.655***	.516***	.167***	.123***	.058	.103***	.062***	.034***	.268***	.406***	.356***	.000	-.091***
TR		1	-.134***	.506***	.621***	.506***	.426***	.419***	.637***	.290***	.647***	.554***	.221***	.219***	-.006	.140***	.107***	.043***	.211***	.383***	.310***	.018	-.159***
LD			1	.041***	-.502***	-.245***	-.195***	-.195***	-.204***	-.023*	-.418***	-.307***	-.056	-.076**	.108**	-.067**	-.128***	-.134***	-.055**	-.306***	-.377***	.040***	-.063***
OC				1	.441***	.540***	.466***	.491***	.569***	.297***	.547***	.376***	.190***	.158***	.035	.073***	.031***	-.071***	.221***	.195***	.150***	.036***	-.125***
CF					1	.786***	.679***	.661***	.817***	.625***	.785***	.566***	.269***	.197***	.040	.146***	.095***	.049***	.254***	.519***	.486***	-0.015	-.125***
FL						1	.916***	.959***	.843***	.723***	.653***	.365***	.120**	.071**	.000	-.015	.048***	.016	.324***	.438***	.387***	-.070***	-.088***
RF							1	.917***	.755***	.618***	.505***	.304***	.073	.099**	-.063	.016	-.097***	.012	.238***	.381***	.310***	-.051***	-.142***
WL								1	.766***	.696***	.524***	.345***	.102**	.081**	.014	.016	-.041***	.012	.269***	.414***	.356***	-.059***	-.098***
EL									1	.727***	.764***	.501***	.207***	.165***	-.018	.095***	.032***	.048***	.287***	.463***	.433***	-.002	-.185***
WR										1	.536***	.119***	.114**	.015***	-.028	-.036	-.051***	.072***	.310***	.379***	.369***	.025*	-.051***
TF											1	.579***	.213***	.152***	-.008	.149***	.138***	.043***	.249***	.479***	.436***	-.004	-.164***
FA												1	.162***	.123***	.062	.135***	.187***	.071***	.149***	.309***	.308***	.051***	-.005
WZ													1	.689***	.659***	c	-.031	.061	c	c	c	-.077*	-.061
HZ														1	-.077	c	-.043	.033	c	c	c	-.127***	-.105**
WH															1	c	-.003	-.120	c	c	c	.032	-.125
BM																1	.036	.036	-.077**	-.782	c	-.012	-.050
HF																	1	.018	-.039***	.002	.043***	.125***	.029**
CI																		1	.023	.278***	.458***	.040***	.026
EN																			1	.961***	.	-.004	.031
LT																				1	.928***	-.019	-.069***
SC																					1	.007	-.061***
SF																						1	.399***

Source: Author's estimates based on the 2015/16 BMTHS data. †Results are estimated at the population level using sample weights. ID: indicator; IF: information; DG: durable goods; TR: transport; LD: land tenure; OC: overcrowding; CF: cooking fuel; FL: floor; RF: roof; WL: wall; WR: water; TF: toilet facility; EN: enrolment; LT: literacy; SC: school attainment; HF: health facility; CI: chronic illness; FA: food access; WZ: weight-for-age; HZ: height-for-age; WH: weight-for-height; BM: body mass index; SF: safety; CR: crime. **, *Correlation is significant at the 0.01 and 0.05 level (2-tailed) (respectively). Sample size: 24,720. cNo data to compute correlations.

5.6. Validity and reliability tests

Deprivation indicators in the MPI need to be valid and reliable to ensure the overall measure is robust. Therefore, in this section, I present validity and reliability results. Following other researchers (e.g., Guio et al., 2012, 2016), I conducted validity tests by running binary logistic regressions for each MPI indicator against three independent variables associated with multidimensional poverty: monetary poverty, subjective poverty and disability status. The monetary poverty variable is associated with deprivation indicators and has been used in other studies to validate indicators (Townsend, 1979; Mack & Lansley, 1985; Guio et al., 2012). Subjective poverty captures one's self-reported economic status ('much worse' or 'little worse') compared to previous years and is associated with deprivation (Bradshaw & Finch, 2003). I use self-reported disability status to capture functional limitations ('difficult' or 'very difficult'). The cyclical relationship between disability and deprivation has been documented globally, with disability increasing the likelihood of being deprived and deprivation increasing the probability of becoming a person with a disability (Trani & Cannings, 2013; Trani et al., 2016; Pinilla-Roncancio, 2017).

Table A5.7 (in the appendix) summarises the validity results. For twenty-two out of twenty-four deprivation indicators, regression results in at least two models were significant, meaning that most indicators are valid multidimensional poverty measures. The regression results were insignificant in at least two models only for two deprivation indicators: weight-for-height and height-for-age. These two indicators apply only to children aged 0-4 and are associated with a very low sample size and low levels of deprivation, which means the measurement errors are larger. For example, no disability was reported for any of the children aged 0-4 reported any disability; hence the validity test could not be generated for weight-for-height and disability.

All deprivation indicators (raw binary variables) were also subjected to reliability tests. The results are not affected by differential weighting (Catalán & Gordon, 2020). I used the Classical Test Theory (CTT) and Cronbach's alpha statistic to measure the internal consistency of the MPI to assess how closely related a set of indicators are as a group (Cronbach, 1951; Nunally, 1978; Guio et al., 2012, 2016). An alpha of 0.70 or higher is considered 'satisfactory' (Nunally, 1978), indicating that the indicators measure an underlying construct (Guio et al., 2016). The CTT results show that Cronbach's alpha

was moderately high across age categories, ranging from 0.773 to 0.803 (Table A5.8 in the appendix). Using the alpha-if-item-deleted (AID) and the item-total correlations (ITC), indicators for health (health facility and chronic illness) and security (crime and safety) seem to be unreliable across all applicable age groups (Table A5.8). Also, child indicators (weight-for-height and height-for-age) showed lower levels of reliability for the 0-4 years age group. However, the child indicators comprise a small sample leading to larger measurement errors.

However, the CTT only provides an assessment of the overall reliability of the MPI but does not provide enough information about the measurement properties of each indicator used in the MPI (Catalán & Gordon, 2020). Therefore, the Item Response Theory (IRT) is used to complement the CTT to provide additional information on the reliability of each indicator used in the MPI (Guio et al., 2012, 2016; Gordon & Catalán, 2020). The IRT models assess the reliability of each indicator based on parameters: difficulty (severity) and discrimination, estimated using the two-parameter logistic model (2PL) (Catalán & Gordon, 2020). Difficulty (severity) provides information on the severity of the indicator, measured by units of standard deviation from the average. Discrimination provides information on how well each indicator differentiates between the deprived and non-deprived persons (Guio et al., 2012; Catalán & Gordon, 2020).

Figure A5.1 (in the appendix) depicts the 2PL IRT model for each indicator included. The Item Characteristic Curves (ICC) show how each indicator relates to the latent construct (multidimensional poverty) (Guio et al., 2012; Catalán & Gordon, 2020). The figure reveals that only two variables: weight-for-height and safety, tend to have flat curves. Flat curves show low discrimination, meaning that weight-for-height and safety do not strongly discriminate between the poor and non-poor. Curves positioned on the far right-hand side indicate high severity. Except for child nutrition indicators (weight-for-age, height-for-age and body mass index) and health indicators (chronic illness and access to health facilities), the IRT models reveal that many indicators are not too severe. Therefore, most indicators used are adequate poverty measures in Botswana, as shown by many ‘S’ curves not positioned on the far right-hand side. The 2PL IRT discrimination and severity coefficients are presented in Table A5.9 (in the appendix). The indicator has discrimination problems if the discrimination coefficient is less than 0.4 and has difficulty

(severity) problems if the estimated difficult coefficient is more than 3.5 (Catalán & Gordon, 2020).

In sum, fifteen out of the twenty-four deprivation indicators included in the overall measure showed high levels of validity and reliability. Tests point to relatively weak validity and reliability for nine deprivation indicators: land tenure, health facility, chronic illness, safety, crime, body mass index, weight-for-age, height-for-age, and weight-for-height. Out of these indicators, four are child nutrition indicators. As noted above, the child-related indicators comprise a small sample size. While acknowledging the empirical basis for including various indicators, there are strong conceptual and theoretical reasons for including these indicators in the overall construct. Land tenure captures the right to the ownership of land; health indicators capture the right to health; land and crime capture the right to security, while child nutrition indicators capture the right to adequate, appropriate healthy food. As discussed in section 5.3, these rights are captured in international documents, including the 1948 UDHR, the 2012 UNOHCHR, the SDGs and the Agenda 2063. Therefore, these indicators are included in the final MPI since they capture basic human rights and are relevant for Botswana.

5.7. Results and discussions

In this section, the results of the multidimensional poverty index for Botswana are presented. First, the descriptive results of the uncensored deprivation headcount ratios are presented and discussed. Second, the aggregate multidimensional poverty index is presented, with aggregate headcount ratio, intensity and adjusted headcount ratio.

5.7.1. Deprivation levels by indicator

There is a need to analyse each deprivation indicator before aggregating the results into a single index. Therefore, in this section, the indicator deprivation rates for the whole population are examined. Table 5.3 presents ‘the uncensored headcount ratio’ (see Alkire & Santos, 2014), that is, the estimated proportion of individuals deprived in each of the twenty-four indicators used. Even though Botswana has done well to reduce monetary poverty, this chapter finds a rather different picture with respect to non-monetary deprivation indicators.

Generally, the results show that most Batswana are deprived of indicators relating to asset and housing and living condition dimensions. Concerning assets, 71.4 per cent of the population do not own any form of transport, and 56.2 per cent are deprived of durable goods. In terms of land, 37.5 per cent of Batswana have no land of their own, and 22.4 per cent have no access to information. In terms of housing and living conditions, 47.5 per cent and 40.2 per cent of the population are deprived of cooking fuel and living space (overcrowding). About 36.2 per cent of the population has no access to electricity, and 10, 12.5 and 17.6 per cent are deprived in the roof, floor, and wall indicators, respectively. A total of 64.7 per cent of the population is deprived in sanitation. They lack access to a safe toilet facility, while 9.7 per cent of the population has no access to safe drinking water.

With respect to food security, about 49.2 per cent of the population indicated they do not have access to food. About 17.4 per cent, 7.6 per cent and 5.2 per cent of children aged 0-4 years are stunted, undernourished, and wasted, respectively, while those aged 5-17 are deprived in terms of body mass index. Concerning education, about 41.7 per cent of adults are deprived in school attainment and about 10.7 per cent of children aged 5-17 years are not enrolled in school, while 8.9 per cent of those aged 15 years and above are illiterate. Regarding health, about 33.8 per cent of the population is deprived of access to a health facility, and 17 per cent are chronically ill. In terms of security, about 39.7 per cent of Batswana indicated they feel unsafe, while 10 per cent reported they had been victims of crime and violence.

Table 5.3: Proportion of deprived population by indicator†

Dimension	Indicator	Sample	% Deprived	SD	Age group
1. Asset	Information	24,720	22.4	0.4167	All
	Durable goods	24,720	56.2	0.4962	All
	Transport	24,720	71.4	0.4521	All
	Land tenure	24,720	37.5	0.4840	All
2. Housing & living conditions	Overcrowding	24,720	40.2	0.4903	All
	Cooking fuel	24,720	47.5	0.4994	All
	Floor material	24,720	12.5	0.3311	All
	Roof material	24,720	10.6	0.3073	All
	Wall material	24,720	17.6	0.3804	All
	Electricity	24,720	36.2	0.4807	All
3. Water & sanitation	Water supply	24,720	9.7	0.2959	All
	Toilet facility	24,720	64.7	0.4780	All
4. Food security	HFIAP	24,720	49.2	0.4999	All
	WAZ	3,104	7.6	0.2653	0-4
	HAZ	3,104	17.4	0.3789	0-4
	WHZ	3,104	5.2	0.2226	0-4
	BMI	6,614	10.7	0.3093	5-17
5. Health	Health facility	24,720	33.8	0.4730	All
	Chronic illness	24,720	17.0	0.3758	All
6. Education	School enrolment	6,614	10.5	0.3051	5-17
	Literacy	16,227	8.9	0.2853	15 and above
	School attainment	15,002	41.7	0.4931	18 and above
7. Security	Safety	24,720	39.7	0.4893	All
	Crime	24,720	10.4	0.3051	All

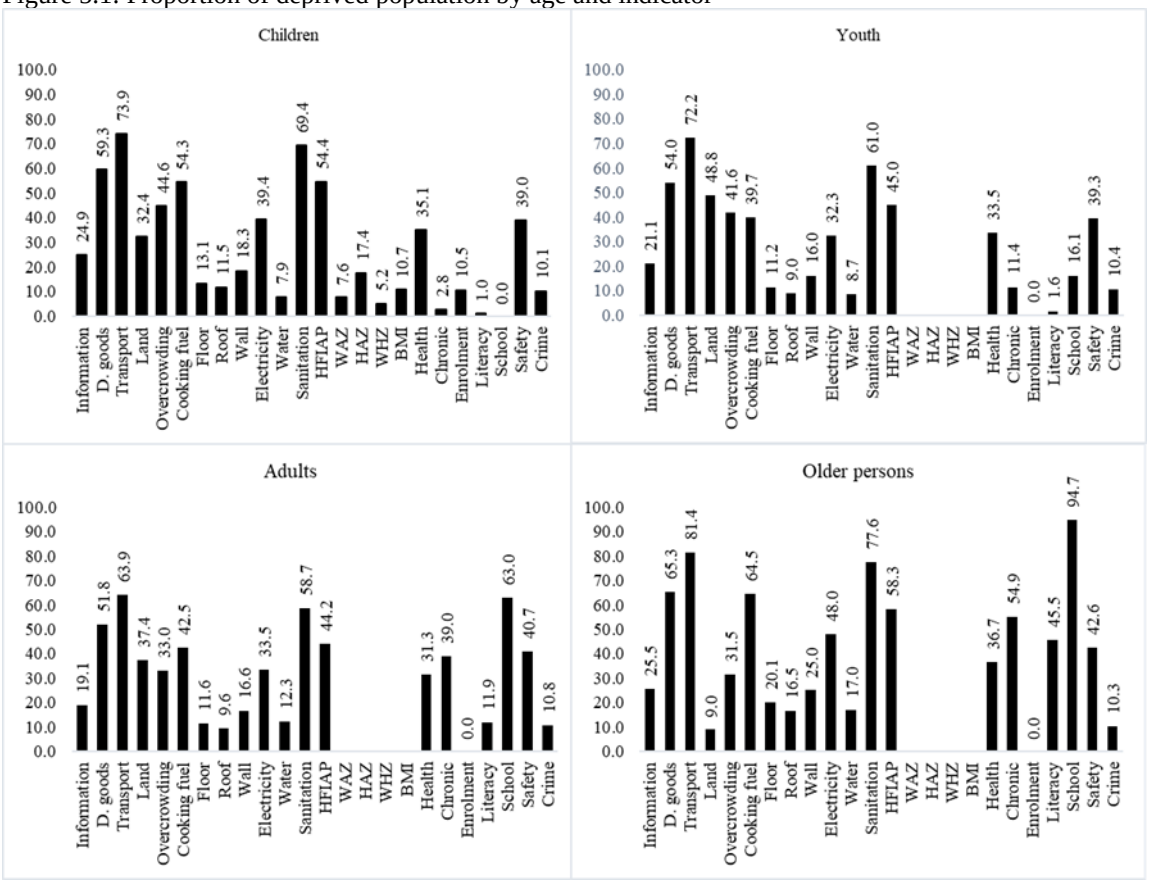
Source: Author's estimates based on the 2015/16 BMTHS data. †All percentages are estimated at the population level using sample weights. SD stands for standard deviation. HFIAP: household food insecurity access prevalence; WAZ: weight-for-age; HAZ: height-for-age; WHZ: weight-for-height; BMI: body mass index. Sample size: 24,720.

5.7.2. Deprivation levels across subgroups of the population

In line with the LNOB principle and SDG 1 (target 1.2), I discuss the deprivation levels across all the indicators in all selected dimensions by different subgroups of the population. Figure 5.1 depicts the decomposition of deprivation indicators among various age groups, and Tables A5.1–A5.3 (in the appendix) present the results across deprivation indicators by demographic characteristics, economic and geographical variables. In general, the results reveal that there exist substantial differences in deprivation levels among deprivation indicators across different groups. Older persons are the worse off group exhibiting higher deprivation rates in most deprivation indicators than other age groups (Figure 5.1). This is because older persons are more deprived of basic capabilities (health and education). For example, more than nine out of ten older persons have not attained basic education in Botswana. This result is not surprising since most of the older persons in Botswana were not exposed to free education. Access to education was

minimal since the country was among the poorest in the world. Regarding health, older persons experienced the highest deprivation concerning chronic illness. This finding is consistent with empirical literature worldwide, where the prevalence of chronic diseases is higher among persons over 65 years (Boutayeb & Boutayeb, 2005; Prasad et al., 2012).

Figure 5.1: Proportion of deprived population by age and indicator†



Source: Authors' estimates based on the 2015/16 BMTHS data. †All percentages are estimated at the population level using sample weights. SD stands for standard deviation. HFIAP: household food insecurity access prevalence; WAZ: weight-for-age; HAZ: height-for-age; WHZ: weight-for-height; BMI: body mass index. Sample size: 24,720.

Table A5.1 in the appendix presents the deprivation levels by individual and household characteristics. With respect to sex, results reveal that, on average, males are worse off than females, except for chronic illness. The finding that females have higher deprivation levels in chronic illness is common in the literature (Case & Paxson, 2005). Females are more likely to suffer from illness (Case & Deaton, 2005). Even though women have higher life expectancy than men (Bird & Rieker, 1999), their lives are characterised by many chronic non-life-threatening illnesses that can significantly affect the quality of their lives (Bird & Fremont, 1991; South-Paul, 2001). Except for the water access indicator, citizens exhibited higher levels of deprivation in all indicators.

Persons with disabilities are worse off in all deprivation indicators except for cooking fuel and weight-for-height than those with no disability. For example, the deprivation rate in school enrolment (attainment) is more than double for children with disabilities (adults). The illiteracy rate is more than four times higher for persons with disabilities than those with no disability. This finding confirms evidence of higher exclusion from the education system for persons with disabilities in Botswana. Similar conclusions, especially in developing countries, exist in the literature (Trani & Loeb, 2012). Exclusion from accessing education negatively impacts the self-esteem and psychological well-being of persons with disabilities (Mollica et al., 1999). Concerning the sex of the household head, individuals residing in female-headed households are worse off than in male-headed households. Households headed by older persons and children have higher levels of deprivation. Concerning marital status, individuals from households headed by married couples are, on average, better off in terms of deprivations.

Apart from land tenure, living in a household whose head has no educational background is associated with higher deprivation levels. Conversely, living in a household headed by someone with a university qualification is associated with lower deprivation levels. Generally, deprivation levels decline with improvements in educational achievements. Except for chronic illness, safety and crime, individuals from households in the poorest quintile have higher deprivations levels. Concerning the household head's employment status, living in a household headed by unpaid family helpers and unemployed persons is associated with higher deprivation levels. Results reveal significant disparities across administrative districts, with Ngamiland West and Kweneng West being the worst-off districts (Table A5.3). Rural areas exhibited higher deprivation levels except for land tenure, safety and crime (Table A5.2).

In sum, the results show considerable variation in deprivations across indicators among different subgroups of the population. Persons with disabilities experience higher deprivation levels across most of the deprivation indicators than those with no disability. Similarly, deprivation levels are higher for older persons compared to other age groups. As expected, deprivation levels are more pronounced in rural areas than in urban villages and cities/towns. Ngamiland West and Kweneng West are the most affected districts in terms of deprivations in most indicators.

5.7.3. Multidimensional poverty estimates

In this section, the results of multidimensional poverty estimates are reported and discussed. Table 5.4 presents the results of the estimates of the multidimensional headcount ratio (*H*), the average deprivation share across the multidimensional poor (*A*), and the adjusted headcount ratio (M_0). The results reveal that 46.2 per cent of the population in Botswana can be considered multidimensionally poor. Multidimensional poverty intensity (*A*) is estimated at 47.4 per cent, meaning, on average, individuals are simultaneously deprived in at least eleven (11) out of the twenty-four (24) indicators considered. The adjusted headcount ratio is estimated at 0.219.

The results show significant varying poverty levels across different age groups of the population. Age positively relates to poverty, with older persons exhibiting higher levels of poverty than children. This finding is consistent with international evidence from similar studies in other countries (Espinoza-Delgado & Klasen, 2018; Franco-Correa, 2014).[53]

Table 5.4: Multidimensional poverty estimates by age 2015/16†

Subgroup	Population	(%)	*H* (%)	*A* (%)	M_0
Age					
0 to 17 years (children) (ref)	817,843	39.4	41.7	43.4	0.181
18 to 35 years (youth)	643,725	31.0	42.5***	46.7***	0.198***
36 to 64 years (adults)	501,325	24.2	51.8***	51.1***	0.264***
65+ (older persons)	110,781	5.3	76.6 ***	53.9***	0.413***
Total	**2,073,675**	**100**	**46.2**	**47.4**	**0.219**

Source: Authors' estimates based on the 2015/16 BMTHS data.
H: headcount ratio; *A*: intensity; M_0: adjusted headcount ratio; *HH*: household head.
†All percentages are estimated at the population level using sample weights. Sample size: 24,720.
Significance levels: $^{*}p$ <0.1; $^{**}p$ <0.05; $^{***}p$ <0.01.

5.7.4. Individual-level and household-level comparison

To compare individual-level and household-level estimates, the same index is calculated using indicators identified at the household level. The same indicators explained in Section 5.3 and presented in Table 5.1 are considered. Equal weighting across the seven dimensions and equal nested weighting for indicators within each dimension used is employed. In household-based multidimensional poverty measurements, thresholds are

[53] A detailed analysis and discussion of multidimensional poverty levels (prevalence, intensity and adjusted headcount ratio) by different sub-groups of the population is presented in chapter 6.

not defined based on the achievements of each individual but collectively for the household. Based on indicators identified at the household level, all members of the household are assumed to have the identical deprivation vector. However, when dealing with indicators identified at the individual level, we classify the thresholds of using individual-level data to assess household-level deprivation into two types, *restrictive* and *expansive* (Klasen & Lahoti, 2020).

The deprivation threshold is defined as *restrictive* when the entire household members are categorised as deprived in an indicator if at least one individual is deprived of that particular indicator (Klasen & Lahoti, 2020). For example, a household deprived of nutrition if at least one household member is undernourished is such a restrictive one. The deprivation threshold is *expansive* when the entire household members are categorised as non-deprived in an indicator if at least one individual is non-deprived of that particular indicator. For example, the entire household is deemed non-deprived in educational achievement if at least one household adult member has nine years of education. Except for educational achievement, all individual-level indicators are defined in a restrictive way in computing a household-level multidimensional poverty measure.

Table 5.5 presents the results. The overall levels of poverty are higher when using an individual-level as compared to a household-level measure. Based on the headcount ratio (H), 36.5 per cent of the population is considered multidimensionally poor when using the household as a unit of analysis compared to 46.2 per cent when using the individual as a unit of analysis. This results in a difference of 9.7 percentage points between the two measures. Similarly, the intensity of poverty (A) and the adjusted headcount ratio (M_0) are higher for the individual-level measure than the household-level measure. The results confirm that household-level measure underestimates the poverty levels of the population.

The multidimensional poverty rate among older persons is 23.6 percentage points higher when using an individual-based MPI measure than when using the household-based measure. By contrast, the multidimensional poverty rate for children is only 1.4 percentage points higher than the household-level measure. The huge disparity in poverty prevalence for adults between the two measures is mainly driven by the education indicators, suggesting that the education indicator plays a crucial role in the overall MPI.

This finding is not surprising given the strong age dependence on educational deprivation (Klasen & Lahoti, 2020). The results point towards a U-shaped relationship between age and household-level multidimensional poverty, while the results based on an individual-level measure reveal a positive linear relationship. The contrasting findings and conclusions between household- and individual-level analysis shows that how poverty is measured has a bearing on policy implications. The results support the use of the individual as a unit of analysis to identify those left behind in line with the LNOB principle.

Table 5.5: Individual- and household-level multidimensional poverty estimates by age 2015/16†

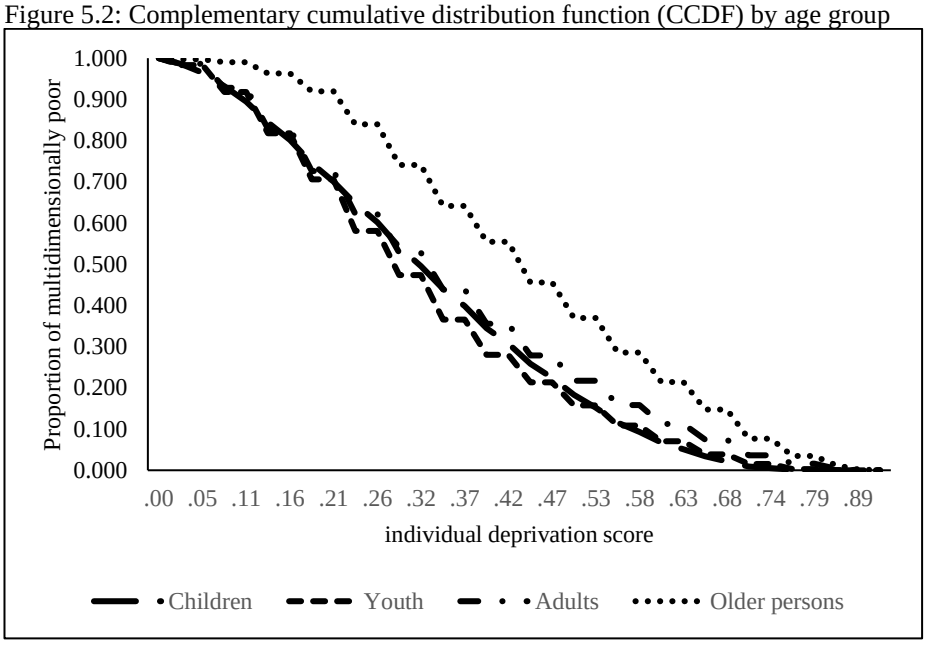
Subgroup	Individual-level			Household-level			
Subgroup	*H*(%)	*A*(%)	M_0	*H*(%)	*A*(%)	M_0	ΔPrevalence
0 to 17 years (children)	41.7	43.4	0.181	40.3	43.0	0.173	1.40
18 to 35 years (youth)	42.5	46.7	0.198	30.7	42.9	0.132	11.8
36 to 64 years (adults)	51.8	51.1	0.264	34.2	44.0	0.151	17.5
65+ (older persons)	76.6	53.9	0.413	53.0	44.9	0.238	23.6
Total	**46.2**	**47.4**	**0.219**	**36.5**	**43.4**	**0.158**	**9.70**

Source: Authors' estimates based on the 2015/16 BMTHS data.
H: headcount ratio; *A*: intensity; M_0: adjusted headcount ratio.
†All percentages are estimated at the population level using sample weights. Sample size: 24,720.
ΔPrevalence is the difference between individual- and household-level poverty prevalences (*H*).

5.8. Robustness analysis

A multidimensional measure is designed based on a choice of diverse parameters (Alkire et al., 2015b). Therefore, there is a need to assess how sensitive the estimates are to the selection of different parameters and if the main conclusions are robust to the different choices of parameters. Therefore, this section examines whether the main conclusions are robust to (i) different poverty cut-offs (*k* values) and (ii) changes in weighting structure (*w*). Following Alkire et al. (2015b), I first employed the complementary cumulative distribution function (CCDF) to investigate whether my results are robust to the choice of a multidimensional poverty line (*k*). Figure 5.2 depicts results for the CCDFs for children, youth, adults, and older persons for various values of *k*. Overall, the results do not find strict first-order stochastic dominance between the CCDFs for different *k* values. In general, the results show that older persons' distribution dominates those of other age groups. That is, no matter what value of *k* I choose, the proportion of multidimensionally poor individuals (*H*) will always be larger for older persons than for children, youth, and adults. These results confirm the conclusion that older persons have higher levels of multidimensional poverty.

Figure 5.2: Complementary cumulative distribution function (CCDF) by age group



Source: Author's estimates based on the 2015/16 BMTHS data

Second, the robustness analysis involved computing poverty headcount ratios (H), intensity (A) and adjusted headcount ratio (M_0), considering two different poverty cut-offs (k values) and alternative weighting schemes.[54] In this case, the equal weighting scheme is employed across all indicators. Tables 5.6 present the results. The main conclusions remain robust, with older persons experiencing higher poverty levels across all the different scenarios under consideration. This robustness analysis proves that even though normative decisions were employed when constructing the index, the public policy conclusions drawn from the index are robust to a choice of diverse parameters.

Third, for further robustness checks, I excluded the indicator of years of schooling for older persons. Table A5.5 (in the appendix) presents the results. Poverty levels for older persons declined, with the headcount ratio reducing by 8.8 percentage points to 67.8 per cent. However, older persons remained the worse off group exhibiting the highest poverty levels compared to other age groups. The rankings based on age groups remained the same. As the ranking is not altered, and due to the intrinsic value of education for older persons, the years of schooling indicator is included in computing the overall MPI. In addition, I excluded chronic illness from the MPI and years of schooling for older persons. The results show that the poverty levels for older persons decline more than the rest of

[54] The values of k are limited to a more plausible range of 25% to 40% to conduct restricted tests of dominance (see Alkire & Santos, 2014).

the age groups. However, older persons remained the worse off group exhibiting the highest poverty levels. Thus, the MPI is stable and can be used for policy analysis. Therefore, both chronic illness and years of schooling for older persons are included in the construction of the MPI, and the same MPI is applied in the following chapters of this thesis.

Table 5.6: Multidimensional poverty estimates using alternative parameters 2015/16[†]

	k=25			*k*=40			Equal weight[a]		
Subgroup	*H*	*A*	M_0	*H*	*A*	M_0	*H*	*A*	M_0
Age									
0 to 17 years (children)	57.9	39.5	0.228	24.4	48.5	0.118	44.0	47.8	0.211
18 to 35 years (youth)	55.7	42.6	0.237	30.2	50.9	0.154	36.5	49.6	0.181
36 to 64 years (adults)	62.6	47.4	0.296	41.6	54.6	0.227	43.9	51.9	0.228
65+ (older persons)	86.8	51.1	0.443	63.3	57.5	0.364	64.1	54.5	0.349
Total	**59.9**	**43.3**	**0.259**	**32.4**	**52.0**	**0.169**	**42.7**	**49.8**	**0.213**

Source: Author's estimates based on the 2015/16 BMTHS data.
H: headcount ratio; *A*: intensity; M_0: adjusted headcount ratio.
[†]All percentages are estimated at the population level using sample weights. Sample size: 24,720. [a]Equal weighting structure across indicators.

5.9. Summary and conclusions

Most empirical studies use the household as the unit of analysis for multidimensional poverty measurement. However, estimation of poverty levels at the household level underestimates the poverty levels of the society and is not sensitive to demographic characteristics such as gender and age. The call to end poverty in all its forms and for everyone, as emphasised by SDG 1.2, acknowledges the multidimensional nature of poverty and that poverty should be examined at the individual level. It should be noted, however, that some of the indicators are identified at the household level due to the unavailability of data at the individual level. The household-level indicators are included for their intrinsic and instrumental significance. Also, even though some of the indicators included performed weakly on validity and reliability tests, they capture basic human rights and are relevant for Botswana.

The results reveal that an estimated 46.2 per cent of individuals in Botswana are considered multidimensionally poor based on individual-level analysis. This figure is higher than the household-level estimate of 36.5 per cent, which indicates that using the household as a unit of analysis leads to underestimating poverty levels in society. Similarly, the results show that, on average, the multidimensionally poor are deprived in 47.4 per cent of the deprivation indicators under consideration. This finding is an

indication that multidimensional poverty intensity is also a considerable concern in Botswana. Overall, the results reveal significant differences in poverty levels across different subgroups. Therefore, a more disaggregated individual-level analysis is needed to identify those left behind.

In conclusion, this chapter provides the first attempt to propose an individual-based multidimensional poverty measure for Botswana to reflect the country's development priorities outlined in NDP 11, Vision 2036 and the proposed BPEPS, and the country's commitment to the 2030 Agenda for sustainable development. This chapter also provides policy implications for adopting and using the individual-based multidimensional poverty measure. First, this measure can be used as a tool for monitoring the progress in national development as outlined by different development priorities. Second, there is a need to emphasise the importance of the multidimensional individual-level measure of poverty in identifying the poor for policymakers to implement nationally appropriate social protection systems and to be able to cover those left behind, as emphasised by SDG 1.3 of the SDGs (UN, 2015). Third, this measure can be used to assess the targeting effectiveness of social protection systems in reaching the poor. Finally, this chapter hopes to set the basis for further discussions and stimulate debates regarding the need for adopting the individual-based multidimensional poverty measure. Also, this chapter hopes for more timely data to develop a more robust, valid and reliable national MPI for Botswana.

CHAPTER 6: MULTIDIMENSIONAL POVERTY PROFILES

6.1. Introduction

As mentioned in previous chapters, the LNOB principle is an essential aspect of the 2030 Agenda of Sustainable Development. The LNOB principle is also recognised by Agenda 2063 (AUC, 2015). The LNOB also acknowledges that data disaggregation is vital to identify those left behind (UN, 2015, 2016a). The High-Level Panel of Eminent Persons on the Post-2015 Development Agenda proposed that to leave no one behind, there is a need to ensure that 'no person – regardless of ethnicity, gender, geography, disability, race or another status – is denied basic economic opportunities and human rights' (UN, 2013: p29). Individuals at the intersection of these factors are at the risk of being left behind.[55] Despite this mandate of producing disaggregated data by LNOB and the call to address poverty in all its forms as stipulated by SDG 1 (UN, 2015), Botswana still uses the monetary poverty measure to identify the poor (SB, 2018).

The objective of this chapter is to identify those left behind in Botswana. The chapter addresses the following research question: *Who are those left behind or at risk of being left behind, and where do they live*? This chapter aims to deepen our understanding of the extent of multidimensional poverty across different subgroups of the population in Botswana. Therefore, this chapter extends the analysis in chapter 5 and disaggregates the analysis by individual characteristics, household-level variables, economic variables and geographical variables. Individual characteristics include sex, age, citizenship, disability status and household level variables include sex, age, marital status, educational attainment and employment status of the household head household size. Household per capita consumption quintiles are used to capture the economic status of the household. For the geographical variable, administrative districts are used.[56] These selected variables are commonly used in the literature as key determinants of poverty (e.g., Grootaert, 1997; Qi & Wu, 2016; Lekobane & Seleka, 2017). This chapter also examines inequality among the multidimensionally poor by employing the absolute measure of inequality proposed

[55] In LNOB personal factors captures what is known as discrimination. For example, people are left behind when they experience exclusion or mistreatment or access to public services based on their gender, disability, age nationality and other personal characteristics.
[56] The final list of variables is also dependent on data availability. For example, the 2015/16 BMTHS data does not capture information on ethnicity or race which are key variables in the LNOB principle.

by Alkire and Seth (2014a). In addition, this chapter employs econometric estimations to identify the correlates of multidimensional poverty.

The results reveal that multidimensional poverty levels in Botswana vary across different subgroups of the population. Older persons and PWDs recorded the highest poverty rates and intensities and have the highest adjusted headcount ratios. The same groups (older persons and PWDs) recorded the highest inequality levels. Econometric results confirm the descriptive findings. Older persons, PWDs, individuals from households headed by men, unmarried couples, children, households whose heads have no educational attainments, and rural areas have higher probabilities of being multidimensionally poor in Botswana. The findings of this chapter are expected to inform policy, especially poverty eradication initiatives.

This chapter makes a novel contribution to a deepened understanding of the multidimensional poverty situation in Botswana by providing multidimensional poverty profiles by different subgroups of the population. Currently, poverty profiles in Botswana are based on the monetary poverty measure. By providing profiles by inequality measure, this chapter adds to the limited literature on inequality among the multidimensionally poor, neglected by most empirical studies. Also, by employing the Tobit regression to capture the censoring component of the adjusted headcount ratio, this chapter makes a novel contribution. Tobit regression is used because it is more appropriate when the dependent variable, deprivation scores (c_i), is set within certain limits; in this case, the deprivation scores are bounded between zero and one. Most studies have used logit or probit regressions in examining determinants of multidimensional poverty.

This chapter is organised as follows. Section 6.2 presents multidimensional poverty estimates by different population subgroups, and section 6.3 discusses inequality among the multidimensionally poor. In section 6.4, a robustness analysis is conducted. Section 6.5 presents the determinants of multidimensional poverty. Last, Section 6.6 provides a summary and conclusions.

6.2. Multidimensional poverty levels

This section extends the analysis in chapter 5. It presents a detailed analysis and discussion of multidimensional poverty levels (headcount ratio, intensity, and adjusted

headcount ratio) by different population subgroups below. As shown earlier (chapter 5), multidimensional poverty in Botswana remains a substantial problem. An estimated 46.2 per cent of the people in Botswana are multidimensionally poor. However, identifying who these people are and where they live provides a shred of clear evidence for policymakers to make more focused and targeted interventions.

6.2.1. Multidimensional poverty estimates by demographic characteristics

The analysis is disaggregated by different demographic characteristics to identify those left behind. Table 6.1 presents the results of multidimensional poverty estimates by demographic variables. The results reveal that poverty levels in Botswana are slightly higher for females than males. This finding exists in the empirical literature in developing countries (Levine et al., 2012; Bader et al., 2016). It is essential to note the substantially wider gap in poverty levels between persons with disabilities (PWDs) and those with no disability, with PWDs exhibiting the highest poverty levels based on poverty headcount ratio (H), intensity (A) and adjusted headcount ratio (M_0). This finding is consistent with the recent literature that found multidimensional poverty to be higher for persons with disabilities (Mitra et al., 2013b; Trani & Cannings, 2013; Trani et al., 2013, 2016).

Individuals residing in households headed by females exhibited higher poverty rates (H) and adjusted headcount ratio (M_0) than those in households headed by men. Similar studies in developing countries confirm this finding (Trani et al., 2016; Fransman & Yu, 2019). However, those from male-headed households have higher poverty intensity (A) than those from female-headed households. As expected, individuals residing in a household headed by older persons experience higher poverty rates (H) and adjusted headcount ratio (M_0) than those living in households headed by adults. These households are comprised of larger families, mostly dependents (children and older persons). These are followed by individuals from households headed by children. Most households headed by children include orphans, and the living conditions in such households are worse, forcing children not to attend school, resulting in higher multidimensional poverty levels. However, the intensity of poverty (A) increases with an increase in the age of the household head.

Table 6.1: Multidimensional poverty measures by demographic variables 2015/16[†]

Subgroup	Population	(%)	*H* (%)	*A* (%)	M_0
Sex					
Female (ref)	1,097,366	52.9	46.8	47.6	0.223
Male	976,309	47.1	45.6***	47.1***	0.215***
Age					
0 to 17 years (children) (ref)	817,843	39.4	41.7	43.4	0.181
18 to 35 years (youth)	643,725	31.0	42.5***	46.7***	0.198***
36 to 64 years (adults)	501,325	24.2	51.8***	51.1***	0.264***
65+ (older persons)	110,781	5.3	76.6 ***	53.9***	0.413***
Disability status					
Persons with disabilities (PWDs)	58,028	2.8	73.3***	53.8***	0.395***
No disability (ref)	2,015,647	97.2	45.5	47.1	0.214
Citizenship					
Citizen (ref)	2,005,908	96.7	47.2	47.4	0.224
Non-citizen	67,767	3.3	18.2***	46.4***	0.085***
Sex of HH					
Female-headed (ref)	1,070,945	51.6	49.7	46.7	0.232
Male-headed	1,002,730	48.4	42.6***	48.2***	0.205***
Age of HH					
12-17 (children)	4,109	0.20	58.1***	41.5***	0.241***
18-35 (youth)	462,535	22.3	40.9***	46.2***	0.189***
36-64 (adults) (ref)	1,202,243	58.0	43.3	47.1	0.204
65+ (older persons)	404,788	19.5	61.0***	48.8***	0.298***
Marital status of HH					
Married (ref)	643,176	31.0	32.6	46.5	0.151
Living together	513,572	24.8	53.8***	48.1	0.259***
Separated	41,454	2.0	52.5***	46.5	0.244***
Divorced	40,579	2.0	38.1***	47.4***	0.181***
Widowed/Widower	273,647	13.2	54.1***	47.8***	0.259***
Never married	561,248	27.1	51.2***	47.2***	0.242***
Household size					
1 to 3 members	630,661	30.4	41.8***	49.1***	0.205***
4 to 6 members (ref)	798,554	38.5	40.8	46.9	0.192
More than 7 members	644,460	31.1	57.3***	46.5***	0.267***
Educational attainment of HH					
None (ref)	573,172	27.6	67.9	49.9	0.339
Primary	530,910	25.6	54.8***	46.9***	0.257***
Secondary	594,822	28.7	39.6***	44.5***	0.176***
Vocational	70,540	3.4	22.2***	42.4	0.094***
University	304,231	14.7	9.1***	44.3***	0.040***
Total	**2,073,675**	**100**	**46.2**	**47.4**	**0.219**

Source: Author's estimates based on the 2015/16 BMTHS data.
H: headcount ratio; *A*: intensity; M_0: adjusted headcount ratio; *HH* stands for the household head.
[†]All percentages are estimated at the population level using sample weights. Sample size: 24,720.
Significance levels: $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$.

With respect to marital status, individuals from households headed by married couples experience lower poverty rates (*H*), intensity (*A*) and adjusted headcount ratio (M_0) than those from households headed by unmarried persons. Individuals from households headed by widows/widowers recorded the highest poverty rates (*H*) and adjusted headcount ratio (M_0). Poverty levels exhibit a U-shaped relationship with household size in terms of headcount ratio (*H*) and adjusted headcount ratio (M_0). Individuals residing in

smaller families experience higher poverty levels, and the trend declines with households with four to six members, after which it increases for households with more than seven members. Families with larger household sizes enjoy economies of scale. In the case of Botswana, family members may serve as labourers in their own farm production. Also, larger families tend to pool resources together. This finding is consistent with similar studies dealing with multidimensional poverty profiles in developing countries (Gaihre, 2012; Bader et al., 2016). As expected, poverty levels decline with higher levels of educational achievement based on poverty rates (H) and adjusted headcount ratio (M_0). The multidimensional poverty intensity for individuals from families whose heads attained university qualifications is higher than those from households whose heads have tertiary qualifications (Table 6.1).

6.2.2. Multidimensional poverty estimates by economic variables

It is interesting to examine how multidimensional poverty levels vary across income groups (Table 6.2). Per capita consumption is used as a proxy for income. The results reveal a wide disparity in poverty levels. Individuals from a household in the poorest households (bottom quintile) exhibited the highest multidimensional poverty levels based on headcount ratio (H), intensity (A) and adjusted headcount ratio (M_0). For example, the poverty rate (H) for individuals from the poorest quintile is almost six times higher than that of individuals from the wealthiest quintile. This finding is consistent with similar studies in developing countries (Fransman & Yu, 2019; Mushongera et al., 2017; Roelen, 2017).

With respect to the employment status of the household head, the results reveal mixed and surprising findings. Poverty levels (H, A and M_0) are more pronounced among individuals from households headed by unpaid family helpers than those from households headed by unemployed persons. These are followed by individuals from households whose heads are engaged in subsistence agriculture based on poverty prevalence (H), intensity (A) and adjusted headcount ratio (M_0). Individuals from households where the household head is involved in their farm have limited access to essential services such as education, health facilities, water, and toilet facilities. As expected, individuals from households whose heads are engaged in formal paid employment exhibited lower poverty levels.

Table 6.2: Multidimensional poverty measures by economic variables 2015/16†

Economic variables	Population	(%)	*H* (%)	*A* (%)	M_0
Employment status of HH					
Unemployed (ref)	910,301	43.9	59.6	47.7	0.284
Paid employment	667,766	32.2	26.1***	44.6***	0.116***
Self-employment	225,456	10.9	29.7***	44.6***	0.132***
Own farm	141,822	6.8	59.8***	50.6***	0.303***
Unpaid family helper	128,329	6.2	70.1***	49.8***	0.350***
Quintiles					
Q1 (ref)	726,785	35.1	68.3	48.1	0.329
Q2	461,592	22.3	51.3***	46.9***	0.241***
Q3	351,832	17.0	36.2***	46.3***	0.168***
Q4	281,835	13.6	23.8***	46.3***	0.110***
Q5	249,105	12.0	11.6***	44.8***	0.052***
Total	**2,073,675**	**100**	**46.2**	**47.4**	**0.219**

Source: Author's estimates based on the 2015/16 BMTHS data.
H: headcount ratio; *A*: intensity; M_0: adjusted headcount ratio; *HH*: household head.
†All percentages are estimated at the population level using sample weights. Sample size: 24,720. Per capita quintiles were calculated at the household level. Per capita quintiles are defined as follows. Q1: y≤371.75; Q2: 371.76 ≤y≤ 665.32; Q3: 665.33.53≤ y≤1172.82; Q4: 1172.83≤y≤2238.13; y≥2238.14.
Significance levels: $^{*}p$ <0.1; $^{**}p$ <0.05; $^{***}p$ <0.01.

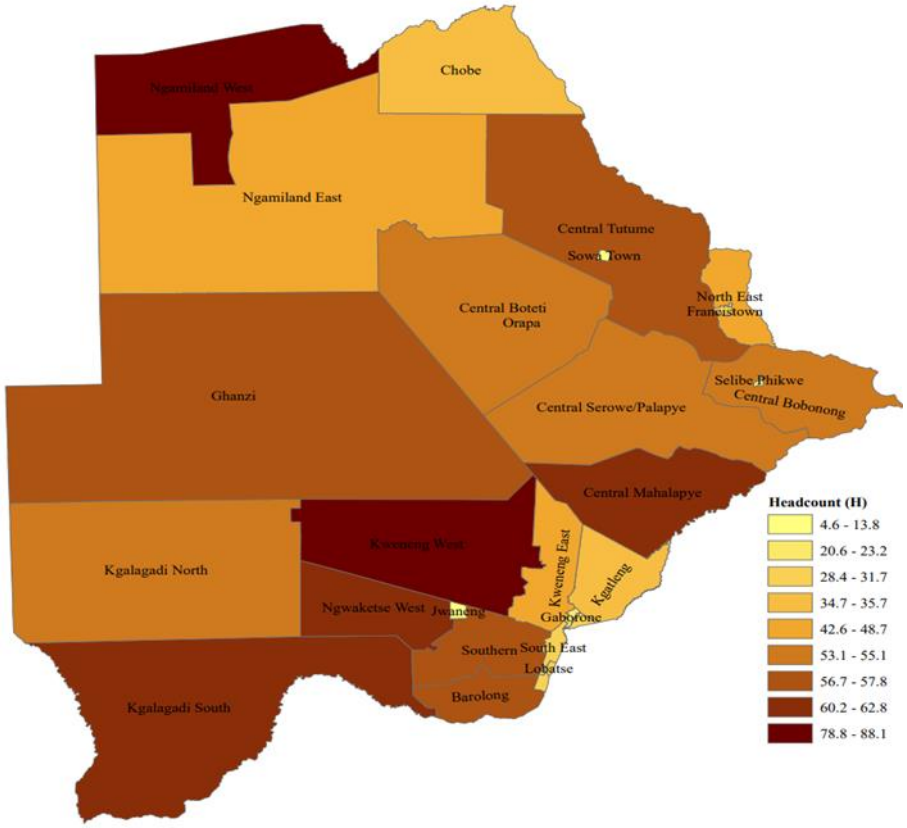
6.2.3. Multidimensional poverty estimates by geographic variables

To identify where those who are multidimensionally poor live, this chapter presents the results by geographical location. Table A6.1 presents poverty levels by geographical variables. The results reveal that multidimensional poverty levels are more pronounced in rural areas than in urban villages and cities/towns. Both poverty headcount ratio (*H*) and adjusted headcount ratio (M_0) are more than three times in rural areas than in cities/towns. Also, multidimensional poverty intensities (*A*) are higher in rural areas. This finding has been confirmed in developing countries (Levine et al., 2012; Bader et al., 2016; Fransman & Yu, 2019) and elsewhere (Alkire & Santos, 2014; Santos & Villatoro, 2018; Trani et al., 2016) in the empirical literature. With respect to administrative districts, the results reveal varying levels of poverty. Individuals from Ngamiland West and Kweneng West experienced the highest headcount ratios (*H*) (88.1% and 78.8%, respectively), intensity (*A*) (51.7% and 53.0%, respectively) and are the only districts that recorded more than 0.400 in terms of adjusted headcount ratio (M_0) (0.456 and 0.418, respectively) (Table A6.1).

Figures 6.3, 6.4 and 6.5 show poverty maps depicting headcount ratio, intensity and adjusted headcount ratio (respectively) across administrative districts. The three maps show diverse poverty patterns across administrative districts. Ngamiland West and Kweneng West districts depict higher poverty levels (as shown by the darker colours on the maps). Ngamiland West is known for its rich tourism and natural resources. However,

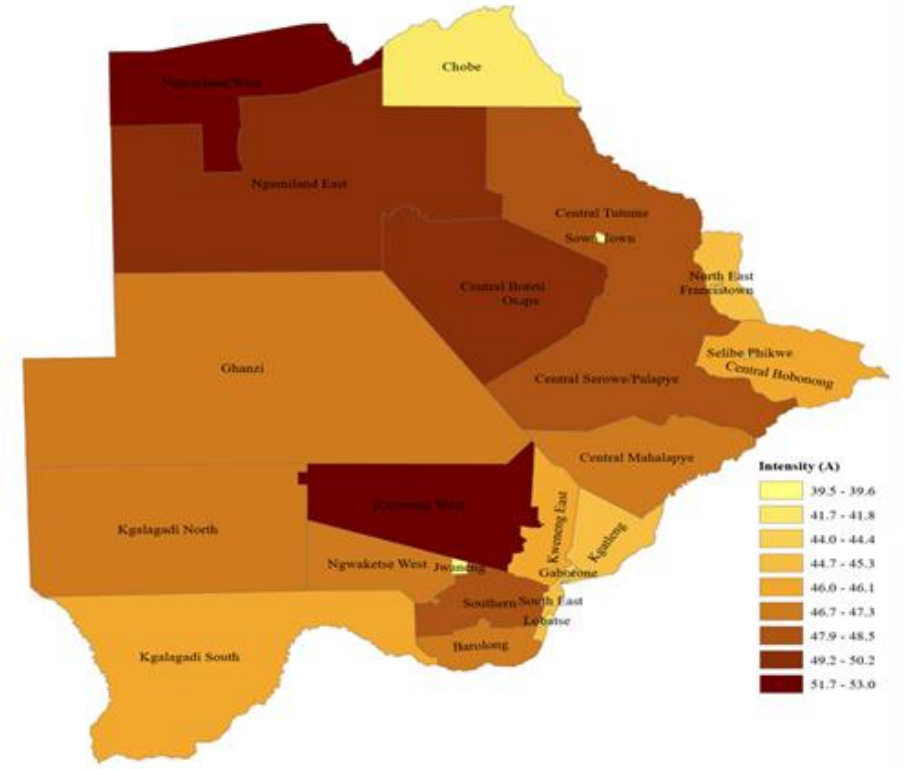
the benefits of tourism are limited to a few. Also, the soils are generally poor, with low rainfall, and the district has no known economic significant mineral deposits. The district is far from most of the cities and towns, with poor road networks limiting market access. There are limited employment opportunities outside agriculture and resource use. Most villages in the districts have no good road networks or improved infrastructure that facilitates market access and reduces production costs. The district comprises individuals with low educational levels. According to data from Statistics Botswana, Ngamiland West has the second-lowest literacy rate at 75 per cent (SB, 2018). The unemployment rate is also among the highest (29.1%) compared to other districts. There are also human-wildlife conflicts, where in most cases, farmers' crops are destroyed by wild animals (elephants), and predators kill livestock making farming less attractive and expensive as farmers have to invest in mechanisms to deter elephants from entering their farms (Republic of Botswana, 2021). In contrast, cities and towns are associated with lower poverty levels, with mining towns recording the lowest poverty levels. For example, Sowa Town and Orapa experienced the lowest levels of poverty. These two districts are mining towns with good infrastructure, and access to essential services such as water, electricity and health are freely provided.

Figure 6.3: Multidimensional poverty headcount ratio (*H*) across districts



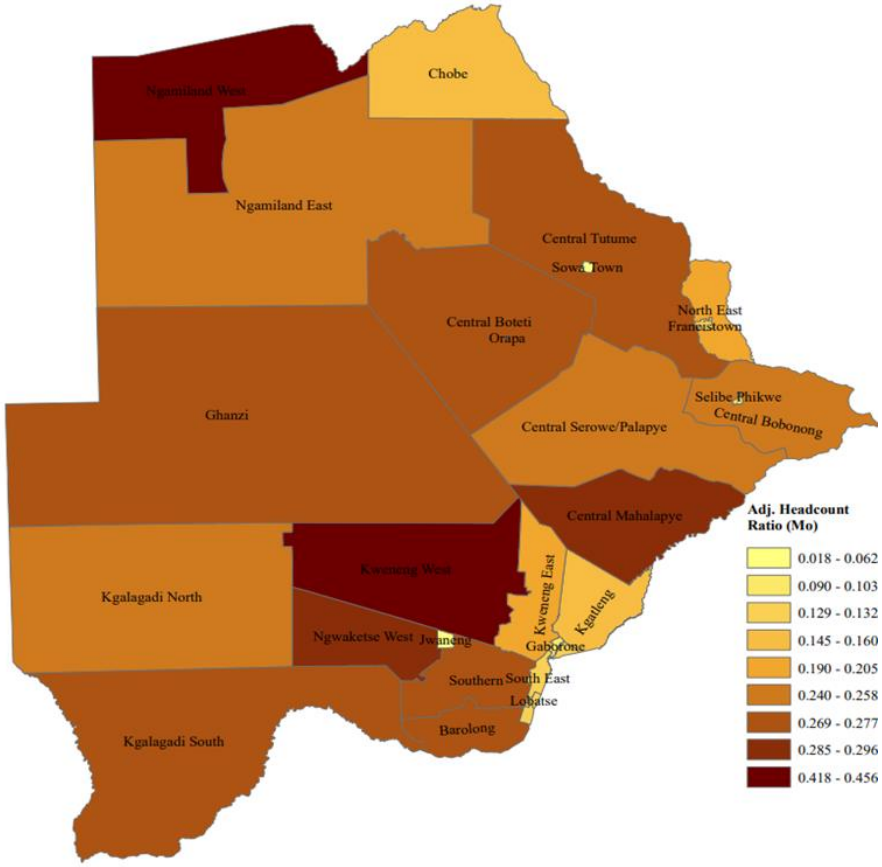
Source: Author's estimates based on the 2015/16 BMTHS data.

Figure 6.4: Poverty intensity (*A*) across districts



Source: Author's estimates based on the 2015/16 BMTHS data.

Figure 6.5: Adjusted headcount ratio (M_0) across districts



Source: Author's estimates based on the 2015/16 BMTHS data.

6.3. Inequalities among the left behind

Inequality across society is a growing and highly prominent issue (Alkire & Seth, 2014a). Inequality is one of the three important dimensions of the 2030 Agenda related closely to the LNOB principle (UN, 2016a). Notwithstanding this, most of the empirical studies on multidimensional poverty have neglected this issue. This chapter contributes to the scarce empirical literature on multidimensional poverty and inequality. Several inequality measures exist in the empirical literature. The Gini index is the most widely used measure of inequality (Gini, 1912). Other common inequality measures include the Atkinson index (Atkinson, 1970) and the Theil index (1967). These indices measure income inequality. For multidimensional inequality, several indices have been proposed and include, among others, Maasoumi (1986), Tsui (1995, 1999), Lugo and Decancq (2009), Rippin (2013, 2016, 2016) and Alkire and Seth (2014a). However, the Maasoumi (1986), Tsui (1995, 1999), and Lugo and Decancq (2009) indices are applicable when dealing with cardinal data.

In this thesis, the absolute inequality measure (I_q) proposed by Alkire and Seth (2014a) is used. I_q is chosen due to the nature of the indicators used to compute the multidimensional poverty index. The indicators used are binary (dichotomous). However, I_q has been criticised for being insensitive to inequality among the poor. Therefore, to address this limitation and for comparison purposes, the CSPI, an inequality-sensitive multidimensional index, is used (Rippin, 2013, 2016, 2017). The inequality index lies between zero and one, with zero indicating complete equality (no inequality) and one showing absolute inequality (Hanandita & Tampubolon, 2016). The inequality measure summarises empirical information that enables policymakers to assess whether the poorest of the poor (in our case, the left behind) share poverty alleviation benefits (Alkire & Seth, 2014b).

Table 6.3 presents the results of inequality estimates among the multidimensionally poor across different subgroups of the population based on the two inequality measures. Inequality among the multidimensionally poor is estimated at 0.044 at the national level based on I_q. The CSPI value is estimated at 0.109 at the national level. It is not surprising that the CSPI value is higher than the one estimated using the absolute inequality measure since the CSPI is based on the union approach. Generally, the variability observed in I_q is quite similar to the one based on CSPI. Therefore, with very few exceptions, the same conclusions are reached based on both inequality measures. The results show that inequality among the multidimensionally poor females is the same as the one estimated among the multidimensionally poor males based on I_q. However, the CSPI estimate is slightly higher for the multidimensionally poor females than the one estimated for the multidimensionally poor males.

With respect to age, the results suggest that there is a positive relationship between inequality levels and the individual's age in Botswana. The results show that the largest inequality in deprivation scores is found among older persons; conversely, the smallest inequality is found among children. This finding is in line with the international evidence, confirming that multidimensional poverty and inequality among the multidimensionally poor are positively related (Alkire & Seth, 2014b; Espinoza-Delgado & Klasen, 2018). The inequality among the multidimensionally poor PWDs is higher than the one estimated for the multidimensionally poor non-disabled persons. Concerning citizenship, the

inequality is higher for the multidimensionally poor citizens than the one estimated for the multidimensionally poor non-citizens.

The level of inequality among the multidimensionally poor is higher for individuals from male-headed households than the inequality level estimated for individuals from female-headed households based on I_q. The CSPI estimate showed contrasting results. However, it should be noted that the differences are very minimal. Regarding the marital status of the household head, the multidimensionally poor from households headed by cohabiting couples have higher inequality than the inequality estimated for the multidimensionally poor in households headed by married couples. The relationship between inequality level and age of household head is U-shaped. That is, inequality among the multidimensionally poor declines with an increase in household age, up to a certain point, after which it starts to rise again. Further, the results reveal that there is a negative linear relationship between inequality and household size in Botswana. According to the results, the largest inequality is found among the multidimensionally poor residing in smaller households; conversely, the smallest inequality is found among the multidimensionally poor residing in larger households.

Further, the results show a declining trend in inequality among the multidimensionally poor with achievement in education. Table 6.3 also reveals mixed results across household head employment status. The multidimensionally poor households residing in households whose heads have no educational achievement have higher inequality than the one estimated for the multidimensionally poor in households whose heads have university qualifications. Concerning the employment status of the household head, the multidimensionally poor residing in households whose heads are engaged in their own farm have a higher inequality than the one estimated for the multidimensionally poor in households whose heads are engaged in paid employment. The inequality among the multidimensionally poor across quintiles showed mixed results based on I_q. However, the CSPI reveal a declining trend in inequality among the multidimensionally poor along quintiles, with inequality estimated among the multidimensionally poor in Q1 being higher than the one estimated for the multidimensionally poor in Q5.

Table 6.3: Inequality across demographic and economic variables 2015/16[†]

Subgroup	*H* (%)	*A* (%)	M_0	I_q	*CSPI*
Sex					
Female	46.8	47.6	0.223	0.044	0.111
Male	45.6	47.1	0.215	0.044	0.106
Age					
0 to 17 years (children)	41.7	43.4	0.181	0.032	0.081
18 to 35 years (youth)	42.5	46.7	0.198	0.036	0.097
36 to 64 years (adults)	51.8	51.1	0.264	0.057	0.142
65+ (older persons)	76.6	53.9	0.413	0.076	0.234
Disability status					
Persons with disabilities	73.3	53.8	0.395	0.079	0.224
No disability	45.5	47.1	0.214	0.042	0.106
Citizenship					
Citizen	47.2	47.4	0.224	0.044	0.111
Non-citizen	18.2	46.4	0.085	0.035	0.041
Sex of HH					
Female-headed	49.7	46.7	0.232	0.040	0.114
Male-headed	42.6	48.2	0.205	0.049	0.104
Age of HH					
12-17 (children)	58.1	41.5	0.241	0.042	0.104
18-35 (youth)	40.9	46.2	0.189	0.038	0.091
36-64 (adults)	43.3	47.1	0.204	0.043	0.101
65+ (older persons)	61.0	48.8	0.298	0.050	0.153
Marital status of HH					
Married	32.6	46.5	0.151	0.042	0.074
Living together	53.8	48.1	0.259	0.048	0.131
Separated	52.5	46.5	0.244	0.037	0.118
Divorced	38.1	47.4	0.181	0.043	0.090
Widowed/Widower	54.1	47.8	0.259	0.045	0.130
Never married	51.2	47.2	0.242	0.041	0.119
Household size					
1 to 3 members	41.8	49.1	0.205	0.056	0.106
4 to 6 members	40.8	46.9	0.192	0.041	0.094
More than 7 members	57.3	46.5	0.267	0.038	0.130
Educational attainment of HH					
None	67.9	49.9	0.339	0.055	0.178
Primary	54.8	46.9	0.257	0.041	0.126
Secondary	39.6	44.5	0.176	0.033	0.081
Vocational	22.2	42.4	0.094	0.028	0.041
University	9.1	44.3	0.040	0.031	0.018
Employment status of HH					
Unemployed	59.6	47.7	0.284	0.042	0.142
Paid employment	26.1	44.6	0.116	0.037	0.054
Self-employment	29.7	44.6	0.132	0.039	0.062
Own farm	59.8	50.6	0.303	0.064	0.162
Unpaid family helper	70.1	49.8	0.350	0.054	0.183
Quintiles					
Q1	68.3	48.1	0.329	0.044	0.166
Q2	51.3	46.9	0.241	0.042	0.118
Q3	36.2	46.3	0.168	0.046	0.082
Q4	23.8	46.3	0.110	0.048	0.054
Q5	11.6	44.8	0.052	0.041	0.024
Total	**46.2**	**47.4**	**0.219**	**0.044**	**0.109**

Source: Author's estimates based on the 2015/16 BMTHS data.

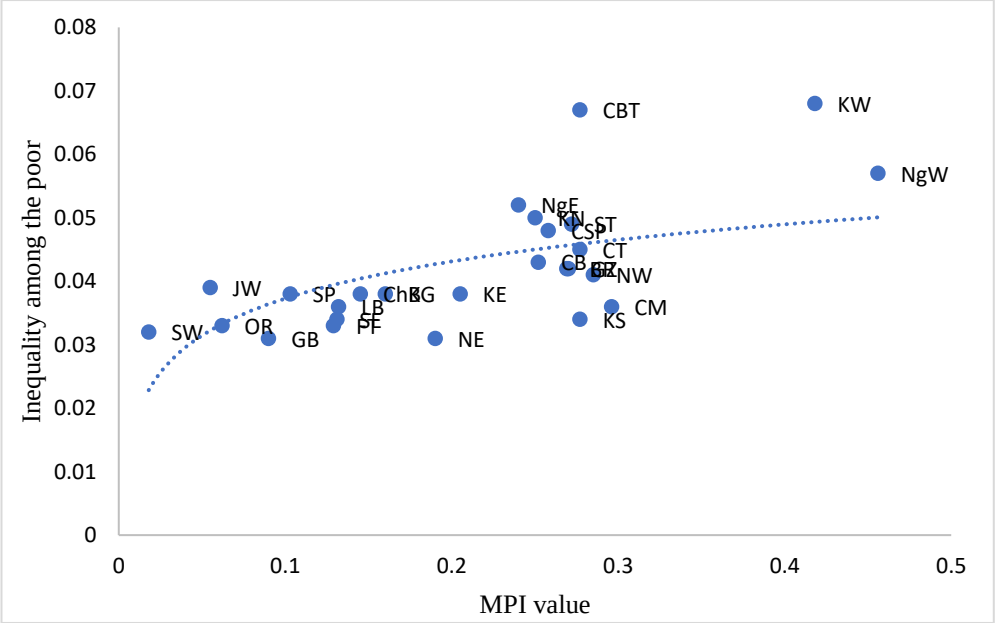
H: headcount ratio; *A*: intensity; M_0: adjusted headcount ratio; *HH* stands for the household head.

I_q: absolute inequality measure; *CSPI*: correlation sensitive poverty index.

[†]All percentages are estimated at the population level using sample weights. Sample size: 24,720.

Figure 6.6 depicts inequality and MPI among the multidimensionally poor across districts. The figure depicts a wide variation across administrative districts in inequality among the multidimensionally poor; Kweneng West (KW) exhibited the highest inequality level, followed by Central Boteti (CBT) and Ngamiland West (NgW). Although we find that the level of inequality among the multidimensionally poor and the poverty levels in MPI are positively related, there are several exceptions across administrative districts. For example, an interesting observation is that CBT, CT and KS have the same MPI value of 0.277 but varying inequality levels. For example, the inequality among the poor in CBT is almost double (0.067) the inequality level of KS (0.034). The higher inequalities among the multidimensionally poor in Ngamiland West, Kweneng West and Central Boteti are not surprising. These three districts are rural districts with limited infrastructural development and access to essential services such as quality health and education. These results show that policymakers should also consider inequality levels in distributing poverty alleviation initiatives.

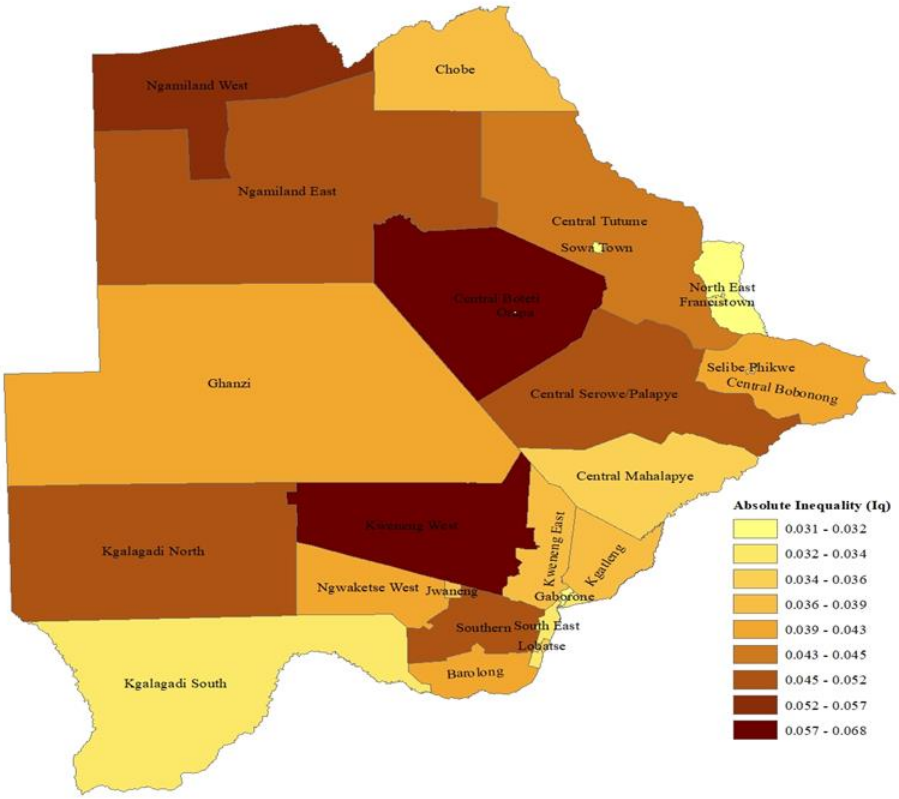
Figure 6.6: Inequality and MPI among the multidimensionally poor across districts



Source: Author derived from 2015/16 BMTHS. GB: Gaborone; FT: Francistown; LB: Lobatse; SP: Selibe Phikwe; OR: Orapa; JW: Jwaneng; SW: Sowa Town; BR: Barolong; NW: Ngwaketse West; SE: South East; KE: Kweneng East; KW: Kweneng West; KG: Kgatleng; CSP: Central Serowe Palapye; CM: Central Mahalapye; CB: Central Bobonong; CBT: Central Boteti; CT: Central Tutume; NE: North East; NgE: Ngamiland East; NgW: Ngamiland West; ChB: Chobe; GZ: Ghanzi; KS: Kgalagadi South; KN: Kgalagadi North.

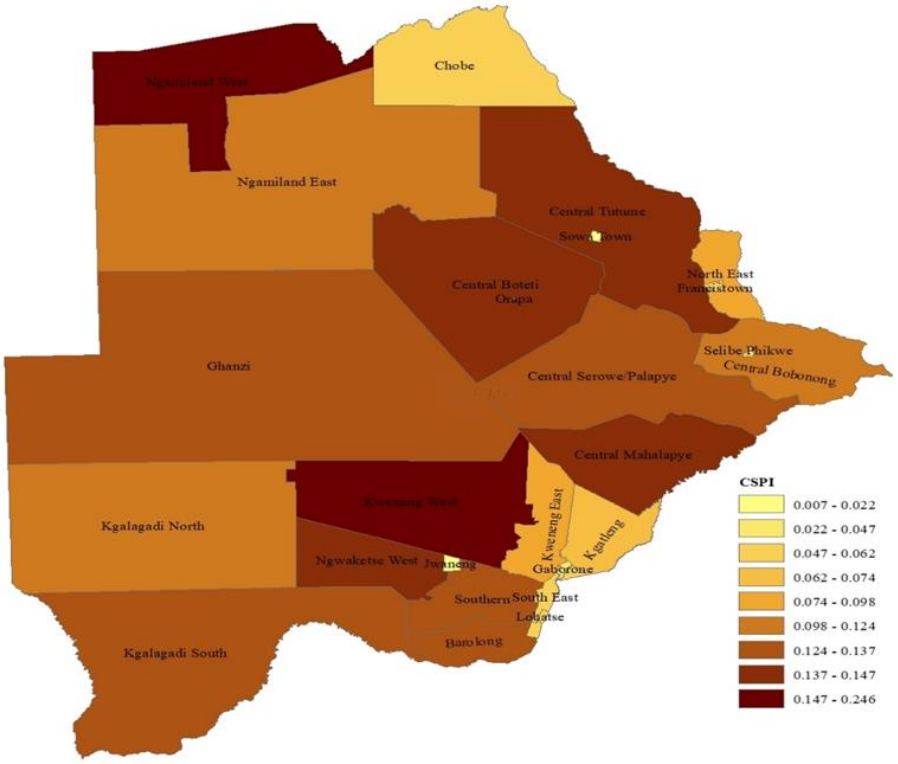
For comparisons purposes, I present choropleth maps depicting inequality levels based on I_q (Figure 6.7) and CSPI (Figure 6.8) across administrative districts. The results based on I_q show lower inequality levels than those based on CSPI. This is expected since the CSPI measure is based on the union approach. However, the two measures lead to the same conclusions. The results reveal varying inequality levels across administrative districts. Ngamiland West, Kweneng West and Central Boteti exhibited higher levels of inequality among the multidimensionally poor. In contrast, cities and towns exhibited lower inequality levels, especially mining towns.

Figure 6.7: Absolute inequality (I_q) across districts



Source: Author's calculations based on the 2015/16 BMTHS data.

Figure 6.8: CSPI values across districts



Source: Author's calculations based on the 2015/16 BMTHS data.

6.4. Robustness analysis

I conducted robustness checks to investigate if the findings are robust to changes in the poverty cut-off (*k*) and changes in the weighting structure (*w*). The robustness analysis involved computing poverty headcount ratios (*H*), intensity (*A*) and adjusted headcount ratio (M_0), considering two different poverty cut-offs (*k* values)[57] and alternative weighting schemes[58] across different subgroups of the population. Tables A6.2–A6.4 in the appendix present the results. The main conclusions remain robust, with older persons experiencing higher multidimensional poverty levels across all the different scenarios under consideration. The results reveal that, in general, poverty headcount ratios (*H*), intensity (*A*), and adjusted headcount ratio (M_0) among females were consistently higher across the different poverty cut-offs and the new weighting structure (Table A6.2). This finding may suggest that multidimensional poverty in Botswana is feminised. However, the gender gaps are minimal. Except for *H* when *k*=25 and the new weighting structure,

[57] The values of *k* are limited to a more plausible range of 25 per cent to 40 per cent to conduct restricted ests of dominance (see Alkire & Santos, 2014).
[58] In this case I employ equal weighting scheme across all indicators.

the results remain robust: multidimensional poverty levels increase with age. The main conclusions remain robust with respect to disability status, where persons with disabilities have higher poverty levels.

Similarly, citizens experience higher poverty levels than non-citizens across different scenarios under consideration. With respect to the sex of the household head, the results remain robust for the different poverty cut-offs to changes in weighting structure. Except for the second poverty cut-off (k=0.40), the results remain robust. Similar conclusions are observed for marital status, household size and educational status of the household head. In addition, the results remain robust concerning economic variables (employment status of household and income quintiles) (Table A6.3). In terms of geography (Table A6.4), results are consistent and robust across strata, with rural areas recording higher rates for H, A and M_0 across all the poverty cut-offs and the weighting structure considered. Generally, the ordering of the poorest districts did not change, with Ngamiland West and Kweneng West ranking one and two (respectively) across the selected parameters. In sum, the results are robust to different choices of parameters and are stable. This robustness analysis proves that even though normative decisions were employed when constructing the index, the public policy conclusions drawn from the index are robust to a choice of diverse parameters. However, it should be noted that the robustness analyses results do not mean that the policy conclusions will be correct since a few of the indicators included in the MPI appear unreliable (Catalán & Gordon, 2020). The unreliable indicators were included because they capture basic human rights such as the right to health, the right to land ownership and the right to food.

6.5. Determinants of multidimensional poverty

This section presents and discusses the econometric results based on both the logit and Tobit regression models. These models are employed to investigate the joint impact of demographic, economic and geographical factors on multidimensional poverty. The logit model is based on a dummy dependent variable, taking a value of 1 if the individual is considered multidimensionally poor and 0 otherwise. On the other hand, the Tobit model is based on a censored dependent variable (censored deprivation score), taking values 0 if $k < 0.3333$ and c_i if $k >= 0.3333$. The Tobit model is also used for robustness checking of the results. Table 6.4 presents the results of both models showing the estimated coefficients, their robust standard errors and the marginal effects. The log

pseudolikelihood ratios show that both models are a good fit. This result indicates that there exists a significant relationship between the dependent variable (probabilities of being multidimensionally poor and the censored deprivation score) and the explanatory variables included in the models ($p < 0.001$).

The sex variable is statistically non-significant, meaning that the sex of the individual does not influence the probability of being considered multidimensionally poor. This finding is consistent with that of Espinoza-Delgado and Klasen (2018), who find sex to be non-significant in the case of Nicaragua. The results reveal a non-linear U-shaped relationship between age and the probability of being considered multidimensionally poor. Similar results exist in the empirical literature elsewhere (Garza-Rodriguez et al., 2021). PWDs have a higher probability of being multidimensionally poor than non-disabled persons. Also, citizens have a higher likelihood of being multidimensionally poor than non-citizens. The probability of being multidimensionally poor increases with an increase in age. The results reveal *ceteris paribus*, a non-linear U-shaped relationship between household size and the probability of being considered multidimensionally poor. Individuals residing in households headed by males have a higher probability of being multidimensionally poor than those headed by women. This finding contradicts the belief that female-headed households are more likely to be multidimensionally poor than male-headed households, as documented in the literature (e.g., Bradshaw et al., 2017; Fransman & Yu, 2019). The finding is consistent with that of Espinoza-Delgado and Klasen (2018) and Salecker et al. (2020).

Individuals from households headed by married couples have lower probabilities of being considered multidimensionally poor than households headed by cohabiting couples, separated, divorced, widowed/widower and those never married. Results further show that individuals residing in households headed by children and youth have a higher probability of being multidimensionally poor than those from households headed by adults. Those from households headed by older persons have a lower probability of being multidimensionally poor than those headed by adults. The probability of being considered poor declines with higher educational achievements. In essence, individuals from households whose household heads have no educational attainments have a higher probability of being considered multidimensionally poor. Similar results exist in the empirical literature (Salecker et al., 2020). The same trend is observed for quintiles, with

the bottom quintile associated with a higher probability of being considered multidimensionally poor. The results make clear that *ceteris paribus*, individuals from rural areas have a higher probability of being multidimensionally poor than those from urban areas. This finding is consistent with other studies (e.g., Alkire & Santos, 2014; Espinoza-Delgado & Klasen, 2018; Salecker et al., 2020). In contrast, individuals from cities and towns have a lower probability of being considered multidimensionally poor than those from urban villages.

The Tobit model confirmed the results of the logit model. Overall, all the signs and significant levels of variables remained unchanged, confirming that the econometric estimation results based on the logit model are robust. Also, I employ simultaneous quantile regression and OLS regression. The quantile regression allows the analysis of the correlates of multidimensional poverty in the different quantiles in the distribution of the dependent variable (deprivation score, c_i), thus showing the full picture of the relationship between the dependant variable and explanatory variables. The OLS regression model is included for comparison purposes. Table A6.5 (in the appendix) reports the results. Overall, results showed that the estimated coefficients retained their signs, but their magnitude differed across quantiles. The OLS estimates are comparable with the median quantile (quantile 50) estimates. With very few exceptions in quantiles 25 and 75, the results are similar to those estimated based on logit and Tobit models.

For further robustness checks, a multilevel logistic regression modelling technique is employed. Two models were estimated (see Table A6.6 in the appendix). First, an intercept-only model (null model) is estimated (Model 1). The estimated variance for the intercept is 1.050 and is statistically significant, indicating that multidimensional poverty varied across administrative districts. The estimated intraclass correlation coefficient in Model 1 indicates that the district-level difference explains 24.2 per cent of the variability of multidimensional poverty, implying that the model satisfies the condition for multilevel analysis (Chen et al., 2019). Second, a random coefficient model (Model 2) is estimated, including individual- and household-level variables. The variance component is significant, suggesting multidimensional poverty variation among districts after controlling for individual- and household-level variables. The signs and significance of the variables remain unchanged. Thus, the baseline econometric estimations are robust.

Table 6.4: Econometric estimations using logit and Tobit models[†]

	Logit			Tobit		
	Coefficient	Robust SE	Marginal effect	Coefficient	Robust SE	Marginal effect
Sex (*base: Female*)						
Male	0.0349	0.0321	0.0086	0.0064	0.0054	0.0025
Age	0.0188***	0.0025	0.0047	0.0051***	0.0004	0.0020
Age squared	0.0001*	0.00004	0.0002	-0.00001	0.00001	-0.00003
Disability status (*base: Non-disabled*)						
Disabled	0.5382***	0.1073	0.1336	0.0827***	0.0150	0.0344
Citizenship status (*base: Non-citizen*)						
Citizen	0.4658***	0.1156	0.1115	0.0936***	0.0197	0.0339
Household size	-0.1619***	0.0157	-0.0402	-0.0292***	0.0024	-0.0114
Household squared	0.0097***	0.0008	0.0024	0.0016***	0.0001	0.0006
Sex of HH (*base: FHH*)						
Male HH	0.1138***	0.0393	0.0282	0.0229***	0.0066	0.0089
Marital status of HH (*base: Married*)						
Living together	0.9771***	0.0483	0.2393	0.1749***	0.0079	0.0735
Separated	0.8057***	0.1091	0.1968	0.1566***	0.0183	0.0693
Divorced	0.2564**	0.1226	0.0640	0.0665***	0.0207	0.0273
Widowed/widower	0.3106***	0.0583	0.0774	0.0722***	0.0099	0.0294
Never married	0.8491***	0.0497	0.2091	0.1607**	0.0083	0.0668
Age of HH (*base: 36-64 years*)						
12-17 years (children)	0.7170**	0.3288	0.1760	0.1072***	0.0542	0.0457
18-35 years (youth)	0.3214***	0.0461	0.0800	0.0679***	0.0078	0.0273
Over 65 years (older persons)	-0.1130**	0.0459	-0.0279	-0.0255***	0.0076	-0.0098
Education of HH (*base: None*)						
Primary	-0.4470***	0.0423	-0.1090	-0.0853***	0.0068	-0.0322
Secondary	-0.8441***	0.0504	-0.2015	-0.1708***	0.0084	-0.0627
Vocational	-1.2196***	0.1027	-0.2606	-0.2479***	0.0179	-0.0797
University	-1.9260***	0.0795	-0.3829	-0.4036***	0.0134	-0.1243
Employment status of HH (*base: Unemployed*)						
Paid employment	-0.2342***	0.0540	-0.0574	-0.0512***	0.0095	-0.0193
Self-employment	0.1742***	0.0617	0.0434	0.0504***	0.0098	0.0204
Own farm	0.6829***	0.0671	0.1685	0.1101***	0.0099	0.0465
Quintiles (*base: Q1*)						
Q2	-0.6310***	0.0409	-0.1518	-0.1144***	0.0069	-0.0423
Q3	-1.1724***	0.0496	-0.2646	-0.2222***	0.0085	-0.0767
Q4	-1.5848***	0.0617	-0.3325	-0.3048***	0.0106	-0.0989
Q5	-2.2500***	0.0811	-0.4159	-0.4481***	0.0138	-0.1326
Strata (*base: Urban villages*)						
Cities and towns	-0.3028***	0.0449	-0.0742	-0.0700***	0.0080	-0.0264
Rural areas	0.9021***	0.0351	0.2215	0.1628***	0.0059	0.0658
Constant	-0.2768*	0.1528		0.0280	0.0259	
Number of observations	24,720			24,720		
LR chi2	9,010.47			10,828.29		
Prob.>chi2	0.0000***			0.0000***		
Pseudo *R*-squared	0.2632			0.3154		
Log likelihood	-12,610.95			-11,753.88		

Source: Authors' estimates based on the 2015/16 BMTHS data.

[†]Sample size: 24,720. *HH* stands for household head; *MHH* stands for Male-headed household. Significance levels: $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$. Robust standard errors (SE) clustered at the household level.

6.6. Summary and conclusions

This chapter seeks to answer the following question: *Who are those left behind in Botswana*? In answering this question, an individual-based multidimensional measure based on the AF approach is used. The analysis goes beyond the national estimates reported in chapter 5 and disaggregates the analysis by different subgroups of the population as stipulated by SDG 1. The findings of this chapter are summarised as follows.

First, the results of this chapter reveal varying multidimensional poverty levels across different subgroups of the population. Thus, a more disaggregated multidimensional poverty analysis is needed to identify those left behind. Poverty levels are positively related to age, with older persons experiencing higher levels of multidimensional poverty. Consistent with the international empirical literature, a substantial wider gap is observed between persons with disabilities and those with no disability, with persons with disabilities experiencing higher poverty levels in Botswana. Ngamiland West and Kweneng West remain the worse off districts in terms of multidimensional poverty levels. It should also be noted that individuals in poorer quintiles (based on expenditures) experience higher multidimensional poverty levels.

Second, with respect to inequality, even though the results are generally consistent with those of multidimensional poverty, some significant disparities are observed across geography, with some districts with the same MPI recording varying levels of inequality. Consistent with multidimensional poverty levels and deprivations, persons living with disabilities and older persons exhibited higher levels of inequality.

Third, the chapter employed both logit and Tobit models to investigate correlates of multidimensional poverty. In addition, the chapter employed the quantile regression model to allow the analysis of the effect of poverty determinants in the different quantiles in the distribution of the dependent variable. The results based on both models remain robust. The results reveal that older persons, disabled persons, individuals from households headed by men, headed by unmarried couples, headed by children and youth, those with no educational attainments and those from rural areas have higher probabilities of being considered multidimensionally poor. The results further show that both the sex of the household head and their marital status impact the probability of being poor.

Similarly, both the sex of the household head and strata strongly influence the probability of being multidimensionally poor.

This chapter makes the following conclusions. First, the extent and nature of multidimensional poverty vary significantly across different subgroups of the population. Second, in Botswana, the left behind are mostly older persons and persons with disabilities, especially those residing in rural areas. These conclusions have policy implications. The analysis across different subgroups provides vital information that policymakers need since it shows the specific areas of *who* the poor are, *where* they live and *how* poor they are. This can influence different decisions in terms of resource allocation and programme targeting. Anti-poverty programmes should target these groups to make progress and catch up with the rest of the population to leave no one behind. For example, specific programmes targeted at the chronically ill should be implemented. Currently, the chronically ill are targeted through the destitute persons programme. Even though it is universal, the old-age pension benefits are relatively low. Therefore, there is a need to improve old-age pension benefits to address high poverty levels among older persons. There is a need to improve access to basic services, housing, employment opportunities, and infrastructure to address poverty in rural areas.

Disaggregating data analysis by different subgroups of the population allows for monitoring the SDG commitment of halving the proportion of men, women, and children experiencing poverty in all its dimensions and the LNOB commitment. In sum, more research is needed to investigate in-depth why certain groups, such as persons with disabilities and older persons, have higher levels of poverty and higher probabilities of being left behind (multidimensionally poor). To achieve that, more timely and individual-level data is needed to facilitate such analysis. The next chapter extends this analysis and examines multidimensional child poverty.

CHAPTER 7: LEAVING NO ONE BEHIND: MULTIDIMENSIONAL CHILD POVERTY IN BOTSWANA[59]

7.1. Introduction

This chapter deals with multidimensional child poverty. This chapter tries to answer the following research question: *What is the situation of multidimensional child poverty in Botswana, and who are those children at risk of being left behind*? The chapter builds from chapters 5 and 6 but focuses on children only. From Chapter 5, the results show that children accounted for the largest proportion of the multidimensionally poor in Botswana. Children account for 35.6 per cent of the multidimensionally poor, followed by youth with 28.5 per cent. The results are consistent with global estimates where children account for the largest proportion of the poor. Child poverty measurement is, therefore, vital for informing policies and for improving children's lives.

Several reasons have been put forward in the literature that outlines the need to analyse and investigate child poverty. First, children are dependent on others in their direct environment for the provision of basic needs that are essential for their development (Trani & Cannings, 2013). Second, children experience poverty and are affected by it differently compared to adults (Leu et al., 2016). Third, a child-centred approach to poverty measurement is vital for ensuring that commitment to children's rights is monitored (Leu et al., 2016). Following widespread acknowledgement of these arguments, there is now robust literature on multidimensional child poverty measurement. The global significance of child poverty has also been recognised in the SDGs. Specifically, SDG target 1.2 presents a significant step forward in the fight against child poverty in three ways: firstly, it explicitly recognises children; secondly, it acknowledges the multidimensional nature of poverty; and thirdly, it highlights the importance of national definitions.

Botswana has made strong commitments to eradicating child poverty, including multidimensional forms of child poverty. Botswana developmental initiatives, such as

[59] This chapter is published as a journal article in Child Indicators Research journal. [Lekobane, K. R., & Roelen, K. (2020). Leaving No One Behind: Multidimensional child poverty in Botswana. *Child Indicators Research*, 13(6), 2003–2030]. The chapter was presented at the 7th Conference of the International Society for Child Indicators, held in Tartu, Estonia from August 27–29, 2019.

NDP 11, Vision 2036 and the BPEPS, articulate the need to eradicate multidimensional (child) poverty (MFED, 2016; Republic of Botswana, 2016, 2018).[60] This commitment is further underpinned by the principle of LNOB, thereby highlighting the need to include all children in efforts to reduce poverty. Notwithstanding these commitments, limited efforts have been undertaken to gain insight into multidimensional (child) poverty issues. In Botswana, monetary measures remain dominant, and child poverty receives relatively limited attention. In 2015, UNICEF published a study of multidimensional child poverty based on the MODA approach (de Neubourg et al., 2015) to offer critical empirical insights and confirm that deprivation is widespread among children in Botswana. However, it did not provide a composite measure of multidimensional poverty for all children in the country. In this chapter, in addition to providing detailed analysis at the indicator level, an aggregate estimate of the proportion of multidimensionally poor children at the national level and across demographic, geographical, and economic variables in line with LNOB is provided.

The objective of this chapter is two-fold. First, it aims to extend the analysis in chapters 5 and 6 by focusing only on children aged 0-17 years to provide insights into the magnitude and depth of multidimensional child poverty in Botswana. Second, this chapter seeks to provide empirical insights into the state of multidimensional child poverty in Botswana through the lens of LNOB. Findings will serve as a baseline to track progress towards SDG 1 and national development plans regarding eradicating multidimensional child poverty as stipulated in the BPEPS and the LNOB principle. Results point toward a relatively high prevalence and intensity of multidimensional child poverty in an upper-middle-income country like Botswana. In addition, various groups of children are at greater risk of deprivation and are likely to be left behind. For example, children aged 0-4 years experienced the highest poverty levels compared to other age groups. Children living with disabilities, orphaned children and children not living with their relatives, for example, are more likely to be poor. This chapter contributes to multidimensional child poverty literature in Botswana.

[60] The BPEPS defines ‘severe multidimensional child poverty’ as deprivation in at least 50% of relevant dimensions under consideration (Republic of Botswana, 2016).

The remainder of the chapter is organised as follows: Section 7.2 offers an overview of multidimensional child poverty measurement. Section 7.3 presents data and methodology. Section 7.4 provides results, and Section 7.5 presents conclusions.

7.2. Multidimensional child poverty measurement

Gordon et al. (2003) pioneered the first global study on child poverty to compare multidimensional child poverty across developing countries. The approach is also referred to as the Bristol approach. Since then, the importance of measuring child poverty from a multidimensional perspective has been recognised (e.g., Roelen & Gassmann, 2008; Roelen et al., 2009, 2010). The pioneering cross-country study by Gordon et al. (2003) gave rise to country-level studies (e.g., Amarante et al., 2010; Roelen et al., 2010; Roche, 2013) in the early 2000s and ultimately paved the way for UNICEF's Multiple Overlapping Deprivation Analysis (MODA) (de Neubourg et al., 2012). More recently, the increasingly adopted global measure of multidimensional poverty (the MPI) has been employed to analyse the situation through a child-focused lens (Alkire et al., 2017b; Alkire et al., 2019). At present, much debate regarding multidimensional child poverty measures focuses on the comparative merits of the MODA and MPI approaches (e.g., Hjelm et al., 2016; Vaz et al., 2019). MODA places the child at the centre of analysis by including individual-level indicators and incorporating the child as a unit of analysis. MPI allows for the calculation of a composite index that offers insights into the scale and magnitude of multidimensional child poverty.

The MPI is theoretically premised on the capability approach and is methodologically grounded in the Alkire-Foster (AF) approach (Alkire & Foster, 2011a). The AF approach is flexible as it allows for the inclusion of different dimensions, indicators, cut-offs and dimensional weights that reflect the relative importance of each dimension (Alkire et al., 2015a) and reflects deprivations into a single measure (Maasoumi & Yalonetzky, 2013). The global MPI represents an application of the AF approach using three dimensions and ten indicators, adopting equal weighting at dimension level and using a proportion of weighted deprivations as the cut-off for being multidimensionally poor (Alkire & Jahan, 2018). Crucially, the indicators within the global MPI are all household-level indicators. Estimates of multidimensional child poverty are based on a simple decomposition of overall poverty estimates for children (see Alkire et al., 2017b). Many multidimensional

child poverty studies are premised on the AF approach (e.g., Roelen, 2010; Roche, 2013; Trani et al., 2013).

The MODA approach was developed by UNICEF (de Neubourg et al., 2012) to facilitate the analysis of inequities and to provide instruments to identify deprived children and is rooted in the rights-based framework of the Convention on the Rights of the Child (CRC) (Hjelm et al., 2016). The approach builds on the Bristol and AF approaches (de Neubourg et al., 2012; Hjelm et al., 2016). It combines household and individual-level indicators and considers the interaction and depth of deprivations across indicators and dimensions. Notably, the MODA approach does not advocate for the construction of a composite index. Instead, MODA presents poverty figures using all possible cut-offs based on the number of dimensions across specific age categories. Its primary focus is more on overlap analysis than aggregating it into a composite index. This approach has been implemented to study multidimensional child poverty across countries (de Milliano & Plavgo, 2014; Chzhen et al., 2016) and within countries (e.g., de Neubourg et al., 2015; Chzhen & Ferrone, 2017).

7.3. Data sources and methods

7.3.1. Data sources

The analysis in this chapter utilises the 2015/16 BMTHS and builds on the index constructed in Chapter 5. The 2015/16 BMTHS has a module on children and allows for the construction of the multidimensional child poverty index for Botswana. A detailed discussion of the dataset is in Chapter 5. The analysis in this chapter is based on a sample of 9,718 children aged 0-17 years (Table 7.1). The sample is divided into four groups of children based on applicable deprivation indicators. The estimated number of children is 817,843.

Table 7.1: Sample and population distributions of children 2015/16

Age group	Sample	Per cent	Population	Per cent
0 - 4	3,104	31.9	258,818	31.6
5 - 9	2,842	29.2	240,576	29.4
10 - 14	2,547	26.2	214,356	26.2
15 -17	1,225	12.6	104,093	12.7
Total	9,718	100.0	817,843	100.0

Source: Author's estimates based on the 2015/16 BMTHS data.

7.3.2. Methods

Following the MPI approach and using the index constructed in chapter 5, this chapter focuses only on children aged 0-17. The index seeks to include as many child-level indicators as possible to create an individual-level multidimensional child poverty measure. The aggregate composite measure allows for estimating the prevalence and depth of multidimensional poverty among children in Botswana. In line with the principle of LNOB, the measure is decomposable for different groups of children, particularly those that may be deemed vulnerable or marginalised.

7.3.3. Dimensions and indicators

In this section, I briefly discuss dimensions and indicators applicable to children. For the multidimensional child poverty index computation, I included twenty-three (23) indicators in seven (7) dimensions discussed in Chapter 5. However, the total number of indicators varies across different age groups of children. Table 7.2 presents the proposed dimensions, deprivation indicators, as well as deprivation cut-offs. The table also indicates the age brackets for which these indicators hold and whether the indicators were included in the 2015 MODA study.

The *asset dimension* comprises four deprivation indicators: information, durable goods, transport and housing tenure. Household durable assets are integral to the functioning and attainment of people's well-being, including children (Lerman & McKernan, 2008). For example, lack of transport can negatively impact children's access to health or education in cases where the facilities are far (Allendorf, 2007). The *housing and living conditions dimension* comprises six deprivation indicators: overcrowding, cooking fuel, electricity, floor material, roof material and wall material. These indicators are closely associated with child health (UN-HABITAT, 2009). Children have the right to a basic shelter that will enable them to live a dignified life (UN, 1989).

The *water and sanitation dimension* includes two deprivation indicators: access to safe drinking water and toilet facility. Contaminated water is a huge cause of diarrhoea-related diseases, including cholera and other diseases such as pneumonia, trachoma and skin infections (UNICEF, 2010), while lack of toilet facilities increases the risk of transmission of diseases (Trani et al., 2016). Access to safe drinking water and clean toilet facility reduce child mortality and morbidity (Trani & Cannings, 2013).

The *food security dimension* includes five indicators. The first indicator captures access to food insecurity at the household level using the HFIAS methodology[61] (Coates et al., 2007). The other four indicators (weight-for-age, height-for-age, weight-for-height and body mass index) are child-specific and capture the functioning of 'being well-nourished' and are derived using anthropometric measures based on WHO methodology (Alkire & Santos, 2014; WHO, 2006).[62] They are used to measure children's nutritional deficiencies (WHO & UNICEF, 2010), which can lead to numerous health disorders (Trani et al., 2016).

The *health dimension* captures bodily health capability and refers to a lack of resources for children's health (D'Agostino et al., 2018). Access to a health care facility is necessary for promoting children's health (UNICEF, 2012). Children with chronic illness are unable to do any kind of work, including play or going to school (Beatty & Fothergill, 2005), which is vital for children's social development and is a crucial aspect of human life and healthy growth and well-being (D'Agostino et al., 2018).

The *education dimension* captures children's access to education and literacy. Education is a fundamental right for children (UN, 1989) and plays a vital role in children's lives. I use two indicators: enrolment and literacy. The *security dimension* is captured using two indicators (safety and crime) to capture the neighbourhood environment (D'Agostino et al., 2018) in recognition that feeling safe is an essential aspect of quality of life (Rees, 2019). According to the CRC, children have the right to be protected from all forms of violence (UN, 1989).

[61] The Household Food Insecurity Access Scale (HFIAS) methodology is explained in Chapter 5 of this thesis.

[62] Most studies do not include stunting. I include stunting (HAZ) in this thesis because it is a concern for Botswana. It should be noted, however, that there may be issues of double counting since the three indicators are related. For example, weight-for-height is a product of weight-for-age and height-for-age (WHZ=WAZ*HAZ).

Table 7.2: List of proposed dimensions and deprivation indicators for children[†]

Dimension	Indicator	Indicator Definition	Deprivation cut-off (A child is deprived if …)	Level	Age Group	MODA[*]
1. Asset	Information	Captures lack of access to information and communication by household members	he/she resides in a household which does not own at least one of the following: TV, radio, PC/laptop, telephone (landline), mobile.	HH	0-17	N
	Durable goods	Captures lack of durable assets used within the house	he/she resides in a household that does not own at least two of the following: refrigerator, washing machine, electric/gas stove, microwave, air conditioner, wheelbarrow, sewing machine, grinding machine.	HH	0-17	N
	Transport	Captures lack of ownership of automobiles (van/bakkie/truck or car)	he/she resides in a household which does not own any automobile, including van/bakkie/truck, car, tractor, donkey cart, motorcycle, bicycle	HH	0-17	N
	Land tenure	Captures land ownership or possession of land and housing in which the housing unit is built	he/she resides in a household that does not own the land on which the housing unit is built.	HH	0-17	N
2. Housing	Overcrowding	Captures the shortage of living space based on the number of rooms and persons in the household	he/she resides in a household with more than three people per sleeping room (excluding the kitchen, bathroom and garage).	HH	0-17	Y
	Cooking fuel	Captures the source of fuel for cooking used by households	he/she resides in a household that uses the following source of fuel: Biogas, wood, paraffin, cow-dung, coal, charcoal, and crop waste OR has no source of cooking fuel at all.	HH	0-17	Y
	Floor material	Assesses the quality of the main material of the floor	he/she resides in a housing unit with the main material of floor made of the following: mud, mud dung, brick/stones, none or any other material apart from cement, floor tiles, or wood.	HH	0-17	N
	Roof material	Assesses the quality of the main material of the roof	he/she resides in a housing unit with the main material of the roof is made of the following: thatch/straw, asbestos or any other material apart from slate, roof tiles, corrugated iron/zinc/tin, concrete.	HH	0-17	N
	Wall material	Assesses the quality of the main material of the outside wall.	he/she resides in a housing unit with the main material of the outside wall is made of the following:	HH	0-17	N

			mud bricks/blocks, mud and poles/ cow dung/ thatch/ reeds, poles and reeds, corrugated iron/zinc/tin, asbestos, wood, stone, other/mixed materials.			
	Electricity	Assess household connectivity to the national grid	he/she resides in a household that is not connected to the BPC grid.	HH	0-17	N
3. Water & sanitation	Water supply	Assesses lack of access to a safe drinking water source	he/she resides in a household that uses unimproved water sources: bowser/tanker, well, borehole, river/stream, dam/pan, rainwater, spring water, OR if it takes at least 30 minutes to fetch water from a communal tap.	HH	0-17	Y
	Toilet facility	Measures lack of access to basic and safe sanitation facility in the household	he/she resides in a household that uses an unimproved toilet facility: pit latrine, communal flush toilet, communal VIP, communal pit latrine, communal neighbours' toilet OR has no toilet facility at all.	HH	0-17	Y
4. Food security	Food insecurity access (HFIAP)	Assesses household's lack of access to sufficient quantity and quality food.	he/she resides in a household that is categorised as moderately food insecure or severely food insecure based on the HFIAP measure.	HH	0-17	N
	Weight-for-age (WAZ)	Assesses children's nutrition status.	he/she is a child who is malnourished. That is, if his/her *z*-score of weight-for-age is below minus two standard deviation from the median of the reference population.	IND	0-4	Y
	Height-for-height (HAZ)	Assesses children's chronic nutrition status (stunting)	he/she is a child who is stunted. That is, if his/her *z*-score of height-for-age is below minus two standard deviation from the median of the reference population.	IND	0-4	N
	Weight-for-height (WHZ)	Assesses children's nutrition status in terms of wasting.	he/she is a child who is wasted. That is, if his/her *z*-score of weight-for-height is below minus two standard deviation from the median of the reference population.	IND	0-4	N
	Body Mass Index (BMI)	Assesses children's nutrition status based on BMI.	he/she is a child aged between 5 and 17 with a BMI z-score below minus two standard deviation from the median of the reference population.	IND	5-17	Y

5. Health	Health facility	Assesses the perceived quality of the nearest health facility.	the perceived quality of the nearest health facility he/she uses is poor and has the following problems: the facility is too far, the facility is not clean or in poor condition, few trained professional staff, staff frequently absent, lack of drugs, does not offer all services, limited opening hours.	HH	0-17	Y
	Chronic illness	Assess individuals' health status.	he/she has a long-term chronic illness that prevents them from working, being active or going to school.	IND	0-17	N
6. Education	Enrolment	Quantifies the enrolment of individuals in the education system	he/she is a child aged 5-17 and is currently not enrolled in school. Children in this age category who have already completed compulsory education are categorised as non-deprived.	IND	5-17	Y
	Literacy	Measures the ability of an individual to read and write	he/she is aged between 15and 17 years and above, and he/she can't read and write.	IND	15-17	Y
7. Security	Safety	Assess the perceived safety of the household from crime and violence	he/she feels not safe from crime and violence.	HH	0-17	N
	Crime	Ascertains whether the member of the household has been a victim of violence or crime in the past 12 months.	he/she resides in a household that has at least one member who has been a victim of violence or crime in the past 12 months	HH	0-17	N

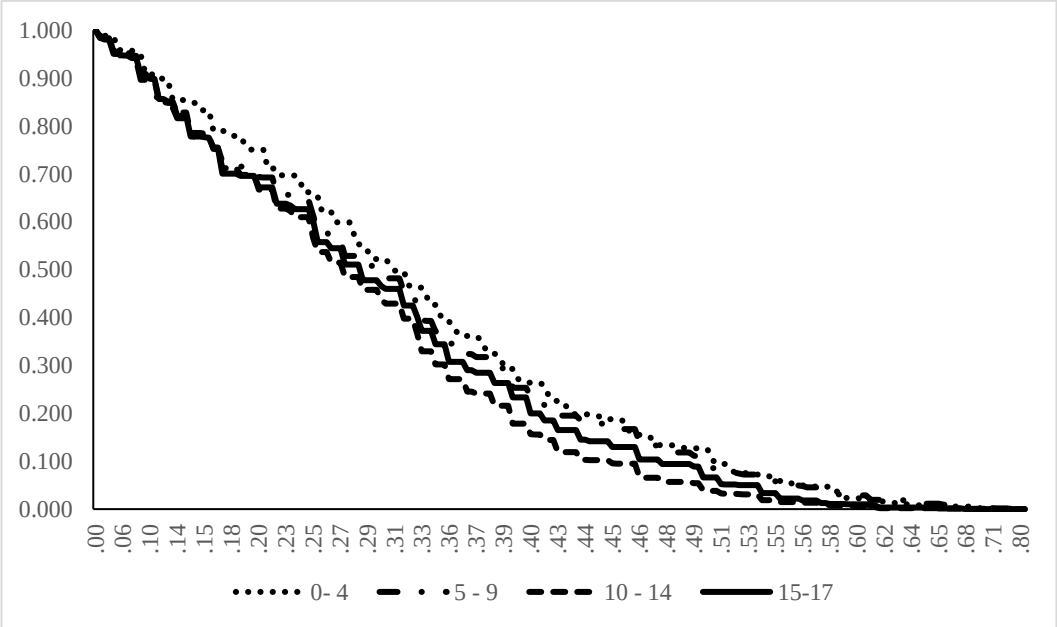
Source: Developed by authors. †HH stands for household, IND stands for individual. Level means the identification level. *Y means the indicator is included in the MODA study, and N means the indicator is not in the MODA study. In MODA, the toilet facility indicator excludes children aged 0-4 years. With respect to nutrition, only the weight-for-age indicator was included (weight-for-height and height-for-age were not included). For education indicators, school enrolment indicator was framed as 'child of 6-11 years is not attending school, if school is open and child is sick, Or not attending school or training of any type for child 12-17 years if a junior school or training of any type was not completed by age 15' (de Neubourg et al., 2015).

7.3.4. Robustness analysis

To conduct a robustness analysis, the CCDF is employed (see chapter 5 for a detailed explanation). Figure 7.2 depicts the CCDFs for children across different age groups for various values of *k*. The figure shows no strict first-order stochastic dominance between the CCDFs for different values of *k*. The results clearly show that no matter the value of *k* one chooses, the proportion of the multidimensionally poor children will always be higher for children aged 0-4 than those aged 5-9, 10-14 and 15-17. This observation means that the distribution of the deprivation scores for children aged 0-4 first-order stochastically dominates the other age groups.

Also, robustness analysis is conducted by computing poverty headcount ratios (*H*), intensity (*A*) and adjusted headcount ratio (M_0), considering three different poverty cut-offs (*k* values). The values of *k* are limited to a range of 25 per cent to 40 per cent to conduct restricted tests of dominance (see Alkire & Santos, 2014). Also, multidimensional poverty measures across age, sex and geography are calculated to check if the results are stable. The results show that, in general, *H*, *A* and M_0 across age, sex and geographical variables remain stable and consistent. For example, the ordering of districts does not change, with Ngamiland West and Kweneng West ranking one and two (respectively) across poverty cut-offs (see Appendix A7 – Table A7.2).

Figure 7.1: Proportion of deprived children by age group and indicator†



Source: Author's estimates based on the 2015/16 BMTHS data

7.4. Results and discussions

7.4.1. Child deprivation levels by indicator

Before computing the multidimensional child poverty, first, the aggregate deprivation level in each indicator is examined. Table 7.3 presents the results. Deprivation levels are higher among asset indicators, with transport recording the highest deprivation levels, followed by durable goods. With respect to housing and living conditions, cooking fuel exhibited the highest level of 54.3 per cent. This figure is high, and a cause of concern since dirty fuel causes indoor air pollution, which might have an adverse effect on young children (Duflo et al., 2008). Deprivation levels in overcrowding and floor material are each estimated at 44.6 per cent. Other studies have found that overcrowding can cause infant mortality (Cage & Foster, 2002) and increase the risk of exposure to contracting airborne diseases and respiratory infections (Baker et al., 2000; Wanyeki et al., 2006). In terms of materials used in construction (wall, roof and floor material), there is a body of evidence associating housing quality with morbidity from infectious diseases, chronic illnesses, injuries, poor nutrition, lung cancer and mental disorders (Landrigan, 1998; Vaughan & Platts-Mills, 2000; Krieger & Higgins, 2002).

Concerning water and sanitation, the toilet facility recorded the highest level of 69.4 per cent. Lack of toilet facilities increases the risk of transmission of diseases (Trani et al., 2016). Concerning food security indicators, most children are deprived in food access. Regarding nutrition, stunting has higher levels than undernutrition and wasting. This finding is consistent with studies in Southern Africa, where stunting has proven to be a problem (Wamani et al., 2007). In terms of health access, a concerning finding is that about 31.5 per cent of children do not have access to a health care facility. Access to health is necessary for promoting children's health (UNICEF, 2012). Education has low deprivation rates, with enrolment and literacy recording 10.5 and 1 per cent, respectively. These results are a result of free basic education for all. However, 10.5 per cent of children not enrolled should not be taken for granted. Children have the right to education (UN, 1989), and it plays a vital role in their lives. With respect to the security dimension, about 39 per cent of children live in households whose heads indicated that they felt unsafe.

Generally, most of the recorded deprivation levels are higher than the estimated monetary child poverty of 20.1 per cent. Twelve (12) out of the total twenty-three (23) indicators considered recorded more than 20.1 per cent (estimated monetary child poverty). This

finding confirms the necessity to shift from monetary measure to the multidimensional approach in measuring and analysing child poverty. Most of the highest deprivation levels are from the asset, housing and water and sanitation dimensions.

Table 7.3: Proportion of deprived children by indicator 2015/16[†]

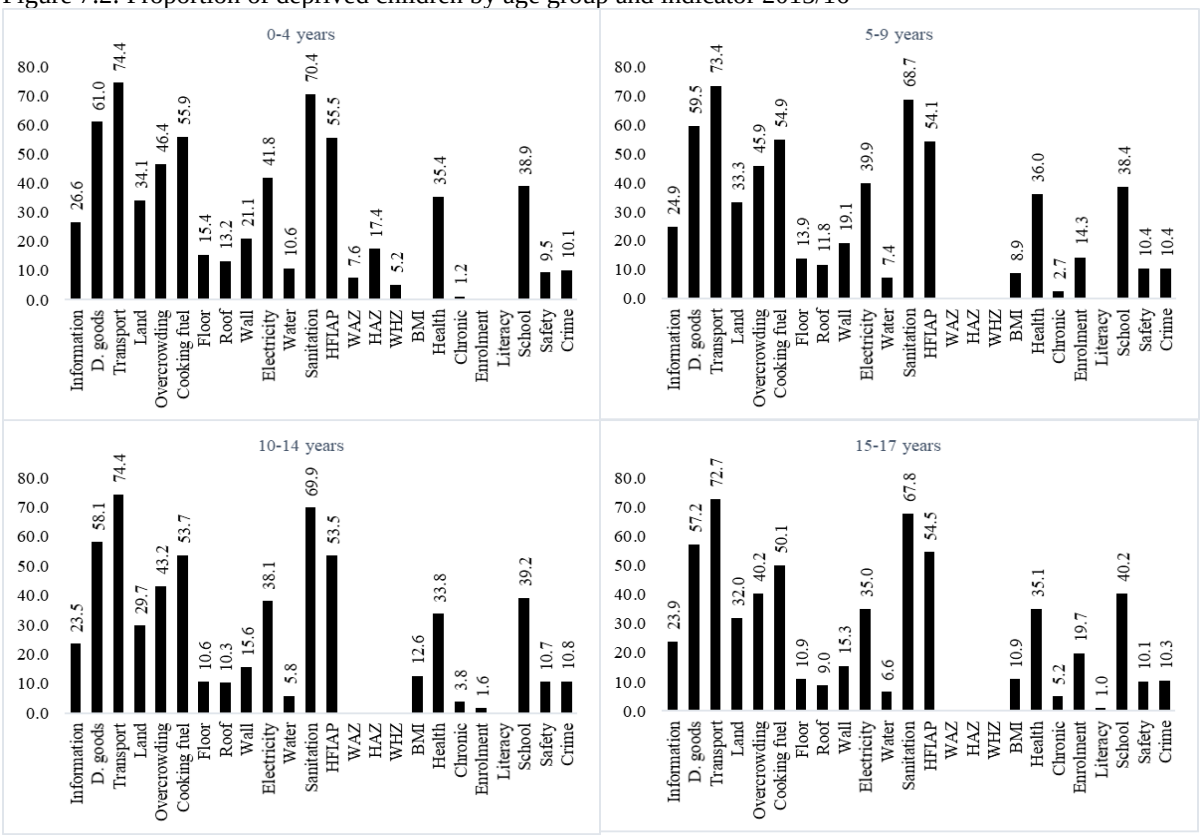
Dimension	Indicator	Sample	% Deprived	SD	Age group
1. Asset	Information	9,718	24.9	0.433	0-17
	Durable goods	9,718	59.3	0.491	0-17
	Transport	9,718	73.9	0.439	0-17
	Land tenure	9,718	32.4	0.468	0-17
2. Housing	Overcrowding	9,718	44.6	0.497	0-17
	Cooking fuel	9,718	54.3	0.498	0-17
	Floor material	9,718	13.1	0.338	0-17
	Roof material	9,718	44.6	0.319	0-17
	Wall material	9,718	18.3	0.387	0-17
	Electricity	9,718	39.4	0.489	0-17
3. Water & sanitation	Water supply	9,718	7.9	0.270	0-17
	Toilet facility	9,718	69.4	0.460	0-17
4. Food security	HFIAP	9,718	54.4	0.498	0-17
	WAZ	3,104	7.6	0.265	0-4
	HAZ	3,104	17.4	0.379	0-4
	WHZ	3,104	5.2	0.223	0-4
	BMI	6,614	10.7	0.309	5-17
5. Health	Health facility	9,718	35.1	0.477	0-17
	Chronic illness	9,718	3.0	0.169	0-17
6. Education	School enrolment	6,614	10.5	0.306	5-17
	Literacy	1,225	1.0	0.100	15-17
7. Security	Safety	9,718	39.0	0.488	0-17
	Crime	9,718	10.1	0.302	0-17

Source: Author's estimates based on the 2015/16 BMTHS data. [†]All percentages are estimated at the population level using sample weights. SD stands for standard deviation. HFIAP: household food insecurity access prevalence; WAZ: weight-for-age; HAZ: height-for-age; WHZ: weight-for-height; BMI: body mass index.

The deprivation levels across different age groups of children are examined. Figure 7.2 depicts the results. Table A7.1 in Appendix A7 also presents the results and the standard deviations. For all applicable indicators across all age groups, children aged 0-4 experience higher deprivations than other age groups. For example, children aged 0-4 exhibited the highest deprivation levels in overcrowding, cooking fuel and toilet facility, increasing the risks of contracting respiratory infections, being exposed to indoor air pollution and infant mortality. Similarly, lack of access to a health facility for those aged 0-4 might imply that they are denied access to essential vaccines and immunisation

needed to prevent them from diseases. In sum, the results reveal varying levels of deprivation across different age groups of children.

Figure 7.2: Proportion of deprived children by age group and indicator 2015/16†



Source: Author's estimates based on the 2015/16 BMTHS data. †All percentages are estimated at the population level using sample weights. SD stands for standard deviation. HFIAP: household food insecurity access prevalence; WAZ: weight-for-age; HAZ: height-for-age; WHZ: weight-for-height; BMI: body mass index. Sample size: 9,718.

7.4.2. Multidimensional child poverty estimates

Table 7.4 shows that 41.7 per cent of children aged 0-17 in Botswana can be considered multidimensionally poor. This result shows that multidimensional child poverty in Botswana remains a substantial problem. The intensity of multidimensional poverty is estimated at 43.4 per cent at the national level, meaning that, on average, children are simultaneously deprived in at least ten (10) indicators out of the twenty-three (23) indicators considered. The adjusted headcount ratio is estimated at 0.181. In the remainder of this section, a discussion on differences in multidimensional child poverty outcomes for different groups is presented. Differences are statistically significant unless otherwise indicated.

7.4.3. Multidimensional child poverty estimates by demographic characteristics

As expected, there are significant differences in poverty according to demographic characteristics (Table 7.4). In terms of sex, the proportion of children identified as multidimensionally poor is significantly higher for boys than girls. Furthermore, both the intensity and adjusted headcount ratio are higher for boys than girls. These differences are driven mainly by deprivation concerning nutrition. Across all indicators, boys experience higher deprivation rates than girls do. This finding aligns with other studies elsewhere in SSA (Wamani et al., 2007). With respect to age, children aged 0-4 experience significantly higher poverty rates compared to other age groups. The same pattern is observed for the adjusted headcount ratio, while the intensity of poverty showed mixed results. Again, these differences are driven mainly by deprivation concerning nutrition. As expected, the results reveal that children with a disability experience significantly higher poverty levels than those without any disability. In terms of citizenship, non-citizen children have lower poverty rates than citizens. Most non-citizens live in cities/towns where poverty levels are lower than in rural areas and employment opportunities exist. The majority of the non-citizen children (60.4%) are from Zimbabwe, 9.9 per cent from South Africa, 14.9 per cent from other parts of Africa and 12.6 per cent rest of the World.

With respect to living arrangements, children living with both parents experience lower multidimensional poverty levels than those living with mothers alone or with none of their biological parents. Interestingly, children living with their fathers alone have lower poverty rates than those living with both parents. The link between living arrangements and household size is examined. The household size differs considerably across living arrangements. In essence, the average household size is 5.5 for children living with their fathers alone compared to 7.3, 6.9 and 6.9 for those living with mothers alone, both parents and non-biological parents, respectively. In other words, children living with their fathers tend to live in smaller households, suggesting that resources do not need to be spread thinly. Indeed, higher poverty prevalence for children in larger households compared to those in smaller households is observed. The same results are observed for intensity and adjusted headcount ratio.

Orphaned children experience a higher prevalence and intensity of poverty compared to children with both parents alive. The poverty situation is worse for double orphans (those

who lost both biological parents) than for single orphans. Similar studies confirmed this finding in developing countries (e.g., Misinde, 2019). Similarly, children not staying with their biological parents experience higher poverty levels than those living with their biological parents.

With respect to the sex of the household head, results show that children living in households headed by women experience higher poverty prevalence and intensity than those living in households headed by men. Similarly, children residing in households headed by other children and older persons have higher poverty levels than those in households headed by adults or youth. Compared with children residing in households headed by married couples, children residing in households headed by cohabiting couples experience higher poverty levels, followed by those residing in households whose heads never married, widowed/widower, separated and divorced. The finding that child poverty is higher among cohabiting partners is not surprising. Children in households with cohabiting partners are often biologically related to only one partner (mostly mothers), which could put them at a disadvantage in sharing resources brought in by the non-biological partner.

Finally, the prevalence of multidimensional child poverty and adjusted headcount ratios declined sharply with improvements in household heads' educational levels. Children residing in households whose heads never attended school experience the highest poverty levels, eight times higher than those residing in households whose heads have a university qualifications.

Table 7.4: Multidimensional poverty estimates by demographic characteristics 2015/16[†]

Description	Population	(%)	*H* (%)	*A* (%)	M_0
Sex					
Boy	414,840	50.7	42.6***	43.7***	0.186***
Girl (ref)	403,003	49.3	40.7	43.2	0.176
Age					
0 to 4 years (ref)	258,818	31.6	46.3	44.1	0.204
5 to 9 years	240,576	29.4	42.0***	44.4***	0.187***
10 to 14 years	214,356	26.2	36.5***	41.5***	0.152***
15 to 17 years	104,093	12.7	40.1***	42.9***	0.172***
Disability status					
Disabled	6,707	0.8	52.9***	46.9***	0.245***
Not disabled (ref)	811,135	99.2	41.6	43.4	0.181
Citizenship					
Citizen (ref)	801,606	98.0	42.3	43.4	0.184
Non-citizen	16,237	2.0	10.5***	43.7	0.046***
Living arrangement					
Both parents (ref)	205,978	25.2	33.0	44.0	0.145
Mother alone	374,026	45.7	45.2***	43.4***	0.196***
Father alone	27,488	3.4	29.1***	43.3***	0.126***
None of his/her parents	210,350	25.7	45.6***	43.2***	0.197***
Parent survival					
Both parents alive (ref)	694,653	84.9	40.5	43.5	0.176
Mother alive	86,754	10.6	49.2***	42.6***	0.209***
Father alive	20,372	2.5	44.6***	43.9***	0.196***
Both parents deceased	16,064	2.0	51.1***	44.3***	0.226***
Relationship to HH					
Head/spouse	2,744	0.3	41.2***	44.3***	0.183***
Son/daughter (ref)	381,524	46.7	35.6	43.6	0.155
Grandchild	304,423	37.2	48.3***	43.2***	0.209***
Other relative	119,097	14.6	44.1***	43.3***	0.191***
Not related	10,054	1.2	44.2***	45.8***	0.202***
Sex of HH					
Male-headed	335,399	41.0	38.2***	43.7***	0.167***
Female-headed (ref)	482,443	59.0	44.1	43.3	0.191
Age of HH					
12-17 (children)	3,656	0.4	55.0***	40.6***	0.223***
18-35 (youth)	160,824	19.7	42.4***	44.5***	0.189***
36-64 (adults) (ref)	494,850	60.5	38.2	43.1	0.165
65+ (older persons)	158,512	19.4	51.4***	43.4***	0.223***
Marital status of HH					
Married (ref)	258,926	31.7	26.4	42.4	0.112
Living together	199,102	24.3	53.0***	43.7***	0.232***
Separated	18,798	2.3	44.1***	42.4***	0.187***
Divorced	14,718	1.8	32.1***	43.6***	0.140***
Widowed/Widower	116,830	14.3	44.6***	43.4***	0.194***
Never married	209,470	25.6	48.7***	43.9***	0.214***
Household size					
1 to 3 members (ref)	116,873	14.3	29.2	43.5	0.127
4 to 6 members	359,333	43.9	36.6***	43.7***	0.160***
More than 7 members	341,636	41.8	51.4***	43.2***	0.222***
Educational attainment of HH					
None (ref)	243,503	29.8	59.0	44.3	0.264
Primary	222,164	27.2	45.6***	42.8***	0.195***
Secondary	224,686	27.5	37.0***	42.5***	0.157***
Vocational	23,420	2.9	22.5***	41.2***	0.093***
University	104,070	12.7	7.3***	47.4***	0.035***
Total	**817,843**	**100**	**41.7**	**43.4**	**0.181**

Source: Author's estimates based on the 2015/16 BMTHS data. *H*: headcount ratio; *A*: intensity; M_0: adjusted headcount ratio; *HH* stands for the household head.

[†]All percentages are estimated at the population level using sample weights. Sample size: 9,718.

Significance levels: $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$.

7.4.4. Multidimensional child poverty by economic variables

Table 7.5 presents results along the lines of economic variables (economic activity and economic status). Employment plays an important role, and multidimensional child poverty significantly varies across the household head's employment status; children residing in households whose heads are unemployed experience significantly higher poverty levels. Surprisingly, children residing in households whose heads are engaged as unpaid family helpers have higher poverty levels than those whose heads are unemployed.

A negative relationship between household expenditures and multidimensional child poverty is observed. Children in the poorest quintile (Q1) experience higher levels of multidimensional child poverty, and the headcount ratio declines along the quintiles, with those in the wealthiest quintile (Q5) experiencing the lowest levels of poverty. The poverty rate in Q1 is twenty-three times higher than in Q5. Similarly, children from Q1 have a higher adjusted headcount ratio compared to those in Q2-Q5. Similar studies have found declining multidimensional child poverty rates along income quintiles/deciles. For example, Roelen (2017) showed declining multidimensional rates of child poverty along income deciles (measured using per capita real consumption), with the wealthiest decile recording the lowest poverty rates in Vietnam.

Table 7.5: Multidimensional child poverty estimates by economic variables 2015/16[†]

Variable	Population	(%)	*H* (%)	*A* (%)	M_0
Employment status of HH					
Unemployed (ref)	392,939	48.0	54.3	43.4	0.236
Paid employment	235,866	28.8	21.6***	42.1***	0.091***
Self-employment	85,473	10.5	24.2***	40.7***	0.098***
Own farm	52,214	6.4	46.5***	45.4***	0.211***
Unpaid family helper	51,351	6.3	62.0***	45.9***	0.285***
Quintiles					
Q1 (ref)	661,102	35.3	61.2	44.1	0.270
Q2	457,266	24.4	40.7***	42.6***	0.173***
Q3	335,069	17.9	24.5***	41.2***	0.101***
Q4	234,215	12.5	9.6***	41.5***	0.040***
Q5	187,213	10.0	4.3***	39.1***	0.017***
Total	**817,843**	**100**	**41.7**	**43.4**	**0.181**

Source: Author's estimates based on the 2015/16 BMTHS data.

[†]All percentages are estimated at the population level using sample weights. Sample size: 9,718. Per capita quintiles were calculated at the household level. Per capita quintiles are defined as follows. Q1: y≤371.75; Q2: 371.76 ≤y≤ 665.32; Q3: 665.33.53≤ y≤1172.82; Q4: 1172.83≤y≤2238.13; y≥2238.14. *H*: headcount ratio; *A*: intensity; M_0: adjusted headcount ratio; *HH* stands for the household head. Significance levels: $^{*}p$ <0.1; $^{**}p$ <0.05; $^{***}p$ <0.01.

7.4.5. Multidimensional child poverty across geographic areas

Table 7.6 considers Botswana's multidimensional child poverty situation across cities/towns, urban villages and rural areas. Children residing in rural areas experience significantly higher poverty levels than those in urban villages and cities/towns. For example, the prevalence of multidimensional child poverty in rural areas is triple that in cities/towns. Furthermore, both intensity and adjusted headcount ratios are higher in rural areas. Similar findings exist in the literature (see Ferrone & de Milliano, 2018).

Table 7.6: Multidimensional child poverty estimates by geographical variables 2015/16[†]

Geographical variable	Population	(%)	*H* (%)	*A* (%)	M_0
Strata					
Cities/towns	141,902	17.4	19.3***	42.2	0.081***
Urban villages (ref)	364,705	44.6	34.4	42.1	0.145
Rural areas	311,236	38.1	60.5***	44.5***	0.269***
Districts					
Gaborone	67,752	8.3	18.7***	42.7***	0.080***
Francistown	32,275	3.9	22.4***	43.5***	0.097***
Lobatse	9,038	1.1	26.0***	37.6***	0.098***
Selibe Phikwe	20,842	2.5	20.7***	40.4***	0.083***
Orapa	3,960	0.5	8.0***	55.6***	0.044***
Jwaneng	6,903	0.8	7.3***	39.8***	0.029***
Sowa Town	1,132	0.1	0.0***	0.00	0.000***
Southern	51,382	6.3	49.1***	43.6***	0.214***
Barolong	23,068	2.8	45.6***	40.9***	0.187***
Ngwaketse West	5,779	0.7	36.4***	42.3	0.154***
South East	30,432	3.7	23.7***	42.1***	0.100***
Kweneng East (ref)	107,595	13.2	38.1	42.4	0.161
Kweneng West	23,836	2.9	76.8***	48.1***	0.370**
Kgatleng	33,218	4.1	25.4***	40.9***	0.104***
Central Serowe/Palapye	80,629	9.9	45.1***	44.4***	0.200***
Central Mahalapye	61,719	7.5	56.8***	43.2***	0.245***
Central Bobonong	29,005	3.5	43.8***	40.7***	0.178***
Central Boteti	22,378	2.7	49.8***	45.5***	0.227***
Central Tutume	67,746	8.3	52.6***	43.7***	0.230***
North East	22,931	2.8	33.7***	41.6***	0.140***
Ngamiland East	43,497	5.3	39.6***	44.0***	0.174***
Ngamiland West	28,343	3.5	86.0***	45.8***	0.394***
Chobe	9,042	1.1	39.3**	37.8***	0.149***
Ghanzi	19,584	2.4	46.6***	42.8***	0.199***
Kgalagadi South	9,636	1.2	53.4***	41.5***	0.222***
Kgalagadi North	6,121	0.7	45.2***	43.6***	0.197***
Total	**817,843**	**100**	**41.7**	**43.4**	**0.181**

Source: Author's estimates based on the 2015/16 BMTHS data.
H: headcount ratio; *A*: intensity; M_0: adjusted headcount ratio
[†]All percentages are estimated at the population level using sample weights. Sample size: 9,718.
Significance levels: $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$.

Further, Table 7.6 explores whether multidimensional child poverty varies across administrative districts. Results reveal that the poverty rate differs significantly across the twenty-six administrative districts, with Ngwaketse West and Kweneng West recording the highest prevalence of multidimensional child poverty, estimated at 86 per cent and 76

per cent, respectively. The two districts also recorded the highest adjusted headcount ratios estimated higher than 0.300.

7.4.6. Micro-determinants of multidimensional child poverty

A logit regression model is employed to investigate the joint correlation of demographic, economic, and geographical factors concerning multidimensional child poverty to complement the descriptive analysis. Table 7.7 presents the results showing the estimated coefficients, their robust standard errors and the marginal effects. The log pseudolikelihood ratio test indicates that there is a significant relationship between the probabilities of being multidimensionally poor and the explanatory variables included in the model (p <0.001).

The findings of regression analysis mainly confirm those of descriptive analysis. Boys, children aged 0-4, citizens and children living with a disability are more likely to experience multidimensional poverty. In terms of living arrangements, children living with mothers alone or with none of their biological parents have a higher probability of being multidimensionally poor than those living with both parents. The finding that children living with their fathers alone experience lower poverty levels is also confirmed through regression analysis; they have a lower probability of being multidimensionally poor than those living with both biological parents. Orphans have higher probabilities of being multidimensionally poor than those with both parents alive. Relationship to the household head also matters: grandchildren and children otherwise related to the household head are more likely to be poor than sons or daughters of the household head.

With respect to the household head's characteristics, children living in households headed by men have a higher probability of being poor than those in households headed by women. This empirical evidence from Botswana is contrary to the general belief that female-headed households are more likely to be poor than male-headed households (see Bradshaw et al., 2017). Our results are consistent with the case of Nicaragua (Espinoza-Delgado & Klasen, 2018). This finding could – in part – be explained by household composition. In Botswana, households headed by men are characterised by slightly larger household sizes than those headed by women. For example, in the case of married couples, household size averaged 7.1 for male-headed households compared to 6.2 for those led by women (SB, 2018).

Children living in households headed by other children and youth have higher probabilities of being multidimensionally poor than those living in households headed by adults. Children living in households headed by married couples have lower probabilities of being multidimensionally poor, indicating that marriage plays a pivotal role in poverty (Lekobane & Seleka, 2017). Larger households are associated with a higher likelihood of being poor. In essence, a unit increase in household size will result in a 0.9 percentage points increase in the probability of being multidimensionally poor. With respect to education, the probability of being multidimensionally poor declines with improvements in educational attainment.

In terms of employment status, children living in households whose heads are engaged in paid employment have a lower probability of being multidimensionally poor than those from households whose heads are unemployed. Children living in households whose heads are involved in farming on their farms or land are more likely to be multidimensionally poor than those from households with unemployed heads. This finding is consistent with Lekobane and Seleka (2017), who found that in Botswana, households whose heads worked on their own farms are more likely to be poor (based on monetary poverty) than those whose heads were unemployed. Low yields in agricultural production due to low technology adoption, especially subsistence arable agriculture, predominant in most rural households in Botswana, could explain this finding. Also, farming households comprise mostly dependents (children and older persons) who are economically inactive.

Children in higher quintiles are significantly less likely to be poor than children in the lowest quintile. Concerning geography, the results show that *ceteris paribus* children residing in rural areas are more likely to be multidimensionally poor than those living in urban villages. Results show statistically insignificant differences in probabilities of being multidimensionally poor between urban villages and cities and towns. Interaction terms are included on the sex and marital status of the household head to capture the joint impact of the two variables to capture intersecting inequalities. The results show that children living in households headed by women who are separated, widows or single (never married) have, *ceteris paribus*, higher probabilities of being multidimensionally poor than those living in households headed by men who are separated, widowers or single,

respectively. Children living in cities/towns-women headed households have higher probabilities of being multidimensionally poor than those living in cities/towns-men headed households.

Table 7.7: Results of the logit regressions

Explanatory variables	Coefficient	Robust SE	Marginal effects
Sex (ref: Female)			
Male	0.1017**	0.0480	0.0237
Age (ref: 0 to 4 years)			
5 to 9 years	-0.2406***	0.0621	-0.0562
10 to 14 years	-0.5402***	0.0666	-0.1231
15 to 17 years	-0.2463***	0.0862	-0.0572
Disability status (ref: Not disabled)			
Disabled	0.6874**	0.2692	0.1695
Citizenship (ref: Non-citizen)			
Citizen	0.7817***	0.2873	0.1631
Living arrangement (ref: Both parents)			
Mother alone	0.1602*	0.0893	0.0380
Father alone	-0.2829*	0.1639	-0.0646
None of his/her parents	0.2218**	0.1074	0.0530
Parent survival (ref: Both parents alive)			
Mother alive	0.1241	0.0779	0.0297
Father alive	0.4343***	0.1613	0.1063
Both parents deceased	0.6781***	0.1730	0.1671
Relationship to HH (ref: Son/daughter)			
Head/spouse	-0.6315	0.5808	-0.1353
Grandchild	-0.3904***	0.0855	-0.0912
Other relative	-0.4304***	0.0899	-0.0976
Not related	-0.3582	0.2323	-0.0807
Sex of HH (ref: Female-headed)			
Male-headed	0.6101***	0.1329	0.1453
Age of HH (ref: 36-64 (adults))			
12-17 (children)	1.3128***	0.4656	0.3146
18-35 (youth)	0.2649***	0.0760	0.0637
65+ (older persons)	0.0357	0.0708	0.0085
Marital status of HH (ref: Married)			
Living together	1.1690***	0.1237	0.2822
Separated	1.0092***	0.1832	0.2471
Divorced	0.5027**	0.2193	0.1234
Widowed/Widower	0.5799***	0.1219	0.1415
Never married	1.0621***	0.1136	0.2567
Household size (continuous)	0.0388***	0.0079	0.0092
Educational attainment of HH (ref: None)			
Primary	-0.4229***	0.0634	-0.0975
Secondary	-0.6640***	0.0810	-0.1500
Vocational	-0.7646***	0.1802	-0.1605
University	-1.6347***	0.1461	-0.3011
Employment status of HH[a] (ref: Unemployed)			
Paid employment	-0.3769***	0.0907	-0.0855
Self-employment	-0.0541	0.0964	-0.0127
Own farm	0.4120***	0.1002	0.1005
Quintiles (ref: Q1)			
Q2	-0.6169***	0.0590	-0.1391
Q3	-0.0865***	0.0787	-0.2245
Q4	-1.6870***	0.1248	-0.3026

Q5	-2.2304***	0.2148	-0.3472
Region (ref: Urban villages)			
Rural areas	0.9409***	0.0651	0.2232
Cities and towns	-0.0690	0.1030	-0.0162
Interaction terms			
Cohabitation (Male-headed household)	-0.2505	0.1509	-0.0578
Separated (Male-headed household)	-1.0358*	0.5993	-0.2032
Divorced (Male-headed household)	-1.7983	1.2042	-0.2911
Widowed (Male-headed household)	-0.4837*	0.2848	-0.1066
Single (Male-headed household)	-0.3381*	0.1859	-0.0766
Rural (Male-headed household)	-0.1706	0.1084	-0.0398
Cities and towns (Male-headed household)	-0.4519***	0.1616	-0.1014
Constant	-1.3842***	0.3194	
Number of observations	9,718		
Wald chi2(38)	2,989.04		
Prob. > chi2	0.0000***		
Pseudo R2	0.2247		
Log pseudolikelihood	-5,157.47		

Source: Author's estimates based on 2015/16 BMTHS. Robust standard errors (SE) clustered at the household level are reported. [a]Unpaid family helper is omitted from the model due to collinearity. ref means reference category. Dependent variable: dummy equals one if the child is considered to be multidimensionally poor and 0 otherwise. Significance levels: $^{*}p$ <0.1; $^{**}p$ <0.05; $^{***}p$ <0.01.

7.5. Summary and conclusions

Measurement of multidimensional child poverty in low- and middle-income countries is relatively widespread, with national and context-specific studies existing alongside large cross-country comparisons. Nevertheless, efforts to measure (child) poverty in Botswana remains primarily dominated by a monetary approach, and the country fails to monitor multidimensional child poverty. This chapter developed a child-centred, individual-level and composite measure that offers nationally relevant and context-specific insights into the magnitude and depth of multidimensional child poverty in Botswana. In particular, it did so through the lens of LNOB by zooming in on demographic, economic and geographical characteristics associated with greater vulnerability or marginalisation. This chapter contributes to the literature on multidimensional child poverty in Botswana. It also serves as a baseline for tracking the progress of the SDGs, BPEPS and Vision 2036 with regard to multidimensional child poverty.

Results point toward a relatively high prevalence and intensity of multidimensional child poverty in an upper-middle-income country like Botswana. More than four out of ten children can be considered multidimensionally poor, and on average, they are deprived in almost half of all deprivations. These numbers suggest the importance of multidimensional child poverty measurement alongside economic indicators such as

economic growth or monetary poverty. The descriptive and parametric analysis leads to both expected and more surprising findings regarding which children may be left behind. Children living with disabilities, orphaned children and children not living with their relatives, for example, are more likely to be poor. More counter-intuitively, children who are citizens of Botswana are more likely to be poor than non-citizens. In addition, children living with their fathers alone have lower poverty prevalences than those living with both parents. Children living in rural areas experience higher levels of poverty and have higher probabilities of being poor. In sum, the results in this chapter reveal that children are not a homogeneous group and that an in-depth analysis across different groups of children is needed to identify the left behind children.

CHAPTER 8: DOES IT MATTER WHICH POVERTY MEASURE WE USE TO IDENTIFY THOSE LEFT BEHIND? INVESTIGATING POVERTY MISMATCH AND OVERLAPS[63]

8.1. Introduction

This chapter investigates poverty mismatch and overlaps to clearly understand whether there is a link between monetary and multidimensional poverty measures to achieve SDG 1 (Ballón et al., 2018). The two poverty measures are captured by SDG 1. Specifically, SDG 1.1 aims to 'eradicate extreme (monetary) poverty for all people', and SDG 1.2 aims to 'reduce at least by half the proportion of men, women and children of all ages living in poverty in all its dimensions' (UN, 2015: p15). These two SDG targets make clear the importance of monetary and multidimensional poverty measures in the 2030 Agenda for sustainable development, especially the LNOB principle.

Therefore, the purpose of this chapter is to provide an in-depth analysis by examining the mismatch between monetary poverty and individual-level multidimensional poverty. This chapter addresses the following research question: *What are the factors contributing to poverty mismatch and overlaps between the official monetary and multidimensional poverty measures*? In answering this research question, this chapter conducts an empirical assessment in the context of Botswana. Botswana presents a fascinating case. Poverty measurement in Botswana is exclusively based on the monetary approach. Thus, it is of utmost importance to examine poverty mismatch when using monetary and multidimensional poverty measures. Therefore, this chapter compares poverty estimates based on Botswana's official monetary-based poverty measure with findings based on a country-specific individual-level multidimensional poverty index (constructed in Chapter 5) using the 2015/16 BMTHS survey data.

Overall, the results show that in Botswana, multidimensional poverty levels are higher than monetary poverty levels. First, consistent with the empirical literature from other developing countries (e.g., Baulch & Masset, 2003; Bradshaw & Finch, 2003; Levine, 2012; Roelen, 2017, 2018; Kim, 2019), the results reveal limited overlap in findings for monetary and multidimensional poverty. Second, monetary poverty identifies a smaller

[63] This chapter is forthcoming in *Journal of Social and Economic Development*.

proportion of the population as poor compared to the multidimensional poverty measure. Third, consistent with other studies from other countries (e.g., Bader et al., 2016; Roelen, 2017, 2018; Salecker et al., 2020), the results reveal a weak correlation between the monetary and multidimensional poverty measures (and various multidimensional poverty indicators). Fourth, the results show that multidimensional poverty levels decline with increasing levels of per capita consumption expenditure. However, consistent with other studies, there is a significant proportion of the multidimensional poor in the wealthiest households (Salecker et al., 2020). Last, the econometric estimation results show that age, household size, education status of household head, employment status of household head and location (place of residence) influence the extent to which individuals are identified as monetary or multidimensionally poor. Therefore, this chapter concludes that the monetary poverty measure alone does not capture the real picture of Botswana's poverty situation. Therefore, it should be complemented with a multidimensional poverty measure.

This chapter makes several contributions. First, to the best of my knowledge, this chapter is the first attempt to compare monetary and multidimensional poverty measures in Botswana. In so doing, the chapter contributes to the literature on poverty mismatch and overlaps in Botswana. Exploring poverty mismatch in a country-specific context allows for a deeper understanding from a broader perspective (Roelen, 2017). Second, this chapter also makes a novel contribution to the limited literature on poverty mismatch in SSA (Levine, 2012; Salecker et al., 2020) by using a country-specific individual-level multidimensional poverty measure. The chapter also adds to the debates on poverty mismatches globally (Baulch & Masset, 2003; Kwadzo, 2015; Bader et al., 2016). Third, the chapter extends the research on poverty mismatch in SSA by investigating factors influencing poverty mismatches using multinomial logistic regression (Roelen, 2018).

The structure of the chapter is as follows. The following section (Section 8.2) presents brief literature on poverty mismatch, followed by section 8.3, presenting an analytical strategy. Next, section 8.4 presents results and discussion, and last, section 8.5 provides a summary and conclusions.

8.2. Literature on the mismatch of monetary and multidimensional poverty measures

Empirical literature points towards evidence of a mismatch between monetary and multidimensional poverty measures (Baulch & Masset, 2003; Bradshaw & Finch, 2003; Ruggeri-Laderchi, 1997; Sumarto & De Silva, 2014; Tran et al., 2015; Ballón et al., 2018; Roelen, 2017, 2018; Kim, 2019). These studies' overall findings show that poverty based on monetary and multidimensional measures identifies different groups of individuals or households as poor (e.g., Alkire et al., 2015a; Tran et al., 2015; Roelen, 2017, 2018). Notwithstanding rich literature on poverty mismatch, a few studies have investigated poverty mismatch in SSA (Klasen, 2000; Levine, 2012; Salecker et al., 2020). In the case of Rwanda, Salecker et al. (2020) found that using a monetary measure alone does not capture the high levels of multidimensional poverty. Also, the chapter found that the two measures differ in poverty risk factors. Levine (2012) found significant discrepancies between the two measures in the case of Uganda. Klasen (2000) compared a standard expenditure-based poverty measure with a specifically created composite measure of deprivation for the case of South Africa and found that the two measures diverge significantly in identifying the poorest and most deprived sections of the population. Therefore, this chapter contributes to the limited literature on poverty mismatch in SSA.

Based on this growing evidence of poverty mismatch and overlaps, other studies have examined factors associated with poverty mismatch (Perry, 2002; Bradshaw & Finch, 2003; Cancian & Meyer, 2004; Alessio et al., 2011; Bader et al., 2016; Ballón et al., 2018; Roelen, 2018). Some studies have argued that individual and household characteristics and structural characteristics (including regional socioeconomic disparities) influence poverty mismatch and overlap (Klasen, 2000; Roelen, 2018; Tran et al., 2015). Klasen (2000) found that ethnicity, sex and education of the household head are associated with varying levels of poverty mismatch in South Africa. Tran et al. (2015) identified the same factors in the case of Vietnam. Bader et al. (2016) identified residence, ethnolinguistic families, and access to the market as drivers of poverty mismatch in the case of the Lao People's Democratic Republic. Roelen (2018) found that household size, level of education and occupational status of the household head and place of residence significantly influence poverty mismatch in Ethiopia and Vietnam. This chapter contributes to the limited literature on factors influencing poverty mismatch in SSA.

Some studies also argued that measurement error might influence the mismatch between monetary and multidimensional poverty measures (Hulme & McKay, 2008; Roelen, 2018; Bradshaw & Finch, 2003). The reliability of the monetary measure concerning their equivalence scale and indicator for disposable income has been questioned (Brewer et al., 2009). Also, different units of analysis may lead to or compound measurement error since the monetary measure is aggregated at the household level, while multidimensional measure aims to include more individual-level indicators (Roelen, 2018). The monetary measure follows an indirect approach to measuring welfare and, therefore, cannot represent the standard of living of a family or individual (Ringen, 1988). Therefore, it provides no way to verify the intra-household allocation of resources/income (Alkire & Santos, 2014). Others point to the time and lagged effects since monetary indicators are considered more likely to fluctuate in the short term than non-monetary indicators (Roelen, 2018).

Other studies have investigated the correlation between income (and thus monetary poverty) and specific dimensions of deprivation (Klasen, 2000; Ruggeri-Laderchi et al., 2003; Alessio et al., 2011; Singh & Sarkar, 2015; Bader et al., 2016; Roelen, 2017, 2018). These studies find a weak correlation between the two measures and conclude that one measure cannot serve as a proxy for another (Klasen, 2000; Roelen, 2018). This chapter contributes to the literature in this regard.

8.3. Analytical strategy

The analytical strategy involves both descriptive and regression analysis. The descriptive analysis consists of three components. Firstly, following other studies (e.g., Tran et al. (2015), this chapter compares monetary and multidimensional poverty rates across different sub-groups of the population. Secondly, the chapter investigates the correlation between consumption and multidimensional poverty (Suppa, 2016; Roelen, 2017; Salecker et al., 2020). Thirdly, the mismatch between the monetary and multidimensional poverty measures is examined. Following other studies analysing overlap and mismatches (e.g., Perry, 2002; Baulch & Masset, 2003; Ruggeri-Laderchi et al., 2003; Suppa, 2016; Roelen, 2017, 2018; Salecker et al., 2020), a cross-tabulation of monetary and multidimensional poverty rate is estimated. The cross-tabulation yields a four-cell matrix that represents four different ‘poverty categories’ (Roelen, 2017, 2018). These categories are (i) *poverty overlap* (both monetary and multidimensionally poor); (ii) *positive*

mismatch (monetary poor but not multidimensionally poor; (iii) *negative mismatch* (multidimensionally poor but are not monetary poor); and (iv) *non-poor* (not monetary nor multidimensionally poor) (see Roelen, 2018).

The chapter then employs a multinomial logit model to examine factors contributing to the poverty mismatch. The multinomial logit model is the most commonly applied model when examining multiple unordered categorical outcomes. Since the dependent variable ('poverty group status') comprises nominal (no ordering) outcomes, multinomial logit is the appropriate model. Independent variables at the individual level include individual characteristics, household characteristics and community indicators. Individual characteristics include sex, age, disability status and household level variables include sex, age, marital status, educational attainment and employment status of the household head, household size and location (see Roelen, 2018; Salecker et al., 2020). These selected independent variables are commonly used in the literature as key determinants of poverty (Grootaert, 1997; Baulch & McCulloch, 2002; Leu et al., 2016; Qi & Wu, 2016; Lekobane & Seleka, 2017; Salecker et al., 2020).

8.4. Results and discussions

8.4.1. Monetary and multidimensional poverty comparisons

A comparison between estimates of monetary and multidimensional poverty measures is presented in Table 8.1. As expected, the two poverty measures produce significantly different estimates of poverty rates, with monetary poverty having significantly lower poverty rates. Based on the official monetary poverty measure, the headcount ratio (P_0) is estimated at 16.3 per cent compared to 46.2 per cent of the multidimensional poverty headcount ratio (H). Generally, the multidimensional poverty rate is higher than the monetary poverty rate across all different population subgroups, as evidenced by positive differentials between multidimensional and monetary poverty rates (Table 8.1). Thus, the results reveal a diverse picture regarding differences between the two measures across subgroups of the population.

Concerning sex, females exhibited slightly higher poverty rates than males, regardless of the poverty method used. However, the differences are very minimal. For example, the difference in poverty between males and females is only 0.9 and 1.2 percentage points based on monetary and multidimensional poverty measures, respectively. Regarding age,

poverty rates based on the monetary measure exhibit a U-shaped relationship with age. The non-linear U-shaped relationship between age and monetary poverty follows the life cycle theory. It is expected that poverty levels are higher in younger age groups but decrease with age to a certain threshold, after which they rise again. This finding is common in the empirical literature (D'Ambrosio et al., 2011; Lekobane & Seleka, 2017; Rodrigues & Rueanthip, 2019; Ravindra Deyshappriya & Minuwanthi, 2020). In contrast, multidimensional poverty findings reveal a positive correlation with age, meaning that the likelihood to be multidimensionally poor increases with age. The rankings of poverty rates regarding disability status reveal a contrasting picture. The monetary poverty rate is higher among people with no disability compared to PWDs. The opposite is true for multidimensional poverty, with the poverty rate being higher for PWDs than those without a disability. The change in poverty rate between the two measures is higher for PWDs (58.7%) than those with no disability (29.2%).

The poverty rate is consistently higher for citizens than non-citizens regardless of the poverty method used. The change in poverty rate between the two measures is more than double (30.5%) for citizens compared to non-citizens (13.2%). Across household headship, individuals residing in female-headed households exhibited slightly higher poverty rates than those in male-headed households regardless of the poverty measure used. Poverty rankings differ concerning the age of the household head. There is a positive correlation between the monetary poverty rate and the household head's age, meaning that households headed by children have lower risks of being monetary poor and vice versa. However, these results should be treated with caution since child-headed households account for the lowest shares (0.2%) of total households. In contrast, rankings based on the multidimensional poverty measure reveal a U-shaped relationship with the age of the household head. This finding means that multidimensional poverty rates decline with an increase in the age of the household head up to a certain point after which they increase. This finding is consistent with the life-cycle theory.

Poverty rankings showed mixed and different results between the two poverty measures based on the household head's marital status. For example, individuals from households headed by married couples recorded lower multidimensional poverty rates (32.6%), ranking first (1). In contrast, in monetary poverty, those from households headed by divorced persons recorded the lowest poverty rates (9.8%), ranking first (1). The rankings

also changed for all other marital status categories except those from households headed by widows/widowers and never married. Rankings also differ between the two measures concerning the household size. When using the monetary measure, poverty levels are positively correlated with household size, meaning that increasing household size will increase monetary poverty rates. This finding is consistent with the empirical literature on monetary poverty (Sekhampu, 2013; Lekobane & Seleka, 2017; Ravindra Deyshappriya & Minuwanthi, 2020). However, based on the multidimensional poverty measure, the results reveal a U-shaped relationship between poverty rankings and household size. This finding means that higher multidimensional poverty rates decline with an increase in household size to a certain level, after which they increase. These contrasting findings and conclusions concerning the relationship between household size and the two poverty measures have policy implications on how poverty is measured.

Poverty rankings exhibited a negative correlation with household head's educational attainment, meaning household head with higher educational attainment have a lower risk of being either monetary or multidimensionally poor. The disparities between the two measures also decline with improvements in educational achievement. Results reveal a mixed and different picture concerning the employment status of the household head. For example, based on the monetary poverty measure, individuals from households headed by unemployed persons recorded the highest poverty rate, ranking last (fifth rank). In contrast, those from households headed by unpaid family helpers recorded the highest multidimensional poverty rate (fifth rank).

Table 8.1: Poverty profiles by demographic and economic characteristics 2015/16[†]

Subgroup	Pop. share	P_0	H	Δ Prevalence
Sex				
Female	52.9	16.7 (2)	46.8 (2)	+30.1
Male	47.1	15.8 (1)	45.6 (1)	+29.8
Age				
0 to 17 years (children)	39.4	20.1 (4)	41.7 (1)	+21.6
18 to 35 years (youth)	31.0	15.0 (2)	42.5 (2)	+27.5
36 to 64 years (adults)	24.2	11.8 (1)	51.8 (3)	+40.0
65+ (older persons)	5.3	15.7 (3)	76.6 (4)	+60.9
Disability status				
Persons with disability	2.8	14.6 (1)	73.3 (2)	+58.7
No disability	97.2	16.3 (2)	45.5 (1)	+29.2
Citizenship				
Citizen	96.7	16.7 (2)	47.2 (2)	+30.5
Non-citizen	3.3	5.0 (1)	18.2 (1)	+13.2
Sex of HH				
Female-headed	51.6	17.4 (2)	49.7 (2)	+32.3
Male-headed	48.4	15.0 (1)	42.6 (1)	+27.6
Age of HH				
12-17 (children)	0.20	0.0 (1)	58.1 (3)	+58.1
18-35 (youth)	22.3	12.2 (2)	40.9 (1)	+28.7
36-64 (adults)	58.0	15.7 (3)	43.3 (2)	+27.6
65+ (older persons)	19.5	22.9 (4)	61.0 (4)	+38.1
Marital status of HH				
Married	31.0	12.9 (2)	32.6 (1)	+19.7
Living together	24.8	17.8 (4)	53.8 (5)	+36.0
Separated	2.0	19.6 (5)	52.5 (4)	+32.9
Divorced	2.0	9.8 (1)	38.1 (2)	+28.3
Widowed/Widower	13.2	21.4 (6)	54.1 (6)	+32.7
Never married	27.1	16.4(3)	51.2 (3)	+34.8
Household size				
1 to 3 members	30.4	4.2 (1)	41.8 (2)	+37.6
4 to 6 members	38.5	13.7 (2)	40.8 (1)	+27.1
More than 7 members	31.1	31.2 (3)	57.3 (3)	+26.1
Educational attainment of HH				
None	27.6	29.3 (5)	67.9 (5)	+38.6
Primary	25.6	18.6 (4)	54.8 (4)	+36.2
Secondary	28.7	9.9 (3)	39.6 (3)	+29.7
Vocational	3.4	6.8 (2)	22.2 (2)	+15.4
University	14.7	2.2 (1)	9.1 (1)	+6.90
Employment status of HH				
Unemployed	43.9	24.3 (5)	59.6 (4)	+35.3
Paid employment	32.2	7.7 (2)	26.1 (1)	+18.4
Self-employment	10.9	6.9 (1)	29.7 (2)	+22.8
Own farm	6.8	13.5 (3)	59.8 (3)	+46.3
Unpaid family helper	6.2	23.8 (4)	70.1 (5)	+46.3
Total	**100.0**	**16.3**	**46.2**	**+29.9**

Source: Authors' estimates based on the 2015/16 BMTHS data.

Δ Prevalence is the difference between H and P_0 (H-P_0). H: Multidimensional poverty rate; P_0: Poverty rate based on monetary poverty measure. The number in parentheses represents rankings. [†]All percentages are estimated at the population level using sample weights.

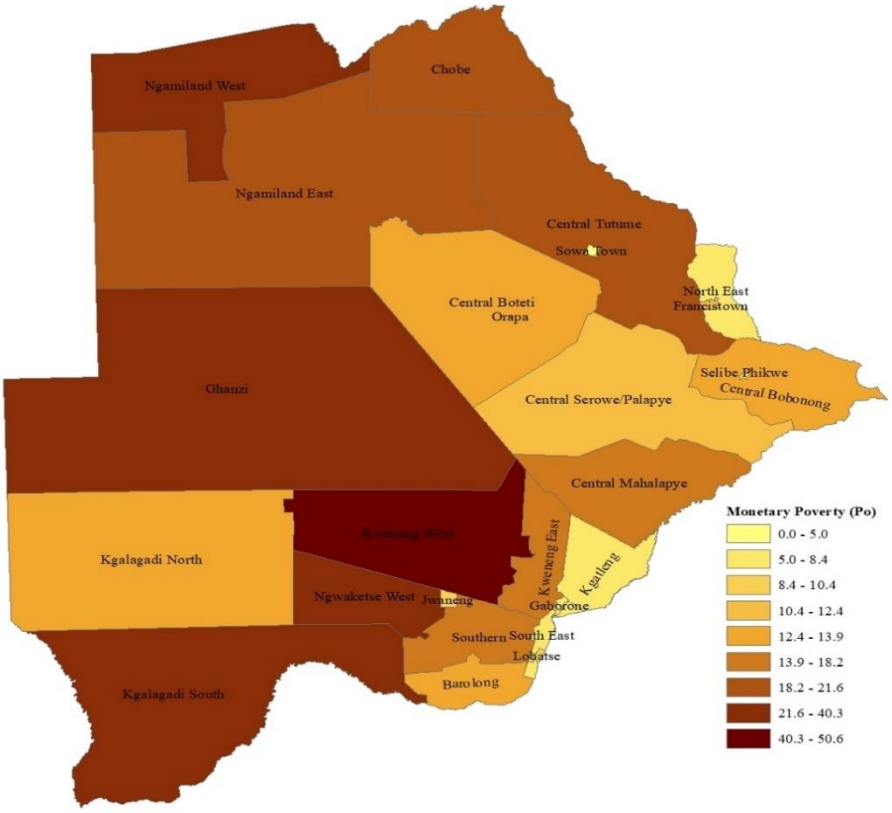
8.4.2. Monetary and multidimensional poverty levels by districts

Figures 8.1 and 8.2 present choropleth maps depicting the levels of monetary and multidimensional poverty across administrative districts. Overall, the two maps depict distinct patterns for monetary and multidimensional poverty measures. The distinct poverty scenarios revealed by these two measures could help policymakers to develop and implement appropriate poverty eradication interventions that are specific to each district. Figure 8.1 shows that, in general, monetary poverty levels are lower compared to those based on the multidimensional poverty measure depicted in Figure 8.2. Figure 8.1 also reveals that monetary poverty levels are lower in the eastern part of Botswana. This finding is not surprising since the eastern corridor connects the two cities (Francistown and Gaborone), thus providing economic opportunities. Also, the two cities are connected by the railway line providing access to markets. By contrast, monetary poverty is higher in the Western part of the country. These districts are far from both cities and characterised by very limited access to economic activities. However, Figure 8.2 reveal mixed results. The results also show that poverty levels are lower for urban districts (cities and towns) regardless of the poverty measure used.[64]

Table 8A.1 in the appendix presents poverty rates based on the two measures and rankings across administrative districts. Except for Orapa and Sowa Town, the multidimensional poverty rate is consistently higher than the monetary poverty rate. This finding is not surprising since these two districts are mining towns with good infrastructure, and most services such as health are provided freely for mining workers and their families. The rankings show diverse differences. Only one district (Sowa Town) maintained its ranking as the least poor district regardless of the poverty measure used. The rankings for all other districts are different across the two measures, with some districts showing more significant disparities than others. For example, even though Ngamiland West recorded the highest multidimensional poverty rate, it ranked fifth based on monetary poverty. Also, North East ranked second based on monetary poverty and eleventh when using a multidimensional poverty measure. These districts comprise mostly rural villages with limited infrastructural development, and access to most basic services is still a challenge. In contrast, Orapa appears better off when using the multidimensional poverty measure, ranking second compared to the sixteenth rank when using the monetary poverty measure.

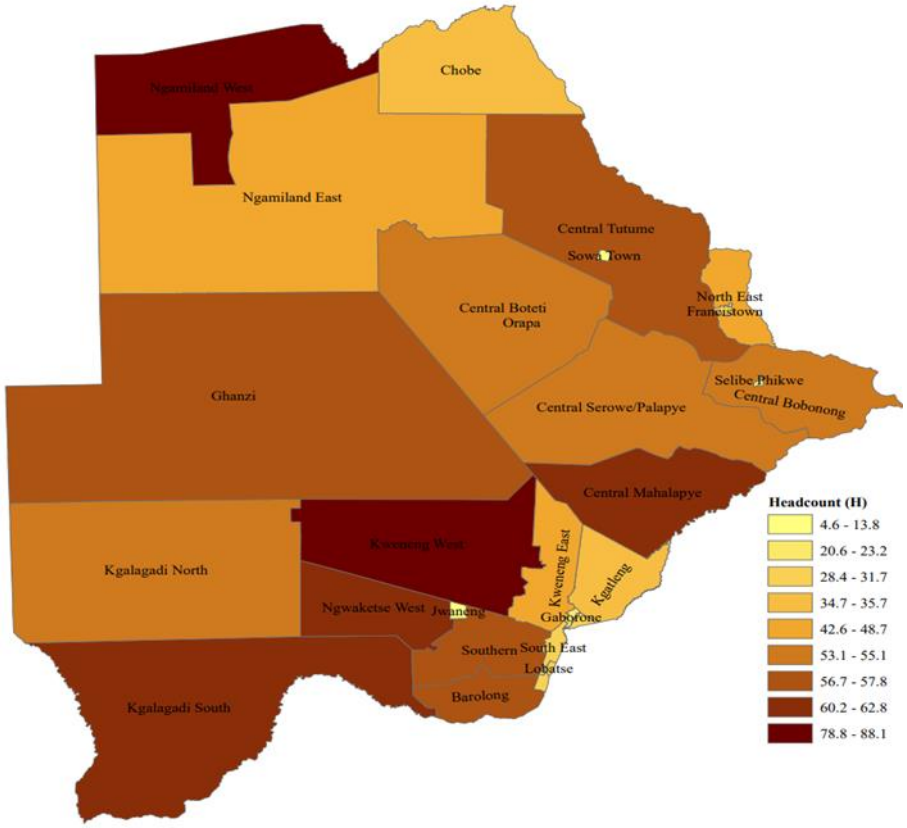
[64] Cities and towns include Gaborone, Francistown, Lobatse, Selibe-Phiwe, Orapa, Jwaneng and Sowa Town, and they are categorised as administrative districts.

Figure 8.1: Monetary poverty estimates across districts



Source: Author's estimates based on the 2015/16 BMTHS data.

Figure 8.2: Multidimensional poverty estimates across districts



Source: Author's estimates based on the 2015/16 BMTHS data.

8.4.3. Patterns of mismatch between monetary and multidimensional poverty

To shed more light on the differences or similarities, it is of paramount importance to examine whether the two measures identify the same or different sub-groups of the population as poor. First, the population is divided into four groups: *A* (monetary poor only, representing positive mismatch); *B* (multidimensionally poor only, representing negative mismatch); *AB* (both monetary and multidimensionally poor, representing overlap) and *C* (non-poor). Table 8.2 presents the summary results of the observed patterns of mismatch in Botswana. The results reveal that the two measures exhibit significant differences in terms of identifying who is poor. About 12 per cent of the population was identified as poor by both measures (*AB*), and roughly 38.5 per cent of the people are either monetary poor (4.3%) or multidimensionally poor (34.2%) (*A* + *B*).

Table 8.2: Poverty overlaps and mismatch†

	MPI non-poor	*MPI* poor	Total
PDL poor	88,176	249,234	337,410
	(4.3)	(12.0)	(16.3)
PDL non-poor	1,026,704	709,560	1,736,264
	(49.5)	(34.2)	(83.7)
Total	1,114,880	958,794	2,073,674
	(53.8)	(46.2)	(100.0)

Source: Author's estimates based on the 2015/16 BMTHS data.
†All percentages are estimated at the population level using sample weights.
Sample size: 24,720. Percentages are reported in brackets.
PDL and *MPI* represent monetary and multidimensional poverty measures (respectively).

Table 8.3 presents the distribution of individuals within each of the four categories. Of those identified as monetary poor, 73.9 per cent were also identified as multidimensionally poor. About 26.0 per cent of multidimensionally poor individuals were also monetary poor. Conversely, among individuals not identified as poor by the monetary measure, 40.9 per cent were multidimensionally poor. A share of 74 per cent of the multidimensionally poor were not identified as poor in monetary terms.

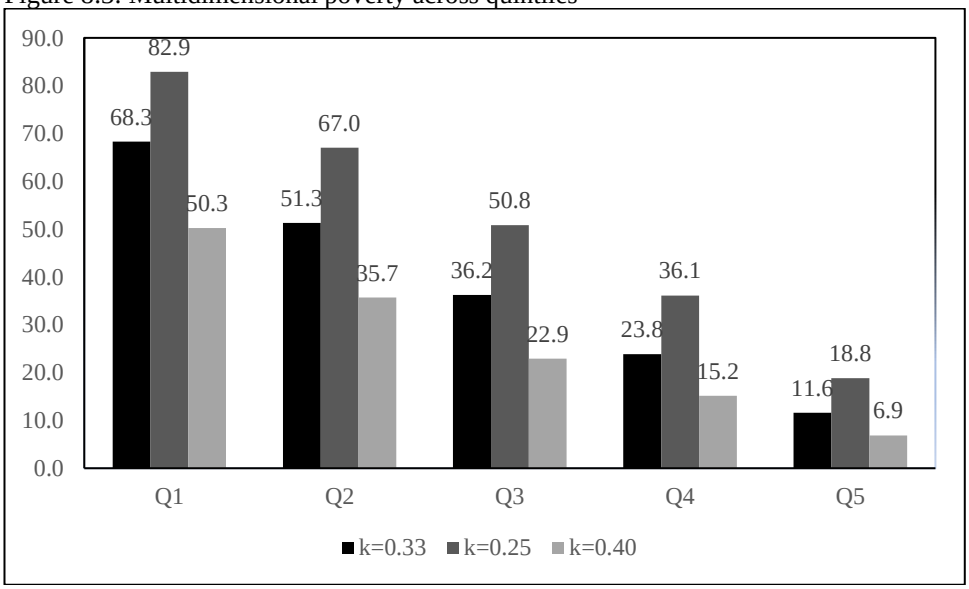
Table 8.3: Shares of poverty overlaps and mismatch within poverty method†

	MPI non-poor	*MPI* poor	Total
PDL poor	26.1	73.9	100.0
	(7.9)	(26.0)	(16.3)
PDL non-poor	59.1	40.9	100.0
	(92.1)	(74.0)	(83.7)
Total	53.8	46.2	100.0
	(100.0)	(100.0)	

Source: Author's estimates based on the 2015/16 BMTHS data.
†All percentages are estimated at the population level using sample weights.
Sample size: 24,720. Percentages reported in brackets refer to 'within *MPI* poor and *MPI* non-poor'.
PDL and *MPI* represent monetary and multidimensional poverty measures (respectively).

To further examine whether monetary poverty and multidimensional poverty are related, the population is partitioned into income groups (consumption per capita quintiles). Figure 8.2 depicts the results of multidimensional poverty rates across quintiles based on three poverty cut-offs.[65] The results show a decreasing effect of income on multidimensional poverty with increasing per capita consumption expenditure levels. These results mean that the higher the income, the less likely one is, on average, to be multidimensionally poor, regardless of the poverty cut-off chosen. These results suggest that income is essential for avoiding multidimensional poverty in the context of Botswana. The results are consistent with those of Suppa (2016) for Germany but different from Salecker et al. (2020) in the case of Rwanda. Salecker et al. (2020) found only a minimal mitigating effect of consumption on being multidimensionally poor. That is, estimated multidimensional poverty rates remain high among individuals at the highest consumption levels.

Figure 8.3: Multidimensional poverty across quintiles†



Source: Author's estimates based on the 2015/16 BMTHS data.
†All percentages are estimated at the population level using sample weights. Sample size: 24,720.

8.4.4. Correlation between monetary and multidimensional poverty indicators

Following other studies (e.g., Bader et al., 2016; Suppa, 2016; Roelen, 2017), the correlation between monetary poverty indicators and multidimensional poverty indicators is examined. This paper used tetrachoric correlation since monetary and multidimensional

[65] A person *i* is identified as multidimensionally poor using a poverty cut-off *k*, such that $c_i \geq k$. The three poverty cut-offs are *k*=0.25, 0.33 and 0.40.

poverty indicators are dichotomous (Agresti, 2010). A point-biserial correlation was used to examine the association between continuous (consumption) and dichotomous variables (MPI indicators). Table 8.4 presents the results. Overall, the results reveal a weak positive correlation between multidimensional poverty and monetary poverty. The correlation between monetary and multidimensional poverty measures is estimated at 0.439 and is statistically significant, meaning the correlation between the two poverty measures is limited. Also, multidimensional poverty and per capita consumption exhibited a negative and limited correlation. This finding is consistent with other similar studies in the empirical literature (Roelen, 2017). For example, Roelen (2017) found a weak negative correlation between multidimensional child poverty and real per capita consumption in Vietnam.

Table 8.4: Correlation between monetary and multidimensional poverty 2015/16†

	Monetary poor	Per capita consumption
Multidimensional poor	.439***	-.137***
Deprivation indicators		
Land tenure	-0.238***	0.105***
Crime	-0.092***	0.030***
Chronic illness	-0.086***	0.001**
Safety	0.057***	-0.025***
Height-for-age	0.068*	-0.023***
Weight-for-height	0.079	-0.041***
Health facility	0.081***	-0.056***
Body Mass Index	0.145***	-0.045***
Water supply	0.147***	-0.017***
Literacy	0.196***	-0.053***
Weight-for-age	0.220***	-0.041***
Schooling achievement	0.223***	-0.088***
Child school attendance	0.259***	-0.077***
Roof material	0.276***	-0.047***
Wall material	0.322***	-0.069***
Floor material	0.352***	-0.064***
Overcrowding	0.357***	-0.099***
Food insecurity access	0.397***	-0.138***
Information	0.407***	-0.076***
Electricity	0.436***	-0.118***
Durable goods	0.448***	-0.138***
Toilet facility	0.471***	-0.177***
Cooking fuel	0.485***	-0.154***
Transport	0.495***	-0.191***

Source: Author's estimates based on the 2015/16 BMTHS data.
†All percentages are estimated at the population level using sample weights.
Significance levels: $^{*}p$ <0.1; $^{**}p$ <0.05; $^{***}p$ <0.01.

The results further reveal a weak correlation between monetary poverty and the indicators underpinning the overall measure of multidimensional poverty. Indicators are negatively and weakly related to per capita consumption except for crime, chronic illness and land

tenure. The negative correlations between monetary poverty and land tenure, chronic illness and crime are not surprising since monetary poverty rates are higher for the non-deprived than deprived individuals for these indicators. In contrast, for the rest of the indicators, the opposite holds. Similar results exist in the empirical literature (e.g., Bader et al., 2016). Thus, overall multidimensional indicators and monetary indicators are weakly related, suggesting that monetary and multidimensional poverty are distinct constructs (Roelen, 2017).

8.4.5. Patterns of mismatch across individual and household characteristics

This chapter examines the extent of the mismatch and overlap between those identified as monetary poor and those identified as multidimensionally poor across different sub-groups of the population, such as individual and household characteristics, to gain an in-depth understanding of the mismatch patterns. Table 8.5 presents descriptive results based on individual and household characteristics across the poverty categories: monetary poor only (positive mismatch) (*A*); multidimensionally poor only (negative mismatch) (*B*); poor based on both measures (overlap) (*AB*) and the non-poor (*C*). Overall, the results reveal that the left behind are overrepresented in category *B* (multidimensional poor only).

Concerning sex, the results reveal that females have slightly higher poverty levels regardless of the poverty method used. However, the differences concerning poverty mismatches (negative and positive) are very minimal. For example, based on the monetary poverty measure alone, poverty rates for females are only 0.1 percentage points higher than for males. When using the multidimensional poverty measure alone, the difference is only 0.5 percentage points. Poverty overlaps are slightly higher for females at 12.4 per cent compared to 11.6 per cent for males. Age reveals contrasting results concerning the negative mismatch and positive mismatch. Based on the monetary measure alone, age is negatively related to poverty prevalence, with children exhibiting the highest poverty rates of 6.4 per cent compared to 1.4 per cent for older persons. On the other hand, the negative mismatch reveals a positive relationship with age, with older persons exhibiting the highest poverty prevalence of 62.2 per cent compared to 28 per cent for children, based on multidimensional poverty measure alone. However, poverty overlaps reveal mixed results, with older persons exhibiting higher rates followed by children.

Regarding disability status, the results are mixed. Regarding positive mismatch, people with no disability have higher poverty prevalences (4.3%) than PWDs (1.3%) based on the monetary measure alone. However, the opposite is true based on a multidimensional poverty measure alone, with PWDs having a higher negative mismatch at 60.5 per cent compared to 33.5 per cent of those with no disability. Concerning overlaps, the proportions of PWDs are slightly higher (12.8%) than those without disabilities (12%). With respect to citizenship, citizens exhibited the highest poverty mismatch and overlap, meaning citizens have higher poverty levels than non-citizens regardless of the poverty measure used. Poverty overlap for citizens is more than seven times higher than that of non-citizens at 12.8 per cent compared to only 1.6 per cent for citizens and non-citizens, respectively.

Regarding the sex of the household head, the results reveal slightly higher negative and positive mismatches and overlap for female-headed households than for male-headed households. This finding means that no matter which poverty method is used, poverty levels are slightly higher for female-headed households than for male-headed households. It should be noted, however, that the differences are very minimal. For example, based on the monetary measure alone, the difference between positive mismatch for individuals residing in female-headed households and those in male-headed is only 0.6 percentage points. Based on the multidimensional poverty measure alone, those from female-headed households have a slightly higher negative mismatch at 36.8 per cent compared to 31.5 per cent of those in male-headed households.

In terms of household headship, results reveal that based on monetary poverty measure alone, the age of the household head is positively related to positive mismatch. This result means poverty prevalence based on the monetary measure alone increases with an increase in the age of household head, with individuals from households headed by older persons exhibiting the highest rates of 5.2 per cent. In contrast, those from households headed by children recorded no poverty prevalence. A similar trend is observed for poverty overlap. However, based on multidimensional poverty measure alone, results reveal a non-linear relationship between age of household head and negative mismatch. That is, the poverty rate based on the multidimensional poverty measure declines with an increase in household head age, up to a certain point, after which it starts to rise again.

Results are mixed concerning the marital status of the household head. For example, based on the monetary poverty measure alone, individuals from households headed by widows/widowers exhibited the highest positive mismatch levels compared to other households. However, based on the multidimensional poverty measure alone, individuals from households headed by the never-married recorded the highest negative mismatch. In addition, those from households whose heads are separated exhibited the highest poverty overlaps.

Household size positively relates to positive mismatch and overlaps, with larger households exhibiting higher levels than smaller households. Based on the monetary measure alone, household size is positively related to a positive mismatch. Individuals from smaller households with 1 to 3 members recorded 1.1 per cent of positive mismatch compared to 8 per cent for those in larger households with more than seven members. The same trend is observed when using both measures, with larger households exhibiting higher overlaps of 23.7 per cent for larger households compared to only 3.1 per cent for smaller households. However, the results reveal a U-shaped non-linear relationship between household size and negative mismatch when using a multidimensional poverty measure alone. This finding means that at lower levels, an increase in household size reduces negative mismatch to a certain threshold, after which a further increase in household size results in an increase in a negative mismatch.

Overall, poverty rates decline with improvements in the educational attainment of the household head. Based on monetary poverty measure alone, individuals from households whose heads have no educational qualification have the highest positive mismatch of 5.9 per cent compared to 1.5 per cent of those in households whose heads have attained university qualifications. The same trend is observed when using a multidimensional poverty measure alone, with individuals from households whose heads have no educational qualification recording a negative mismatch of 44.5 per cent compared to 8.4 per cent for households headed by persons with a university qualification. A similar trend is observed when using both measures (overlaps). This finding means that regardless of the poverty method used, families headed by individuals with no educational attainment have higher poverty levels.

Regarding the employment status of the household head, the results are mixed. Among the monetary poor only (positive mismatch), households headed by the unemployed have higher levels. In contrast, for negative mismatch and overlaps, households headed by unpaid family helpers have the highest poverty levels. This finding is not surprising since individuals from households headed by unpaid family helpers have higher multidimensional poverty rates than those from households headed by unemployed individuals. This descriptive analysis confirmed that poverty mismatch and overlaps exist between monetary and multidimensional poverty measures and that they differ across different subgroups of the population.

Table 8.5: Poverty mismatch and overlap by individual and household characteristics 2015/16[†]

Subgroup	*A*	*B*	*AB*	*C*	Total
Sex					
Female	4.3	34.5	12.4	48.9	100.0
Male	4.2	34.0	11.6	50.2	100.0
Age					
0 to 17 years (children)	6.4	28.0	13.7	51.9	100.0
18 to 35 years (youth)	4.0	31.5	11.0	53.5	100.0
36 to 64 years (adults)	1.7	41.7	10.1	46.5	100.0
65+ (older persons)	1.4	62.2	14.3	22.1	100.0
Disability status					
Persons with disability (PWD)	1.8	60.5	12.8	24.9	100.0
No disability	4.3	33.5	12.0	50.2	100.0
Citizenship					
Citizen	4.3	34.8	12.4	48.5	100.0
Non-citizen	3.5	16.7	1.6	78.3	100.0
Sex of HH					
Female-headed	4.5	36.8	12.9	45.8	100.0
Male-headed	3.9	31.5	11.1	53.5	100.0
Age of HH					
12-17 (children)	0.0	58.1	0.0	41.9	100.0
18-35 (youth)	3.1	31.8	9.1	56.0	100.0
36-64 (adults)	4.4	32.0	11.3	52.3	100.0
65+ (older persons)	5.2	43.4	17.6	33.8	100.0
Marital status of HH					
Married	4.4	24.0	8.6	63.1	100.0
Living together	3.2	39.2	14.6	43.0	100.0
Separated	2.0	34.8	17.6	45.6	100.0
Divorced	3.7	31.9	6.2	58.2	100.0
Widowed/Widower	5.9	38.6	15.5	40.0	100.0
Never married	4.5	39.3	12.0	44.3	100.0
Household size					
1 to 3 members	1.1	38.7	3.1	57.2	100.0
4 to 6 members	3.7	30.8	10.0	55.5	100.0
More than 7 members	8.0	34.1	23.2	34.7	100.0
Educational attainment of HH					
None	5.9	44.5	23.4	26.2	100.0
Primary	5.1	41.2	13.6	40.2	100.0
Secondary	3.2	32.9	6.7	57.1	100.0
Vocational	5.1	20.5	1.7	72.7	100.0
University	1.5	8.4	0.7	89.5	100.0
Employment status of HH					
Unemployed	5.7	41.0	18.6	34.7	100.0
Paid employment	2.9	21.4	4.7	71.0	100.0
Self-employment	3.0	25.8	3.9	67.3	100.0
Own farm	2.3	48.7	11.1	37.8	100.0
Unpaid family helper	5.3	51.6	18.6	24.6	100.0
Total	**4.3**	**34.2**	**12.0**	**49.5**	**100.0**

Source: Author's estimates based on the 2015/16 BMTHS data.

HH stands for the household head. *A*: monetary poor but not multidimensionally poor; *B*: multidimensionally poor but not monetary poor; *AB*: overlaps; *C*: non-poor.

[†]All percentages are estimated at the population level using sample weights. Sample size: 24,720.

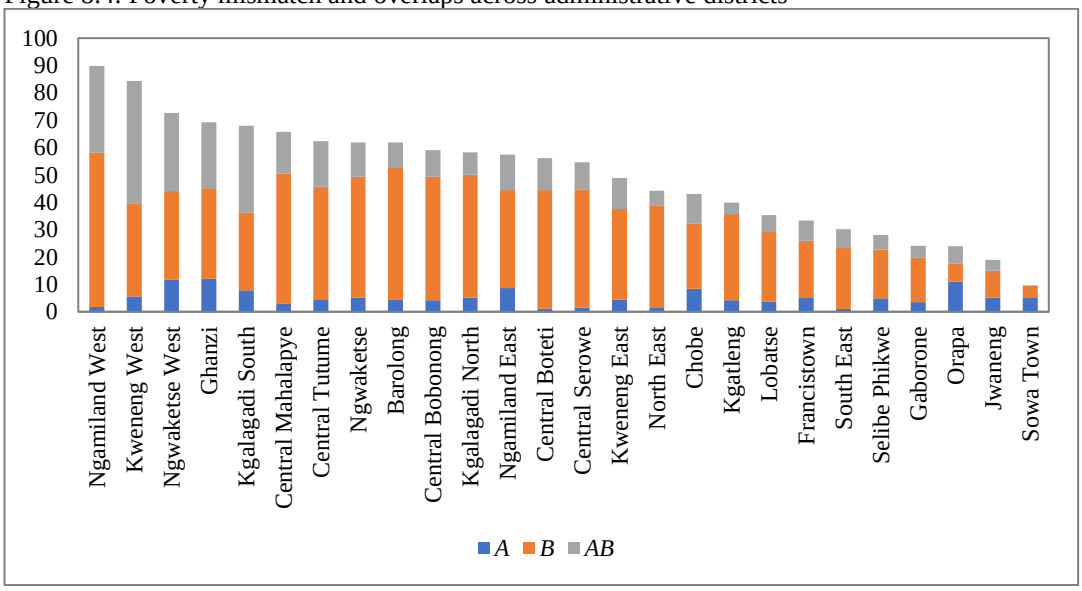
8.4.6. Patterns of mismatch and overlap across districts

The patterns of mismatch and overlap across districts are examined (Figure 8.3). Overall, the results reveal diverse patterns of mismatch and overlap across districts and that most of the poor people are over-represented in the negative mismatch (*B*), implying that most people are multidimensionally poor but not monetary poor. However, in Orapa, the opposite is true, where the positive mismatch is higher than the negative mismatch, implying that many people are considered monetary poor but not multidimensionally poor. The results are not surprising since Orapa is a mining town, and the residents are mostly mining workers and their relatives. Also, most services such as water, electricity, education and health are provided free by the mine, resulting in very low multidimensional poverty prevalence among the residents.

Another interesting observation is that in Kweneng West, where poverty overlaps (*AB*) are higher than both positive (*A*) and negative (*B*) mismatches, meaning the poorest of the poor are found in Kweneng West. The results for Kweneng West are not surprising. Despite its proximity to the city, the Kweneng West district lacks infrastructural development leading to limited employment opportunities. For example, after 50 years since the country gained its independence, the district has no senior secondary school and low access to health facilities. This district has the lowest literacy rate of 75.3 per cent compared to the national average of 88.7 per cent. The unemployment rate is estimated at 24 per cent compared to the national average of 17.6 per cent (SB, 2018). Kgalagadi South also reveal overlaps slightly higher than poverty overlaps.[66] Across strata, rural areas exhibited higher negative poverty mismatch and poverty overlaps (Table A8.2 in appendix). However, the proportions of those identified as monetary poor alone are not statistically different across the three strata, while results based on the multidimensional poverty measure alone reveal significant disparities.

[66] These two districts form part of the Kgalagadi region where poverty levels are higher. Other districts include Kgalagadi North, Ghanzi and Ngwaketse West.

Figure 8.4: Poverty mismatch and overlaps across administrative districts†



Source: Author's estimates based on the 2015/16 BMTHS data. Sample size: 24,720.
A: monetary poor but not multidimensionally poor; *B*: multidimensionally poor but not monetary poor; *AB*: overlaps. †All percentages are estimated at the population level using sample weights.

8.4.7. Factors affecting poverty mismatch and overlap

Table 8.6 reports the estimated multinomial regression results. The reference category is the non-poor category. This category comprises individuals who are neither monetary nor multidimensionally poor. The log-likelihood ratio (*LR*) test is significant, showing that there exists a significant relationship between the dependent variables and the explanatory variables included in the estimated model ($p < 0.001$; $R^2 = 0.1918$) (Hosmer & Lemeshow, 2000; Long & Freese, 2006). The significant result of the *LR* test means that at least one of the regression coefficients in the model is not equal to zero, indicating the overall model is a good fit (Long & Freese, 2006). The interpretation of the results is based on relative probabilities (also called relative odds), obtained by exponentiating the estimated coefficients as $100(e^{\tau} - 1)$, where τ represents the estimated coefficient for the considered independent variable (Giles, 2011; Halvorsen & Palmquist, 1980).[67] For example, concerning the place of residence, living in rural areas is associated with a 100.7, 152.6 and 288.9 per cent relative probability of being in positive mismatch, negative mismatch, and poverty overlap (respectively) than being non-poor compared to living in urban villages.

[67] In interpreting the results, I only discuss the direction of the effects of the considered independent variables and not the magnitudes of such effects.

The econometric results confirm the findings based on descriptive analysis. Overall, the regression model results reveal that age, household size, education status of household head, employment status of household head and location (place of residence) are significant determinants of poverty mismatch and overlap. However, the magnitude of their impacts differs in terms of size and signs. These factors were identified as significant determinants of poverty overlap and mismatch elsewhere in the empirical literature (e.g., Roelen, 2018).

The interpretation of the results is limited to only statistically significant variables across all three models. The relative probability of being in a negative mismatch than being non-poor is higher for males than for females. Age reveals a non-linear U-shaped effect on negative mismatch and poverty overlap, meaning the relative poverty of being in a negative mismatch or poverty overlap than being non-poor declines at lower age levels but increases at higher age levels. People living with disabilities have a higher relative probability of being in negative mismatch than being non-poor compared to those with no disabilities. The relative probability of being in a negative mismatch than being non-poor is higher for citizens than for non-citizens. The same results are observed for poverty overlaps. Household size reveals a non-linear (inverted U-shaped) effect on poverty overlap and negative mismatch, meaning the relative probability of being in a positive mismatch or poverty overlap than being non-poor increases at lower household size levels but declines with an increase in levels of household size. The opposite results are observed for a negative mismatch.

Individuals residing in male-headed households have higher probabilities of being in poverty overlap than being non-poor compared to those in female-headed households. Living in households headed by cohabiting couples or those who never married is associated with higher relative probabilities of being in a positive mismatch than being non-poor compared to living in households headed by married couples. The relative probability of being in a negative mismatch than being non-poor is lower for individuals living in households headed by married couples than for individuals residing in any household type. The relative probability of being in a poverty overlap than being non-poor is higher for individuals whose heads are living together, separated, widowed, or never married than individuals living in households headed by cohabiting couples, married couples.

The relative probability of being in a positive mismatch than being non-poor is higher for individuals residing in households headed by youth than for those in households headed by adults. Results for older persons are mixed. Individuals living in households headed by older persons have lower relative probabilities of being in positive mismatch or poverty overlap than being non-poor compared to those living in households headed by adults. In contrast, the relative probability of being in a negative mismatch than being non-poor is higher for individuals living in households headed by older persons than those headed by adults. The relative probabilities of being in positive mismatch, negative mismatch, or poverty overlap than being non-poor are lower for individuals living in a household with a head having some form of educational attainment than those living in households whose heads have no educational attainment. The magnitude of the impacts increases with increased academic level, with the highest impacts observed for individuals living in households whose heads have a university qualifications.

Concerning the employment status of the household head, Table 8.6 reveals mixed results. Living in a household headed by someone engaged in formal paid employment is associated with lower relative probabilities of being in positive mismatch, negative mismatch or poverty overlap than being non-poor compared to living in a household headed by someone unemployed. The relative probability of being in positive mismatch or poverty overlap than being non-poor is higher for individuals living in a household whose head is engaged in self-employment than individuals in a household headed by someone unemployed. In contrast, the relative probability of being in a negative mismatch than being non-poor is higher for individuals living in a household whose head is engaged in self-employment than individuals living in a household headed by someone unemployed. Living in a household whose head is engaged in their own farm is associated with higher relative probabilities of being in positive mismatch, negative mismatch, or poverty overlap than being non-poor compared to living in a household headed by an unemployed person.

The results reveal that individuals residing in rural areas have higher relative probabilities of being in positive mismatch, negative mismatch or poverty overlap than being non-poor compared to those living in urban villages. The results are mixed for cities and towns. The relative probability of being in a positive mismatch than being non-poor is higher for individuals living in cities and towns than those in urban villages. The same results are

observed for poverty overlap. However, individuals living in cities and towns have lower relative probabilities of being in negative mismatch than being non-poor compared to those in urban villages (Table 8.6).

Table 8.6: Econometric estimations using multinomial logit model[†]

	A		*B*		*AB*	
	Coefficient	Robust SE	Coefficient	Robust SE	Coefficient	Robust SE
Sex (*base: Female*)						
Male	-0.0168	0.0690	0.1159***	0.0337	0.0658	0.0478
Age	0.0118**	0.0053	-0.0374***	0.0025	-0.0351***	0.0035
Age squared	-0.0001	0.0001	0.0004***	0.0000	0.0003***	0.0000
Disability status (*base: Non-disabled*)						
Disabled	0.2200	0.2149	0.3531***	0.0985	0.1373	0.1579
Citizenship status (*base: Non-citizen*)						
Citizen	0.1337	0.2520	0.3407***	0.1151	0.8773***	0.2942
Household size	0.4244***	0.0328	-0.1760***	0.0154	0.2797***	0.0221
Household squared	-0.0114***	0.0017	0.0101***	0.0009	-0.0050***	0.0012
Sex of HH (*base: FHH*)						
Male HH	-0.1251	0.0878	0.0011	0.0407	0.2164***	0.0602
Marital status of HH (*base: Married*)						
Living together	0.2183**	0.1065	0.9984***	0.0500	1.1998***	0.0725
Separated	-0.5025	0.3153	0.7241***	0.1189	1.3984***	0.1543
Divorced	-0.1209	0.2671	0.2387*	0.1249	-0.1066	0.2143
Widowed/widower	0.1973	0.1205	0.2687***	0.0614	0.4193***	0.0889
Never married	0.4517***	0.1061	0.9003***	0.0517	1.0754***	0.0781
Age of HH (*base: 36-64 years*)						
12-17 years (children)	-15.160	2043.0	0.3035	0.3275	-15.204	1285.8
18-35 years (youth)	0.4352***	0.1070	0.0697	0.0473	0.6290	0.0763
Over 65 years (older persons)	-0.3669***	0.0962	0.1546***	0.0493	-0.1470***	0.0650
Education of HH (*base: None*)						
Primary	-0.4521***	0.0863	-0.5071***	0.0451	-0.7672**	0.0590
Secondary	-1.0289***	0.1092	-1.1266***	0.0528	-1.8840***	0.0809
Vocational	-0.8230***	0.2048	-1.6329***	0.1035	-2.7540***	0.2639
University	-1.9970***	0.1711	-2.6784***	0.0797	-4.0037***	0.2136
Employment status of HH (*base: Unemployed*)						
Paid employment	-0.6248***	0.1238	-0.3566***	0.0544	-1.1398***	0.1088
Self-employment	-0.6683***	0.1632	0.2183***	0.0625	-0.4262***	0.0954
Own farm	0.8039***	0.1397	0.8239***	0.0725	0.7912***	0.0944
Strata (*base: Urban villages*)						
Cities and towns	0.5716***	0.0915	-0.4555***	0.0472	0.1356*	0.0793
Rural areas	0.7016***	0.0778	0.9267***	0.0369	1.3582***	0.0530
Constant	-4.5435***	0.3290	0.4251***	0.1503	-3.5015***	0.3252
Number of observations	24,720					
LR chi2	10579.89					
Prob.>chi2	0.0000***					
Pseudo *R*-squared	0.1918					
Log-likelihood	-22293.32					

Source: Author's estimates based on the 2015/16 BMTHS data. [†]Sample size: 24,720. *HH* stands for household head; *FHH* stands for the female-headed household. *A*: monetary poor but not multidimensionally poor; *B*: multidimensionally poor but not monetary poor; *AB*: overlaps. Reference poverty category: Non-poor (*C*). Robust standard errors (SE) clustered at the household level. Significance levels: $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$.

8.5. Summary and conclusions

This chapter compares poverty estimates based on the official monetary poverty measure and the individual-level multidimensional poverty measure for Botswana using the 2015/16 BMTHS dataset to investigate poverty mismatch and overlaps. Also, the chapter investigates factors influencing poverty mismatch and overlaps. Despite overwhelming evidence of poverty mismatches and overlaps, few studies have been carried out in SSA (Klasen, 2000; Levine, 2012; Salecker et al., 2020). This chapter fills this gap and contributes to the literature on poverty mismatch in the SSA context.

The results show that multidimensional poverty levels are higher than monetary poverty levels. The results also reveal a significant mismatch between monetary and multidimensional poverty measures. However, the sizes of the mismatch vary across different subgroups of the populations and the place of residence. These results are consistent with findings in the empirical literature (e.g., Ruggeri-Laderchi, 1997; Klasen, 2000; Baulch & Masset, 2003; Bradshaw & Finch, 2003; Levine, 2012; Sumarto & De Silva, 2014; Roelen, 2017, 2018; Kim, 2019). This finding confirms that monetary and multidimensional measures identify different groups of individuals as poor (e.g., Alkire et al., 2015a; Roelen, 2017, 2018; Salecker et al., 2020). The results reveal limited poverty overlap, with Botswana recording lower poverty overlaps compared to SSA countries, with only 12 per cent of the population identified as poor by both measures. For example, in Uganda's case, 23 per cent of the population was identified as poor by both measures (Levine, 2012), and 23.6 per cent of the individuals were identified as poor by both measures in Rwanda in 2013/14 (Salecker et al., 2020).

Concerning the correlation between monetary and multidimensional poverty measures, results show a positive but weak association. Also, per capita consumption shows a weak association with specific dimensions of deprivation and overall multidimensional poverty measure. Similar evidence appears in the empirical literature (Klasen, 2000; Ruggeri-Laderchi et al., 2003; Alessio et al., 2011; Singh & Sarkar, 2015; Bader et al., 2016; Roelen, 2017, 2018; Ballón et al., 2018).

Following similar studies (Bradshaw & Finch, 2003; Bader et al., 2016; Ballón et al., 2018; Roelen, 2018), this chapter investigated factors influencing poverty mismatches and overlaps and found that individual and household characteristics, as well as regional

socioeconomic disparities, influence poverty mismatch and overlap in Botswana. For example, the relative probability of being in positive mismatch, negative mismatch or poverty overlap than being non-poor is lower for individuals residing in households whose heads have higher educational achievements than those whose heads have no educational qualification. Regarding the place of residence, those living in rural areas have higher relative probabilities of being in positive mismatch, negative mismatch or poverty overlap than being non-poor compared to those in urban villages. This finding is consistent with the empirical literature (Klasen, 2000; Tran et al., 2015; Bader et al., 2016). The findings confirm that the left behind are mostly found in rural areas.

The conclusion that individuals identified as poor by the monetary measure are different from those identified as poor by the multidimensional poverty measure has important policy implications. First, consistent with other findings elsewhere (Roelen, 2017, 2018; Bader et al., 2016; Ballón et al., 2018), this evidence from Botswana suggests that the official monetary poverty measure cannot be used as a proxy for multidimensional poverty measure and vice versa. This finding means that using the official monetary poverty measure alone does not capture the real picture of Botswana's poverty situation. Therefore, there is the need to go beyond traditional monetary poverty measure and complement it with the multidimensional poverty measure to identify those left behind.

Second, the weak correlation between monetary and multidimensional poverty means that targeting social assistance programmes based on monetary poverty alone may not be effective. For example, North East districts recorded the lowest monetary poverty levels (ranking second). However, the North East district recorded higher poverty levels and moved to the eleventh rank when using a multidimensional poverty measure. Therefore, relying on the official poverty measure alone may send inadequate information to policymakers resulting in weak policy designs, which will yield low impacts on poverty eradication.

Third, policymakers should consider the effects of different factors influencing poverty mismatch and overlaps in designing appropriate policies and programmes for poverty eradication. The use of multidimensional poverty indicators to supplement the monetary measure may assist in monitoring the trends and understanding the multifaceted forms of poverty. Therefore, complementing the current official monetary poverty measure with a

country-specific individual-level multidimensional poverty measure would help policymakers better understand the real poverty situation in Botswana and help them put appropriate and specific policy mechanisms in place. Like all poverty measures, this measure relies on several critical assumptions that pose validity and reliability threats to the overall MPI. However, conclusions based on the individual-level MPI are consistent with those of the global MPI and the 2021 Botswana pilot national MPI, suggesting that the results are meaningful and indicative of poverty levels and should be considered by policymakers.

CHAPTER 9: DOES SOCIAL PROTECTION REACH THOSE LEFT BEHIND: EMPIRICAL EVIDENCE FROM BOTSWANA USING MULTIDIMENSIONAL POVERTY APPROACHES

9.1. Introduction

The LNOB principle of the 2030 Agenda of Sustainable Development represents a normative progression towards more inclusive development (Pogge & Sengupta, 2016; Biermann et al., 2017), focusing on the inclusion of marginalised and vulnerable groups (UN, 2015, 2016a). The LNOB is identified as a principle for social protection (Fukuda-Parr & Hegstad, 2018). This is in line with the LNOB principle and the 2030 Agenda for Sustainable Development, where social protection is viewed as having the potential to address simultaneously many drivers of exclusion and deprivation (UNDP, 2016).

Social protection has become an important component of the broader social and economic development worldwide and has been used to respond to poverty and vulnerability in developing countries (Barrientos, 2010; UNDP, 2016). This is evidenced by the substantial increase in social protection programmes in developing countries since the beginning of the 1990s (Dodlova et al., 2018). Social protection has been mainstreamed in the international development policy, especially during the MDG period (Devereux & Sabates-Wheeler, 2004). The prominence of social protection has also been recognised by the 2030 Agenda for Sustainable Development (UN, 2015). The SDG, as specified by SDG 1 (target 1.3), aims at implementing nationally appropriate social protection systems and measures for all, including floors, and by 2030 achieve substantial coverage of the poor and the vulnerable (UN, 2015: p15).[68]

Social protection is defined in several ways by different organisations and countries. In this chapter, the conceptual definition of social protection, as proposed by Devereux and Sabates-Wheeler (2004), is adopted. They define social protection as follows. ‘Social protection describes all public and private initiatives that provide income or consumption transfers to the poor, protect the vulnerable against livelihood risks, and enhance the social status and rights of the marginalised; with the overall objective of reducing the

[68] Social protection is also included in SDG 3, 5, 8 and 10 in the 2030 Agenda for Sustainable Development (UN, 2015).

economic and social vulnerability of poor, vulnerable and marginalised groups' (Devereux & Sabates-Wheeler, 2004: p9).[69] This shows that social protection is concerned with protecting and helping those who are poor, vulnerable, marginalised or dealing with risks (Carter et al., 2019).

The most common social protection tools to address risks of poverty and vulnerability are social assistance, social insurance and active labour market programmes (Hinds, 2014; Browne, 2015; White, 2016; Carter et al., 2019).[70] Social assistance is the primary form of social protection available in most developing countries (World Bank, 2018). They account for the largest expansion of social protection programmes (Bastagli et al., 2016), and the growth has been higher in SSA (World Bank, 2015). For this purpose, this chapter focuses only on social assistance programmes.[71] Social assistance is defined as non-contributory interventions targeted at individuals and households suffering from poverty, destitution, and vulnerability (Barrientos, 2010; White, 2016).[72] Social assistance programmes, especially in developing countries, are designed to contribute to poverty reduction (Dodlova et al., 2018) and as an essential vehicle to address the structural causes of inequality, poverty, and exclusion (UNDP, 2016). These three components are recognised as important dimensions of the 2030 Agenda (UN, 2016a).

An ideal situation would be to implement universal social programmes to reach everyone, especially those left behind. However, due to costs associated with universal programmes (Devereux et al., 2017), most countries, especially developing countries, have opted to target social assistance programmes to only eligible beneficiaries (Besley, 1990). Targeting can be defined as any mechanism for identifying eligible individuals and screening out those who are defined as ineligible for purposes of resource transfers (Sabates-Wheeler et al., 2015; Devereux et al., 2017). Several targeting mechanisms have been put in place to improve 'targeting' to explicitly aim at concentrating the benefits of

[69] This definition is in line with usage in international development and in developing countries.
[70] For a detailed discussion of these components see White (2016).
[71] Social assistance programmes are also referred to as 'social safety nets' ('safety nets'), a term used by the World Bank interchangeably with social assistance (World Bank, 2018). The term 'social assistance' is used throughout this chapter.
[72] Examples include unconditional and conditional cash transfers, non-contributory social pensions, food and other in-kind transfers, school feeding programmes, public works programmes, and fee waivers (World Bank, 2018).

social protection on the poor (Besley, 1990). Considering this, which targeting mechanisms are more effective in combating poverty and inequality is a debatable issue (Besley, 1990; Dutrey, 2007; Marx et al., 2013). Several targeting methodologies are used for classifying individuals or households into eligible or ineligible for social assistance programmes (Devereux et al., 2017).[73] However, whether these different targeting mechanisms effectively achieve their intended beneficiaries remains a key question in the evaluation of these programmes. Currently, there are ongoing debates on specific design elements of the programmes that contribute most to poverty alleviation (Beukes et al., 2017).

This chapter assesses the targeting performance of several social assistance programmes using two criteria: their targeting errors by *implementation* and by *design*, each with two indicators. The targeting error by *implementation* means that the set criteria for identifying and registering eligible beneficiaries are not fully met in practice. Targeting error by *design* (poverty method) means that a programme cannot reach all poor individuals or households, or it reaches some non-poor beneficiaries (Sabates-Wheeler et al., 2015; Devereux et al., 2017). Each of these performance criteria is judged by computing the inclusion error (leakage) and exclusion error (under-coverage) (Cornia & Stewart, 1993; Ravallion, 2008, 2009; Brown et al., 2018).[74]

These two indicators have been widely used in the empirical literature to measure the targeting performance of social transfer programmes (Brown et al., 2018; Devereux et al., 2017; Sabates-Wheeler et al., 2015; Seleka et al., 2007). Inclusion error is defined as the proportion of a programme's beneficiaries who receive social assistance programmes despite not meeting the eligibility criteria and indicates the leakage of the programme (Coady et al., 2004). Exclusion error is defined as the proportion of individuals or households that do not receive social assistance programmes despite meeting the

[73] Six popular targeting mechanisms have been widely used: (1) means testing, (2) proxy means testing, (3) categorical, (4) geographic, (5) community-based, and (6) self-selection (Coady et al., 2004; Barrientos, 2013; Devereux et al., 2017). Other researchers have proposed three broad social transfer mechanisms which have been traditionally employed worldwide to target poor and vulnerable groups: (1) means-tested, (2) categorical; and (3) self-selection (Legovini, 1999; Lavallee et al., 2010; Sabates-Wheeler et al., 2015).

[74] Some authors use the terms inclusion errors/leakages and exclusion errors/under-coverage interchangeable. Errors of inclusion and exclusion can arise at the design stage and/or during implementation (Sabates-Wheeler et al., 2015).

eligibility criteria and represents the under-coverage of a programme (Brown et al., 2018; Cornia & Stewart, 1993; Devereux et al., 2017).[75] For targeting errors by implementation, this chapter uses inclusion and exclusion errors, while for targeting errors by design (poverty method), I use leakage and under-coverage rates. Additionally, the targeting outcomes based on monetary and multidimensional poverty measures are compared.

Building on this existing body of literature, this chapter uses the 2015/16 BMTHS data to investigate the targeting performance of selected social assistance programmes in Botswana and whether they reach those left behind. In doing so, this chapter attempts to answer the following question: *Do social protection programmes reach those left behind*?

For this purpose, this chapter focuses on social assistance programmes in Botswana that aim to tackle poverty and have clear eligibility criteria captured in the dataset. Botswana presents a salient case study. Public policy in Botswana has aimed to address poverty through promoting economic growth and the provision of public infrastructure and social services, and targeted social assistance programmes.[76] Such commitments have been expressed in National Development Plans (NDPs), the 2003 National Strategy for Poverty Reduction (NSPR), Vision 2036 and the BPEPS (MFDP, 2003; Republic of Botswana, 2016; MFED, 2016).[77] Botswana presents a rare case in SSA, having a mature and domestically funded set of social protection programmes. The country devotes about 4.4 per cent of GDP to social protection (World Bank & BIDPA, 2013).

I will show, first, that both exclusion and inclusion error rates are higher in all social assistance programmes except for the Old Age Pension (OAP), meaning most social assistance programmes do not reach most of their targeted beneficiaries. Second, we see that there are high under-coverage rates irrespective of which of the two poverty measures are used. However, concerning leakage rates, there are significant differences between monetary and multidimensional poverty measures, with the latter performing somewhat

[75] Non-take-up of a social assistance programme can be defined as a situation in which someone is eligible for, but does not receive, a (social) benefit (Goedemé & Janssens, 2020). In this case, non-take-up rate is the same as exclusion error rate.

[76] Social assistance programmes are also referred to as 'social safety nets' ('safety nets'), a term used by the World Bank interchangeably with social assistance (World Bank, 2018). The term 'social assistance' is used throughout this chapter.

[77] National Development Plan 11 recognises social protection as a critical driver of social development (MFED, 2016), and social protection is now a vital component of the human and social development pillar of the country's Vision 2036 (Republic of Botswana, 2016).

better in targeting the poor. Therefore, if only monetary poverty measure is used for targeting, one may be tempted to conclude that all social assistance programmes are not pro-poor. The fact that the different targeting mechanisms reveal different results based on both targeting performance by implementation and the poverty method proves that there is no single targeting mechanism that is 'best' for targeting social assistance programmes. This shows that it is crucial to match the targeting mechanism with the objectives of each programme.

This chapter makes several contributions. First, this chapter makes an original contribution by assessing the targeting performance of several social assistance programmes in Botswana by (a) the specific programme eligibility criteria, (b) the monetary poverty indicators, and (c) the multidimensional poverty index, using the rich information from 2015/16 BMTHS. Studies that assessed targeting performance in Botswana employed monetary poverty alone (e.g., Seleka et al., 2007; Seleka & Lekobane, 2020). These studies found that social assistance programmes in Botswana are associated with low coverage of poor households, therefore, limiting their effectiveness in terms of poverty reduction, as they leave many low-income families uncovered (Seleka et al., 2007). This chapter updates earlier findings by other studies (Seleka et al., 2007; Seleka & Lekobane, 2020), thereby contributing to the literature.

Second, this chapter provides the first attempt in Botswana to assess the targeting performance of social protection programmes using multidimensional poverty measures. A few empirical studies have focused on examining whether social protections are effective in targeting the poor (Coady et al., 2004; Coady & Skoufias, 2004; Azevedo & Robles, 2013; Sabates-Wheeler et al., 2015; Devereux et al., 2017). Studies that employed the multidimensional poverty measure for targeting the performance of social assistance programmes are very few (Azevedo & Robles, 2013; Silva-Leander & Merttens, 2016). Last, this chapter contributes to the debate in Botswana on better linking multidimensional poverty and social protection by suggesting ways to combine better and target social assistance programmes.

The rest of the chapter is structured as follows. Section 9.2 presents a brief overview of social protection schemes in Botswana. In Section 9.3, data and methods are discussed.

Section 9.4 presents results and discussions, while Section 9.5 presents a summary and conclusions.

9.2. Evolution of social assistance programmes in Botswana

Social protection in Botswana can be traced back to the country's independence in 1966 with the introduction of programmes including the Vulnerable Group Feeding Programme, Primary School Feeding Programme, food-for-work drought relief programs and feeding programs for permanent destitute persons (BIDPA, 2013; World Bank, 2015). The social protection system experienced expansion between 1970 and 1980 with the establishment of programmes geared towards addressing extreme poverty and unemployment among poor and marginalised communities (MLG, 2002; BIDPA, 2003). These programmes included the Remote Area Development Programme (RADP), the Destitute Persons Programme (DPP) and the Labour-Based Drought Relief Programme (LBDRP) (BIDPA, 2003). Between 1980 and 1990, programmes for human capital development, such as free public primary education, were introduced, and this was extended to public secondary education in 1989 (Seleka, 1999). During the same period (1980-1990), the country introduced agricultural support programmes to improve agricultural incomes and food security. These included the Arable Lands Development Programme (ALDEP) and the Accelerated Rainfed Arable Programme (ARAP) (Seleka, 1999). These two programmes have since been discontinued.

The period 1990-2000 witnessed the introduction of a diversity of social protection programmes aimed at addressing emerging socio-economic challenges. These included in-kind food transfer programmes such as the Community Home Based Care Programme (CHBC) and the Orphan Care Programme (OCP). Also, cash transfer schemes such as the Old Age Pension (OAP) and the World War II Veterans (WWII) geared at improving the welfare of the elderly were introduced (MoH, 1996; MLG, 2002, 2005). The period between 2000 and 2010 witnessed a further expansion in Botswana's social protection system.

Agricultural programmes, including the Livestock Management Infrastructure Development (LIMID) and the Integrated Support Programme for Arable Agriculture Development (ISPAAD) programmes, were introduced to promote poverty reduction for agricultural households (MoA, 2013; MoAFS, 2018). The *Ipelegeng* (self-reliance) public

works programme was launched to replace the Labour-Based Drought Relief Programme and offer temporary employment continuously rather than only upon the declaration of drought (BIDPA, 2010; World Bank & BIDPA, 2013). The period 2000-2010 also witnessed the introduction of Economic Empowerment Schemes targeted at the youth, including the Young Farmers Fund (YFF) and the Youth Development Fund (YDF), aimed at creating jobs and combating youth unemployment (MYESCD, 2017). Table 9.1 presents a summary of selected social assistance programmes, their objectives, associated eligibility criteria and packages/benefits. For a detailed description of these programmes, see World Bank and BIDPA (2013).

Table 9.1: Selected social assistance programmes in Botswana

Program (year introduced)	Objectives	Eligibility Criteria	Packages/Benefits
Destitute Persons Programme (1980)	• To provide welfare support to permanent and temporary destitute persons.	• Monthly income not exceeding P120(P150) for an individual without (with) dependents. • Should own four or less cattle. • Individuals unable to engage in economic activity due to disability. • Children under 18 living under difficult circumstances.	• Prescribed monthly food basket supplying about 1750 calories/day. • Additional food baskets depending on the number of dependents. • Monthly near-cash transfer of P300 ('coupon').
Needy Students Package (Annex to DPP) (1980)	• To ensure that children of destitute persons are in school.	• Children of registered destitute persons under 18 enrolled in primary, secondary, vocational or tertiary schools. • Children of destitute persons aged 18-29 still enrolled in school. • Children from dysfunctional households still in school	• Uniform, street clothes, toiletry, snack pack, touring fees, school fees, hostel/boarding requirements, development fees, sports fees, accommodation support. (see MLG, 2002).
Community Home Based Care (1995)	• To ensure the optimum level of care for patients with chronic illness.	• Uses criteria for the Destitute Persons Programme. • Patients suffering from AIDS, diabetes, hypertension and heart diseases.	• Prescribed CHBC monthly food baskets • Special food basket as prescribed by a government dietician.
Livestock Management and Infrastructure Development (2006)	• Promote food security and eliminate destitution.	• Individuals aged 18 and above meeting the criteria for the Destitute Persons Programme.	• Grant not exceeding P12,000 for investment in goats/sheep, guinea fowl or Tswana chicken production.
Poverty Eradication Programme (2008)	• To promote productive investment and eradicate absolute poverty.	• Able-bodies individuals registered in the Destitute Persons Programme aged 18 years and above. • Potential destitute persons • People Living with disability • Ipelegeng beneficiaries.	• Grants not exceeding P15,000 for investment in any of the 45 prescribed enterprises; or a viable enterprise proposed by the beneficiary.

Remote Area Development Programme (1978)	• Improve livelihoods of remote area communities.	• A community with a population not exceeding 250 people or 50 households. • Community should be located at least 15 kilometres from a recognised settlement.	• Community-based income-generating projects. • Access to other social transfer programs at the individual level.
School Feeding Programmes (1966)	• Reduce hunger and malnutrition • Improve cognition and learning	• All children attending public primary and secondary schools.	• One (two) meals/day to non-borders (boarders) at secondary schools
Vulnerable Group Feeding Programme (1966)	• To improve health and nutrition.	• Children under five, medically selected pregnant and lactating mothers and TB and leprosy patients attending clinics.	• Prescribed monthly food baskets provided through health facilities.
Old Age Pension (1996)	• To provide welfare support to the elderly	• All citizens aged 65 and above in possession of a national identity card.	• Monthly cash transfer of P530.
World War II Veterans Programme (1998)	• To provide welfare support to World War II veterans and families.	• World War II veterans. • Alternatively, surviving spouse or children under 21.	• Monthly cash transfer of P550.
Orphan Care Programme (1999)	• To provide protection and care to orphans	• Any child under 18 who has lost one single parent or two married parents.	• A monthly food basket • Clothing and school uniform. • Psycho-social support
Scholarships and sponsorships	• Improve human capabilities in education	• Scholarships are provided to students studying abroad	• Cover costs related to tuition, books, equipment, medical costs, insurance and allowance (part loan, part grant).
Youth Development Fund (2009)	• To create sustainable employment opportunities for young people through the development of sustainable projects.	• Unemployed youth aged 18-35.	• Start-up capital not exceeding P100,000 to individuals (50% loan, 50% grant). • Start-up capital not exceeding P450,000 to youth cooperatives (50% grant, 50% loan).

Ipelegeng (2008)	• To provide temporary employment and income support to unemployed, underemployed and vulnerable citizens.	• Citizens aged 18 and above.	• Temporary employment for a continuous period, not exceeding six months, six hours/day, five days a week. • Monthly wage of P567 for labourer and P651 for supervisor. • Meal allowance of P8.00/day.

Source: Seleka et al. (2007); BIDPA (2013); World Bank and BIDPA (2013); World Bank (2015); MLG (2002, 2005); MoH (1996); Seleka and Lekobane (2020).

9.3. Data and methodology

9.3.1. Data sources

This chapter uses the 2015/16 BMTHS data collected by Statistics Botswana (SB) to assess the targeting performance of these programmes. The dataset contains information from 24,720 individuals from 7,060 households surveyed in 2015/16. After applying sample weight, the survey translates to an estimated 589,909 households and a national population of 2,073,675 individuals (SB, 2018), which is comparable to the 2016 projected population of 2,219,736 (SB, 2015). The 2015/16 BMTHS data is a nationally representative cross-sectional dataset containing socio-economic information on a variety of modules. The chapter relied heavily on topical module 8, capturing information on social protection. The module did not include information on all social assistance programmes. Therefore, due to data limitations, only seven programmes with information on eligibility criteria are included. The selected programmes are also aimed at poverty eradication except for two programmes which are universal categorical programmes. The seven programmes include orphan care programme (OCP), destitute persons programme (DPP), needy student package (NSP), community home-based care (CHBC), livestock management and infrastructure development programme (LIMID), poverty eradication programme (PEP) and old age pension (OAP).

9.3.2. Measures of targeting performance and poverty

Most social assistance programmes in Botswana explicitly aim to reach the poorest members of society. Therefore, the effectiveness of a targeting mechanism to reach the poor is how accurately it identifies poor people (Sabates-Wheeler et al., 2015). This chapter examines the measure of targeting performance of social assistance programmes in two aspects: targeting errors by *implementation* and targeting performance by *design*, measured according to two poverty measurement methods: the monetary and the multidimensional poverty measures.

9.3.2.1. Measures of targeting performance by implementation

In this sub-section, this chapter assesses the targeting performance of selected social assistance programmes on whether they reach their intended beneficiaries (eligible groups) (see Devereux et al., 2017). If a large proportion of programme beneficiaries are those eligible based on the set criteria, then the programme is well-targeted. The inclusion and exclusion error rates are calculated for each social assistance programme. To achieve

this, first, the eligibility criterion for different programmes is derived. The 2015/16 BMTHS dataset did not have all the information to compute eligibility criteria for some programmes. Also, except for OAP and OCP, the selected programmes are aimed at the poor (social assistance programmes).

To derive the eligibility criterion for each social protection programme, the following notations are adopted. Let E_i^j denotes eligibility for individual *i* participating in programme *j* such that when $E_i^j = 1$ then individual *i* is eligible to participate in programme *j*, and when $E_i^j = 0$ individual *i* is not eligible to participate in programme *j*.

For the individual *i* to be eligible to participate in DPP, they need to be residing in a household owning less than four (4) livestock units and earning a monthly cash income of less than BWP150.00 with dependents or BWP120.00 without dependents (MLG, 2002). Algebraically this is expressed as: $E_i^j = 1;$ if $i \in H[(C + 0.25G + 0.25S \leq 4)\ \&\ (Y \leq 150)]$ and $E_i^j = 0$ otherwise; *C*, *G*, *S* represent the number of cattle, goats and sheep, respectively, owned by the household; *Y* represent household income (see Seleka & Lekobane, 2020).[78] The statement $i \in H[\cdot]$ means individual *i* belongs to household *H*, which meets the eligibility criteria expressed in the parentheses. This eligibility criterion also applies to PEP and LIMID programmes. However, for PEP, the income threshold is set at BWP366.00.[79] PEP and LIMID apply to those aged 18 and above, meeting the DPP requirements. Therefore, the eligibility criterion is expressed as follows: $E_i^j = 1;$ if $i(A \geq 18) \in H[(C + 0.25G + 0.25S \leq 4\ \&\ Y \leq 366)]$ and $E_i^j = 0$ otherwise; *C*, *G*, *S* represent the number of cattle, goats and sheep, respectively, owned by the household; *Y* represent household income; *A* represents the age of individual *i*.

NSP is targeted at school-going children residing in DPP households. It, therefore, uses the DPP criterion except that it only includes children. The eligible criterion is expressed as: $E_i^j = 1;$ if $i(A \leq 17\ \&\ SCH = 1) \in H[(C + 0.25G + 0.25S \leq 4\ \&\ Y \leq 150)]$ and $E_i^j = 0$ otherwise; *C*, *G*, *S* represent the number of cattle, goats and sheep, respectively,

[78] One cow is equivalent to four goats or four sheep, hence the ratio 0.25 for sheep and goats. For households without dependents, *Y* is set at BWP120.00. In that case the equation becomes: $E_i^j = 1;$ if $i \in H[(C + 0.25G + 0.25S \leq 4)\ \&\ (Y \leq 120)]$.

[79] BWP120.00 is equivalent to US$10.00

owned by the household; *Y* represent household income; *A* represents child age, and $SCH = 1$ represents school-going children. The statement $i(\cdot) \in H[\cdot]$ describes the characteristics of individual *i* eligible for NSP and belonging to household *H*, meeting the eligibility criteria for DPP.

The CHBC programme was initially targeted at terminally ill AIDS patients (MoH, 1996; MLG, 2005) but has since been extended to other chronic illnesses such as diabetes, hypertension and heart diseases. The programme covers chronically ill patients in DPP households. To derive the eligibility criterion for CHBC, the DPP criterion and an individual's health status are used to capture chronically ill patients. Algebraically, $E_i^j = 1;$ if $i(CI = 1) \in H[(C + 0.25G + 0.25S \leq 4 \,\&\, Y \leq 150)]$ and $E_i^j = 0$ otherwise; *C*, *G*, *S* and *Y* represent cattle, sheep, goats and household income, respectively; $CI = 1$ represents chronic illness of individual *i*. The statement $i(\cdot) \in H[\cdot]$ means that a chronically ill patient *i* belongs to a household eligible for DPP.

The OCP is aimed at providing protection and care to orphans under the age of 18 (Seleka et al., 2007). Thus, the programme employs categorical targeting based on age and vulnerability. The eligibility criterion is derived as follows: $(E_i^j = 1;$ if $i[(A \leq 17 \,\&\, PD = 2)]$ and $E_i^j = 0$ otherwise; *A* represents the age of child *i*, and $PD = 2$ means all biological parents of child *i* are deceased or if single parent, the mother is deceased and the fathers' whereabouts are unknown (single-orphans).

With respect to OAP, to be eligible, one needs to be 65 years or above and in possession of a valid national identity card to prove their age and citizenship. To benefit from OAP, if one meets the requirement, they should register with the relevant office. To derive this, let $(E_i^j = 1;$ if $i[(A \geq 65 \,\&\, ID = 1)|(REG = 1)]$ and $E_i^j = 0$ otherwise; *A* represents age; *ID* represents national identity card, and *REG* is for registration into the programme. If an individual meets the age requirement of OAP and has an identity card but is not registered, they do not benefit from OAP.

After deriving eligibility criteria for programmes under review, the population is classified into whether they are eligible $(E_i^j = 1)$ or not $(E_i^j = 0)$. Further individuals are

classified into whether they benefit from programme *j*, denoted by ($B_i^j = 1$) or do not benefit ($B_i^j = 0$), to calculate the targeting indicators and errors of implementation.

The first indicator of targeting performance is the inclusion error rate (IER), capturing the proportion of non-eligible individuals who are benefiting from programme *j*, expressed as:

$$IER_j = \frac{\sum_{i=1}^{n} I\left(B_i^j = 1 | E_i^j = 0\right)}{\sum_{i=1}^{n} I\left(B_i^j = 1\right)} \tag{9.1}$$

When $IER_j = 1$, only non-eligible individuals benefit, and all eligible individuals are excluded from programme *j*, meaning everyone who is benefiting does not meet the set eligibility criteria.

The second indicator of targeting performance is the exclusion error rate (EER), capturing the proportion of eligible individuals who are not benefiting from programme *j* to the total eligible individuals expressed as:

$$EER_j = \frac{\sum_{i=1}^{n} I\left(B_i^j = 0 | E_i^j = 1\right)}{\sum_{i=1}^{n} I\left(E_i^j = 1\right)} \tag{9.2}$$

When $EER_j = 1$, this means all eligible individuals are excluded from the programme *j*.

9.3.2.2. Measures of targeting performance by design and poverty method

Given that most of the social assistance programmes' main aim is to reach the poor to reduce poverty, this chapter also assesses the impact of poverty measures on the performance of selected programmes. To achieve this, the analysis is replicated to assess their targeting performance using both the monetary and multidimensional poverty measures. For each programme and using both poverty methods, *leakage* and *under-coverage* rates are used (replacing inclusion and exclusion error rates used in targeting by implementation).

First, the monetary poverty measure is used by adopting the Botswana official monetary poverty measure. Specifically, I use the headcount count ratio (P_0), which gives the poverty prevalence. Second, the individual-level multidimensional poverty measure constructed in Chapter 5 of the thesis is employed. Specifically, the multidimensional headcount ratio (H) is used to capture the prevalence of poverty. To calculate the targeting indicators, eligibility criterion E is replaced by c_i in the case of multidimensional poverty and z_i for monetary poverty in equations 9.1 and 9.2. For example, the statement $E_i^j = 1$, is replaced with $c_i \geq k$ in the case of the multidimensional poverty measure and with $y_i < z_i$ for monetary poverty measure to calculate *leakage* and *under-coverage* rates.

9.4. Results and discussions

9.4.1. Do social assistance programmes reach their intended beneficiaries?

One of the debates concerning the social assistance programmes in Botswana is whether they are effective in reaching their intended beneficiaries. That is, are those meeting the set pre-defined eligibility criteria benefiting as expected. To answer this question, the targeting performance by implementation of each selected social assistance programme is assessed by decomposing the analysis into exclusion and inclusion error rates. Below, the results for each programme are presented and discussed.

9.4.1.1. Destitute persons programme

The Destitute Persons Programme (DPP) started in 1980. This programme is intended "to ensure that government provides minimum assistance to genuine destitute persons to ensure their good health and welfare" (MLG, 2002: p2). A near-cash component has been added, and the value is now P500/month in food and P300/month in the form of a "coupon" to be spent in local grocery stores. The programme also has provisions for shelter, medical care, occasional fares, funeral expenses, exemption from levies, taxes, school fees and water charges, and tools for rehabilitation projects. Each adult (aged 18 years and above) is individually assessed for eligibility through means-testing.

To calculate the number of destitute persons, households are subdivided into two groups: Those with dependents and those with no dependents. Households with dependents owning less than four cattle and earning less than BWP150.00 were categorised as eligible for DPP. Also, households with no dependents but earning less than BWP120.00 and

owning less than four cattle were categorised as eligible for DPP. Therefore, individuals from these households were considered eligible for DPP, resulting in an estimated 768,309 eligible beneficiaries.

Table 9.2 presents the results of DPP targeting performance by implementation. The programme is associated with a high exclusion error rate of 91.8 per cent, meaning that the majority of eligible beneficiaries do benefit from this programme. The high non-take-up rates may be associated with administrative issues such as implementation and design issues associated with means-tested programmes. For example, social workers responsible for assessing and registering eligible beneficiaries cannot reach all eligible beneficiaries. Also, they are unable to complete all the assessments on time because they are also expected to undertake other socio-psychological roles for vulnerable groups of the population (Seleka et al., 2007). Additionally, the programme income thresholds have not been updated in years and today represent only one-third of the minimum wage in agriculture and less than 20% of the food poverty line. This may be contributing to the low coverage of the programme and its high exclusion errors (World Bank & BIDPA, 2013). Also, the poor performance of DPP could be attributed to budgetary constraints. This finding is consistent with the non-take-up literature (e.g., Corden, 1995; van Oorschot, 1991, 1998).

Regarding inclusion error rates, DPP included 40.7 per cent of individuals not meeting eligibility criteria. While the DPP eligibility criteria are clear, the criteria are not applied in practice because the thresholds are considered outdated and most likely also because of the difficulty in verifying self-reported information (World Bank & BIDPA, 2013). In addition, there are situations where applicants do not declare all their assets, making assessment difficult. Thus, it is possible to register ineligible individuals in the programme (BIDPA, 2010, 2014). Also, the target groups are not clearly defined. For example, the DPP may include the elderly who cannot work and able-bodied persons who were “victims of an accident such as a train crash, plane crash, and motor vehicle accident or a natural disaster, ill health, or the death of the breadwinner.” (MLG, 2002: p6-7). This makes targeting eligible beneficiaries difficult.

Table 9.2: Errors associated with DPP†

	Eligible	Non-eligible	Total
Recipient	62,665	43,082	105,747
Non-recipient	705,644	1,262,284	1,967,928
Total	768,309	1,305,366	2,075,675
	Errors		
	EER	*IER*	
Per cent	91.8	40.7	

Source: Author's estimates based on the 2015/16 BMTHS data.
EER: Exclusion error rate; *IER*: Inclusion error rate. Sample size: 15,002.
†All percentages are estimated at the population level using sample weights.

9.4.1.2. Needy student package

The Needy Student Package (NSP) is not a stand-alone programme. Packages under this programme are provided as part of the destitute programme. The NSP provides uniforms, toiletries, transport fees, and psycho-social support to school-going children of DPP households (MLG, 2010b).[80] The NSP also includes graduated orphans (over 18 years) who are still attending school, up to a maximum age of 29 years. Packages under this programme are provided as part of the destitute programme. The school enrolment and age variables are used to calculate the number of NSP eligible beneficiaries. In addition, the parental survival variable is used to capture eligible orphans aged between 18 and 29 and who are attending school to get the total NSP eligible beneficiaries. Based on this, the estimated eligible NSP beneficiaries are 380,060.

Table 9.3 presents the results. Like DPP, NSP is associated with higher exclusion error rates, recording 91.9 per cent. The NSP reaches only 9.1 per cent of its intended beneficiaries. Several reasons could be attributed to this poor performance by NSP. The NSP uses the DPP policy, which is old, and the income threshold is low, resulting in high exclusion error rates. The exclusion of children, especially those from poor families, may contribute to the intergenerational poverty outcomes in such families. Inclusion error rates are estimated at 43.2 per cent.

[80] However, schooling children from DPP households who turn 18 will continue to receive similar benefits until they are 29 years of age. Children from RADP households are also included and they receive special dispensation to access tertiary education and exemption from paying school fees in basic education institutions.

Table 9.3: Errors associated with NSP†

	Eligible	Non-eligible	Total
Recipient	30,907	23,478	54,385
Non-recipient	349,153	444,114	793,267
Total	380,060	467,592	847,652
	Errors		
	EER	*IER*	
Per cent	91.9	43.2	

Source: Author's estimates based on the 2015/16 BMTHS data.
EER: Exclusion error rate; *IER*: Inclusion error rate. Sample size: 9,718.
†All percentages are estimated at the population level using sample weights.

9.4.1.3. Community home-based care programme

The Community Home Based Care (CHBC) programme started in 1995. It was initially intended to provide HIV infected persons with fully blown AIDS with nutrition and care at home until they passed on (MLG, 2005, 2010a).[81] However, it has now been changed to cover individuals with other chronic illnesses, such as diabetes and cardiovascular conditions, who require special diets and are unable to provide for themselves (World Bank & BIDPA, 2013). The programme provides food baskets, counselling, and transport for medical check-ups. Beneficiaries are referred to the programme by the health services and are means-tested using the same criteria as the DPP. Benefits include monthly food baskets ranging from P500-P1200 (World Bank & BIDPA, 2013).

In this chapter, I follow Statistics Botswana and consider only patients with HIV/AIDS, tuberculosis, anaemia, cancer, and malaria (SB, 2018) to derive the number of chronically ill patients. After identifying the chronically ill patients, the next step was to select only those belonging to DPP households as eligible CHBC beneficiaries. All other remaining chronically patients were excluded from eligible beneficiaries and categorised as non-eligible. A total of 353,017 were identified as chronically ill patients. Out of these, 130,280 belonged to DPP households (eligible beneficiaries).

Table 9.4 presents the results. The CHBC programme performed poorly in reaching its targeted beneficiaries. The exclusion error rate is estimated at 99.4 per cent, meaning it reaches only 0.6 per cent of its intended beneficiaries. The lack of policy documents could cause the poor performance of CHBC to guide implementation, resulting in high errors of exclusion (Seleka et al., 2007; World Bank & BIDPA, 2013). Instead, the destitution

[81] The programme was started before the advent of the Anti Retroviral (ARV) drug programme roll-out, when there was little hope for the possibity of individuals with fully blown AIDS to recover and return to normal life.

policy is used to assess potential beneficiaries for the CHBC programme. Given the low-income threshold used for means-testing under the destitution programme, many individuals who genuinely need assistance under the CHBC programme are not enrolled (World Bank & BIDPA, 2013). Also, the DPP low-income threshold disqualifies most chronically ill patients who may be in greater need of assistance. Regarding inclusion error rates, CHBC recorded 45.4 per cent.

Table 9.4: Errors associated with CHBC†

	Eligible	Non-eligible	Total
Recipient	838	698	1,536
Non-recipient	129,442	222,039	351,481
Total	130,280	222,737	353,017
	Errors		
	EER	*IER*	
Per cent	99.4	45.4	

Source: Author's estimates based on the 2015/16 BMTHS data.
EER: Exclusion error rate; *IER*: Inclusion error rate. Sample size: 4,328.
†All percentages are estimated at the population level using sample weights.

9.4.1.4. Poverty eradication programme

Poverty Eradication Programme (PEP) started in 2008 and targets poor individuals and uses similar eligibility requirements as DPP. The PEP aims at eliminating extreme poverty by, among other things, capitalising on poor households and helping them to develop sustainable livelihoods (World Bank & BIDPA, 2013). The Poverty Unit in the Office of the President coordinates this programme. However, different ministries implement different components of PEP. The DPP criterion is used for PEP eligible beneficiaries but considers only individuals aged 18 and above from DPP households. The income threshold is set at BWP366.00. The number of eligible beneficiaries is estimated at 287,362.

Table 9.5 presents the results. The programme is associated with higher exclusion error rates of 97 per cent, meaning the majority of eligible beneficiaries do not benefit from PEP. Administrative and implementation issues contribute to the high non-take-up rates. In addition, the poor performance of PEP may be due to the fragmentation of its components, which are coordinated and implemented by different ministries. PEP does not have a policy and instead uses the destitution policy to assess potential beneficiaries. These findings are in line with the non-take-up literature (van Oorschot, 1998). Like all other programmes using the DPP policy, the low-income threshold used for means testing

results in many individuals who genuinely need assistance under the PEP programme being left out (World Bank & BIDPA, 2013). The PEP is associated with inclusion error rates of 44.7 per cent. The target groups of PEP are not clearly defined. For example, the PEP may include non-disabled individuals working in the Ipelegeng public works programme who may not necessarily be from DPP households (BIDPA, 2014). Also, the lack of policy or guidelines makes implementation problematic.

Table 9.5: Errors associated with PEP†

	Eligible	Non-eligible	Total
Recipient	9,338	11,940	21,277
Non-recipient	278,024	956,531	1,234,554
Total	287,362	968,471	1,255,831
	Errors		
	EER	*IER*	
Per cent	96.8	56.1	

Source: Author's estimates based on the 2015/16 BMTHS data.
EER: Exclusion error rate; *IER*: Inclusion error rate. Sample size: 15,002.
†All percentages are estimated at the population level using sample weights.

9.4.1.5. Livestock management infrastructure development programme

The Livestock Management Infrastructure Development Programme (LIMID) was introduced in 2007. The main objectives of LIMID are to (i) promote improved food security through increases in livestock production; (ii) improve livestock management practices; (ii) enhance sustainable utilisation and conservation of range resources; (iv) provide economic resources to the poor to eliminate destitution; and (v) provide infrastructure to promote hygienic and safe processing of poultry products (TRANSTEC & BIDPA, 2010). This programme comprises four packages (small stock, beekeeping, poultry and backyard gardening). These are targeted at resource-poor farmers who own no more than four cattle or 20 goats/sheep or for individuals earning no more than P150/month with dependents or P120/month without dependents. LIMID is part of the PEP, managed by the ministry of agriculture and food security (MoAFS). Benefits include small stock, guinea fowls and Tswana chickens for resource-poor farmers.

LIMID eligibility guidelines are similar to DPP guidelines. Individuals aged 18 and above residing in DPP households are considered in calculating LIMID eligible beneficiaries. This resulted in 287,362 eligible beneficiaries. Table 9.6 reveals that LIMID has high exclusion error rates, implying that it does not reach most targeted beneficiaries. The poor performance of LIMID is not surprising. Like PEP, LIMID does not have a policy and

instead uses the destitution policy to assess potential beneficiaries (World Bank & BIDPA, 2013). This has resulted in implementation issues. For example, this programme targets DPP beneficiaries whose programme is coordinated by a different ministry.

To improve the performance of this programme, PEP and DPP should be coordinated from the same ministry since they use similar guidelines. This will reduce administrative costs and address issues of implementation and coordination. Also, there are instances where it takes a long time to give the package to beneficiaries due to a lack of resources to buy the packages despite approvals (BIDPA, 2014). These results are consistent with the non-take-up theory, where administrative issues, including imprecise eligibility criteria, leads to higher probabilities of non-take-up occurrence (van Oorschot, 1998). LIMID has high inclusion error rates, suggesting that most of those beneficiaries are not eligible. Due to a lack of policy, there may be cases where individuals being assessed do not disclose all their assets to qualify for LIMID packages (BIDPA, 2014), resulting in high inclusion error rates.

Table 9.6: Errors associated with LIMID†

	Eligible	Non-eligible	Total
Recipient	3,821	12,389	16,210
Non-recipient	283,541	956,082	1,239,623
Total	287,362	968,471	1,255,833
	Errors		
	EER	*IER*	
Per cent	98.7	76.4	

Source: Author's estimates based on the 2015/16 BMTHS data.
EER: Exclusion error rate; *IER*: Inclusion error rate. Sample size: 15,002.
†All percentages are estimated at the population level using sample weights.

9.4.1.6. Orphan care programme

The Orphan Care Programme (OCP) was introduced in 1999 and is targeted children under the age of 18 years who have lost both parents (married parents) or one parent (single parents). This is a narrow definition of orphans, often used to determine eligibility for social assistance programmes in many countries (World Bank & BIDPA, 2013). However, this official definition contrasts with the international definition in which an orphan is defined as a child who has lost *one or both* parents. This programme provides food baskets, clothing, education support, shelter, and protection and care to the children to ensure that they remain in school, get adequate nutrition, and overcome trauma associated with the loss of parent(s) (Seleka et al., 2007; MFDP, 2010; MLG, 2010a,

2010b). The OCP is not means-tested and is open to all families who apply. The age and parental survival variables are used to calculate the number of orphans. All children aged 0 to 17 years who have lost both parents (married parents) or one parent (single parents) were included in the calculations, resulting in 16,063 eligible children.

The OCP programme is performing poorly in terms of targeting eligible orphans (Table 9.7). The exclusion error rates are estimated at 47.8 per cent, meaning the programme reaches 52.2 per cent of orphans. This implies that almost half of the orphan children are not benefitting from OCP. Both administration and individual issues play a role in the non-take-up of this programme. For example, the definition of an orphan may be interpreted differently by implementers, thus making implementation problematic. Furthermore, enrolment into OCP is sometimes tricky because some children do not have birth certificates required for registration, resulting in many eligible orphans being excluded (BIDPA, 2014). Also, social workers have many responsibilities, including caring for elders, support for destitute families and victims of domestic violence, and community development and administration, causing delays in the proper registration of eligible orphans (BIDPA, 2010, 2014). Concerning individual issues, some families may choose not to register orphans, especially if the relatives are well-off and willing to take care of the children. These issues are well captured by the non-take-up theory (see van Oorschot, 1991, 1998).

The OCP is associated with high inclusion error rates, reaching 83.3 per cent, implying many non-orphans are benefitting. The higher inclusion error rate is partly due to the definition of an orphan in the policy (Seleka et al., 2007; World Bank, 2015), where an orphan is defined as someone who has lost one single parent (in the case where the whereabouts of the surviving father is unknown). This poses a challenge for implementation since social workers are faced with challenges in registering orphans. The high inclusion error rate could also be attributed to the programme's limited resources, such as the unavailability of transport hindering proper monitoring of OCP, resulting in non-deserving children being included in the programme (BIDPA, 2010). Also, in cases where the father is known and is even paying child maintenance through District Commissioner's office (Seleka et al., 2007), this information is sometimes not provided to social workers when registering orphans, resulting in many children from single families being registered.

Table 9.7: Errors associated with OCP†

	Eligible	Non-eligible	Total
Recipient	8,379	41,781	50,160
Non-recipient	7,684	759,998	767,682
Total	16,063	801,779	817,842
	Errors		
	EER	*IER*	
Per cent	47.8	83.3	

Source: Author's estimates based on the 2015/16 BMTHS data.
EER: Exclusion error rate; *IER*: Inclusion error rate. Sample size: 9,718.
†All percentages are estimated at the population level using sample weights.

9.4.1.7. Old age pension programme

The Old Age Pension (OAP) started in 1966 and is a universal programme for all citizens over 65 years. The OAP provides a monthly cash benefit of P530 to each eligible pensioner, which is not intended to meet all the pensioner's basic needs (Seleka et al., 2007; MFDP, 2010). To be eligible to benefit from OAP, one needs to be 65 years or above and in possession of a national identity card (ID) to prove their age and citizenship. The age and citizenship status variables are used to calculate OAP eligible beneficiaries. The number of citizens aged 65 and above who are considered eligible for OAP is estimated to be 110,780 in 2015/16.

Table 9.8 presents the results. Exclusion error rates for OAP are relatively low, estimated at 11 per cent, meaning OAP reaches 89 per cent of older persons. This exclusion error may be due to the unregistered beneficiaries. OAP had no inclusion error, meaning all the recipients are all citizens aged 65 years and above. The low non-take-up rates for OAP are mainly attributed to the design and popularity of the programme. Most people are aware of the OAP programme, and registering for OAP is very easy, requiring a national ID card for proof of age and citizenship. This finding is consistent with findings in the literature that social pensions generally perform better in reaching older persons in developing countries (Devereux et al., 2017). In addition, universal, targeted programmes such as OAP are associated with low non-take-up rates (see van Oorschot, 1991, 1998).

Table 9.8: Errors associated with OAP†

	Eligible	Non-eligible	Total
Recipient	98,623	0	98,623
Non-recipient	12,157	0	12,157
Total	110,780	0	110,780
	Errors		
	EER	*IER*	
Per cent	11.0	0.0	

Source: Author's estimates based on the 2015/16 BMTHS data.
EER: Exclusion error rate; *IER*: Inclusion error rate. Sample size: 1,397.
†All percentages are estimated at the population level using sample weights.

In sum, all social assistance programmes except for OAP are associated with higher exclusion and inclusion error rates. These results are consistent with other empirical studies in Botswana (Seleka et al., 2007; World Bank & BIDPA, 2013; Seleka & Lekobane, 2020). The higher exclusion error rates imply that most of the eligible beneficiaries do not take up social assistance programmes, and this, in turn, may distort their efficacy and efficiency, resulting in most of the programmes not being successful in achieving their intended objectives, especially that of poverty alleviation (Bargain et al., 2012; Fuchs et al., 2020). The large inclusion error rates could be caused by the political interference from community leaders such as village development committee (VDC) members and local councillors on who should be included, resulting in the inclusion of non-eligible beneficiaries (Seleka et al., 2007; BIDPA, 2010, 2014). The poor targeting performance by implementation, especially with regard to high exclusion error rates (low coverage rates), is primarily due to limited resources. The Botswana government spent only 1.56 per cent of GDP on social assistance programmes (World Bank & BIDPA, 2013). This figure is comparable with the average of 1.5 per cent of GDP for SSA (World Bank, 2018). Also, the implementation, coordination and capacity constraints are some of the key issues for the poor performance of most of the social assistance programmes in Botswana (Seleka et al., 2007; World Bank & BIDPA, 2013).

9.4.2. Do social assistance programmes reach the poor?

To assess whether these seven social assistance programmes reach those left behind, both monetary (P_0) and multidimensional poverty measures (H) are utilised to generate leakage and under-coverage rates. Table 9.9 presents the results. Under-coverage rates are incredibly high across both monetary and multidimensional poverty measures. The under-coverage rates are comparable across the two poverty measures, as shown by the ratio of monetary to multidimensional poverty coverage rates (ratio=1). The under-

coverage rates are slightly higher for DPP, NSP and OCP (slightly more than 1), meaning that monetary poverty recorded slightly higher under-coverage rates among these three programmes. The rankings of programmes remain unchanged for under-coverage rates, with OAP performing better while CHBC is the worst performer ranking last.

Concerning leakage rates, there exist significant differences between monetary and multidimensional poverty measures. In particular, all social assistance programmes performed better when assessed with the multidimensional poverty measure, recording much lower leakage rates than those under monetary poverty. For example, the leakage rate for DPP is more than four times higher for monetary poverty than for multidimensional poverty. On the other hand, except for LIMID, all programmes recorded more than twice higher leakage rates for monetary poverty than for the multidimensional poverty measure. Also, the rankings of programmes based on leakage rates vary across the two poverty methods.

Generally, even though most of the social assistance programmes reviewed in this chapter aim to reach the poor, they display high under-coverage rates, irrespective of the poverty method used. This finding means that most of the poor (both monetary and multidimensional poor) are excluded from the social assistance programmes. Regarding leakage rates, the results show that the multidimensional poverty measure generally results in lower leakage rates than the monetary poverty measure. Therefore, if only monetary poverty measure is used, one may be tempted to conclude that all social assistance programmes are not pro-poor. In contrast, the use of the multidimensional measure would result in another ranking of performance. According to the under-coverage rate, the ranking is the same for both ways of measuring poverty, but there are marked differences when looking at the leakage rate. For example, the DPP ranks first when using the H while being fifth when using the P_0, and the OAP, which ranked second in the ranking when using the P_0, falls back to fifth when comparing the leakage rate. The results show that the rankings based on under-coverage are consistent regardless of the poverty method used. However, the results are mixed regarding rankings based on leakage rates.

Table 9.9: UR and LR across programmes by poverty method (%, with relative ranking in brackets)

SP programme	Under-coverage rates		Leakage rates		P_0/H	
	P_0	H	P_0	H	*UR*	*LR*
Destitute persons programme	95.6 (2)	91.3 (2)	86.5 (5)	20.8 (1)	1.05	4.16
Needy student package	96.6 (3)	92.6 (3)	88.1 (6)	25.9 (2)	1.04	3.40
Community home-based care	99.6 (7)	99.7 (7)	75.6 (1)	34.4 (4)	1.00	2.20
Poverty eradication programme	97.4 (5)	97.0 (5)	78.7 (3)	28.7 (3)	1.00	2.74
LIMID	98.5 (6)	98.6 (6)	84.0 (4)	57.6 (7)	1.00	1.46
Orphan care programme	97.0 (4)	94.2 (4)	88.9 (7)	40.3 (6)	1.03	2.21
Old age pension	73.9 (1)	73.6 (1)	78.7 (2)	38.9 (5)	1.00	2.02

Source: Author's estimates based on the 2015/16 BMTHS data.

UR: Under-coverage rates; LR: Leakage rates. Sample size: 24,720; Relative rankings of programmes are reported in parentheses. P_0 monetary poverty rate; H: multidimensional poverty rate. The ratio P_0/H gives an indicator of the difference in the estimate between both ways of measuring poverty. †All percentages are estimated at the population level using sample weights.

To further investigate whether the social assistance programmes reached those left behind, individuals are subdivided by their eligibility and poverty rates across the two poverty methods for each programme (Table 9.10). In so doing, the analyses shed more light on whether those targeted by social assistance programmes are those left behind. Overall, poverty rates differ across the two poverty measures, with multidimensional poverty having higher rates than the monetary poverty measure. However, across eligibility status, generally, eligible beneficiaries are worse-off than those not eligible to benefit from the social assistance programmes.

Specifically, the likelihood of being monetary poor is higher among eligible beneficiaries than non-eligible beneficiaries for those programmes whose main objective is poverty eradication (DPP, NSP, LIMID and PEP). However, for those programmes whose objective is not poverty eradication (OAP and OCP), the opposite is true. That is, non-eligible beneficiaries have a higher likelihood of being monetary poor than eligible beneficiaries.

Based on the multidimensional poverty measure, eligible beneficiaries experience higher poverty rates than those not eligible across all programmes. However, poverty headcount ratios differ significantly for those programmes whose main objective is poverty eradication. The fact that the different targeting mechanisms reveal different results based on both targeting performance by implementation and the poverty method proves that there is no single targeting mechanism that is 'best' for targeting social assistance programmes. This shows that it is important to match the targeting mechanism with the objectives of each programme.

Table 9.10: Poverty rates across SA programmes by eligibility status and poverty method

SA programme	Monetary poverty		Multidimensional poverty	
	Eligible	Non-eligible	Eligible	Non-eligible
Destitute persons programme	43.0	0.2	75.0	37.2
Needy student package	44.4	0.01	60.9	25.9
Community home-based care	13.7	16.8	66.8	42.0
Poverty eradication programme	51.0	2.8	77.1	40.9
LIMID	51.0	2.8	77.1	40.9
Orphan care programme	15.4	42.2	50.7	41.5
Old age pension	15.7	16.3	76.6	44.5

Source: Author's estimates based on the 2015/16 BMTHS data. Sample size: 24,720.
†All percentages are estimated at the population level using sample weights.

9.5. Summary and conclusions

The 2030 Agenda for Sustainable Development have recognised the prominence and importance of social protection. Social protection is integrated into the LNOB principle to focus on the inclusion of the marginalised and vulnerable groups, to ensure that human and economic development benefits everyone, including those left behind. This chapter investigated the targeting performance of seven selected social assistance programmes in Botswana using the 2015/16 BMTHS. Specifically, this chapter examines whether selected social assistance programmes are effective in reaching their intended beneficiaries and whether these are poor.

The chapter makes an original contribution by assessing the targeting performance of several social assistance programmes in Botswana by the specific programme eligibility criteria, the monetary poverty indicators, and the multidimensional poverty index. Also, the chapter contributes to the debate in Botswana on better linking multidimensional poverty and social protection by suggesting ways to combine better and target social assistance programmes. This chapter shows that the relative ranking of programmes when considering leakage to non-poor households changes according to the poverty measure used. This issue is crucial as it may have a high impact on a country's strategies to reduce poverty. This is important considering the discussion about the design of future social protection programmes, where some of these programmes are likely to be replaced by more integrated life-cycle oriented programmes (Freeland et al., 2020).

The findings of this chapter are summarised as follows. The overall results reveal higher inclusion and exclusion errors rates in most social assistance programmes, indicating that they perform poorly in reaching their intended beneficiaries. Specifically, targeting

performance by implementation is very poor across all social assistance programmes, except for OAP. Also, the results show that the targeting performance of social assistance programmes depends largely on their objective, design and targeting mechanism. For example, OAP performed better in targeting its intended beneficiaries since it is designed to cover all persons aged 65 and above.

The higher exclusion error rates mean that eligible beneficiaries are excluded from the benefits of social assistance programmes. These higher exclusion error rates could be caused by the current eligibility criteria or targeting and registration process. Therefore, there is an urgent need to review the eligibility guidelines and targeting mechanisms across all means-tested social assistance programmes. In addition, to address the issue of non-take-up of benefits, there is a need for programme implementers to sensitise people about social assistance programmes through registration campaigns. Last, budgeting constraints result in few people enrolling in programmes, leading to high under coverage rates. Therefore, the government should consider expanding budgets for social assistance programmes to include more vulnerable people to leave no one behind. The higher inclusion error rates mean that non-eligible beneficiaries enjoy the benefits of social assistance programmes. The inclusion of non-eligible beneficiaries is mainly due to implementation and design issues. For example, political interference during the selection of beneficiaries may result in some undeserving people benefitting from social assistance programmes. Therefore, more resources should be availed for qualified personnel such as social workers to do the selection process.

Based on targeting performance by design (poverty measure), the results reveal high under-coverage rates irrespective of the poverty measures used, implying most of the social assistance programmes do not reach the poor. However, there exist significant differences between monetary and multidimensional poverty measures concerning leakage rates. When the programmes are ranked according to their leakage rates, the use of one or the other measure makes a difference. It shows that some programmes appear to be performing somewhat better in targeting the poor when using multidimensional poverty measures to rank them according to their leakage compared with their ranking according to the monetary poverty measure. Therefore, to target the poor, multidimensional poverty measures should be employed to supplement monetary measures.

CHAPTER 10: DISCUSSIONS AND POLICY IMPLICATIONS

10.1. Introduction

The 2030 Agenda for Sustainable Development has reinforced interest in multidimensional poverty measures. The LNOB principle is at the core of the 2030 Agenda for sustainable development. It relates closely to three important dimensions of the 2030 Agenda: poverty, inclusiveness, and inequality. The call to end poverty in all its forms and for everyone, as emphasised by SDG 1.2, acknowledges the multidimensional nature of poverty and that poverty should be examined at the individual level according to national definitions. SDG 1.2 encourages each country to not rely only on the global MPI but also to develop its own country-specific multidimensional poverty measure to monitor progress in reducing poverty in all its dimensions. Botswana needs to recognise that, despite the importance of the global MPI, it is necessary to conduct country-specific individual-level multidimensional poverty assessment in the context of Botswana as stipulated by SDG 1.2 to identify those left behind. The global MPI uses the household as a unit of analysis, thus underestimating the poverty levels of society. SDG 1.2 presents an opportunity to reflect on the way poverty is conceptualised and measured.

Botswana represents a salient case study. Like many other countries, Botswana has committed to the SDGs, Agenda 2063 and the 2030 Agenda, including committing to the LNOB principle. National developmental initiatives like the NDP 11, Vision 2036 and the BPEPS articulate the need to eradicate multidimensional poverty. Notwithstanding this, the country still uses only the unidimensional monetary measure of poverty to identify the poor. Several countries, especially developing countries, have started to move away from relying solely on unidimensional monetary measures of poverty and have supplemented these with multidimensional measures.

This thesis aimed to measure and analyse poverty in accordance with the LNOB principle using an individual-level multidimensional poverty measure. Therefore, the objectives of this thesis were to (i) construct an individual-level multidimensional poverty measure for Botswana in accordance with the LNOB principle; (ii) examine multidimensional poverty profiles and inequality among the multidimensional poor; (iii) investigate poverty mismatch and overlaps; (iv) examine targetting performance of social assistance

programmes in reaching their intended beneficiaries; and (v) provide policy implications for using multidimensional poverty measure. This thesis utilised the 2015/16 BMTHS dataset. The 2015/16 BMTHS is a cross-sectional and nationally representative survey conducted by Statistics Botswana covering all administrative districts in Botswana and collects information on socio-economic, demographic, and other topical modules capturing information on households and individuals. This thesis offers the first attempt to develop a country-specific individual-level multidimensional poverty measure for Botswana. It also provides the first in-depth analysis of multidimensional poverty and inequality in Botswana at the national level based on nationally representative survey data.

The structure of this chapter is as follows. Section 10.2 presents the summary and discussion of the empirical chapters, while Section 10.3 presents the academic contribution of the thesis. Section 10.4 presents policy implications for using the multidimensional poverty measure. Last, Section 10.5 presents the limitations of the thesis and future research.

10.2. Summary of findings

Chapter 5 dealt with the construction of the individual-level multidimensional poverty index and addressed the overarching research question: *How to measure and analyse poverty in accordance with the LNOB principle*? This chapter constructed a multidimensional poverty index using the individual as the unit of analysis in measuring poverty. Most empirical studies use the household as the unit of analysis for multidimensional poverty measurement. However, the call to end poverty in all its forms and for everyone, as emphasised by SDG 1.2, acknowledges the multidimensional nature of poverty and that poverty should be analysed based on individual-level measures.

The results reveal that in Botswana, household-based MPIs substantially underestimate the poverty levels of the society. The results reveal that an estimated 46.2 per cent of individuals are considered multidimensionally poor based on the individual-level analysis compared to the household-level estimate of 36.5 per cent.

Chapter 6 extended the analysis in Chapter 5 by disaggregating the analysis by individual characteristics, household-level variables, economic variables, and geographical

variables in line with the LNOB principle. The chapter also examined correlates of poverty and examined inequality among the multidimensionally poor. This chapter attempted to answer the following question: *Who are those left behind or at risk of being left behind, and where do they live?* The chapter contributes to the deepened understanding of poverty and inequality in Botswana.

The results reveal that the extent and nature of multidimensional poverty in Botswana vary significantly across different population subgroups. In Botswana, those left behind are mostly older persons and persons with disabilities, especially those residing in rural areas. The regression results also confirm these results. Significant disparities are observed across geography, with some districts with the same MPI recording varying inequality levels. Consistent with multidimensional poverty levels and deprivations, persons living with disabilities and older persons exhibited higher inequality levels. In sum, the analysis in this chapter highlighted the heterogeneity of different population groups. The chapter suggests that to leave no one behind and end poverty in all its forms, we need data disaggregation to identify poverty levels and highlight inequalities for different population subgroups. Data disaggregation would shed light on how overall progress translates into outcomes for particular population subgroups. It suggests that more in-depth analyses of poverty at specific individual groups levels are needed to reveal the poverty situation of the society to inform policy better and improve the effectiveness of evidence-based planning. This way, interventions can be customised, considering these heterogeneities and improving the targeting of policy interventions.

Chapter 7 provided empirical insights into the state of multidimensional child poverty in Botswana. The chapter dealt with the following research question: *What is the situation of multidimensional child poverty in Botswana, and who are those children at risk of being left behind*. In answering this question, this chapter extended the analysis in chapters 5 and 6 by focusing on the child-centred, individual-level and composite measure that offers nationally relevant and context-specific insights into the magnitude and depth of multidimensional child poverty in Botswana. In particular, it did so through the lens of LNOB by zooming in on demographic, economic and geographical characteristics associated with greater vulnerability or marginalisation using both descriptive and regression analysis. The chapter contributes to the limited literature on multidimensional child poverty in Botswana.

Results point towards a relatively high prevalence and depth of multidimensional child poverty in Botswana. More than four out of ten children can be considered multidimensionally poor, and on average, they are deprived in almost half of all deprivations. Results also show that disabled children, orphans, children living in larger families, families headed by unmarried couples, and rural areas are more likely to be multidimensionally poor. The findings of this chapter will serve as a baseline to track progress towards SDG 1 and national development plans regarding eradicating multidimensional child poverty as stipulated in the BPEPS, NDP 11, Vision 2036 and LNOB principle.

Chapter 8 compared estimates based on Botswana's official monetary-based poverty measure with findings based on a country-specific individual-level multidimensional poverty index. This chapter addressed the following research question. *What are the factors contributing to the poverty mismatch between the official monetary and multidimensional poverty measures*? Exploring poverty mismatch in a country-specific context allows for a deeper understanding from a broader perspective.

The results reveal significant mismatches and limited overlap. However, the size of mismatch and overlap vary across different subgroups of the populations and places of residence. This finding confirms that monetary and multidimensional measures identify different groups of individuals as poor. The finding that most individuals identified as multidimensionally poor are not monetarily poor means that they are at risk of being left behind if only monetary poverty measure is used. Therefore, this chapter concluded that the use of the monetary poverty measure alone does not capture the real picture of Botswana's poverty situation. This evidence from Botswana suggests that the official monetary poverty measure cannot be used as a proxy for multidimensional poverty measure and vice versa. Also, the weak correlation between monetary poverty and multidimensional poverty means that targeting social assistance programmes based on monetary poverty alone may not be effective.

Chapter 9 investigated the targeting performance of seven selected social assistance programmes in Botswana. Specifically, the chapter attempted to answer the following question: *Do social protection programmes reach those left behind*? The chapter makes

an original contribution by assessing the targeting performance of several social assistance programmes in Botswana by the specific programme eligibility criteria, the monetary poverty indicators, and the multidimensional poverty index.

The overall results reveal high inclusion and exclusion errors rates in most social assistance programmes, indicating that they perform poorly in reaching their intended beneficiaries. The results show that the targeting performance of social assistance programmes depends mainly on their objective, design and targeting mechanism. The results reveal high under-coverage rates irrespective of the monetary or multidimensional poverty measures used. Concerning leakage rates, there exist significant differences between monetary and multidimensional poverty measures. When the programmes are ranked according to their leakage rates, the use of one or the other measure makes a difference. It shows that some programmes appear to be performing somewhat better in targeting the poor when using multidimensional poverty measures to rank them according to their leakage compared with their ranking according to the monetary poverty measure.

10.3. Policy implications

This thesis developed an individual-level and country-specific multidimensional poverty measure that is able to support policy-making processes in line with SDG 1.2. A country-specific individual-level multidimensional poverty measure helps identify those left behind, thus helping policymakers implement nationally appropriate social protection systems and be able to cover those left behind, as emphasised by SDG 1.3. Also, a country-specific MPI could be particularly useful in analysing whether the benefits of economic growth reduced deprivations in other dimensions of poverty other than the monetary dimension. Therefore, it is expected that introducing a country-specific MPI will help in many ways to target better poverty reduction policies and interventions across countries and in Botswana.

Disaggregating data analysis by different subgroups of the population allows for monitoring the SDG commitment of halving the proportion of men, women, and children experiencing poverty in all its dimensions and the LNOB commitment. The analysis across different subgroups provides vital information that policymakers need since it shows the specific areas of *who* the poor are, *where* they live and *how* poor they are. Since different indicators are related to services whose provision falls under the mandate of

different ministries/departments, an integrated approach to service delivery is key to reducing multidimensional poverty. Identifying the subgroups of those left behind will help policymakers prioritise these groups in the reform and financing of social policy: 'putting the furthest behind first' (Stuart & Samman, 2017; Samman et al., 2021). Implementation of all social assistance programmes and allocation of resources should be guided by deprivation levels across districts, considering the heterogeneity of these districts. The current one size fits all implementation strategy is ineffective in targeting eligible beneficiaries. Geographical targeting can be used to give priority to the poorest districts, such as Kweneng West and Ngamiland West.

The finding that persons with disabilities have higher multidimensional poverty levels warrants policy intervention. This finding can help platforms for persons with disabilities to develop and strengthen their advocacy programmes so that the voices of persons living with disabilities should be heard regarding their specific lived experiences and priorities. Persons with disabilities should be included in the broader decision-making processes stipulated by the Convention on the Rights of Persons with Disabilities (CRPD). The needs of persons with disabilities need to be addressed and prioritised to leave no one behind. Social policies aiming to reduce poverty and deprivation should explicitly mention disability, recognising their characteristics and specific needs. Implementation of policies should give priority to PWDs. For example, categorical targeting can be used to reach all PWDs. Botswana is among the only five African countries that have not yet ratified the CRPD. Political pressure groups of PWDs could put pressure on the government of Botswana to sign the CRDP, which is intended as a human rights instrument for persons with disabilities.

The finding that various groups of children are at greater risk of deprivation than others shows that children are not a homogeneous group, which has critical policy implications. For example, targeted policies dealing with specific groups such as those aged 0-4 who are children experiencing higher poverty levels can be developed. Adopting an individual- and context-specific measure of multidimensional child poverty will be vital in guiding those efforts. For Botswana to live up to the LNOB principle and SDG 1.2 as set out in the BPEPS, Vision 2036 and the 2030 Agenda for Sustainable Development, it will be vital to put in place relevant policies that will consider the heterogeneity of different groups of children.

Analysis by administrative districts reveals that mining plays a vital role in socio-economic development, as evidenced by lower multidimensional poverty levels in mining towns. For example, Sowa Town recorded the lowest multidimensional poverty prevalence, intensity, and adjusted headcount ratio among all administrative districts. However, whether mining contributes to socio-economic development for all is not clear-cut. Concerning tourism, the chapter concludes that it is not clear-cut that tourism plays an essential role in the socio-economic development of ordinary citizens. For example, Ngamiland West recorded the highest poverty levels with the highest adjusted headcount ratio, despite the district being rich in natural resources and providing some of the best tourist attraction places in the country. These findings warrant policy intervention. The government of Botswana should put in place tourism policies that will benefit communities living in areas with rich natural resources.

The considerable lack of overlap between the official monetary and multidimensional poverty measures means that targeting social assistance programmes based on only one type of poverty measure will involve serious targeting errors. Also, results show that relying on the official poverty measure alone may send inadequate information to policymakers, resulting in ineffective policy instruments, which will yield low impacts on poverty eradication. Therefore, complementing the current official monetary poverty measure with a country-specific individual-level multidimensional poverty measure to identify those left behind would help policymakers better understand the actual poverty situation and help them put in place appropriate and specific policy mechanisms.

The thesis shows that social assistance programmes are associated with high leakages, as shown by higher inclusion and exclusion errors. This means that the targeting performance of social assistance programmes needs improvement. This finding calls for a more improved, effective and transparent administration and coordination of different social protection programmes. Also, the fact that the different social assistance programmes rank differently when ordered according to their targeting performance based on targeting performance by implementation and poverty method shows that policy decisions on social assistance programmes need to be made cautiously. Acknowledging that each targeting mechanism needs to be evaluated according to the objectives of each

programme, this thesis shows that poverty is not only about money but can originate from other dimensions.

The findings are highly relevant to Botswana's current process of social assistance reform. The policy reform should focus on improving anti-poverty and effectiveness by building and strengthening a more integrated and comprehensive social protection system (Carter et al., 2019). Social protection in Botswana is fragmented, with individual programmes coordinated and implemented by different ministries (despite using the same guidelines). At the implementation level, the long-term strategy must consider how to move away from the currently costly fragmented programmes to an integrated and holistic state-led social protection system as stipulated by SDG 1.3. Also, there is a need to put systems in place to address the political interference caused by the involvement of some political leaders in the selection process or registration of some beneficiaries. This thesis argues that the reform should consider using multidimensional poverty targeting to complement the monetary poverty targeting in evaluating individual social protection programmes. In sum, to achieve the objective of the LNOB principle, the Government of Botswana should apply the lessons from the OAP to the other social assistance programmes: publicise the programmes better, make their eligibility criteria simpler, make them easy to apply for, and make them rights-based.

10.4. Academic contributions

This thesis makes several contributions to the academic literature on the study of multidimensional poverty. First, this thesis contributes to the limited literature on individual-based multidimensional poverty by proposing a country-specific individual-based multidimensional poverty measure for Botswana, which can be applied in other similar contexts. Most studies use household-based MPIs in multidimensional poverty assessment. However, it remains that household-based multidimensional poverty measures are not sensitive to the intra-household distribution of deprivation and are thus unable to capture individuals' multidimensional poverty across different subgroups of the population (Klasen & Lahoti, 2020). In addition, household-based measures underestimate the poverty levels of society. Also, the prevalence of female headship as a sign of gendered poverty would be deeply misleading (Klasen & Lahoti, 2020).

This thesis argues that poverty is an individual characteristic, and it should be examined at the individual level to overcome some of the shortcomings of the existing household-based measures. However, most studies that attempted individual-based MPIs focused on a specific population subgroup such as children, adults and women. That is, they have not examined multidimensional poverty using individuals as a unit of analysis for the whole population. Therefore, this thesis uses the whole population to assess individual-level MPI and inequality, thus contributing to the limited literature in this regard. In addition, this thesis constitutes the first attempt in the African region and Botswana to estimate individual-level multidimensional poverty and inequality using the whole population.

Second, few studies that assessed individual-based multidimensional poverty across the entire population (Franco-Correa, 2014; Espinoza-Delgado & Klasen, 2018; Klasen & Lahoti, 2020) did not provide a detailed analysis of different groups of the population. They only focused on data disaggregation by age and gender. This thesis provides strong evidence supporting a more disaggregated multidimensional poverty and inequality by individual and household characteristics and geography. Thus, the thesis supports the need for data disaggregation as stipulated by the LNOB principle and SDG 1.2.

Third, the literature on the operationalisation of the LNOB is still in its infancy stage. I used the theoretical premise of the capability approach in the functioning space and conceptualised multidimensional poverty in terms of deprivation along various relevant functioning dimensions as a framework for the LNOB principle and SDG 1.2. Thus, this thesis contributes to the literature on operationalising the capability approach within the functioning space.

Last, the existing empirical literature on targeting methods mainly focuses on unidimensional poverty, and targeting assessments based on multidimensional poverty are limited (Alkire & Seth, 2013; Azevedo & Robles, 2013). This thesis contributes to this limited literature by examining the targeting performance of several social assistance programmes in Botswana by the specific programme eligibility criteria, the monetary poverty measure, and the country-specific individual-based multidimensional poverty index. Thus, the thesis adds to the debates and discussions regarding the multidimensional targeting method (see Azevedo & Robles, 2013).

10.5. Limitations and future research

Due to the inherent intricacy in the conceptualisation and measurement of poverty, this thesis has its share of limitations concerning the various theoretical and empirical assumptions. First, the ideal operationalisation of the capability approach advocates for an evaluation at the capability space. However, considering the constraints regarding available data, it is challenging to obtain appropriate information on the capability set (what an individual can do or be). Survey datasets based on explicit capability indicators need to be collected by countries to address this limitation (see Anand et al., 2021). On the other hand, the information on the functionings ('doings or beings') is widely available in the existing data. Therefore, the capability approach is operationalised in the functioning space in this thesis.

Second, there are conceptual and empirical challenges and data limitations in constructing individual indicators from indicators defined and identified at the household level, such as housing and living conditions, water and sanitation and asset indicators. The assumption that these indicators are true public goods and equally accessible to all individuals within the household may be unsatisfactory. It might underestimate poverty and inequality in certain groups of the population like women (Espinoza-Delgado & Klasen, 2018). For example, according to the gender literature, deprivation in some of these indicators, especially water, energy, and assets, is higher for women compared to men (Bradshaw et al., 2017). However, the selected household-level indicators are included for their intrinsic and instrumental significance (Klasen, 2000). Future improved collection of individual-level data would likely shed more light on poverty differentials in poverty by age and gender, especially in a country such as Botswana.

Third, the selection of dimensions would ideally involve the poor and engage in discussions and debates to gain legitimacy. Qualitative data collected through participatory poverty assessment can help understand poverty from the perspective of poor people. This, in turn, may help to inform policy better and develop targeted poverty reduction policies (Norton et al., 2001). The poor can identify the dimensions they deem relevant to their context, thereby contributing to a deeper understanding of the multidimensionality of poverty. Participatory assessment can also help capture some dimensions not included in household-based surveys, such as intra-household dimensions of poverty, especially gender (Norton et al., 2001). Also, household-based surveys

exclude several categories of people who might be extremely vulnerable to multidimensional poverty, such as street children, homeless people, incarcerated people, displaced people, foreign migrants and refugees.

Fourth, the MPI measure may have validity and reliability issues since some of the included indicators performed weakly on validity and reliability tests. However, the indicators included capture basic human rights and are aligned to the SDGs and relevant for Botswana. For example, the health indicators are included because the right to health is a fundamental right to everyone and is vital in the capability approach.

Last, the lack of more frequent and timely data prevented this thesis from analysing multidimensional poverty trends. Unfortunately, the previous household survey datasets did not have some of the topical modules used to derive deprivations indicators. A study of multidimensional poverty trends can show where progress has been made and the dimensions contributing to the decline or increase in poverty. Also, multidimensional poverty trends can reveal localities and groups where limited or no progress has been made, thus helping policymakers to put in place relevant policy interventions so that those left behind can make progress and catch up with the rest of the population.

This research has opened some opportunities to investigate new topics in future research. First, there is a need for further research to investigate the poverty mismatch between household and individual-based MPIs. Currently, the poverty mismatch literature is on monetary and multidimensional poverty measures. Second, a country-specific individual multidimensional poverty measure can be employed to study trends in multidimensional poverty to explore the complexity of poverty dynamics over time and their policy implications. Currently, poverty dynamics are based on household-based MPI. Fourth, future research should include collecting data from groups of people not covered in household surveys to leave no one behind. Fifth, more frequent data is needed to construct a national MPI that is valid and reliable for use in the monitoring and evaluation of policies. Last, there is a need to investigate the conceptual and empirical issues regarding the inclusion of household-level indicators in computing individual-level MPI. The major aspiration of this thesis is for the government of Botswana to adopt the individual-based multidimensional poverty measure to identify those left behind, as stipulated in the BPEPS, NDP 11, Vision 2036 and track the progress of the 2030 Agenda for Sustainable

Development, especially the SDG 1 and the LNOB principle. In addition, I hope this thesis will set the basis for further discussions and stimulate debates in the academic and policy domains regarding the adoption of a country-specific individual-level multidimensional poverty measure.

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APPENDICES

Appendix A4 for chapter 4

Figure A4.1: Research ethics certificate of approval

UNIVERSITY OF SUSSEX

Social Sciences & Arts C-REC
c-recss@admin.susx.ac.uk

Certificate of Approval	
Reference Number	ER/KL375/1
Title Of Project	Multidimensional poverty in Botswana: Leaving no one behind
Principal Investigator (PI):	Khaufelo Raymond Lekobane
Student	Khaufelo Raymond Lekobane
Collaborators	
Duration Of Approval	1 month and 14 days
Expected Start Date	01-Aug-2019
Date Of Approval	03-Jan-2019
Approval Expiry Date	15-Sep-2019
Approved By	Vacancy
Name of Authorised Signatory	Liz McDonnell
Date	03-Jan-2019

*NB. If the actual project start date is delayed beyond 12 months of the expected start date, this Certificate of Approval will lapse and the project will need to be reviewed again to take account of changed circumstances such as legislation, sponsor requirements and University procedures.

Please note and follow the requirements for approved submissions:

Amendments to protocol

* Any changes or amendments to approved protocols must be submitted to the C-REC for authorisation prior to implementation.

Feedback regarding the status and conduct of approved projects

* Any incidents with ethical implications that occur during the implementation of the project must be reported immediately to the Chair of the C-REC.

Feedback regarding any adverse(1) and unexpected events(2)

* Any adverse (undesirable and unintended) and unexpected events that occur during the implementation of the project must be reported to the Chair of the Social Sciences and Arts C-REC. In the event of a serious adverse event, research must be stopped immediately and the Chair alerted within 24 hours of the occurrence.

Monitoring of Approved studies

The University may undertake periodic monitoring of approved studies. Researchers will be requested to report on the outcomes of research activity in relation to approvals that were granted (full applications and amendments).

Research Standards

Failure to conduct University research in alignment with the Code of Practice for Research may be investigated under the Procedure for the Investigation of Allegations of Misconduct in Research or other appropriate internal mechanisms (3). Any queries can be addressed to the Research Governance Office: rgoffice@sussex.ac.uk

(1) An "adverse event" is one that occurs during the course of a research protocol that either causes physical or psychological harm, or increases the risk of physical or psychological harm, or results in a loss of privacy and/or confidentiality to research participant or others.

(2) An "unexpected event" is an occurrence or situation during the course of a research project that was a) harmful to a participant taking part in the research, or b) increased the probability of harm to participants taking part in the research.

(3) http://www.sussex.ac.uk/staff/research/rqi/policy/research-policy

Appendix A5 for chapter 5

Table A5.1: Proportion of deprived individuals in each indicator by individual and household characteristics 2015/16†

Subgroup	IF	DG	TR	LD	OC	CF	FL	RF	WL	EL	WR	TF	EN	LT	SC	HF	CI	FA	WZ	HZ	WH	BM	SF	CR
Sex																								
Male	22.7	57.0	70.5	39.7	40.8	48.5	13.4	10.8	18.5	37.6	11.4	65.3	10.8	8.9	38.9	33.1	12.1	48.9	7.8	17.8	5.6	11.9	39.2	10.3
Female	22.1	55.4	72.2	35.5	39.6	46.5	11.7	10.3	16.7	35.0	8.2	64.1	10.1	8.9	44.0	34.4	21.4	49.5	7.4	16.9	4.8	9.5	40.1	10.5
Citizenship																								
Non-citizen	16.5	37.3	46.1	81.7	31.0	14.2	5.9	5.1	9.5	13.8	10.6	29.3	3.5	1.2	23.4	14.1	8.4	18.7	4.2	7.7	7.5	3.1	35.0	9.7
Citizen	22.6	56.8	72.2	36.0	40.5	48.6	12.8	10.7	17.8	37.0	9.7	65.8	10.6	9.3	42.5	34.5	17.3	50.2	7.7	17.6	5.2	10.8	39.9	10.4
Disability																								
No-disability	22.3	55.9	71.1	38.0	40.4	47.1	12.4	10.4	17.4	35.9	9.5	64.3	10.3	7.9	40.0	33.6	16.0	48.7	7.6	17.4	5.2	10.6	39.6	10.3
PWD	24.1	64.7	82.1	20.2	33.9	58.6	17.8	15.3	23.5	47.2	16.7	75.5	25.0	33.8	82.3	39.3	51.7	65.7	21.7	23.9	0.0	20.7	44.9	12.0
Sex of HH																								
FHH	24.7	59.1	82.1	31.1	40.3	53.2	11.6	10.0	16.1	39.1	6.6	69.8	10.6	8.4	42.7	35.3	17.9	55.3	8.0	17.5	5.1	11.0	41.0	9.9
MHH	19.9	53.0	59.9	44.3	40.0	41.3	13.5	11.2	19.1	33.2	13.0	59.2	10.2	9.5	40.9	32.2	16.1	42.7	7.1	17.2	5.4	10.3	38.3	10.9
Age of HH																								
Children	64.3	80.4	87.0	73.6	40.3	70.8	28.8	19.3	40.1	62.1	11.2	83.3	20.2	0.0	36.7	4.3	9.4	45.9	0.0	0.0	0.0	9.3	21.0	15.6
Youth	20.8	55.5	77.4	71.4	49.7	34.9	12.3	11.1	18.3	36.5	9.8	59.6	11.0	2.1	17.1	29.9	9.7	43.2	7.2	16.9	6.5	8.8	38.5	10.6
Adults	21.0	53.2	65.0	34.3	37.1	45.5	10.8	9.0	15.2	33.2	9.2	61.0	9.5	7.4	44.4	33.4	17.9	46.6	7.6	16.6	4.7	10.9	40.2	10.5
Older persons	27.7	65.3	83.1	7.7	38.3	67.5	17.8	14.5	23.4	44.5	10.9	81.2	12.6	21.7	64.2	39.7	23.0	63.7	8.3	20.5	5.4	11.9	39.7	9.9
Marital status HH																								
Married	16.0	42.5	46.2	32.3	29.4	37.1	8.8	8.6	13.0	20.7	10.2	50.9	7.6	8.0	41.7	31.8	16.7	36.6	4.8	14.9	4.7	9.0	38.1	11.0
Living together	25.6	62.7	80.1	52.7	56.6	49.3	17.6	13.7	24.1	47.3	11.7	70.7	12.4	9.7	40.1	32.8	16.4	52.6	10.7	20.9	5.4	11.6	38.6	9.3
Separated	18.5	49.9	85.4	29.5	34.3	54.9	9.7	10.6	14.8	34.9	2.7	68.6	8.0	6.0	46.4	32.1	19.7	60.8	7.0	16.9	8.5	14.0	46.8	11.2
Divorced	22.8	55.3	65.3	25.9	28.4	43.1	7.9	13.5	16.4	37.6	12.2	53.7	10.4	8.0	38.1	28.3	19.3	37.8	0.0	11.2	0.0	6.1	48.3	19.2
Widow/Widower	24.8	60.5	84.6	8.7	31.9	63.4	12.6	8.9	16.0	38.1	8.6	78.5	12.7	14.7	57.3	41.0	21.3	61.0	6.8	16.9	3.7	12.1	41.3	10.7
Never married	25.8	64.3	85.2	44.9	42.8	49.7	12.7	10.5	17.8	43.0	8.1	68.6	11.2	7.0	36.3	33.9	15.5	54.7	8.6	17.3	6.7	11.2	40.7	9.8
Education of HH																								
None	32.5	73.5	84.8	14.0	50.5	74.5	23.0	18.8	29.3	54.3	15.4	87.1	14.1	30.3	66.5	37.5	19.1	67.4	9.7	21.8	4.9	13.0	38.6	9.7
Primary	23.4	62.3	80.9	21.2	40.4	59.8	13.3	10.2	19.1	41.9	10.7	77.6	11.7	2.4	64.4	38.5	20.8	58.6	8.7	18.2	5.8	12.0	39.8	9.1
Secondary	19.2	53.4	72.2	58.3	44.9	33.8	7.3	6.9	12.1	31.5	5.9	59.4	8.1	0.8	22.6	32.4	14.6	44.3	6.2	16.1	6.0	10.4	41.7	9.9
Vocational	13.9	41.1	47.8	57.1	31.3	16.9	3.1	3.3	3.9	12.8	3.2	35.4	6.8	0.8	9.1	35.2	16.5	30.8	5.5	12.2	5.5	5.1	43.4	18.3
University	9.5	21.7	33.2	64.9	13.1	8.8	3.8	4.4	6.5	7.0	6.2	16.9	5.2	0.3	9.2	21.1	11.5	12.4	3.8	9.1	3.3	4.6	37.1	12.8
National	**22.4**	**56.2**	**71.4**	**37.5**	**40.2**	**47.5**	**12.5**	**10.6**	**17.6**	**36.2**	**9.7**	**64.7**	**10.5**	**8.9**	**41.7**	**33.8**	**17.0**	**49.2**	**7.6**	**17.4**	**5.2**	**10.7**	**39.7**	**10.4**

Source: Author's estimates based on the 2015/16 BMTHS data. †Results are estimated at the population level using sample weights. Sample size: 24,720. IF: information; DG: durable goods; TR: transport; LD: land tenure; OC: overcrowding; CF: cooking fuel; FL: floor; RF: roof; WL: wall; WR: water; TF: toilet facility; EN: enrolment; LT: literacy; SC: school achievement; HF: health facility; CI: chronic illness; FA: food access; WZ: weight-for-age; HZ: height-for-age; WH: weight-for-height; BM: body mass index; SF: safety; CR: crime; PWDs persons with disabilities

Table A5.2: Proportion of deprived individuals in each indicator by economic variables and strata 2015/16†

	IF	DG	TR	LD	OC	CF	FL	RF	WL	EL	WR	TF	EN	LT	SC	HF	CI	FA	WZ	HZ	WH	BM	SF	CR
Quintiles																								
Q1	37.5	77.3	92.0	21.5	56.1	71.3	21.5	17.4	29.3	56.9	12.8	88.7	14.6	14.9	55.9	37.8	15.1	70.7	10.3	20.5	5.8	13.4	39.4	7.6
Q2	22.2	61.9	81.1	32.2	40.9	51.8	12.8	10.9	16.2	38.0	10.0	73.3	9.9	10.4	48.3	35.9	18.8	54.9	5.8	15.8	4.8	10.6	40.2	10.6
Q3	13.3	45.1	66.9	45.8	36.5	31.7	6.7	5.9	11.4	26.2	7.6	56.7	6.8	7.7	40.3	34.7	18.0	41.0	4.5	14.0	5.5	8.5	42.0	10.8
Q4	9.4	34.6	47.7	54.4	25.4	17.9	4.9	4.8	8.7	18.6	7.2	38.3	3.7	4.1	31.1	29.7	17.9	24.0	5.6	14.4	4.7	6.6	41.5	12.3
Q5	5.6	23.6	26.0	63.0	14.0	8.7	2.1	2.2	4.1	6.4	5.5	19.6	4.9	1.4	18.3	21.8	17.1	15.9	4.2	11.1	3.3	5.6	34.6	15.1
Employment																								
unemployed	31.2	67.4	84.4	22.7	44.8	63.4	17.5	14.8	23.0	47.2	9.6	79.4	12.4	13.6	51.6	37.8	18.5	63.5	9.5	20.7	5.2	12.7	38.7	9.0
paid employment	13.1	38.7	55.9	61.0	32.0	21.9	4.3	4.6	8.0	18.5	4.4	41.7	6.7	2.4	25.7	30.8	15.2	29.8	5.0	12.5	5.5	8.1	39.7	10.4
Self-employment	13.0	41.4	53.3	33.6	33.1	29.9	3.4	3.2	8.6	20.4	4.2	49.4	7.7	4.1	34.8	31.5	15.0	36.1	4.2	11.8	5.0	8.8	44.5	14.1
own farm	19.8	68.8	68.4	14.0	42.7	73.4	22.9	18.1	28.9	48.7	29.5	80.4	10.9	16.3	59.5	31.7	20.1	57.5	8.7	16.8	4.8	9.8	40.3	14.1
Unpaid family helper	27.5	79.0	94.8	53.1	59.2	69.8	25.0	15.8	32.1	64.6	25.5	88.6	17.8	13.5	57.7	27.1	16.5	62.9	9.2	23.3	4.7	11.6	37.8	9.9
Strata																								
Cities/Towns	13.8	34.3	53.1	67.7	31.2	11.4	3.3	5.2	6.9	17.5	3.8	23.6	6.9	2.0	23.6	24.7	14.4	26.2	5.2	13.9	4.6	6.7	41.8	11.5
Urban Villages	17.9	49.7	69.8	36.2	35.4	38.7	4.3	3.8	8.4	22.4	3.8	66.6	8.9	6.4	38.4	34.5	16.7	48.8	6.4	16.4	4.6	11.7	43.8	13.0
Rural areas	33.2	77.5	84.3	20.8	51.7	80.3	28.4	22.3	35.6	65.0	20.6	87.1	14.2	17.4	59.2	38.4	19.0	63.7	9.9	19.8	6.1	11.5	33.3	6.4
National	**22.4**	**56.2**	**71.4**	**37.5**	**40.2**	**47.5**	**12.5**	**10.6**	**17.6**	**36.2**	**9.7**	**64.7**	**10.5**	**8.9**	**41.7**	**33.8**	**17.0**	**49.2**	**7.6**	**17.4**	**5.2**	**10.7**	**39.7**	**10.4**

Source: Author's estimates based on the 2015/16 BMTHS data. †Results are estimated at the population level using sample weights. Sample size: 24,720. IF: information; DG: durable goods; TR: transport; LD: land tenure; OC: overcrowding; CF: cooking fuel; FL: floor; RF: roof; WL: wall; WR: water; TF: toilet facility; EN: enrolment; LT: literacy; SC: school achievement; HF: health facility; CI: chronic illness; FA: food access; WZ: weight-for-age; HZ: height-for-age; WH: weight-for-height; BM: body mass index; SF: safety; CR: crime.

Table A5.3: Proportion of deprived individuals in each indicator across district 2015/16[†]

District	IF	DG	TR	LD	OC	CF	FL	RF	WL	EL	WR	TF	EN	LT	SC	HF	CI	FA	WZ	HZ	WH	BM	SF	CR
Gaborone	11.9	31.0	47.9	61.5	31.0	6.5	4.5	4.6	6.0	14.3	5.3	21.8	5.3	1.2	21.1	23.1	12.7	22.2	3.1	10.7	3.3	5.3	45.1	12.9
Francistown	19.2	40.8	65.8	60.1	31.5	25.5	1.0	1.0	6.3	22.2	1.2	24.8	8.9	3.2	25.8	34.4	16.2	35.9	8.9	18.3	9.3	8.9	42.6	11.2
Lobatse	15.3	48.0	72.5	70.8	36.0	5.2	0.0	0.0	3.8	31.6	1.0	49.2	9.9	2.4	29.2	14.9	16.3	40.7	6.1	21.4	4.2	9.9	33.9	9.8
S/Phikwe	8.9	35.9	51.2	90.6	35.5	15.6	1.8	18.6	12.9	22.3	1.5	28.8	6.8	3.8	28.3	19.2	18.2	26.9	6.2	16.8	3.5	6.8	38.4	8.7
Orapa	43.5	52.4	63.4	100	11.4	6.6	6.6	6.6	6.6	6.6	6.6	6.6	0.0	0.0	30.2	1.5	16.8	10.9	9.7	14.7	5.1	0.0	15.0	10.1
Jwaneng	9.4	17.1	34.2	93.6	27.8	5.5	5.3	2.0	5.3	11.7	5.5	5.6	7.5	2.1	24.8	36.4	13.2	19.5	5.1	5.1	3.0	7.5	35.1	7.6
Sowa Town	2.7	16.0	49.4	100	1.3	11.2	0.0	0.7	24.8	0.0	4.2	0.0	15.8	1.1	22.3	33.2	13.2	13.4	0.0	24.6	0.0	15.8	8.5	4.7
Southern	25.3	67.3	82.8	21.4	36.8	60.1	11.8	9.5	20.4	44.7	19.0	79.9	17.0	14.0	53.9	34.2	17.9	63.7	7.0	16.4	4.7	17.0	36.2	12.1
Barolong	14.9	69.7	80.0	25.8	35.0	69.2	4.5	4.2	9.1	46.5	19.0	80.7	13.3	12.2	54.2	45.3	17.6	67.7	8.0	23.6	8.2	13.3	30.2	5.6
Ngwaketse W	36.6	80.1	91.4	10.6	54.7	90.4	20.0	11.3	25.1	56.2	4.1	84.9	13.1	22.5	52.7	34.2	15.2	65.2	0.0	11.1	0.0	13.1	24.5	0.7
South East	19.5	37.8	66.2	43.1	26.6	22.2	2.8	4.0	4.8	14.9	7.4	47.9	5.2	3.6	30.1	28.1	15.9	37.4	6.5	12.4	0.0	5.2	44.6	10.4
Kweneng E	17.6	53.3	68.5	38.7	38.4	33.8	4.6	4.2	7.5	30.2	9.2	71.8	13.4	9.0	39.1	37.3	14.5	47.4	7.6	15.3	7.3	13.4	50.0	14.3
Kweneng W	48.1	83.8	90.8	21.4	63.5	86.5	36.4	32.8	37.9	76.8	26.6	92.5	15.8	22.6	62.0	43.8	20.4	81.1	11.0	26.7	4.2	15.8	33.2	7.5
Kgatleng	15.8	40.6	65.1	24.6	29.9	39.3	3.6	1.7	8.8	23.9	6.2	71.6	10.5	8.5	43.6	31.2	16.0	44.7	5.8	15.5	8.3	10.5	41.3	9.4
Central SP	24.1	58.4	75.7	31.6	44.1	57.7	16.4	11.9	21.7	39.2	9.9	72.0	9.6	10.5	52.6	35.9	22.2	57.6	9.6	20.2	5.3	9.6	40.6	11.2
Central MH	29.9	69.9	82.3	21.0	46.9	71.7	10.6	8.2	16.4	49.3	7.4	83.8	9.4	10.2	51.0	43.7	20.3	59.7	6.1	15.6	2.8	9.4	47.0	7.9
Central BB	24.6	73.6	82.4	15.8	48.3	74.2	10.6	5.2	18.1	45.4	10.4	81.9	11.8	9.4	52.8	32.3	20.5	56.5	6.0	22.7	3.2	11.8	33.9	8.8
Central BT	19.9	64.7	73.3	35.9	51.4	62.8	30.7	16.5	30.0	41.6	17.8	78.2	9.8	14.0	45.0	42.5	15.6	55.2	14.4	22.6	7.1	9.8	27.8	10.1
Central TT	31.2	69.0	81.2	21.9	40.9	75.1	27.3	24.8	36.8	53.3	12.5	78.0	12.4	12.3	53.8	29.7	18.4	53.9	9.1	22.1	5.7	12.4	33.8	8.2
North East	18.6	59.7	75.9	41.2	24.5	67.0	7.3	11.5	12.1	36.8	6.1	70.3	12.6	4.7	48.9	24.0	19.7	43.0	8.7	20.8	3.1	12.6	33.8	3.9
Ngamiland E	26.9	65.0	70.7	26.8	54.8	55.4	18.3	9.1	22.4	35.0	11.5	80.2	7.2	9.5	43.1	38.3	15.3	56.6	6.2	15.7	4.5	7.2	35.1	14.3
Ngamiland W	39.3	91.1	92.8	12.6	65.2	92.1	61.1	67.3	71.6	78.0	16.5	98.0	11.8	27.3	61.5	49.6	16.7	83.0	5.4	9.8	7.3	11.8	29.2	4.7
Chobe	20.1	42.3	75.4	65.9	33.9	33.3	4.7	3.6	15.3	19.8	2.4	49.1	7.2	4.7	29.1	34.7	17.6	29.2	6.2	13.2	5.9	7.2	46.9	4.1
Ghanzi	31.6	65.9	79.3	32.7	51.7	64.9	25.5	9.9	35.2	54.1	7.3	67.8	13.8	15.1	54.7	31.7	16.8	62.6	18.0	22.8	9.3	13.8	29.9	10.1
Kgalagadi S	36.5	73.2	81.3	32.5	46.7	78.7	12.9	1.8	14.1	53.1	9.4	86.1	13.1	8.0	56.8	30.9	18.4	58.7	12.5	22.9	1.9	13.1	15.0	6.6
Kgalagadi N	14.6	63.5	75.1	38.8	48.5	49.0	11.6	3.6	25.4	41.3	12.2	77.2	11.1	13.5	44.8	38.7	21.9	53.3	8.2	28.0	5.8	11.1	38.9	6.1
National	**22.4**	**56.2**	**71.4**	**37.5**	**40.2**	**47.5**	**12.5**	**10.6**	**17.6**	**36.2**	**9.7**	**64.7**	**10.5**	**8.9**	**41.7**	**33.8**	**17.0**	**49.2**	**7.6**	**17.4**	**5.2**	**10.7**	**39.7**	**10.4**

Source: Author's estimates based on the 2015/16 BMTHS data. [†]Results are estimated at the population level using sample weights. Sample size: 24,720. IF: information; DG: durable goods; TR: transport; LD: land tenure; OC: overcrowding; CF: cooking fuel; FL: floor; RF: roof; WL: wall; WR: water; TF: toilet facility; EN: enrolment; LT: literacy; SC: school achievement; HF: health facility; CI: chronic illness; FA: food access; WZ: weight-for-age; HZ: height-for-age; WH: weight-for-height; BM: body mass index; SF: safety; CR: crime. W: west, E: east; S: south; SP: Serowe Palapye; MH: Mahalapye; BB: Bobonong; BT: Boteti; TT: Tutume.

Table A5.4: Weight structure by age group

Dimension	Indicator	Age groups			
		0-4	5-14	15-17	18 and above
1. Asset	Information	1/24	1/28	1/28	1/28
	Durable goods	1/24	1/28	1/28	1/28
	Transport	1/24	1/28	1/28	1/28
	Land tenure	1/24	1/28	1/28	1/28
2. Housing & living conditions	Overcrowding	1/36	1/42	1/42	1/42
	Cooking fuel	1/36	1/42	1/42	1/42
	Floor material	1/36	1/42	1/42	1/42
	Roof material	1/36	1/42	1/42	1/42
	Wall material	1/36	1/42	1/42	1/42
	Electricity	1/36	1/42	1/42	1/42
3. Water and sanitation	Water supply	1/12	1/14	1/14	1/14
	Toilet facility	1/12	1/14	1/14	1/14
4. Food security	Food insecurity access (HFIAP)	1/24	1/14	1/14	1/7
	Weight-for-age (WAZ)	1/24	na	na	na
	Height-for-height (HAZ)	1/24	na	na	na
	Weight-for-height (WHZ)	1/24	na	na	na
	Body Mass Index (BMI)	na	1/14	1/14	na
5. Health	Health facility	1/12	1/14	1/14	1/14
	Chronic illness	1/12	1/14	1/14	1/14
6. Education	Child school attendance	na	1/7	1/14	na
	Schooling achievement	na	na	na	1/14
	Literacy	na	na	1/14	1/14
7. Security	Safety	1/12	1/14	1/14	1/14
	Crime	1/12	1/14	1/14	1/14
Sum of weights		**1.00**	**1.00**	**1.00**	**1.00**

na; means the indicator is not applicable to the age group. All individual dimensions carry equal weight.

Table A5.5: Multidimensional poverty estimates for robustness checks 2015/16[†]

	without *SCH*[a]			without *SCH*[a] and *CI*[b]		
	H (%)	*A* (%)	M_0	*H* (%)	*A* (%)	M_0
0 to 17 years (children) (ref)	41.7	43.4	0.181	46.9	45.8	0.215
18 to 35 years (youth)	42.5***	46.7***	0.198***	46.2***	47.8***	0.221***
36 to 64 years (adults)	51.8***	51.1***	0.264***	51.3***	50.9***	0.261***
65+ (older persons)	67.8***	53.5***	0.362***	65.3***	53.6***	0.350***
Total	**45.8**	**47.3**	**0.216**	**48.8**	**48.3**	**0.235**

Source: Authors' estimates based on the 2015/16 BMTHS data.
H: headcount ratio; *A*: intensity; M_0: adjusted headcount ratio; *HH*: household head.
SCH[a]: means excluding years of schooling for older persons; *CI*[b]: excluding chronic illness from the MPI.
[†]All percentages are estimated at the population level using sample weights.
Sample size: 24,720. Significance levels: $^{*}p$ <0.1; $^{**}p$ <0.05; $^{***}p$ <0.01.

Table A5.6: Pearson's rank correlation coefficients between deprivation indicators 2015/16†

	DG	TR	LD	OC	CF	FL	RF	WL	EL	WR	TF	FA	WZ	HZ	WH	BM	HF	CI	EN	LT	SC	SF	CR
IF	.382**	.236**	-.059**	.230**	.292**	.260**	.225**	.250**	.419**	.165**	.237**	.198**	.055**	.022**	.034**	.024**	.007**	-.009**	.083**	.120**	.108**	.015**	-.041**
DG	1	.402**	-.115**	.318**	.480**	.312**	.254**	.329**	.582**	.218**	.426**	.339**	.055**	.047**	.040**	.058**	.048**	.021**	.119**	.166**	.217**	.002*	-.041**
TR		1	-.069**	.295**	.386**	.195**	.160**	.195**	.353**	.107**	.421**	.336**	.075**	.096**	0.001	.069**	.071**	.025**	.084**	.135**	.180**	.006**	-.074**
LD			1	.038**	-.319**	-.108**	-.076**	-.097**	-.120**	-.014**	-.268**	-.189**	-.021**	-.048**	.041**	-.033**	-.085**	-.072**	-.024**	-.132**	-.241**	.023**	-.020**
OC				1	.286**	.281**	.234**	.274**	.374**	.132**	.343**	.240**	.083**	.090**	.030**	.043**	.025**	-.037**	.107**	.087**	.092**	.024**	-.056**
CF					1	.366**	.311**	.368**	.584**	.268**	.525**	.388**	.098**	.098**	.019**	.080**	.074**	.032**	.119**	.238**	.316**	-.006**	-.059**
FL						1	.693**	.750**	.459**	.417**	.250**	.180**	.030**	.018**	.005*	-.004**	-.008**	.004**	.145**	.208**	.195**	-.030**	-.040**
RF							1	.655**	.392**	.344**	.198**	.142**	.015**	.041**	-.022**	.012**	-.038**	0.001	.095**	.174**	.149**	-.020**	-.050**
WL								1	.470**	.394**	.243**	.194**	.030**	.029**	0.003	.011**	-.010**	.008**	.123**	.200**	.199**	-.030**	-.043**
EL									1	.350**	.461**	.327**	.077**	.082**	-0.002	.050**	.035**	.030**	.141**	.224**	.273**	.007**	-.081**
WR										1	.190**	.047**	.037**	-.006**	-0.001	-.011**	-.016**	.032**	.107**	.162**	.176**	.019**	-.024**
TF											1	.381**	.067**	.074**	0.003	.072**	.093**	.026**	.108**	.181**	.270**	-.002**	-.081**
FA												1	.045**	.060**	.022**	.077**	.130**	.041**	.077**	.145**	.207**	.028**	-.008**
WZ													1	.373**	.331**	.c	-.014**	.014**	.c	.c	.c	-.030**	-.010**
HZ														1	-.028**	.c	-.018**	.012**	.c	.c	.c	-.068**	-.040**
WH															1	.c	0.000	-.011**	.c	.c	.c	0.000	-.037**
BM																1	.020**	.009**	-.025**	-.035**	.c	-.009**	-.016**
HF																	1	.011**	-.007**	.006**	.030**	.075**	.006**
CI																		1	.007**	.134**	.290**	.021**	.011**
EN																			1	.203**	.c	0.000	.007**
LT																				1	.385**	-.011**	-.023**
SC																					1	.010**	-.030**
SF																						1	.196**

Source: Author's estimates based on the 2015/16 BMTHS data. †Results are estimated at the population level using sample weights. ID: indicator; IF: information; DG: durable goods; TR: transport; LD: land tenure; OC: overcrowding; CF: cooking fuel; FL: floor; RF: roof; WL: wall; WR: water; TF: toilet facility; EN: enrolment; LT: literacy; SC: school attainment; HF: health facility; CI: chronic illness; FA: food access; WZ: weight-for-age; HZ: height-for-age; WH: weight-for-height; BM: body mass index; SF: safety; CR: crime. **, *Correlation is significant at the 0.01 and 0.05 level (2-tailed) (respectively). Sample size: 24,720. cNo data to compute correlations.

Table A5.7: Validity tests using logistic regression

	Income poverty	Subjective poverty	Disability
Information	1.243***	0.214*	0.075
Durable goods	1.461***	0.520***	0.325***
Transport	1.867***	0.482***	0.611***
Land tenure	-0.727***	-0.379***	-0.897***
Overcrowding	1.066***	0.246***	-0.316***
Cooking fuel	1.555***	0.451***	0.410***
Floor material	1.129***	0.417***	0.364***
Roof material	0.904***	0.460***	0.385***
Wall material	0.993***	0.288***	0.283***
Electricity	1.326***	0.459***	0.419***
Water supply	0.491***	0.081***	0.509***
Toilet facility	1.637***	0.401***	0.451***
Food insecurity access	1.222***	0.975***	0.649***
Weight-for-age	0.740***	0.224	1.387***
Height-for-age	0.204*	**0.080**	**0.405**
Weight-for-height	**0.288**	**0.252**	–
Body Mass Index	0.470***	0.06	0.774***
Health facility	0.238***	0.268***	0.215***
Chronic illness	-0.284***	0.179***	1.782***
Child school attendance	0.841***	0.235***	0.999***
Schooling achievement	0.667***	0.326***	1.883***
Literacy	0.676***	0.308***	1.690***
Safety	0.164***	0.302***	0.227***
Crime	-0.333***	0.378***	0.192

Source: Author's estimates based on the 2015/16 BMTHS data.

– cannot be computed: one of the cells is zero in the four-way table.

Significance levels: $^{*}p$ <0.1; $^{**}p$ <0.05; $^{***}p$ <0.01. Bolded figures are not significant.

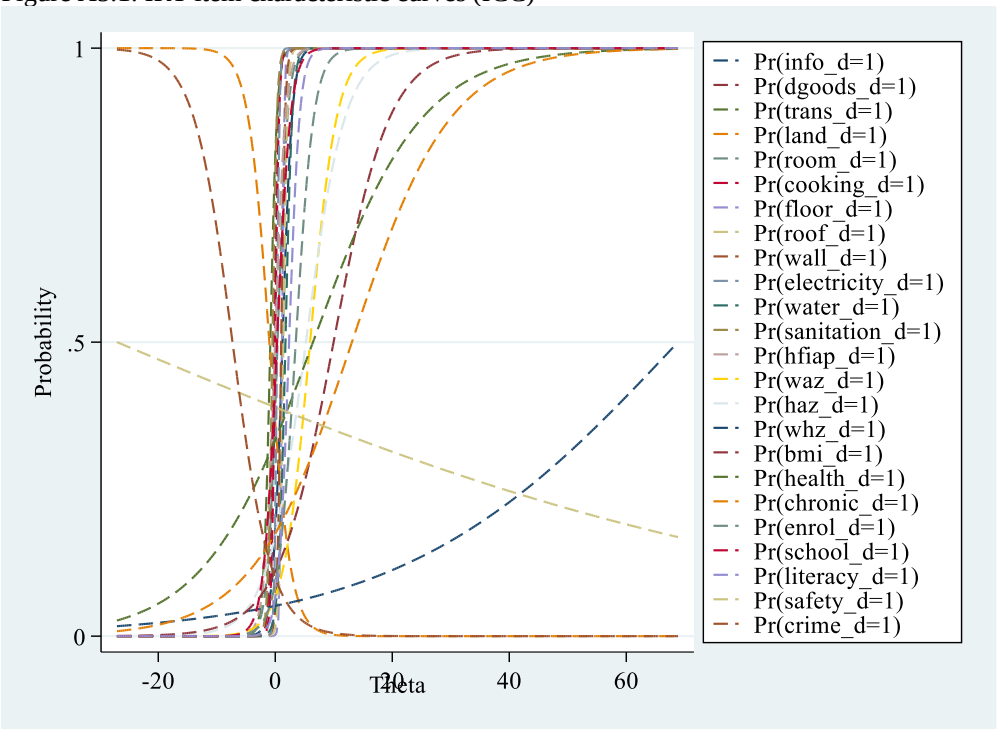
Table A5.8: Classical test theory analysis

	0-4 years		5-14 years		15-17 years		18 years and over	
Indicator	ITC	AID	ITC	AID	ITC	AID	ITC	AID
Information	0.486	0.783	0.503	0.775	0.390	0.767	0.464	0.794
Durable goods	0.685	0.766	0.683	0.759	0.713	0.736	0.663	0.780
Transport	0.556	0.777	0.562	0.770	0.629	0.746	0.534	0.790
Land tenure	0.382	0.791	0.355	0.787	0.316	**0.777**	0.341	**0.805**
Overcrowding	0.532	0.780	0.539	0.773	0.535	0.756	0.476	0.795
Cooking fuel	0.716	0.763	0.711	0.756	0.744	0.732	0.740	0.774
Floor material	0.616	0.774	0.595	0.769	0.572	0.755	0.609	0.787
Roof material	0.548	0.778	0.534	0.773	0.419	0.764	0.513	0.792
Wall material	0.623	0.772	0.593	0.768	0.503	0.758	0.605	0.786
Electricity	0.758	0.759	0.746	0.753	0.745	0.733	0.750	0.773
Water supply	0.421	0.785	0.316	0.784	0.407	0.765	0.468	0.794
Toilet facility	0.641	0.771	0.653	0.762	0.709	0.737	0.665	0.780
Food insecurity access	0.533	0.780	0.560	0.771	0.485	0.761	0.527	0.791
Weight-for-age	0.235	0.793	–	–	–	–	–	–
Height-for-age	0.236	**0.797**	–	–	–	–	–	–
Weight-for-height	0.086	**0.797**	–	–	–	–	–	–
Body Mass Index			0.152	**0.793**	0.228	0.767		
Health facility	0.144	**0.808**	0.182	**0.801**	0.084	**0.793**	0.182	**0.814**
Chronic illness	0.042	**0.796**	0.067	**0.791**	0.041	**0.791**	0.237	**0.809**
Child school attendance	–	–	0.245	**0.788**	0.160	0.768		
Schooling achievement	–	–	–	–	–	–	0.501	0.793
Literacy	–	–	–	–	0.340	0.767	0.400	0.797
Safety	0.156	**0.807**	0.170	**0.802**	0.120	**0.794**	0.129	**0.818**
Crime	0.191	**0.796**	0.178	**0.791**	0.152	**0.781**	0.112	**0.809**
Overall alpha		0.793		0.787		0.773		0.803

Source: Author's estimates based on the 2015/16 BMTHS data.

AID: alpha if item deleted; ITC: item-total correlations. The bolded figure means the indicator increases unreliable. – this means the indicator is not applicable to the age group.

Figure A5.1: IRT item characteristic curves (ICC)



Source: Author's estimates based on the 2015/16 BMTHS data.

Table A5.9: Item response theory analysis

	Discrimination		Difficulty	
	Coefficient	Robust SE	Coefficient	Robust SE
Information	1.244***	0.023	1.237***	0.021
Durable goods	2.810***	0.052	-0.238***	0.009
Transport	1.785***	0.035	-0.845***	0.014
Land tenure	**-0.554*** **	0.017	-1.012***	0.037
Overcrowding	1.186***	0.021	0.391***	0.015
Cooking fuel	3.169***	0.057	-0.008	0.009
Floor material	5.483***	0.246	1.163***	0.012
Roof material	3.061***	0.096	1.393***	0.017
Wall material	3.038***	0.077	1.011***	0.012
Electricity	4.958***	0.131	0.292***	0.008
Water supply	1.746***	0.040	1.739***	0.026
Toilet facility	2.735***	0.054	-0.479***	0.010
Food insecurity access	1.148***	0.022	-0.020	0.014
Weight-for-age	0.442***	0.069	**5.952*** **	0.866
Height-for-age	**0.301*** **	0.049	**5.245*** **	0.818
Weight-for-height	**0.042**	0.089	**68.84**	144.3
Body Mass Index	**0.210*** **	0.040	**9.970*** **	1.887
Health facility	**0.107*** **	0.014	**6.450*** **	0.852
Chronic illness	**0.119*** **	0.018	**13.103*** **	1.944
Child school attendance	0.657***	0.048	3.408***	0.229
Schooling achievement	0.876***	0.023	0.303***	0.023
Literacy	1.126***	0.033	2.367***	0.056
Safety	**-0.017**	0.014	-27.06	22.98
Crime	**-0.303*** **	0.024	-7.308***	0.572

Source: Author's estimates based on the 2015/16 BMTHS data.
The bolded figure means the indicator is not reliable. SE: Standard error
Significance levels: $^{*}p$ <0.1; $^{**}p$ <0.05; $^{***}p$ <0.01.

Appendix A6 for chapter 6

Table A6.1: Multidimensional poverty estimates by geographical variables 2015/16[†]

Geographical location	Population	(%)	*H* (%)	*A* (%)	M_0
Strata					
Cities/towns	438,262	21.1	22.6***	44.1***	0.100***
Urban villages (ref)	911,022	43.9	40.2	45.2	0.182
Rural areas	724,391	34.9	68.1***	49.6***	0.338***
Districts					
Gaborone	238,643	11.5	20.6***	44.0***	0.090***
Francistown	90,992	4.4	28.4***	45.3***	0.129***
Lobatse	23,825	1.1	31.7***	41.7***	0.132***
Selibe Phikwe	53,427	2.6	23.2***	44.4***	0.103***
Orapa	9,532	0.5	12.9***	48.1***	0.062***
Jwaneng	18,856	0.9	13.8***	39.6***	0.055***
Sowa Town	2,987	0.1	4.6***	39.5***	0.018***
Southern	119,739	5.8	56.7***	48.0***	0.272***
Barolong	53,818	2.6	57.6***	46.7***	0.269***
Ngwaketse West	13,517	0.7	61.0***	46.7***	0.285***
South East	90,130	4.3	29.2***	44.8***	0.131***
Kweneng East (ref)	297,420	14.3	44.5	46.1	0.205
Kweneng West	52,441	2.5	78.8***	53.0***	0.418***
Kgatleng	94,258	4.5	35.7***	44.8***	0.160***
Central Serowe/Palapye	184,216	8.9	53.2***	48.5***	0.258***
Central Mahalapye	135,225	6.5	62.8***	47.1***	0.296***
Central Bobonong	64,719	3.1	54.8***	46.0***	0.252***
Central Boteti	57,868	2.8	55.1***	50.2***	0.277***
Central Tutume	143,497	6.9	57.8***	47.9***	0.277***
North East	48,293	2.3	42.6***	44.7***	0.190***
Ngamiland East	105,845	5.1	48.7***	49.2***	0.240***
Ngamiland West	63,381	3.1	88.1***	51.7***	0.456***
Chobe	24,418	1.2	34.7***	41.8***	0.145***
Ghanzi	45,082	2.2	57.1***	47.3***	0.270***
Kgalagadi South	24,950	1.2	60.2***	46.0***	0.277***
Kgalagadi North	16,594	0.8	53.1***	47.1***	0.250***
Total	**2,073,675**	**100**	**46.2**	**47.4**	**0.219**

Source: Author's estimates based on the 2015/16 BMTHS data.

H: headcount ratio; *A*: intensity; M_0: adjusted headcount ratio.

[†]All percentages are estimated at the population level using sample weights. Sample size: 24,720.

Significance levels: $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$.

Table A6.2: Robustness analysis using alternative parameters by demographics 2015/16[†]

	k=25			*k*=40			Equal weight[a]		
	H	*A*	M_0	*H*	*A*	M_0	*H*	*A*	M_0
Sex									
Female	60.4	43.5	0.263	33.0	52.2	0.172	42.7	49.6	0.212
Male	59.2	43.0	0.255	31.7	51.8	0.164	42.8	50.1	0.214
Age									
0 to 17 years	57.9	39.5	0.228	24.4	48.5	0.118	44.0	47.8	0.211
18 to 35 years	55.7	42.6	0.237	30.2	50.9	0.154	36.5	49.6	0.181
36 to 64 years	62.6	47.4	0.296	41.6	54.6	0.227	43.9	51.9	0.228
65+	86.8	51.1	0.443	63.3	57.5	0.364	64.1	54.5	0.349
Disability status									
PWD	2.6	51.2	0.423	60.7	57.4	0.348	61.0	54.4	0.332
No disability	9.2	43.0	0.254	31.6	51.7	0.163	42.2	49.6	0.210
Citizenship									
Citizen	61.0	43.3	0.264	33.1	52.0	0.172	43.6	49.8	0.217
Non-citizen	5.9	41.3	0.107	11.9	51.7	0.061	17.0	49.6	0.084
Sex of HH									
Female-headed	64.5	42.8	0.276	34.2	51.4	0.176	46.5	48.8	0.198
Male-headed	54.9	43.9	0.241	30.6	52.7	0.161	38.8	51.1	0.227
Age of HH									
12-17 (children)	73.8	39.0	0.288	21.4	50.2	0.108	65.6	50.7	0.333
18-35 (youth)	55.6	41.7	0.232	27.5	51.0	0.140	40.4	49.6	0.200
36-64 (adults)	56.4	43.1	0.243	30.1	51.8	0.156	39.5	49.5	0.196
65+ (older persons)	75.0	45.1	0.338	45.1	53.1	0.239	54.8	50.8	0.278
Marital status of HH									
Married	44.6	41.9	0.187	21.7	51.5	0.112	27.3	49.3	0.135
Living together	67.3	44.4	0.299	38.4	52.7	0.203	53.4	50.8	0.271
Separated	65.0	43.1	0.280	35.6	51.2	0.182	47.8	47.8	0.228
Divorced	52.9	42.6	0.225	28.6	51.1	0.146	35.4	50.1	0.177
Widowed/Widower	70.0	43.7	0.306	38.7	52.3	0.203	48.1	48.7	0.234
Never married	65.7	43.2	0.284	36.2	51.7	0.187	48.3	49.8	0.241
Household size									
1 to 3 members	54.3	44.6	0.242	30.5	53.8	0.164	37.5	51.2	0.192
4 to 6 members	53.8	42.7	0.230	28.1	51.7	0.145	37.0	49.7	0.184
7+ members	72.8	42.9	0.312	39.6	51.0	0.202	55.1	49.1	0.270
Education of HH									
None	80.6	46.7	0.376	52.1	53.9	0.281	65.0	52.2	0.339
Primary	71.0	42.9	0.305	38.1	51.4	0.196	49.6	49.0	0.243
Secondary	55.4	40.2	0.223	24.6	49.5	0.122	36.6	46.8	0.171
Vocational	36.3	37.4	0.136	12.4	47.1	0.058	16.5	44.8	0.074
University	15.7	38.0	0.060	5.3	50.0	0.026	6.9	52.5	0.036
Total	**59.9**	**43.3**	**0.259**	**32.4**	**52.0**	**0.169**	**42.7**	**49.8**	**0.213**

Source: Author's estimates based on the 2015/16 BMTHS data.

H: headcount ratio; *A*: intensity; M_0: adjusted headcount ratio; *HH*: household head.

[†]All percentages are estimated at the population level using sample weights. Sample size: 24,720. [a]Equal weighting structure across indicators.

Table A6.3: Robustness analysis using alternative parameters by economic variables 2015/16[†]

	k=25			*k*=40			Equal weight[a]		
Economic variables	*H*	*A*	M_0	*H*	*A*	M_0	*H*	*A*	M_0
Employment of HH									
Unemployed	73.5	44.3	0.325	43.2	51.9	0.224	55.8	50.4	0.281
Paid employment	39.9	39.4	0.157	15.6	50.1	0.078	22.5	46.4	0.104
Self-employment	43.6	39.7	0.173	17.9	50.1	0.090	25.3	45.0	0.114
Own farm	72.3	46.8	0.339	47.1	54.5	0.257	56.2	53.0	0.298
Unpaid family helper	82.0	46.9	0.384	52.8	54.1	0.286	70.6	52.7	0.372
Quintiles									
Q1	82.9	44.8	0.372	50.3	52.3	0.263	67.6	50.7	0.343
Q2	67.0	42.9	0.287	35.7	51.5	0.184	46.4	48.9	0.227
Q3	50.8	41.5	0.211	22.9	51.9	0.119	30.0	48.6	0.146
Q4	36.1	40.5	0.146	15.2	52.1	0.079	18.9	49.0	0.092
Q5	18.8	38.9	0.073	6.9	52.3	0.035	8.0	45.9	0.037
Total	**59.9**	**43.3**	**0.259**	**32.4**	**52.0**	**0.169**	**42.7**	**49.8**	**0.213**

Source: Author's estimates based on the 2015/16 BMTHS data.
H: headcount ratio; *A*: intensity; M_0: adjusted headcount ratio; *HH*: household head. [a]Equal weighting structure across indicators. [†]All percentages are estimated at the population level using sample weights. Sample size: 24,720. Per capita quintiles were calculated at the household level.

Table A6.4: Robustness analysis using alternative parameters by geography 2015/16[†]

	k=25			*k*=40			Equal weight[a]		
	H	*A*	M_0	*H*	*A*	M_0	*H*	*A*	M_0
Strata									
Cities/towns	33.9	39.2	0.133	13.3	49.6	0.066	20.1	46.2	0.093
Urban villages	56.1	40.8	0.229	25.6	50.2	0.128	33.4	45.9	0.153
Rural areas	80.3	46.5	0.374	52.5	53.5	0.281	68.2	52.9	0.361
Districts									
Gaborone	31.4	39.0	0.122	12.3	49.2	0.060	17.7	47.3	0.084
Francistown	41.2	40.4	0.167	18.3	50.2	0.092	25.5	45.5	0.116
Lobatse	46.8	37.8	0.177	15.6	47.4	0.074	31.7	40.4	0.128
Selibe Phikwe	34.8	39.4	0.137	12.8	50.7	0.065	22.7	45.7	0.104
Orapa	18.0	42.7	0.077	10.3	51.4	0.053	10.3	58.2	0.060
Jwaneng	23.2	35.4	0.082	4.4	47.1	0.021	9.8	48.6	0.048
Sowa Town	13.1	33.1	0.043	1.4	45.2	0.006	1.4	36.8	0.005
Southern	71.2	44.3	0.315	40.7	52.6	0.214	51.1	50.3	0.257
Barolong	74.4	42.9	0.319	39.0	51.6	0.201	53.2	46.3	0.246
Ngwaketse West	82.9	42.1	0.349	41.7	51.7	0.215	67.0	47.4	0.317
South East	42.9	40.0	0.172	18.5	49.7	0.092	21.3	47.6	0.101
Kweneng East	60.5	41.7	0.252	30.2	50.6	0.153	38.3	46.1	0.176
Kweneng West	87.3	50.7	0.442	68.0	55.7	0.379	79.4	56.3	0.447
Kgatleng	53.3	39.8	0.212	22.3	49.9	0.111	27.4	46.2	0.126
Central Serowe/Palapye	66.6	44.7	0.297	39.4	52.7	0.208	47.9	51.7	0.248
Central Mahalapye	74.4	44.3	0.330	45.2	51.1	0.231	58.9	49.0	0.289
Central Bobonong	72.3	41.9	0.302	35.9	51.2	0.184	53.4	47.7	0.254
Central Boteti	67.0	46.4	0.311	40.8	55.2	0.225	50.7	54.9	0.278
Central Tutume	70.5	44.6	0.315	40.7	52.6	0.214	58.9	51.9	0.306
North East	59.6	40.3	0.240	27.9	49.1	0.137	41.4	46.8	0.194
Ngamiland East	65.2	44.2	0.288	36.7	53.5	0.196	47.4	50.7	0.241
Ngamiland West	94.5	50.2	0.475	73.8	54.6	0.403	88.7	57.6	0.511
Chobe	47.9	38.3	0.183	16.7	48.0	0.080	31.6	44.0	0.139
Ghanzi	71.8	43.6	0.313	38.7	52.2	0.202	55.3	51.3	0.284
Kgalagadi South	72.0	43.4	0.312	40.9	50.6	0.207	61.0	47.9	0.292
Kgalagadi North	71.3	42.6	0.304	34.2	52.9	0.181	50.8	48.5	0.246
Total	**59.9**	**43.3**	**0.259**	**32.4**	**52.0**	**0.169**	**42.7**	**49.8**	**0.213**

Source: Author's estimates based on the 2015/16 BMTHS data. *H*: headcount ratio; *A*: intensity; M_0: adjusted headcount ratio; *HH*: household head. [†]All percentages are estimated at the population level using sample weights. Sample size: 24,720. [a]Equal weighting structure across indicators.

Table A6.5: Simultaneous quantile regression and OLS regression results†

	quantile 25		quantile 50		quantile 75		OLS	
	Coefficient	SE	Coefficient	SE	Coefficient	SE	Coefficient	SE
Sex (*base: Female*)								
Male	0.0005	0.0016	0.0013	0.0025	0.0005	0.0025	0.0006	0.0017
Age	0.0004*	0.0002	0.0016***	0.0002	0.0023***	0.0002	0.0015***	0.0001
Age squared	0.00001***	0.0000	0.00001***	0.0000	0.00001	0.0000	0.000001***	0.0000
Disability status (*base: Non-disabled*)								
Disabled	0.0477***	0.0083	0.0416***	0.0082	0.0376***	0.0104	0.0412***	0.0052
Citizenship status (*base: Non-citizen*)								
Citizen	0.0083	0.0056	0.0202***	0.0058	0.0317***	0.0074	0.0204***	0.0050
Household size	-0.0062***	0.0008	-0.0106***	0.0007	-0.0108***	0.0012	-0.0100***	0.0008
Household squared	0.0003***	0.0000	0.0005***	0.0000	0.0005***	0.0001	0.0005***	0.0000
Sex of HH (*base: FHH*)								
Male HH	0.0014	0.0023	0.0057***	0.0020	0.0141***	0.0033	0.0093***	0.0021
Marital status of HH (*base: Married*)								
Living together	0.0582***	0.0033	0.0614***	0.0032	0.0691***	0.0039	0.0638***	0.0025
Separated	0.0297***	0.0068	0.0416***	0.0056	0.0590***	0.0112	0.0463***	0.0061
Divorced	0.0259***	0.0066	0.0205***	0.0061	0.0435***	0.0110	0.0316***	0.0064
Widowed/widower	0.0204***	0.0051	0.0209***	0.0042	0.0354***	0.0067	0.0268***	0.0032
Never married	0.0418***	0.0026	0.0527***	0.0028	0.0651***	0.0041	0.0546***	0.0026
Age of HH (*base: 36-64 years*)								
12-17 years (children)	0.0923***	0.0324	0.0616***	0.0161	0.0143	0.0175	0.0384**	0.0183
18-35 years (youth)	0.0316***	0.0023	0.0311***	0.0034	0.0306***	0.0031	0.0313***	0.0024
Over 65 years (older persons)	-0.0117***	0.0037	-0.0160***	0.0037	-0.0209***	0.0043	-0.0172***	0.0026
Education of HH (*base: None*)								
Primary	-0.0345***	0.0038	-0.0427***	0.0041	-0.0447***	0.0050	-0.0406***	0.0024
Secondary	-0.0717***	0.0045	-0.0842***	0.0056	-0.0837***	0.0047	-0.0802***	0.0028
Vocational	-0.0908***	0.0057	-0.0978***	0.0077	-0.0992***	0.0062	-0.0965***	0.0052
University	-0.1174***	0.0044	-0.1450***	0.0058	-0.1574***	0.0050	-0.1388***	0.0036
Employment status of HH (*base: Unemployed*)								
Paid employment	-0.0088**	0.0036	-0.0100***	0.0030	-0.0171***	0.0040	-0.0122***	0.0028
Self-employment	0.0137***	0.0046	0.0248***	0.0046	0.0305***	0.0052	0.0228***	0.0033
Own farm	0.0569***	0.0050	0.0533***	0.0052	0.0519***	0.0054	0.0514***	0.0035
Quintiles (*base: Q1*)								

Q2	-0.0555***	0.0033	-0.0509***	0.0039	-0.0420***	0.0035	-0.0484***	0.0023
Q3	-0.0946***	0.0042	-0.0957***	0.0030	-0.0853***	0.0051	-0.0866***	0.0028
Q4	-0.1194***	0.0044	-0.1289***	0.0041	-0.1218***	0.0048	-0.1178***	0.0032
Q5	-0.1423***	0.0038	-0.1605***	0.0056	-0.1640***	0.0065	-0.1534***	0.0038
Strata (*base: Urban villages*)								
Cities and towns	-0.0261***	0.0028	-0.0282***	0.0035	-0.0295***	0.0035	-0.0270***	0.0023
Rural areas	0.0579***	0.0030	0.0680***	0.0024	0.0641***	0.0032	0.0639***	0.0020
Constant	0.2625***	0.0102	0.3380***	0.0083	0.3995***	0.0145	0.3345***	0.0074
Number of observations	24,720		24,720		24,720		24,720	
Pseudo *R*-squared	0.2673		0.2807		0.2739		0.4498	

Source: Author's estimates based on the 2015/16 BMTHS data. *HH* stands for the household head. *FHH* stands for the female-headed household.
Robust standard errors (SE) clustered at the household level. †All percentages are estimated at the population level using sample weights. Sample size: 24,720.

Table A6.6: Multilevel logistic regression†

	Model 1		Model 2	
	Coefficient	SE	Coefficient	SE
Sex (*base: Female*)				
Male			0.0375	0.0325
Age			0.0196***	0.0026
Age squared			0.0001***	0.0000
Disability status (*base: Non-disabled*)				
Disabled			0.5504***	0.1078
Citizenship status (*base: Non-citizen*)				
Citizen			0.4709***	0.1156
Household size			-0.1619***	0.0159
Household squared			0.0096***	0.0009
Sex of HH (*base: FHH*)				
Male HH			0.1251***	0.0399
Marital status of HH (*base: Married*)				
Living together			0.9367***	0.0491
Separated			0.7550***	0.1101
Divorced			0.2442***	0.1244
Widowed/widower			0.2960***	0.0590
Never married			0.7987***	0.0504
Age of HH (*base: 36-64 years*)				
12-17 years (children)			0.6931**	0.3316
18-35 years (youth)			0.3103***	0.0470
Over 65 years (older persons)			-0.0965***	0.0467
Education of HH (*base: None*)				
Primary			-0.3562***	0.0434
Secondary			-0.7695***	0.0514
Vocational			-1.1488***	0.1040
University			-1.8602***	0.0806
Employment status of HH (*base: Unemployed*)				
Paid employment			-0.2726***	0.0545
Self-employment			0.1223**	0.0625
Own farm			0.7131***	0.0679
Quintiles (*base: Q1*)				
Q2			-0.6178***	0.0417
Q3			-1.1476***	0.0506
Q4			-1.5639***	0.0624
Q5			-2.2188***	0.0818
Strata (*base: Urban villages*)				
Cities and towns			-0.6349***	0.2258
Rural areas			0.8864***	0.0391
Constant	-0.2064	0.2025	-0.3376*	0.1902
Number of observations	24,720		24,720	
Variance components	1.0500		0.2276	
Chi2	2866.06***		374.74***	
ICC	0.2419		0.0645	

Source: Authors' estimates based on the 2015/16 BMTHS data.
†Sample size: 24,720. *HH* stands for household head; *MHH* stands for Male-headed household; ICC: Intraclass correlation coefficient. Significance levels: *p <0.1; **p <0.05; ***p <0.01.

Appendix A7 for chapter 7

Table A7.1: Proportion of deprived children by indicator and age groups[†]

Dimensions	Indicator	0-4 years (*n*=3,104)	5-9 years (*n*=2,842)	10-14 years (*n*=2,547)	15-17 years (*n*=1,225)
1. Asset	Information	26.6 (0.442)	24.9 (0.432)	23.5 (0.424)	23.9 (0.426)
	Durable goods	61.0 (0.488)	59.5 (0.491)	58.1 (0.493)	57.2 (0.495)
	Transport	74.4 (0.436)	73.4 (0.442)	74.4 (0.437)	72.7 (0.446)
	Land tenure	34.1 (0.474)	33.3 (0.471)	29.7 (0.457)	32.0 (0.466)
2. Housing	Overcrowding	46.4 (0.499)	45.9 (0.498)	43.2 (0.495)	40.2 (0.490)
	Cooking fuel	55.9 (0.497)	54.9 (0.498)	53.7 (0.499)	50.1 (0.500)
	Floor material	15.4 (0.361)	13.9 (0.346)	10.6 (0.308)	10.9 (0.312)
	Roof material	13.2 (0.339)	11.8 (0.323)	10.3 (0.304)	9.0 (0.287)
	Wall material	21.1 (0.408)	19.1 (0.393)	15.6 (0.363)	15.3 (0.360)
	Electricity	41.8 (0.493)	39.9 (0.490)	38.1 (0.486)	35.0 (0.477)
3. Water & sanitation	Water supply	10.6 (0.308)	7.4 (0.261)	5.8 (0.234)	6.6 (0.248)
	Toilet facility	70.4 (0.456)	68.7 (0.464)	69.9 (0.459)	67.8 (0.467)
4. Food security	HFIAP	55.5 (0.497)	54.1 (0.498)	53.5 (0.499)	54.5 (0.498)
	WAZ	7.6 (0.265)	-	-	-
	HAZ	17.4 (0.379)	-	-	-
	WAZ	5.2 (0.223)	-	-	-
	BMI	-	8.9 (0.285)	12.6 (0.332)	10.9 (0.312)
5. Health	Health facility	35.4 (0.478)	36.0 (0.480)	33.8 (0.473)	35.1 (0.477)
	Chronic illness	1.2 (0.110)	2.7 (0.161)	3.8 (0.192)	5.2 (0.222)
6. Education	Enrolment	-	14.3 (0.351)	1.6 (0.126)	19.7 (0.398)
	Literacy	-	-	-	1.0 (0.100)
7. Security	Safety	38.9 (0.488)	38.4 (0.486)	39.2 (0.488)	40.2 (0.490)
	Crime	9.5 (0.293)	10.4 (0.305)	10.7 (0.309)	10.1 (0.301)

Source: Author's estimates based on the 2015/16 BMTHS data.

[†]All percentages are estimated at the population level using sample weights. Standard deviations (SD) are reported in parentheses. *n* is the sample size for different age groups. -The indicator is not applicable to the age group.

Table A7.2: Robustness checking using three alternative values of k 2015/16†

	k =0.33			k =0.25			k =0.40		
Variable	H	A	M_0	H	A	M_0	H	A	M_0
Sex									
Male	42.6	43.7	0.186	59.7	39.5	0.236	25.2	48.8	0.123
Female	40.7	43.2	0.176	58.0	39.0	0.226	23.5	48.2	0.113
Age									
0 to 4 years	46.3	44.1	0.204	65.2	39.5	0.258	29.3	48.7	0.143
5 to 9 years	42.0	44.4	0.187	58.0	40.3	0.234	25.4	49.6	0.126
10 to 14 years	36.5	41.5	0.152	53.7	37.7	0.202	17.8	47.0	0.084
15-17 years	40.1	42.9	0.172	55.7	39.1	0.218	23.3	47.6	0.111
Region									
Cities/towns	19.3	42.2	0.081	31.8	37.1	0.118	9.4	48.4	0.046
Urban villages	34.4	42.1	0.145	53.6	37.4	0.200	18.3	47.4	0.087
Rural areas	60.5	44.5	0.269	77.5	41.2	0.319	38.2	49.2	0.188
District									
Gaborone	18.7	42.7	0.080	28.9	37.9	0.110	9.7	48.9	0.047
Francistown	22.4	43.5	0.097	38.4	37.6	0.144	13.3	48.2	0.064
Lobatse	26.0	37.6	0.098	48.3	33.7	0.163	6.4	43.0	0.027
Selibe Phikwe	20.7	40.4	0.083	32.1	36.5	0.117	6.7	47.0	0.031
Orapa	8.0	55.6	0.044	13.3	44.8	0.059	8.0	55.6	0.044
Jwaneng	7.3	39.8	0.029	20.6	32.9	0.068	3.5	46.9	0.016
Sowa Town	0.0	0.00	0.000	9.3	29.8	0.028	0.0	0.00	0.000
Southern	49.1	43.6	0.214	67.6	39.6	0.268	28.2	49.4	0.139
Barolong	45.6	40.9	0.187	67.8	37.2	0.252	18.4	48.1	0.088
Ngwaketse West	36.4	42.3	0.154	81.2	35.1	0.285	20.3	47.4	0.096
South East	23.7	42.1	0.100	38.1	37.1	0.141	13.2	47.3	0.062
Kweneng East	38.1	42.4	0.161	59.2	37.6	0.223	21.6	47.1	0.101
Kweneng West	76.8	48.1	0.370	89.9	45.3	0.407	61.6	51.1	0.315
Kgatleng	25.4	40.9	0.104	42.7	36.2	0.155	11.7	46.9	0.055
Central Serowe/Palapye	45.1	44.4	0.200	61.8	40.2	0.249	28.0	49.2	0.138
Central Mahalapye	56.8	43.2	0.245	72.1	40.3	0.290	33.9	47.8	0.162
Central Bobonong	43.8	40.7	0.178	68.6	36.3	0.249	20.2	45.8	0.093
Central Boteti	49.8	45.5	0.227	67.1	41.1	0.276	36.1	49.0	0.177
Central Tutume	52.6	43.7	0.230	68.8	40.4	0.278	31.1	48.7	0.152
North East	33.7	41.6	0.140	56.4	36.4	0.206	17.0	46.8	0.080
Ngamiland East	39.6	44.0	0.174	59.4	38.8	0.230	24.4	49.0	0.120
Ngamiland West	86.0	45.8	0.394	94.1	44.5	0.419	64.6	48.8	0.316
Chobe	39.3	37.8	0.149	50.3	36.0	0.181	8.5	46.3	0.039
Ghanzi	46.6	42.8	0.199	66.7	38.7	0.258	23.0	48.6	0.112
Kgalagadi South	53.4	41.5	0.222	70.5	38.5	0.271	24.1	47.8	0.115
Kgalagadi North	45.2	43.6	0.197	77.2	37.7	0.291	20.4	52.2	0.107
Total	**41.7**	**43.4**	**0.181**	**58.9**	**39.2**	**0.231**	**24.4**	**48.5**	**0.118**

Source: Author's estimates based on the 2015/16 BMTHS data.

H: headcount ratio; *A*: intensity; M_0: adjusted headcount ratio; *HH*: household head.

†All percentages are estimated at the population level using sample weights. Sample size: 9,718.

Appendix A8 for chapter 8

Table A8.1: Monetary and multidimensional poverty estimates by districts 2015/16†

	Pop. share	*PDL*	*MPI*	ΔPrevalence
Gaborone	11.5	7.7 (3)	20.6 (4)	+12.9
Francistown	4.4	12.4 (10)	28.4 (6)	+16.0
Lobatse	1.1	9.8 (7)	31.7 (8)	+21.9
Selibe Phikwe	2.6	10.4 (8)	23.2 (5)	+12.8
Orapa	0.5	17.5 (16)	12.9 (2)	-4.60
Jwaneng	0.9	9.1 (6)	13.8 (3)	+4.70
Sowa Town	0.1	5.0 (1)	4.6 (1)	-0.40
Ngwaketse	5.8	17.7 (17)	56.7 (18)	+39.0
Barolong	2.6	13.7 (13)	57.6 (20)	+43.9
Ngwaketse West	0.7	40.3 (25)	61.0 (23)	+20.7
South East	4.3	8.1 (4)	29.2 (7)	+21.1
Kweneng East	14.3	15.8 (15)	44.5 (12)	+28.6
Kweneng West	2.5	50.6 (26)	78.8 (25)	+28.2
Kgatleng	4.5	8.4 (5)	35.7 (10)	+27.3
Central Serowe	8.9	11.6 (9)	53.2 (15)	+41.6
Central Mahalapye	6.5	18.2 (18)	62.8 (24)	+44.6
Central Bobonong	3.1	13.9 (14)	54.8 (16)	+41.0
Central Boteti	2.8	12.9 (11)	55.1 (17)	+42.1
Central Tutume	6.9	21.2 (20)	57.8 (21)	+36.6
North East	2.3	7.2 (2)	42.6 (11)	+35.4
Ngamiland East	5.1	21.6 (21)	48.7 (13)	+27.1
Ngamiland West	3.1	33.4 (22)	88.1 (26)	+54.8
Chobe	1.2	19.3 (19)	34.7 (9)	+15.4
Ghanzi	2.2	36.3 (23)	57.1 (19)	+20.8
Kgalagadi South	1.2	39.5 (24)	60.2 (22)	+20.7
Kgalagadi North	0.8	13.4 (12)	53.1 (14)	+39.7

Source: Author's estimates based on the 2015/16 BMTHS data.
ΔPrevalence is the difference between *MPI* and *PDL* (*MPI-PDL*).
†All percentages are estimated at the population level using sample weights.

Table A8.2: Poverty mismatch and overlap across strata 2015/16†

	PDL poor (*A*)	*MPI* poor (*B*)	Both poor (*AB*)	Non-poor (*C*)	Total
Cities/Towns	4.2	17.4	5.1	73.2	100.0
Urban Villages	4.3	31.2	9.0	55.5	100.0
Rural areas	4.2	48.1	20.0	27.7	100.0
Total	**4.3**	**34.2**	**12.0**	**49.5**	**100.0**

Source: Author's estimates based on the 2015/16 BMTHS data.
†All percentages are estimated at the population level using sample weights. Sample size: 24,720.