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Abbreviations and Acronyms

2SLS	Two-Stage-Least-Squares
3SLS	Three-Stage-Least-Squares
ACT	Artemisinin based Combination Treatment
ADDO	Accredited Drug-Dispensing Outlets
ALMA	African Leaders Malaria Alliance
ANC	Antenatal Care
ARI	Acute Respiratory Infection
BCC	Behaviour Change Communication
BEST	Basic Education Statistics Tanzania
CBA	Cost-Benefit Analysis
CCM	Chama Cha Mapinduzi
CEA	Cost-Effectiveness Analysis
CFA	Case-fatality rate
CHADEMA	Chama cha Demokrasia na Maendeleo
CHOICE	CHOosing Interventions that are Cost Effective
CQ	Chloroquine
CUF	Civic United Front
DALY	Disability-Adjusted Life Year
DHS	Demographic and Health SurveyDHS
DISC	Diagnosis of Sustainable Collaboration
DMA	Decision Maker's Appraoch
ESDP	Education Sector Development Programme
EWURA	Energy and Water Utilities Regulatory Authority
FBOs	Faith-Based-Organizations
GDP	Gross Domestic Product
GMM	Generalized Method of Moments
HDSS	Health Demographic Surveillance System
HiAP	Health in All Policies
HMIS	HIV/AIDS and Malaria Indicator Survey
HSBF	Health Sector Basket Fund
HYE	Healthy Years Equivalents

IFPRI	International Food Policy Research Institute
IHA	Intersectoral Health Action
IHI	IFAKARA Health Institute
IPT	Intermittent Preventive Treatment
IPTi	Intermittent Preventive Treatment in infants
IPTP	Intermittent presumptive treatment with SP in pregnancy
IRS	Indoor Residual Spraying
ITN	Insecticide-Treated bed Net
LGAs	Local Government Authorities
LLIN	Long-lasting Insecticide-treated Nets
M&E	Monitoring and Evaluation
MCT	Media Council of Tanzania
MDG	Millennium Development Goals
MMTSP	Malaria Medium-Term Strategic Plan
MoEVT	Ministry of Education and Vocational Training
MoFEA	Ministry of Finance and Economic Affairs
MoHSW	Ministry of Health and Social Welfare
MoWI	Ministry of Water and Irrigation
MSPAS	Ministry of Public Health and Social Assistance, El Salvador
NBS	National Bureau of Statistics
NEC	National Electoral Commission
NGO	Nongovernmental Organization
NIP	Nutrition Improvement Project
NMCP	National Malaria Control Programme
OLS	Ordinary Least Squares
PASHA	Prevention and Awareness in Schools of HIV/AIDS
PHAC	Public Health Agency of Canada
PMI	President's Malaria Initiative
PMO-RALG	Prime Minister's Office Regional Administration and Local Government
PNVR	Permanent National Voters Register
PPPHW	Public-Private Partnership for Handwashing with Soap
PTR	Pupils-Teacher-Ratio
RBM	Roll Back Malaria Partnership

RDT	Rapid Diagnostic Test
SDOH	Social Determinants of Health
SEM	Simultaneous Equation Model
SMS	Short Message System
SP	Sulphadoxine-Pyrimethamine
SRH	Sexual and Reproductive Health
SWAP	Sector Wide Approach
TACAIDS	Tanzania Commission for AIDS
TDHS	Tanzania Demographic and Health Survey
TGPSH	Tanzanian German Programme to Support Health
TNVS	Tanzania National Voucher Scheme
URT	United Republic of Tanzania
WHO	World Health Organization
WTP	Willingness To Pay
WSDP	Water Sector Development Program
ZEF	Zentrum für Entwicklungsforschung / Center for Development Research

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Abstract

The optimal allocation of scarce resources for health improvement is a crucial factor to lower the burden of disease and to strengthen the productive capacities of people living in developing countries. This research project aims to devise tools in narrowing the gap between the actual allocation and a more efficient allocation of resources for health in the case of Tanzania. Firstly, the returns from alternative government spending across sectors such as agriculture, water etc. are analysed. Maximisation of the amount of Disability Adjusted Life Years (DALYs) averted per dollar invested is used as criteria. A Simultaneous Equation Model (SEM) is developed to estimate the required elasticities. The results of the quantitative analysis show that the highest returns on DALYs are obtained by investments in improved nutrition and access to safe water sources, followed by spending on sanitation.

Secondly, focusing on the health sector itself, scarce resources for health improvement create the incentive to prioritise certain health interventions. Using the example of malaria, the objective of the second stage is to evaluate whether interventions are prioritized in such a way that the marginal dollar goes to where it has the highest effect on averting DALYs. PopMod, a longitudinal population model, is used to estimate the cost-effectiveness of six isolated and combined malaria intervention approaches. The results of the longitudinal population model show that preventive interventions such as insecticide–treated bed nets (ITNs) and intermittent presumptive treatment with Sulphadoxine-Pyrimethamine (SP) during pregnancy had the highest health returns (both US$ 41 per DALY averted).

The third part of this dissertation focuses on the political economy aspect of the allocation of scarce resources for health improvement. The objective here is to positively assess how political party competition and the access to mass media directly affect the distribution of district resources for health improvement. Estimates of cross-sectional and panel data regression analysis imply that a one-percentage point smaller difference (the higher the competition is) between the winning party and the second-place party leads to a 0.151 percentage point increase in public health spending, which is significant at the five percent level. In conclusion, we can say that cross-sectoral effects, the cost-effectiveness of health interventions and the political environment are important factors at play in the country's resource allocation decisions. In absolute terms, current financial resources to lower the burden of disease in Tanzania are substantial. However, there is a huge potential in optimizing the allocation of these resources for a better health return.

Zusammenfassung

Die optimale Allokation von knappen Ressourcen zur Verbesserung der Gesundheit ist ein entscheidender Faktor für die Verringerung der Krankheitslast und die Stärkung der verfügbaren Produktionskapazitäten in Entwicklungsländern. Die vorliegende Dissertation soll durch die Anwendung verschiedener empirischer Methoden am Beispiel Tansanias zeigen, wie die Kluft zwischen der aktuellen und einer effizienteren Allokation von Gesundheitsressourcen verringert werden kann. In einem ersten Schritt wird analysiert, inwiefern sektorenübergreifende Investitionen in Landwirtschaft, Wasser etc. zur Verbesserung der Gesundheit beitragen können. Zur Schätzung der entsprechenden Elastizitäten wird ein simultanes Gleichungsmodell (SEM) mit dem Zielkriterium der sogenannten behinderungsbereinigten Lebensjahre (Disability Adjusted Life Years, DALYs) als Maßstab für Gesundheit formuliert. Die Ergebnisse der quantitativen Analyse zeigen, dass Investitionen in verbesserte Ernährung und Zugang zu sauberem Trinkwasser den größten positiven Effekt auf die Gesundheit der Bevölkerung haben.

Knappe Ressourcen im Gesundheitssektor schaffen den Anreiz, sich auf bestimmte Maßnahmen zu konzentrieren. Im zweiten Schritt dieser Dissertation wird daher am Beispiel von Malaria analysiert, wie bei einem gegebenen Budget bestimmte Maßnahmen zu priorisieren sind, um den positiven Gesamteffekt auf die Gesundheit zu maximieren. Das Verhältnis von Kosten und Effektivität von Malariainterventionen wird anhand eines Bevölkerungsmodells (PopMod) geschätzt. Die Ergebnisse der Analyse verdeutlichen, dass präventive Maßnahmen wie die Nutzung von mit Insektiziden behandelte Moskitonetze (ITNs) und die vorsorgliche Behandlung von Schwangeren mit Sulphadoxine-Pyrimethamine (SP) den größten Effekt auf die Verbesserung des Gesundheitszustandes der Bevölkerung haben.

Im dritten Schritt wird im Rahmen der politischen Ökonomie analysiert, welche Auswirkungen der Wettbewerb zwischen politischen Parteien und der Zugang zu Massenmedien auf die Bereitstellung öffentlicher Gesundheitsgüter haben. Die Ergebnisse der Querschnitts- bzw. Paneldatenanalyse zeigen, dass ein um einen Prozentpunkt geringerer Unterschied (je größer der Wettbewerb) zwischen der erst- und zweitplatzierten Partei zu einem signifikanten Anstieg der öffentlichen Gesundheitsausgaben um 0,151 Prozentpunkte führt. Die vorliegende Dissertation identifiziert somit sektorenübergreifende Investitionen, die Kosteneffizienz von Interventionen und das politische Umfeld als ausschlaggebende Faktoren, die in Entscheidungen zur Allokation von knappen Gesundheitsressourcen einfließen sollten.

1. Introduction

The first chapter presents a brief introduction into the topic of resource allocation for health and derives the objectives and research questions of this dissertation. Section 1.1 gives some background information on the research topic and outlines the allocative decisions, which will be analysed in this dissertation. This is followed by a presentation of the research objectives in section 1.2, the main research questions and hypotheses in section 1.3 and the structure of the present work (section 1.4).

1.1 Resource Allocation for Health

Human capital investments are critical for the development and growth of nations. In addition to education and training, a minimum level of health care is a crucial factor to increase the productive capacity of people (Hayami, 2005). The Millennium Development Goals (MDGs), defined in the year 2000, addressed this challenge by calling for a reduction of child mortality rates (MDG4), an improvement of maternal health (MDG5), and the combat of HIV/AIDS, Malaria, and other diseases (MDG6).

Today, developing countries are still faced with an extreme scarcity of resources for health improvement and an enormous burden of disease, especially among the poor and the marginalized, due to the vicious circle of poverty and ill health. Thus, strengthening the development and growth of a nation stricken by poverty will require governments to provide a minimum level of public health services to their citizens. However, the provision of public services strongly depends on the resources available at lower government levels. Since these resources are extremely scarce for the majority of developing countries, there is a need for prioritization. One example of a country facing these problems is the United Republic of Tanzania (Tanzania), which is said to have a highly inefficient health system (Makundi et al., 2007 I) with a very low physician-to-population ratio compared to many other developing countries (Munga and Maestad, 2009). One way to deal with these challenges is to allocate more efficiently the given resources for health improvement.

This dissertation aims to identify possible alternative strategies to close the gap between the actual allocation and the potentially more efficient allocation of scarce resources for health improvement in the case of Tanzania. Decisions on allocative issues are reached at various government levels, for example, at the central level, on general budget affairs or, at the district level, on the actual provision of public health services. In the following analysis,

allocative decisions at three government levels will be evaluated in order to identify the determinants of resource allocation. At the regional level, the marginal health returns to cross-sectoral government expenditures, measured in Disability Adjusted Life Years (DALYs), will be analyzed to identify the potential for Intersectoral Health Action (IHA). The hypothesis that health priorities, at the central government level, are set in such a way that the marginal dollar goes to where it has the highest effect on averting[1] DALYs will be tested, taking the case of malaria. From the central to the district level, we will explore how mechanisms of the political economy influence the distribution of resources and we will show how the resulting allocation may differ from an allocation in accordance with the burden of disease.

1.2 Objectives and Purpose

This dissertation aims to identify various ways to narrow the gap between a more efficient allocation and the actual allocation of resources for health improvement in Tanzania. This discussion is quite relevant due to the extreme scarcity of resources for health improvement as well as the high burden of diseases, such as HIV/AIDS or Malaria, present in Tanzania.

One way to address this challenge is to allocate resources to government sectors with the highest impact on public health, since most of the common diseases in Tanzania have multifaceted causes, led by malnutrition and poor water supply (WHO & UN Water, 2012; NBS and Macro International Inc., 2011). However, should the government spend more on health care, education, infrastructure, or agricultural research to alleviate the intolerable burden of disease? Fan (2000, 2002, 2004, 2005) has used sectoral budget analysis to build a Simultaneous Equation Model (SEM) aiming at the exploration of the relative impacts of cross-sectoral government expenditures, such as education and health, on poverty reduction in the cases of India, China, Uganda, and Tanzania. In the case of Tanzania, Fan found that additional public investment in education, roads, and agricultural research has favorable impacts on poverty reduction. Part one of the proposed research builds on these results and uses a similar model to identify the marginal health returns to cross-sectoral government expenditures, under the normative assumption of minimizing DALYs. The analysis applies sectoral budget analysis as a new approach to evaluate the effects of IHA.

[1] DALYs are negatively defined, which means that a DALY is a Disability Adjusted Life Year lost. Thus, interventions aim at averting DALYs.

According to the Government of Tanzania (URT, 2010), the "recognition of cross-sectoral contribution to outcomes and inter-sectoral linkages and synergies" is one of the major prerequisites for the implementation of the Tanzanian poverty reduction strategy MKUKUTA. Each of the government's major sectors has its own prime objectives. Health is one of these major sectors, but improving health affects all other sectors' achievement of their objectives. The results of this budget analysis will be used as a basis to discuss the challenges and opportunities that arise during the process of cross-sectoral collaboration. As an outcome, policy recommendations on how to improve IHA will be provided.

Since resources for health interventions in a developing country like Tanzania are extremely scarce, there is also a need for prioritizing health interventions. However, most of these resources remain disproportionately spent on health interventions with a low overall impact (James et al., 2005). To contribute to the solution of this problem, the objective of part two is to carry out a normative analysis on how health interventions should be prioritized in such a way that the marginal dollar goes to where it has the highest effect on averting DALYs. The analysis is carried out on the example of interventions combating malaria and builds on a comprehensive study led by the WHO (Morel et al., 2005). For the whole of southern and eastern Africa, a state-transition model was used to show that case management with ACT at 90% target coverage is most cost-effective in lowering the malaria burden (INT$ 12 per DALY averted), followed by the combination of ITNs (INT$ 28), IRS (INT$ 41), and IPTP (INT$ 41). However, this and further studies have limited relevance in the priority setting process of a single country, since many factors may vary across settings, e.g. the availability, mix and quality of inputs, local prices, labour costs, demographic structures, and epidemiological characteristics (Hutubessy et al., 2003). Consequently, there is a need for country-specific cost-effectiveness assessments. The few analyses that exist for the case of Tanzania have assessed single malaria interventions with limited specifications only. This study will be the first to analyze several strategies to combat malaria within a standardized modelling framework, making results comparable.

In order to take into account changing resistance of parasites to certain malaria drugs, the long-term population-level impact of selected interventions is calculated by tracking the Tanzanian population over a ten-year implementation period, from 2002 to 2012. In the case of Tanzania, malaria causes the second largest disease burden after HIV/AIDS (WHO, 2009). The ecological conditions of the country favor the expansion of the anopheles gambiae, which

is the most effective mosquito in transmitting malaria parasites. Tanzania has made great progress in scaling up interventions to fight the dreaded disease, including the distribution of insecticide–treated bed nets (ITNs), indoor residual spraying (IRS), intermittent presumptive treatment with Sulphadoxine-Pyrimethamine (SP) during pregnancy, and case management with Chloroquine (CQ), SP, and Artemisinin-based combination treatments (ACTs). The Tanzanian government has already acknowledged the importance of prioritization with respect to the health sector. " […] prioritisation within these sectors needs to receive maximum attention to ensure the efficiency and effectiveness of the spending programs" (URT, 2011 II, p. 14). To achieve this, timely information on health effects and costs of several measures to combat malaria are urgently needed to inform policy makers. The actual allocation of financial resources, within the health sector to fight malaria, will be compared to an optimal allocation, based on the results of this analysis. The identification of the relative impact of various measures to strengthen public health will enable policymakers to understand the trade-offs between different investments and enable them to set health priorities in such a way that a higher amount of DALYs can be averted.

Distributing resources for health improvement to regions, proportionally to the burden of disease, can reduce inefficiencies in the allocation of these resources. However, political economy influences may hinder this process. Similarly to other countries, Tanzania allocates government and non-government resources for health improvement, from the national to the district level, according to an official allocation formula, taking into account population patterns, poverty, remoteness, and the burden of disease. It remains questionable whether these are the only determinants of local resources for health improvement since politicians have different incentives to provide public health services and to reduce poverty. Governments are responsive through the electoral process (Downs 1957). Studies of government responsiveness in Britain, Denmark, and the United States showed that political attention is indeed higher when under pressure (Hobolt and Klemmensen, 2007). Consequently, the amount of district health spending is also based on various political factors, such as the competition among political parties. Beyond political factors, mass media affects the level of district resources for health improvement due to their role of transmitting politically relevant information to the electorate and monitoring politicians' efforts to providing public services (Besley, Burges and Prat 2002, Strömberg 2004).

However, most of the previous studies focus on the political economy of developed countries, and, in particular, the United States. Since institutional arrangements and electoral systems are at an earlier stage in the developing world, mechanisms of government attention might differ. As a contribution to close this research gap, the following analysis aims at answering the question whether similar effects of political factors and mass media on government responsiveness also exist in a very low-income country. Consequently, recommendations to modify allocative decision mechanisms can be made and the importance of good governance for the political economy will be explained.

1.3 Main Research Question, Hypotheses, and Sub-Questions

To answer the main research question: "how to close the gap between actual and optimal resource allocation for health in Tanzania", selected theories of health resource allocation will be tested. Each research question focuses on a certain level of action. Firstly, at the regional level, potential synergies between the health sector and related sectors, through cross-sectoral collaboration, will be identified and analyzed (chapter three). Secondly, the process of health priority setting, in a context of extreme resource scarcity, will be analyzed taking the case of malaria (chapter four). From the central to the local level, we will explore whether resources for health improvement are allocated to the district level, in accordance with the potential of reducing the burden of disease. Furthermore, the role of the political economy will also be explored (chapter five).

In accordance with the theoretical framework described in section 3.3, IHA is needed to improve the health status of people living in developing countries. Since governments face tight budgets, politicians need to know the health impact of additional investment in health related areas and synergies across sectors. The underlying normative concept to measure these elasticities is to calculate the amount of DALYs that can be averted per additional dollar invested. Consequently, chapter three of this dissertation aims to answer the following research question:

Q1: What are the marginal health returns on government expenditure across sectors?

The study benefits from secondary data on social indicators and public spending within a Simultaneous Equation Model (SEM). Information on the returns on investments in various sectors is a pre-requisite to devise ways to explore mechanisms in order to implement cross-sectoral collaboration. Such an interdisciplinary approach is applied, for example, when the

transport sector includes questions regarding the reduction of pedestrian and vehicle accidents into their proposal for a new freeway (Egan et al., 2003). According to coalition theory, which is the underlying theoretical concept of IHA, the determinants of successful cross-sectoral collaboration are the initial distribution of resources, the payoffs for each sector, non-utilitarian preferences, and the rules of the game (Gamson (1961), see section 3.3.1). In assuming that these factors are determined in such a way that all sectors profit from cooperation, we can assume the validation of the following hypothesis:

H1: Intersectoral Health Action (IHA) leads to synergies in allocating resources for health improvement and contributes to an optimized resource allocation for health.

To better understand the mechanisms behind IHA, the following subquestions have to be answered: what are the major preconditions for a successful cross-sectoral collaboration? Which organisations and ministries are currently the main drivers for IHA? Does IHA include the private sector and faith based organisations? All these sub questions will be answered with the help of semi-structured interviews and the analysis of key documents.

Moving from cross-sectoral thoughts to the health sector itself, one key challenge is to reduce major projected causes of the disease burden by increasing the allocative and technical efficiency of health systems. In this context, allocative efficiency means the distribution of resources for health improvement across interventions in such a way that the highest possible level of health is reached for the people living in a certain region. Since resources in a developing country like Tanzania are extremely scarce, priorities of health interventions have to be set. Priority setting is most important for interventions combating major diseases, for example, plasmodium falciparum malaria, causing the second highest burden of disease in the country. Assuming an optimal allocation of resources for health improvement and the minimization of DALYs as a normative measurement concept, we can state the following hypothesis:

H2: Interventions to combat malaria are prioritized in such a way that the marginal dollar goes to where it has the highest impact on averting DALYs.

Methodically, cost-effectiveness analysis (CEA) will be applied to test this hypothesis. The identification of the relative impact of various measures to lower the malaria burden will enable policymakers to understand the trade-offs between different strategies. Moreover, an

adequate priority setting process to ensure efficient resources allocation depends heavily on the availability, the quality, and the use of health information as an input into the decision-making process. Consequently, the first problem within this process might be the responsible health planners' lack of awareness of the impacts of certain health investments and the missing capacities and incentives to carry out an appropriate priority setting process that includes questions of allocative efficiency. Secondly, the criteria of Donors and NGOs may be used to set health priorities (e.g. earmarked funding) due to their high influence on decision-making at the local level (Kapiri & Norheim, 2004). Moreover, political constraints such as dominant interest groups and multiple levels of government may hinder priority setting in line with the efficiency criteria (Makundi et al., 2007 II). To further evaluate the priority setting process for health in the case of Tanzania, the following issues have to be explored: to what extent are disease-related, patient-related, and society-related criteria (e.g. equity of health care access) included in the health priority setting process? Who should be the main actors in health priority setting? What are the major challenges of the health priority setting process? Again, all these sub questions will be answered with the help of semi-structured interviews and the analysis of key documents in chapter four.

Besides cross-sectoral and sectoral ways of enhancing the efficiency of resources for health improvement, political factors often play a major role in decisions on resource allocation. From a theoretical point of view, allocative efficiency is ensured when resources for health improvement are distributed between different regions and districts according to their relative needs. This would result in a larger flow of resources to districts with a higher burden of disease compared to healthier districts. However, whether this corresponds to reality remains questionable. To express political interests, people of a certain region must vote and they must know whether resources have been allocated to the preferred public services, in the past, by the elected politicians. Consequently, politicians might pay more attention to regions where many have access to mass media and where political competition and voter turnout is higher (Strömberg, 2004). This may lead to the allocation of more resources for health improvement to these regions and determines the level of equity reached. Furthermore, the positive analysis in chapter five aims to test the following hypothesis:

H3: Political factors and mass media directly affect the distribution of district resources for health improvement in Tanzania

Indirect effects of mass media on health spending via voter turnout are explored. This information is needed to understand the mechanisms of government responsiveness within the health sector and to emphasize the importance of democratic structures for an efficient allocation of scarce resources. The study benefits from Tanzanian secondary data on social indicators, public spending, and the results of the last two parliamentary elections in 2005 and 2010. Cross-sectional and panel data regression analysis is used to estimate the intended effects for the 134 districts on Tanzania mainland.

1.4 Structure of the Dissertation

This dissertation is organized as follows: chapter 2 presents a brief overview on Tanzania's economy, health policies, decentralized governance, and burden of disease. Section 2.1 discusses the economic situation of the country and corresponding trends in public expenditure. This is followed by a description of current and past health reforms in section 2.2 and a review of the progressing decentralization process in section 2.3. The disease burden of Tanzania is presented in section 2.4.

The first empirical analysis is presented in chapter 3, dealing with the marginal health returns on cross-sectoral government spending. After a brief introduction, section 3.2 reviews the groundwork of various authors regarding both, the need for IHA and the relative importance of certain sectors. In the following section, the theoretical underpinnings of cross-sectoral collaboration for health are discussed with regard to the incentives and conditions to form coalitions aiming at the improvement of public health. The subsequent section 3.3.2 derives a SEM to model the outcomes of these coalitions. This is followed by the quantitative analysis including the description of data sources and a discussion of estimation methods and major results. The data and findings of the qualitative analysis are presented in section 3.5. In addition, examples of implemented IHA are given. Finally, conclusions, policy recommendations, and limitations of the study are presented at the end of this chapter.

A second aspect of health resource allocation is presented in chapter 4, testing the hypothesis that interventions to combat malaria are prioritized in such a way that the marginal dollar goes to where it has the highest effect on averting DALYs. It is organized as follows: after a brief introduction in section 4.1, section 4.2 summarizes the current status of the Malaria

burden in Tanzania. The subsequent section reviews the existing literature on the cost-effectiveness analysis of malaria interventions, at the international and the national level, including the added value of this study (section 4.3). Section 4.4 discusses the theoretical underpinnings of cost-effectiveness analysis and derives the population model applied in this chapter. The estimates of the quantitative analysis are presented in section 4.5, followed by the results of the structured interviews and some ethical considerations. The final section outlines the conclusions drawn from the analysis.

Chapter 5 positively assesses how political party competition and the access to mass media directly affect the distribution of district resources for health improvement. It is organized as follows: section 5.2 describes the development of the political and electoral system in Tanzania including the role of the media. The subsequent section 5.3 reviews the existing literature on determinants of government responsiveness, including the added value of this study. Section 5.4 discusses the theoretical underpinnings of government responsiveness and explains the corresponding regression models that will be used to identify causal effects of the political economy and mass media on the provision of public health services. The corresponding estimates of the quantitative analysis are presented in section 5.5. Finally, conclusions, policy recommendations, and limitations of the study are presented at the end of this chapter.

Chapter 6 summarizes the quantitative and qualitative results of the three previous empirical chapters and gives some insights on how these three aspects of health resource allocation are linked to each other. Furthermore, corresponding policy recommendations are given and missing aspects of resource allocation are discussed.

2. Background

The following chapter presents a brief overview of Tanzania's economy, health policies, decentralized governance, and burden of disease. Section 2.1 discusses the economic situation of the country and corresponding trends in public expenditure. This is followed, in section 2.2, by a description of current and past health reforms and, in section 2.3, a review of the progressing decentralization process. Moreover, the disease burden of Tanzania is presented in section 2.4.

2.1 The Tanzanian Economy and Trends in Public Expenditure

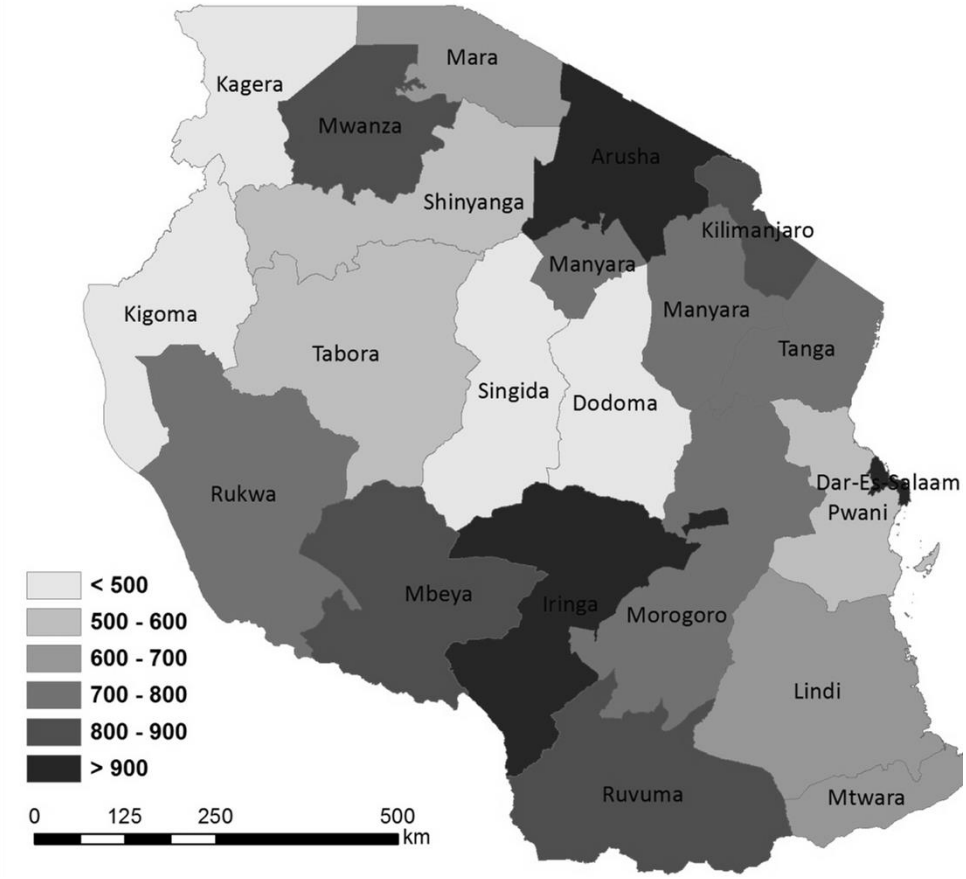
During the last two decades, the Tanzanian Economy has dismantled its socialist economic controls and moved to a liberal market economy. Measures that have been taken include the encouragement of both foreign and domestic private investment, the introduction of certain policies to reduce the budget deficit, the removal of price controls, and the privatization of state-owned enterprises. Liberalized trade led to an increase of exports of goods and services from 24.1%, in 2006, to 30.2%, in 2012 (% of GDP). Imports of goods and services rose at the same time from 35.8% to 44.5% (Ministry of Finance and Economic Affairs (MoFEA), 2013 II). However, Tanzania's integration into the world economy is still comparatively low. This was one reason why the recent global recession only had a small negative impact on Tanzania mainland. A second reason was the strong gold price which bolstered the mining sector. In 2012, the service sector was the largest contributor to the GDP (43.9%), followed by agriculture, hunting and forestry (24.7%), industry and construction (22.1%), and fishing (1.4%, MoFEA, 2013 II). However, about 80% of the workforce is employed in the agricultural sector, which also accounts for 85% of exports (CIA, 2014).

The GDP per capita is a widely used indicator to assess the income and wealth situation of a certain geographical area. In turn, income and wealth influence public health through various channels (see section 3.3). Total GDP at market prices rose from about 14 billion Tanzanian shillings[2] in 1999/2000 to about 32 billion Tanzanian shillings in 2010/2011 (table 1). This corresponds to an average annual growth rate of 7.9%, which is remarkably high compared to other developing countries in Sub-Saharan Africa (4.4%) and OECD countries (1.9%). However, today's per capita GDP remains at a very low level of 824,000 current Tanzanian shillings (527 current US Dollars) with high differences across regions (map 1). The percentage of people

[2] 1 USD = 1441 Tanzanian Shillings.

living with less than 1.25 PPP-dollars a day was still 68 percent in 2007 (World Bank, 2013).

Map 1: Regional per Capita GDP at Current Prices, 2010 (in thousands of Tanzanian Shillings)



Source: National Bureau of Statistics / Ministry of Finance (2011)

Besides direct public investments in health, the expenditures on sectors relevant to health such as education, water, and agriculture highly influence the health status of the Tanzanian people through various channels. Total government expenditures, including all sectors, increased from 2,373 billion Tanzanian shillings during the budget year 1999/2000 to 10,750 billion Tanzanian shillings in 2010/2011 (Table 1)[3]. This corresponds to an annual growth rate of 14.7 percent. In relation to GDP at market prices, public expenditure steadily increased from 17 percent, in 1999/2000, to 33 percent in 2010/2011, which is consistent with the average in developing countries in Sub-Saharan Africa (World Bank, 2012).

[3] All government expenditures have been converted into 2010 constant prices using the GDP deflator.

Table 1: Government Expenditure on Major Sectors, 2010 constant billion Tanzanian shillings

Year	Education	Health	Water	Agriculture	Total Government Expenditure	GDP (market prices)
1999/00	443.17	165.07	29.48	43.91	2,373.39	13,927.26
2000/01	481.72	190.30	34.58	36.10	2,405.36	16,303.48
2001/02	618.93	255.00	58.32	57.25	2,625.04	17,536.16
2002/03	730.88	312.83	86.96	100.87	3,333.54	18,893.68
2003/04	661.88	334.03	94.25	181.23	3,888.64	20,145.42
2004/05	1,021.39	455.62	207.31	177.72	4,702.89	21,608.81
2005/06*	908.14	496.19	216.90	228.83	5,473.40	22,995.85
2006/07*	1,148.24	550.67	244.67	251.89	6,249.61	25,053.31
2007/08*	1,284.04	697.47	365.47	448.11	7,173.15	26,529.82
2008/09	1,517.28	798.48	250.52	318.60	7,807.71	27,434.52
2009/10	1,716.50	787.20	347.30	472.30	9,532.70	31,109.00
2010/11	2,062.31	1,116.57	350.28	836.85	10,749.63	32,175.93

* Budget data available only (not actual expenditure)

Source: Ministry of Finance

Within the government's discretionary budget, more than 60 percent is allocated to six key sectors including education, health, water, agriculture, roads, and energy. This share increased by more than 10 percent during previous budget years (URT, 2011 II). On average, the education sector received most of the allocated funds (19 percent), followed by health (9 percent), agriculture (4 percent), and water (3 percent, see figure 1).

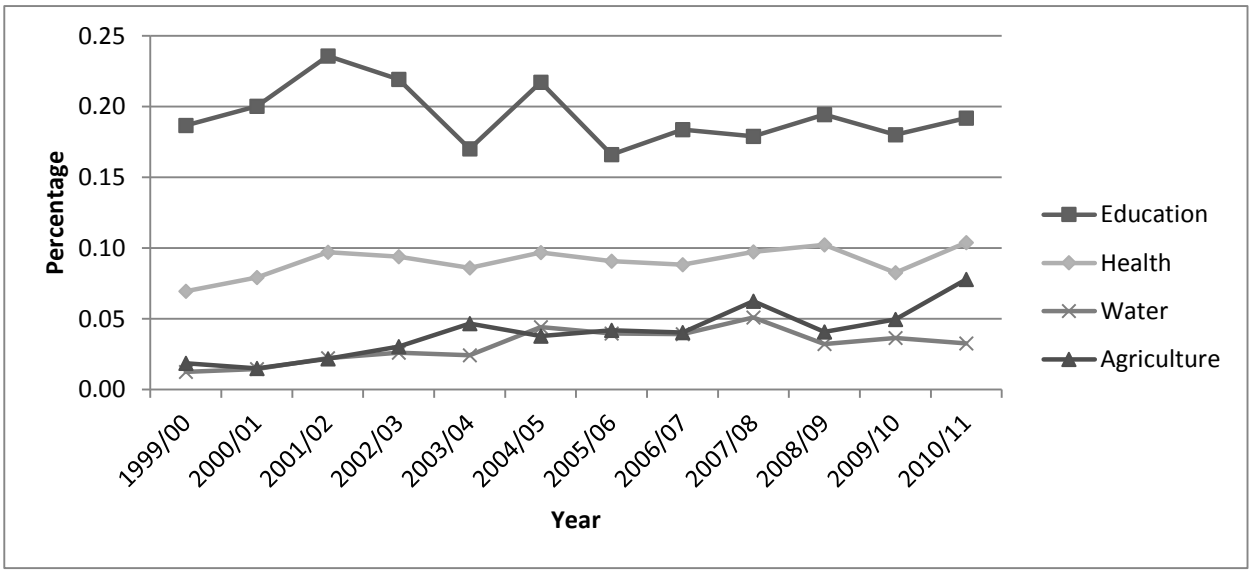


Figure 1: Government Expenditure on Major Sectors (percentage)
Source: Authors calculations / Ministry of Finance

As mentioned above, the largest share of the local population in Tanzania works in the agricultural sector, providing food, medicines, and raw material for domestic and foreign

industries (URT, 2010). Since a large share of the food produced is consumed domestically, the developments in this sector directly influence the nutritional status of the people, which in turn affects productivity, susceptibility to infections, and recovery time from illness. The allocation of funds to agriculture, relatively to the total budget, increased from 2 percent, during the budget year 1999/2000, to 8 percent in 2010/2011 (figure 1). In absolute figures, the agricultural budget rose from 43.91 to 836.85 billion Tanzanian shillings during the same period of time.

There are large regional variations in per capita agricultural spending in favor of wealthier regions such as Arusha, Kilimanjaro or Ruvuma (Appendix 1). In general, these resources consist of subsidies for agricultural inputs such as fertilizer, improved seeds and agro chemicals as well as agricultural research and extension. As mentioned above, weaknesses in the agricultural production directly influence the food security in rural areas. The Tanzanian DHS 2010 shows that 42 percent of children under the age of five are stunted or have low height-for-age, 5 percent have low weight-for-height or are wasted and 16 percent have low weight-for-age. These results show the prevalence of chronic and acute undernourishment in Tanzania. Cross-sectoral efforts are needed in the field of nutrition, as children, with mothers who have at least some secondary education, were less likely than others to have micronutrient deficiencies (e.g. using inadequately iodised salt) (NBS, 2011).

Public expenditure to improve access to safe water resources is critical to prevent unhygienic practices and the use of polluted water for food preparation, both of which can lead to water-borne diseases such as diarrhoea and cholera. For the period of 1999/2000 to 2010/2011, the budget of the water and sanitation sector increased from 29.48 to 350.28 billion Tanzanian shillings (table 1). This corresponds to an average increase of 25.2 percent per year. In relative terms, the budget share allocated to water and sanitation fluctuated between 1 and 5 percent with an average of 3 percent (figure 1). Landlocked and low-income areas receive comparably less than other regions (Appendix 2).

MDG 7 aims at halving the proportion of the population without sustainable access to safe drinking water and basic sanitation (United Nations, 2011). In the case of Tanzania, 68.3 percent of households have access to safe water sources, with a minimum of 45.0 percent in Shinyanga region and a maximum of 99.5 percent in Kagera region. This shows an increase of 28.1 percent compared to 2004, where 53.3 percent of the population had access to safe

water (Energy and Water Utilities Regulatory Authority EWURA, 2009). In general, the probability of being connected to the water network is significantly higher in urban areas. Even if Tanzania is lagging behind in reaching the global MDG drinking water target of 89 percent coverage by 2015, the country is developing well in contrast to other countries in Sub-Saharan Africa (60 percent coverage, United Nations, 2011). To be classified as using improved sanitation facilities, a household has to be connected to a public sewer or a septic system or has to use improved toilet facilities (UNICEF/WHO 2004). In 2010, only 13 percent of Tanzanian households used such improved facilities (NBS, 2011).

Investment in education is positively correlated with the health of mothers, reproductive behavior, healthy lifestyle, and many other aspects of public health (Ross and Wu, 1995; Arole, 1999). The government of Tanzania has acknowledged the high importance of education and allocated an average of 19 percent of the total annual budget to this sector, which significantly exceeds the allocation to other priority sectors (figure 1). Total public expenditure on education increased from 443 billion Tanzanian shillings, in 1999/2000, to 2,062 billion Tanzanian shillings, in 2010/2011 (table 1). This corresponds to an average annual growth rate of 15.0 percent. Regional per capita expenditure on education varies strongly across regions, with less than 10,000 Tanzanian shillings in Kigoma region and more than 20,000 shillings in Arusha, Kilimanjaro, and Iringa region (Appendix 3). Literacy can help the Tanzanian people understand the messages of health workers and use the drugs as prescribed. Results from the latest surveys indicate that 72 percent of women and 82 percent of men are literate, showing a small increase, for both sexes, since 2004/2005 (NBS, 2011). These figures top the average literacy rates of the whole Sub-Saharan Africa region, with 54 percent of women and 71 percent of men being able to read and write properly (World Bank, 2013).

2.2 Health Policies, Reforms and Financing

With the beginning of the new millennium, Tanzania started to implement various health reforms planned during the 1990s. It was one of the leading countries adopting a sector-wide approach (SWAP) for medium and long-term planning. This approach metamorphosed many different vertical programmes of numerous actors into a joint initiative in which government and donor institutions finance the health sector within a coherent policy. The objective of a SWAP was to increase the coordination within the health sector and to strengthen national leadership, health management, and service delivery (Hutton and Tanner, 2004). As requested

in the poverty-reduction strategy MKUKUTA, interventions to improve child survival such as Integrated Management of Childhood Illness (IMCI), insecticide-treated nets, immunization, or vitamin A supplementation were scaled up (Masanja et al., 2008). The difficulty remains in the evaluation of these reforms. After a decade of working with a health SWAP in Tanzania, its impact has received mixed reviews (Zinnen & Robert, 2010). Programs of sectors related to health such as Nutrition Improvement Projects (NIPs) have been implemented since the early 80s. However, the success of these programs was hampered by high transaction costs caused by great disharmony of the institutions involved (Msuya, 1999).

Today, funding sources used to finance the Tanzanian health sector include the government's budget, the Health Sector Basket Fund (HSBF), comprised of funds from development partners, collected user-fees, and funds from health insurances and NGOs (Boex, 2008). All these resources compete with the financial needs of other sectors. Although nominal health resource allocation increased during the last few years, the government has failed to reach an annual growth rate of 24% as intended in the Health Sector Strategy Plan (URT, 2009 I). Health spending, as a percentage of total government spending, increased from 7.0%, in the financial year 1999/2000, to 10.4%, in 2010/2011 (Table 1). Total per capita health spending increased from US$ 3.60, in 1999/2000, to US$ 17.79, in 2010/2011, but remains far below the target of US$ 34, recommended by the WHO to address health challenges (URT, 2009 I, authors' calculations).

2.3 Decentralized Governance

Today, mainland Tanzania is subdivided into 156 district administrations, municipalities, cities, and towns (NBS, 2013). Each of these so-called Local Government Authorities (LGAs) elects its own district council. Since the introduction of the Decentralization by Devolution (D-by-D) policy, LGAs have become more and more important in delivering local health services. Various key actors are involved in the process of allocating resources for health improvement from the central to the local level. The central institution responsible for monitoring all processes, at LGA-level, is the Ministry of Regional Administration and Local Government in the Prime Minister’s Office (PMO-RALG). LGAs have to follow all guidelines and policies disseminated by PMO-RALG. The MoHSW is the central line ministry responsible for providing sector-specific policy guidelines on planning, budgeting, and implementation of local health services. The task of the Regional Health Secretary and the Regional Health Management Team is then to spread these guidelines to LGAs and to link central-local government

relations. The Council directors and the Council Health Management Team are finally in charge of overseeing the implementation of planned health services (Haki Elimu & Policy Forum 2008).

Prior to the approval of local health spending by elected district representatives in the parliament, the budget plan has to pass through several government levels. At the beginning of the budget cycle, LGAs review lower level village and ward plans and construct a consolidated budget for the whole district. This initial plan is divided into development and recurrent budgets. As a further step, the regional secretariat verifies the budget plan at the LGA-level, combines it to a plan for the whole region, and submits it to PMO-RALG. Here, the budget estimates are reviewed again, consolidated into a single budget, and finally submitted for approval to the district representatives in the parliament. This analysis treats these representatives as the most influential actors within the process of state-to-district resource allocation. At each of these stages, the plans might be sent back to the lower level for revision. The final budget can vary substantially from the initial budget, since national development priorities often differ from the preferences of the local population. The disbursement of funds begins after the budget has passed the parliament. Since all disbursements are published in newspapers, the amount of funds available to implement health services can be monitored by the local population (Haki Elimu & Policy Forum 2008).

The sources of health funding at the central level include government funds and financial resources from the donors' Health Sector Basket Fund (HSBF), both disbursed through the Ministry of Finance and Economic Affairs (MoFEA, figure 2). These funds are allocated from the central to the local government level according to an official allocation formula. This regulation takes into account the population size (70%), poverty level (10%), the district medical vehicle route[4] (10%), and mortality of children under the age of five (10%) (MoHSW, 2007) However, it remains questionable whether these factors are the only determinants of local resources for health improvement. As this analysis suggests, political factors and mass media might play a role in resource allocation. A total budget of 1,289 billion Tanzanian shillings[5] was allocated to the health sector during the financial year 2012/2013, compared to 1,209 billion Tanzanian shillings in the previous financial year. Out of the total budget in 2011/2012, a share of 471 billion Tanzanian shillings (38 percent) was directly distributed to LGAs and regions. This

[4] Distance regularly travelled by vehicles of the health sector to account for higher operational costs in rural areas.
[5] All government expenditures have been converted into 2010 constant prices using the GDP deflator. 1 USD = 1.562,73 Tanzanian Shillings

amount was further divided at the local level into a recurrent expenditure of 327 billion Tanzanian shillings and a development expenditure of 144 billion Tanzanian shillings. However, the proportion of the total government budget allocated to health has declined from 10.8 percent, in 2011/2012, to 10.3 percent, in 2012/2013 (MoFEA, 2013). There is a large variation in per capita health spending at the district level, ranging from 1,069 Tanzanian shillings, in the Njombe district (Iringa region), to 20,490 Tanzanian shillings, in the Pangani district (Tanga region, 2010). Similar differences occur at the regional level, as shown in map 2. The reasons for these variations at sub-national levels, beyond differing poverty and 'under-five' mortality rates, are the subject of this analysis.

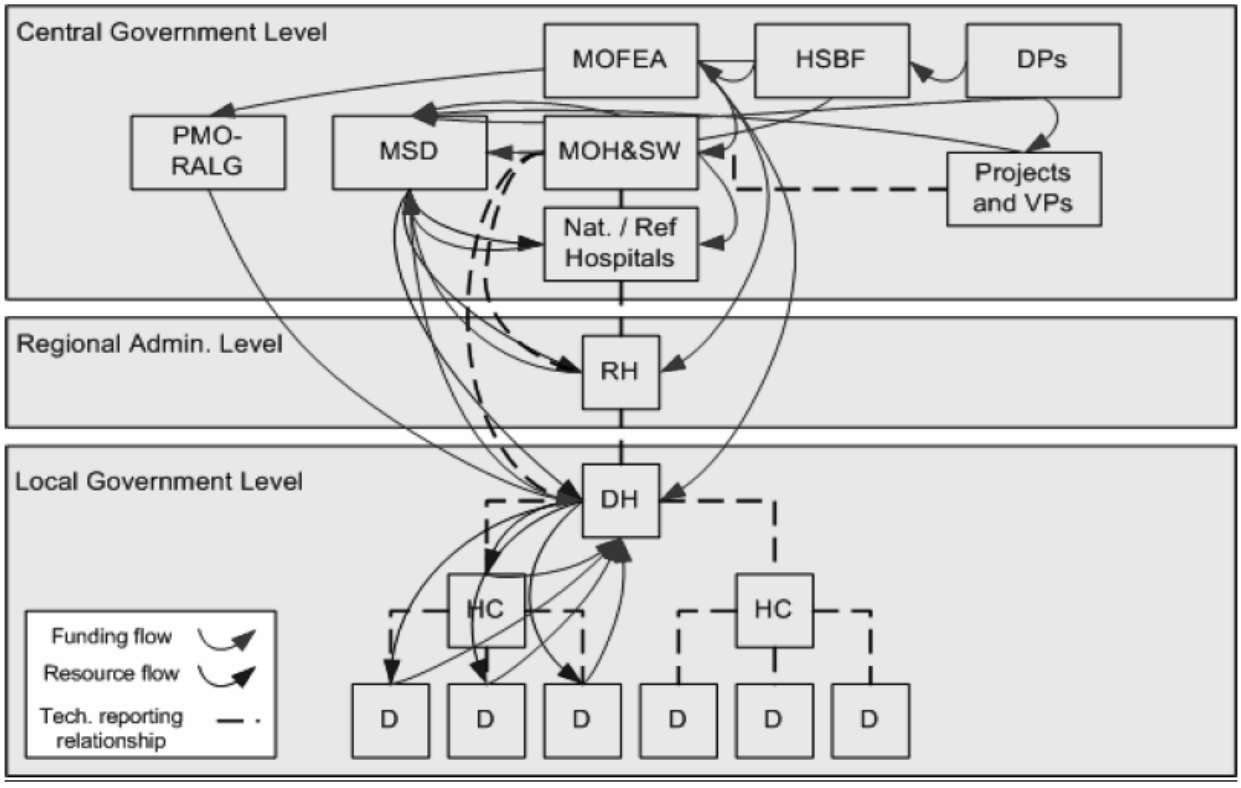
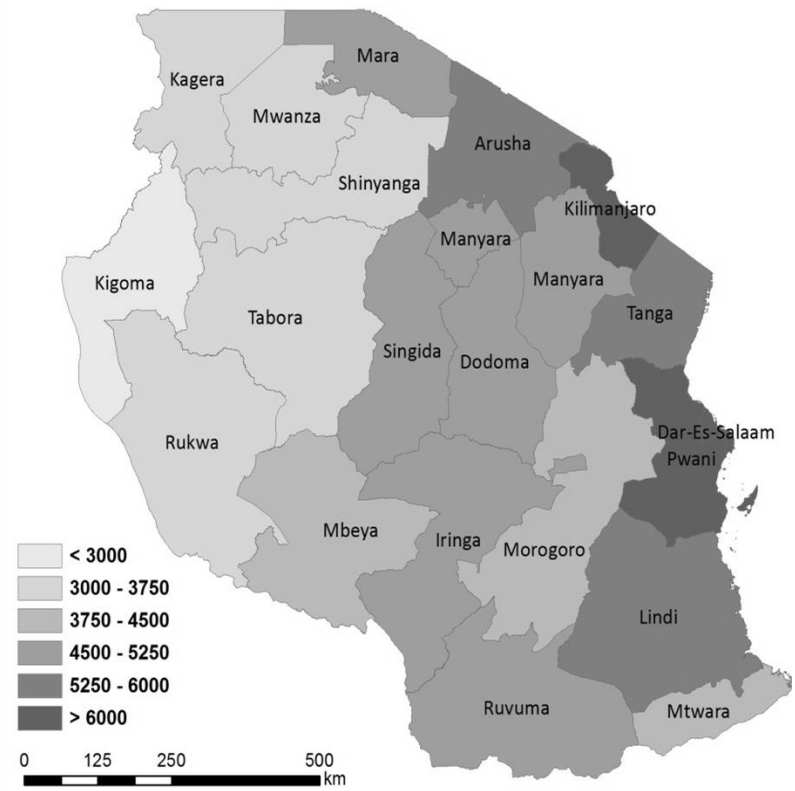


Figure 2: Financial Flows in the Health Sector of Tanzania
Source: Boex 2008. DPs = Development Partners, VPs = Vertical Projects, MSD = Medial Stores Department, RH = Regional Hospital, DH = District Hospital, HC = Health Centre, D = Dispensary

Map 2: Regional per Capita Health Investment at Current Prices, 2010 (in Tanzanian Shillings)



Source: Login Tanzania Database 2011 (mapped by the author)

2.4 Burden of Disease

The current burden of disease in Tanzania has been evaluated by the latest Tanzania Demographic Health Survey (DHS / NBS, 2011), a nationally representative survey of 10,300 households selected from 475 sample points throughout Tanzania. According to the survey, the country was successful in reducing its under-five child mortality rate from 147 deaths per 1000 live births, in 1999, to 81 deaths per 1000 live births, in 2010. Similarly, the infant mortality rate declined from 68, in 2005, to 51, in 2010 (deaths per 1000 live births, respectively). This is well on track to achieve MDG 4 (TGPSH, 2010).

HIV/AIDS still causes the highest amount of annual DALYs lost, compared to other diseases, with 3,276,000 of 18,189,000 total annual DALYs (WHO, 2009). However, HIV prevalence slightly decreased from 7% in 2003/2004 to 6% in 2007/2008 according to HIV/AIDS and Malaria Indicator Surveys (NBS, 2005/2008). The level of HIV infection is higher for urban residents compared to rural residents (9 and 5 percent, respectively). However, prevalence rates for HIV/AIDS have to be considered with caution, since errors in testing and political pressure are high. Increased use of contraceptive methods also contributed to these achievements. The use of contraceptives relies heavily upon cross-sectoral investments in

education, as evidenced by the increased usage: from 22 percent of married women, with no education, to 52 percent of married women, with at least secondary education (NBS, 2011). The prevalence of Malaria is the second largest cause of annual DALYs lost in Tanzania (1,644,000 DALYs). Efforts to reduce this burden of disease include the distribution of insecticide-treated bed nets (ITNs) and antimalaria drugs. In 2010, three out of four Tanzanian households owned at least one mosquito net, but the percentage of households who owned an ITN was only 64. There is also an increasing distribution of intermittent preventive treatment (IPT) to protect pregnant women from malaria. The percentage of women who received the needed amount of IPTs (IPT-2) increased from 22%, in 2004/2005, to 30%, in 2007/2008.

Furthermore, acute respiratory infection (ARI) is one of the leading causes of morbidity and mortality in Tanzania (1,478,000 annual DALYs). Pneumonia is the most serious type of ARI for young children. Fortunately, the prevalence of ARI symptoms among children, under the age of five, declined from 8 percent, in 2004/2005, to 4 percent, in 2010 (NBS, 2011). An additional, tremendous amount of 1,150,000 DALYs lost is caused by diarrhoeal diseases. Dehydration is a major health risk especially among young children. Cross-sectoral investments, in water and sanitation, are needed to prevent unhygienic practices and the use of polluted water, the two main causes of diarrhoeal diseases. According to the DHS, the prevalence of diarrhoea increased slightly from 12.6 percent, in 2004/2005, to 14.6 %, in 2010.

Table 2: Prevalence Rates of Major Diseases in Tanzania

Year	Malaria	ARI	Diarrhoea	Year	HIV/AIDS
2004/2005	24.2%	8%	12.6%	2003/2004	7%
2010	23.0%	4%	14.6%	2007/2008	6%

Source: NBS, 2005; 2008; 2011.

3. Intersectoral Health Action: Exploring the Health-Agriculture-Education Nexus

Chapter 3 analyzes the health returns from alternative government spending across sectors. After a brief introduction on IHA, the groundwork of various authors regarding the need for IHA and the relative importance of certain sectors, is presented in section 3.2. In the following section, the theoretical underpinnings of cross-sectoral collaboration for health are discussed and a SEM is derived to model the outcomes of these coalitions (section 3.3). This is followed by a quantitative analysis, including the description of data sources, and a discussion of estimation methods and major results in section 3.4. The data and findings of the qualitative analysis are presented in section 3.5. In addition, examples of implemented IHA are given. Finally, conclusions, policy recommendations, and limitations of the study are presented at the end of this chapter.

3.1 Introduction

In the literature, a clear consensus exists regarding the necessity of IHA to fight against the high burden of disease prevalent in many developing countries (O'Neill et al., 1997, Benson, 2007 etc.), since most of the common diseases have multifaceted causes led by malnutrition and poor water supply (WHO & UN Water, 2012). Thus, cross-sectoral action is needed to strengthen the health status of the population. Each of the governments' major sectors has its own prime objectives. Health is one of these major sectors, but improving health affects all other sectors in achieving their objectives. However, should the government spend more on health care, education, infrastructure, or agricultural research to fight against the intolerable burden of disease? For example, Tanzania faces a tight government budget that is already supported, to a large extent, by the donor community. Consequently, politicians need to know the health impact of additional investment in health related areas in order to apply the given resources most efficiently and to use synergies in allocating preventive resources for health improvement. Moreover, to increase such cooperation efforts in the future, they have to be aware of the preconditions and skills required for successful IHA.

So far, evidence regarding the relative size of the impact of cross-sectoral spending on health has been limited (Fan 2000; 2002; 2004; 2005). This chapter aims to provide the information needed for future policy making. First, the marginal health returns on cross-sectoral government expenditures are identified with the help of a quantitative budget analysis. The underlying normative concept to measure these elasticities is to calculate the amount of DALYs

that can be averted per additional dollar invested. The study benefits from secondary data on social indicators and public spending within a Simultaneous Equation Model (SEM). Upon establishing the returns on investments in certain sectors, the political mechanisms to implement cross-sectoral collaboration have been explored. This has been done with the help of semi-structured interviews and the analysis of key documents.

3.2 Literature Review

The need for a comprehensive health care strategy, including IHA, was mentioned first at the Alma-Ata conference on Primary Health Care in 1978. Further initiatives such as the Ottawa Charter for Health Promotion (1986), the WHO conference on IHA (1997), and the Bangkok Charter for Health Promotion (2005) supported the idea of working across sectoral boundaries (Public Health Agency of Canada (PHAC), 2007). Various concepts and efforts, such as the Social Determinants of Health (SDOH) project, initiated by the WHO, have been developed to implement IHA in practice. In line with the final report of the SDOH project, the existing health gap could be closed by investing in education, housing, employment, transport, and health, at the same time and at all government levels. They further emphasized the importance of sufficient nourishment of mothers, since adequate nutrition begins before birth (Marmot et. al, 2008). The European Union and South Australia have started to implement a Health in All Policies (HiAP) approach. In contrast to health impact assessment, the HiAP approach informs policy makers at the conceptual stage of an initiative. This led to increased understanding of IHA by politicians, increased partnerships between health and non-health sectors, and the development of corresponding research (Lock and McKee, 2004; Kickbusch and Buckett, 2010; Lawless et al., 2012).

Concrete ideas regarding the organization of IHA were pointed out by Armstrong et. al (2006). The authors suggested that the formation of cross-sectoral advisory committees and partnerships between academics and practitioners of health- and non-health sectors is a tool for successful, evidence-based intersectoral work. Such collaborative efforts need to include the major sectors related to health, namely the agriculture, education, water, and housing sectors (World Health Assembly, 1986). The correlation of interventions in these sectors with the health status of the population will be discussed when we develop the conceptual framework in section 3.3.1. Essential key pre-conditions for IHA, such as a balanced number of stakeholders, mutual respect and trust between partners, a clear definition of the issue, and community support, have been widely discussed in the literature (Nutbeam, 1994; PHAC &

WHO, 2008; von Braun et al., 2011). According to these authors, practical steps to implement IHA also include the provision of leadership, delineated roles and responsibilities, and the formulation of a corresponding exit point.

Various methodological approaches have been utilized to evaluate IHA. Case studies from Uganda (Mutambi et al., 2007), Ecuador (Vega C., 2007), El Salvador (MSPAS, 2007), a selection of sub-Saharan countries (Benson, 2007), the Netherlands (Leurs et al., 2008), and Australia (Kickbusch and Buckett, 2010) have used qualitative methods, such as the analysis of key documents or semi-structured interviews with government officials and local health workers, to assess IHA in practice. In the case of the Netherlands, these methods have been combined with cross-sectional surveys in the so-called Diagnosis of Sustainable Collaboration (DISC) model. This model aims at exploring the opportunities and obstacles of collaborative change on the basis of evidence from intersectoral collaboration, organizational behaviour, and planned organizational change (Leurs et al., 2008). It distinguishes between 'perceptions', 'intentions', and 'actions'.

However, in most of these studies, it was too early to draw conclusions about the effectiveness of IHA and the adequacy of the applied evaluation method because the initiatives just had started or the period of time considered was too short. However, one major outcome of these studies was that cross-sectoral coordination fails if there is no broader political commitment to improve health in general, as shown in case studies on multisectoral agencies in Mozambique, Nigeria, and Uganda (Benson, 2007).

A further method to assess cross-sectoral collaborative efforts in a quantitative manner is sectoral budget analysis. Fan (2000, 2002, 2004, 2005) has used this method to build a SEM aiming at the exploration of the relative impacts of cross-sectoral government expenditures, such as education and health, on poverty reduction, in the case of India (2000), China (2002), Uganda (2004), and Tanzania (2005). In the case of Tanzania, Fan found that additional public investment in education, roads, and agricultural research has favorable impact on poverty reduction. Besides budget analysis, numerous authors have explored the socioeconomic underpinnings of Health. For example, the results of Lee and Paxmann (1997) indicate that premature mortality in the United States is attributed to genetic factors (20%), environmental factors (20%), inadequacies in the health system (10%), and life-style (50%). For the Netherlands, Mooy and Gunning-Schepers (2001) used a dynamic population model with a

cohort specific approach to quantify the impact of several intersectoral health policies. In terms of the number of actual years of life gained, the highest health gains were found from increased cigarette pack prices, followed by stimulating commuter cycling, and nutritional interventions. Similarly, a meta-analysis regarding the impact of various domains on the health of the population has been carried out by Mc Ginnis et al. (2002). The authors concluded that genetic predisposition (30 percent), social circumstances (15 percent), environmental exposure (5 percent), behavioral patterns (40 percent), and expenditures in medical care (10 percent) are responsible for early death in the United States.

However, the impact of cross-sectoral interventions also depends on how the health status of a population is measured. For example, Lee, Rosenzweig and Pitt (1997) used structural-equation models to estimate the effects of improved sanitation, nutrition, and water quality on the mortality of children in low-income countries. Based on data on Bangladesh and the Philippines, the authors found that neither improved sanitation facilities nor variation in water sources increase the weight of surviving children, but parental schooling levels and wealth does. Similar studies point out that cross-sectoral determinants of health strongly depend on the degree of urbanization. Using data from Nicaragua, men's education turned out to have a significant effect on health only in urban areas, and, in contrast, income, only in rural areas (Wolfe and Behrman, 1982). Moreover, possible synergies of interventions in health and non-health sectors were analyzed (Behrman, 2000).

Consequently, most of the previous studies show that IHA plays a large role in promoting public health. However, economic arguments, such as measuring the cost-effectiveness of preventive health measures, are not enough to persuade political decision makers to implement IHA. To push public policies into this direction, more empirical evidence is needed (Potvin, 2012; Martinez, 2013). The relative size of the impact of cross-sectoral interventions on health differs among health related sectors. Thus, there is a need to measure these effects, as requested by various authors (e.g. Kindig et al., 2003). Due to the lack of quantitative monitoring instruments, this analysis applies sectoral budget analysis as a new approach to evaluate the effect of IHA. In order to overcome the challenge of short periods of investigation, as mentioned by previous studies, time-series data of almost 15 years is used in the analysis.

3.3 Theoretical Framework

3.3.1 Economic Theory of IHA

Most of the common diseases have multifaceted causes led by malnutrition, poor water supply, and inadequate sanitation (WHO & UN Water, 2012). Thus, public health is determined by a variety of factors within and outside the health sector. Figure 3 shows how all these factors are linked to health and other determinants of health. Firstly, there is an assumed correlation between governmental and non-governmental health spending and the health status of the population. This includes expenditure on curative and preventive measures in the short and long run. However, the actual impact might be small, since more public spending on health doesn't necessarily mean that more public health services are created. (Filmer & Pritchett, 1999, see section 3.4.2).

As mentioned in section 3.3.2, public spending on agriculture mainly consists of subsidies for agricultural inputs such as fertilizer, improved seeds and agro chemicals as well as agricultural research and extension. This in turn influences agricultural production, which is predominantly used for own-consumption. Both, the nutritional value of the agricultural products and health hazards of agricultural technology determine the health status of the population (von Braun 2007; Arole, 1999). Farm income and the income from agricultural labor influences health in an indirect manner. Investments to improve access to drinking water, sanitation facilities, and hygiene practices reduce the risk of diarrhoeal disease, which is still a leading cause of morbidity and mortality in developing countries. Moreover, access to safe water sources strengthens public health by reducing the risk of contamination during storage and transport of water (Fewtrell et al., 2005).

The links between infrastructure and health have been exhaustively reviewed by Brenneman and Kerf (2002). They found evidence, reported in various studies, that improved transport saves cost and time to reach health providers and strengthens the timely access to health care, especially for the poor. Moreover, it facilitates the staffing and operation of health institutions. The number of hospitals, health centres, and dispensaries, available in a certain region, further determines access to health providers.

The positive relationship between education and health has been widely verified in the literature. Educated people are more likely to afford health measures, their jobs are less stressful and dangerous, their social-psychological resources are larger, and they have a more

positive health related lifestyle (Ross and Wu, 1995). Furthermore, education promotes the improvement of personal hygiene, environmental sanitation, and the understanding of preventive and curative care (Arole, 1999).

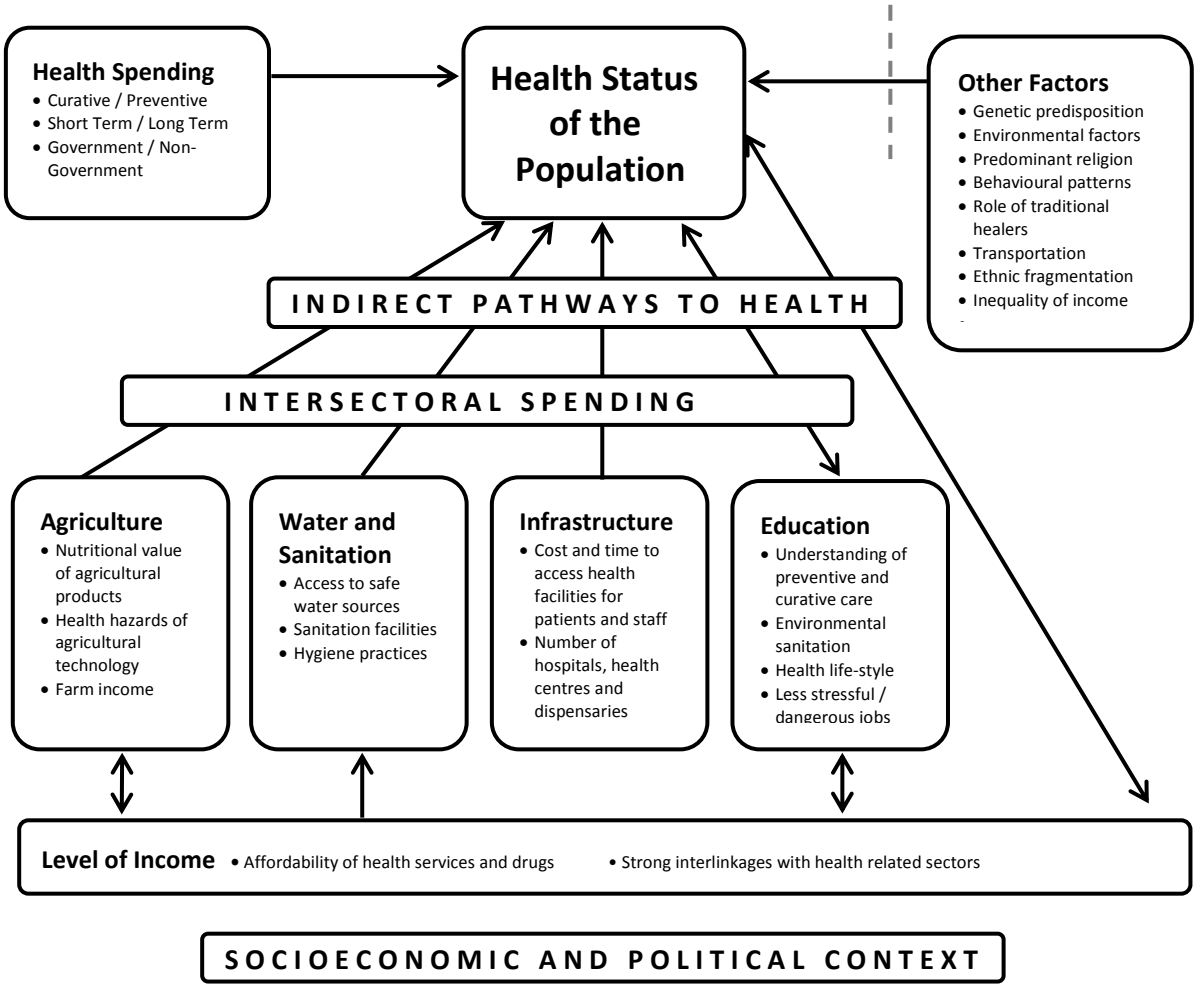


Figure 3: Determinants of the Health Status of the Population
Source: author

Income enables people to afford health services extending beyond the free services offered by the government. Further determinants of health, such as education, sanitation, or nutrition, are directly correlated with income, as shown in figure 3. Thus, using the words of Pritchett and Summers (1996), "wealthier is healthier". In a cross-country analysis they found that differences in income growth rates explain roughly 40% of the differences in infant and child mortality improvements. However, the causality of wealth and health goes in both directions. Using adult height as a proxy for health status within an instrumental variable regression, Schultz (2005) stated that wage rates increase by 5-10 percent for every additional centimetre in height. Thus, "healthier is also wealthier". Further determinants of health, such as environmental conditions, the existence of traditional healers, genetic conditions, and social

determinants (e.g. social gradient or social exclusion, see Marmot, 2005) have not been included in the model due to poor data. The impact of cross-sectoral efforts on health is strongly influenced by the political and socioeconomic context of the country.

The allocation problem of public resources to health- and non-health sectors is addressed by various economic theories, among them the "Maximum Welfare Principle of Budget Determination", developed by Musgrave (1959), Pigou (1928) and Dalton (1936). According to the authors, public resources should be allocated among different sectors based on the following two principles: firstly, resources should be allocated in such a way that the marginal returns of each of the sectors are equalized. Secondly, public expenses of a certain sector should be increased up to a level where the marginal returns of certain interventions equal the marginal costs in terms of taxes. Adhesion to these two principals results in maximization of societal welfare. Figure 4 shows the optimal budget determination as illustrated by Musgrave (1959). Here, public expenditure on, for example, health measures and the corresponding amount of taxation is shown on the X-axis. On the Y-axis, the 'Marginal Social Benefit' (MSB) is shown above the X-axis, and the 'Marginal Social Sacrifice' (MSS) below the X-axis. Curve EE shows a decreasing marginal utility of social benefit with increasing funds allocated to the budget. Curve TT, in contrast, indicates how marginal social sacrifice increases with additional spending. The optimal size of the budget is reached at the intersection of the net benefit curve NN and the X-axis (MSB = MSS, point M).

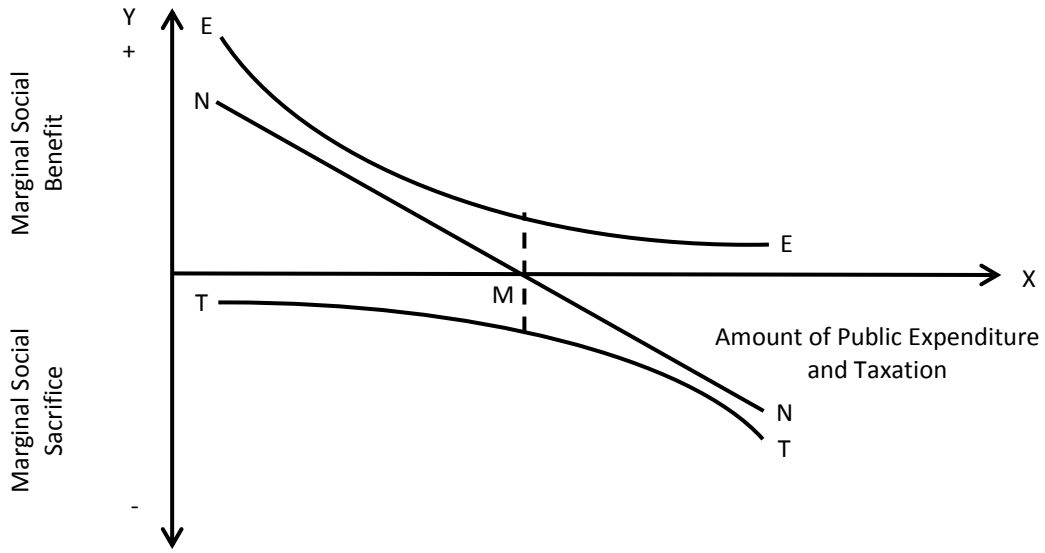


Figure 4: Maximum Welfare Principle of Budget Determination
Source: Musgrave 1959

Moreover, coalition theory has widely been used as a framework for understanding and implementing cross-sectoral health interventions that lead to synergies in the allocation of scarce resources for health improvement (O'Neill et al., 1997). Gamson (1961) defined coalitions which, in the context of this analysis, are collaborations between the health sector and related sectors, as " […] temporary, means oriented, alliances among individuals or groups which differ in goals."(p. 374). According to the author, the collaboration of different sectors depends on four parameters. Firstly, the initial distribution of given resources among the participants have to be known. Secondly, the payoffs for each coalition have to be calculated, similarly to game theoretical approaches. Thirdly, the so-called "Non-utilitarian strategy preferences" have to be identified. These strategy preferences can be described as inclinations to join with other groups determined by interpersonal attraction and independently from other players' resources. Fourthly, the "effective decision point" reveals the specified amount of resources that will enable the player to control the decision.

In general, the implementation of cross-sectoral coordination will contribute to an efficient use of scarce resources for health improvement. This coordination includes the health services provided by the private sector. According to Samuelson (1954), pareto-optimal provision of the public good "health services" is given when the sum of individuals' marginal rates of substitution equals the marginal rate of transformation between the health services offered by the public sector and health services provided by the private sector (Σ MRS_i = MRT). In reality, the governmental share of a developing country's total health budget is determined by the priorities of that country (e.g. Poverty Reduction Strategy Papers), the power relations between different government sectors, corruption, and lobbyism.

Further preconditions for the successful use of intersectoral synergies are to ensure an adequate balance regarding the number of relevant stakeholders in each sector and their relative skills, the recognition of different cultures and incentives, and the consensus on the benefits that could result from cross-sectoral cooperation. Furthermore, functional ways of communication between the stakeholders have to be ensured, tools for analyzing common problems have to be developed, and sufficient capacities and incentives have to be in place (von Braun et al., 2011).

3.3.2 Modelling the Impact of Nutrition, Water, and Education on Health

Marginal health returns on cross-sectoral government expenditures have been determined using quantitative budget analysis. This information is needed by politicians as an incentive to form coalitions for health. Building on previous IFPRI studies in Asia and Africa (see Fan, 2000-2005), a SEM has been developed to estimate these effects. The formal structure of the system is represented by equation (1) to (5):

(1) DISPREV = ƒ (THINV, NUTR, SWATER, SANI, INFRA, GDP, EDU, URB)

(2) NUTR = ƒ (TAINV, GDP, BREASTF, IODINE, MEDU, VACC, URB, DISPREV)
(3) SWATER = ƒ (TWINV, GDP, URB)
(4) EDU = ƒ (TEINV, GDP, DISPREV, URB)
(5) GDP = ƒ (LABOUR, LAND, EDU, RAIN, URB)

The model can be grouped into two blocks of equations: The first block (equation 1) models the hypothesized major determinants of the dependent variable disease prevalence (DISPREV). Block two (equation 2-5) models the determinants of each endogenous variable used in block one. Each of these equations has a clear ceteris paribus interpretation, which makes it an appropriate SEM (Wooldrigde, 2009). The advantage of this method is that it allows measuring direct and indirect effects on health. To optimize the trade off between accuracy and complexity of the model, the Akaike Information Criterion (AIC) has been used. The linearity of the model has been tested using two-way plots and additional non-linear regressors. According to the results of these tests, the non-linearity hypothesis can be rejected. Moreover, all expenditure variables have been transformed into logs in order to better fit into a linear model.

Equation (1) models the influence of various factors on the endogenous variable DISPREV, which is an index reflecting the most prevalent diseases among children 'under-five' in Tanzania. Disease prevalence has widely been used as a measure of need in the literature (e.g. Munga & Maestad, 2009). Children under the age of five have been chosen to reflect the age group most vulnerable to diseases influenced by cross-sectoral factors such as malnutrition or waterborne diseases. In addition, it accounts for the cohort-specific differences in the strength of health determinants. The index includes the percentage of children with fever (used as an indicator for malaria), diarrhoea, and symptoms of acute respiratory infections (ARIs) in the two weeks preceding the DHS survey. These three diseases are weighted by annual DALYs lost, according to the latest WHO-data, resulting in an index allocation of 38.2 percent to Malaria,

35.2 percent to Acute Respiratory Infections (ARI), and 26.7 percent to Diarrhoea (WHO, 2009). On the right hand side of the equation, the exogenous variable THINV measures the logarithm of deflated public per capita spending on health, in the short- and long-term[6]. This includes the total expenditure of the current and the last five budget years[7]. Thus, short-term spending for curative measures, such as the provision of drugs or salaries for health personnel, as well as long-term spending, like preventive interventions or health research, are considered. To account for the assumed correlation of nutrition and health, the endogenous variable NUTR has been included as an additional covariate. It captures the percentage of children under the age of five classified as malnourished according to weight-for-age[8], which is considered a general indicator for the nutritional status of children (Haddad et al., 2003).

The endogenous variable SWATER reflects the percentage of households with access to safe water sources, which is defined as living within reach of an official water point. As an indicator for sanitation, the variable SANI captures the number of latrines per 100 pupils in Tanzanian schools. INFRA is a stock variable considering infrastructure, such as the number health facilities and the condition of roads needed to access them. Specifically, it is measured here as the percentage of women and men aged 15-49 who reported serious problems in accessing health care due to the distance to the next health facility. Yearly, regional per capita GDP serves as a proxy for income. The nexus of health and education is reflected by the endogenous variable EDU, which captures the number of primary school pupils divided by the number of primary school teachers (Pupils-Teacher-Ratio, PTR). In each of the five equations, URB serves as a control variable for the degree of urbanization. The effect of urbanization on health remains unclear, since negative aspects of larger cities such as air pollution and industrial waste might outweigh the advantage of better health care and health infrastructure in urban areas (Moore et al., 2003).

Equation (2) models the factors influencing the endogenous nutritional status (NUTR) included in the first equation. As stated by von Braun et al. (2005), an increase of domestic budgetary allocations to agriculture strengthens agricultural growth, and, in turn, reduces malnutrition and hunger. The first covariate on the right hand side of equation 2 (TAINV) takes this correlation into account reflecting the logarithm of deflated public per capita spending on

[6] For comparison, all figures on sectoral government spending and GDP have been converted into 2010 constant prices using the GDP deflator. Moreover, the model uses logs of the per capita values.
[7] Due to problems of Multicollinearity, short- and long-term spending has not been included as separate variables.
[8] below -2 standard deviation units (SD) from the median of the WHO Child Growth Standards adopted in 2006.

agriculture at the regional level (total of current and previous year). Moreover, sustained income growth can lead to a reduction of malnutrition in the long run, as shown in a cross-country and household level study by Haddad et al. (2003). The log of regional per capita GDP has been included in the model as a proxy for household income.

In principle, malnutrition consists of protein-energy malnutrition and micronutrient deficiencies. One measure to prevent protein-energy malnutrition is to promote initial breast-feeding, reflected by the exogenous variable BREASTF. This variable indicates the percentage of mothers who started breastfeeding within one hour of birth among the last children born in the five years preceding the survey. Although not exclusively, micronutrient deficiencies are mainly due to deficiencies in iodine, iron, vitamin A, and zinc, although not exclusively (see Müller and Krawinkel, 2005). To cover at least one of these deficiencies, the percentage of households with adequate iodine content of salt (15+ ppm) is included by the variable IDODINE. Increasing the education of mothers augments their skills at providing care and, in turn, improves the nutritional status of their children (Sahn & Alderman, 1997). To account for this correlation, the variable MEDU captures the percentage of women aged 15-49 who completed at least grade 6 at the secondary level. Two further variables reflect the impact of health on nutrition. Besides the endogenous variable DISPREV, the covariate VACC represents the percentage of children aged 12-23 months with a vaccination card. Ideally, regional differences in food prices, climate conditions, and the existence of nutrition programmes should be included in the model. However, sufficient information about these variables was not available for the selected period of time.

Determinants of access to safe water sources are modelled in equation (3). In the short term, public investments into the water sector extend the reach of water networks and improve the management of regional water sources. Long-term spending aims at capacity building of water personnel and structural changes, such as the privatization of water suppliers. Both effects are captured in the right hand side variable TWINV, taking into account the logarithm of average, deflated public per capita spending on water, in the current and the last five budget years. Whether consumers can afford to use safe water sources is also determined by income. Consequently, the log of the regional per capita GDP is included as a proxy for income. Information regarding the volatility of water prices, the gap between water demand and supply, and the existence of certain interventions such as the installation of water kiosks has not been included in the model due to incomplete time series.

Equation (4) describes the relationship between education and its determinants. Since most of the Tanzanian schools are public, government spending on teachers' salaries and school supplies influences pupils' performance in the short run. Long-term investments include the construction and maintenance of classrooms or educational research. Both effects are reflected by the independent variable TEINV (same measurement procedure as for water spending). Health (DISPREV) affects children's cognitive functions and students' as well as teachers' school attendance, which in turn influences the level of education achieved (Jukes, 2005). Moreover, equation (4) includes per capita GDP as a proxy for income, necessary to cover education costs. Tuition for primary schools was eliminated in 2002, but families still have to pay for testing fees, uniforms, and school supplies for primary education, as well as tuition for pupils in secondary schools. Information about additional variables, such as the educational status of the parents, cultural aspects, political factors, and family background has been excluded from the model due to data constraints.

Widely used production functions such as Cobb-Douglas represent the relationship of an output (Y) to the inputs labour (L), capital (K) and total factor productivity (A) (Cobb & Douglas, 1928). In equation (5), a similar but more simplistic approach is used to model the determinants of regional per capita GDP. The variable LABOUR measures the percentage of women and men employed in the 12 months preceding the survey. Due to the high share of agricultural production and its major share in the family income, 'hectares of farmland (LAND)' are taken as a proxy for capital. This covariate includes the area under temporary mono or mixed crops, permanent mono or mixed crops, and the area under pasture. Since agricultural output strongly correlates with rainfall variability, the variable RAIN, which measures yearly rainfall in millimetres, has been included in equation (5). Due to increased skills and knowledge (EDU), the contribution of educated people to the GDP might be higher compared to others. Technological change and innovation are captured by the total factor productivity in the Cobb-Douglas model. Reasons for omitting these variables in equation (5) are the short period of time considered in this analysis and the fact that technology might not be a local phenomenon.

Public spending on health, agriculture, water, and education might have long lead times in affecting the prevalence of diseases. Consequently, current and past values of government expenditure have been included as lags in the model. Various econometric methods exist to determine the adequate length of lag for each of the investment variables. Authors of similar works (e.g. Fan, 2000) used the adjusted R^2 criterion suggested by Greene (2008). This method

was also applied in this study, resulting in a lag length that maximizes adjusted R^2 as defined by McElroy (1977). As mentioned above, the outcome was to include total spending of the current and the last five budget years. Furthermore, the choice of the appropriate length of lags was constrained by the length of the time series data available.

To measure the direct and indirect effects of cross-sectoral government spending and other variables on the prevalence of diseases, we have to totally differentiate equations (1) to (5). To this effect, we take the derivative of equation (1) with respect to the desired variable. Since most of the model variables are given as a percentage or included as logs, the result is the elasticity of the selected variables. As an example, the direct impact of agricultural investments (TAINV) on the prevalence of diseases through nutritional status (NUTR) can be derived as:

(6) $\partial DISPREV/\partial TAINV = (\partial DISPREV/\partial NUTR)\,(\partial NUTR/\partial TAINV)$

Similar, the effect of LAND on health is derived as:

$$
\begin{aligned}
(7)\quad \partial DISPREV/\partial LAND &= (\partial DISPREV/\partial GDP)\,(\partial GDP/\partial LAND) \\
&\quad + (\partial DISPREV/\partial SWATER)\,(\partial SWATER/\partial GDP)\,(\partial GDP/\partial LAND) \\
&\quad + (\partial DISPREV/\partial EDU)\,(\partial EDU/\partial GDP)\,(\partial GDP/\partial LAND) \\
&\quad + (\partial DISPREV/\partial NUTR)\,(\partial NUTR/\partial GDP)\,(\partial GDP/\partial LAND)
\end{aligned}
$$

The first term on the right hand side of equation 7 shows the direct effect of LAND on the variance of regional per capita GDP, which in turn is a determinant of public health. Secondly, the change of GDP also leads to indirect effects on health through its influence on access to safe water, education, and nutrition, as shown in the following terms. Direct and indirect effects of other variables on health can be derived in a similar way.

3.4 Quantitative Analysis: Model Estimation and Results

3.4.1 Data

This study uses data at the regional level of Tanzania, excluding the five regions on the semi-autonomous state Zanzibar. Almost all of the 21 regions of Tanzania mainland include one regional capital classified as an urban district and several further districts all classified as rural. Since no systematic secondary data is available at the regional level, a panel dataset was generated by aggregating survey data for the years 2004, 2005, 2009 and 2010. Thus, this study is based on a total of 84 observations. Data on public spending on health, education, agriculture, and water was retrieved from various budget books, for the years 1999/2000-2004/2005, and from the Local Government Information database (LOGIN Tanzania, see URT, 2012 II), for the years after 2005. This database is jointly provided by MoFEA and the Prime Minister's Office Regional Administration and Local Government (PMORALG). The figures include recurrent and development spending of the government and, partly, donor funds allocated to the regions. For comparison, all data on government expenditures was deflated to the common base year 2010, using the GDP deflator retrieved from the World Bank's development indicators (World Bank, 2013). Population data, used for computing per capita amounts, was generated from the last population and housing census 2002 (NBS, 2006 I). According to LOGIN Tanzania, population variables are inflated uniformly across all regions by 2.9% per annum.

Information about per capita GDP was obtained from national accounts and deflated like public spending (URT, 2011). For the variable measuring the percentage of people with access to safe water sources, aggregated data from the Water Utilities Performance Report (EWURA, 2009) and Annual Health Statistical Abstracts (URT, 2006) was used. Data about agricultural farmland was retrieved from Country STAT, a database for food and agriculture statistics provided by the NBS (URT, 2012 I). For all other variables included in the model, data comes from the HIV/AIDS/STI surveillance report (URT, 2009 II), Basic Education Statistics Tanzania (BEST, URT, various years), and selected DHS and HMIS household surveys (NBS, 2005-2011). Presently, the included data sources are the most comprehensive and reliable ones in Tanzania. Numerous studies, notably a paper published by Fan, Nyange & Rao (2005), have also used these data sources. Table 3 shows an overview of all variables. The behavior of selected dependent and independent variables over time is reflected in figure 5.

Table 3: Descriptive Statistics

Variable	Mean	St. Dev.	Description	Unit of Measurement
DISPREV	0.150	0.061	Health-Index disease prevalence	Fractions
THINV	17811	7733	Total per capita health investment	Tanzanian Shillings
NUTR	0.199	0.068	Malnourished under age 5	Fractions
SWATER	0.608	0.168	Access to safe water sources	Fractions
SANI	1.706	0.601	Access to sanitation	No. of Latrines per 100 pupils
INFRA	0.305	0.137	Problems to health facility access	Fractions
GDP	0.667	0.246	Gross domestic product	Million Tanzanian Shillings
EDU	53.214	9.188	Access to education	Pupils-Teacher-Ratio (PTR)
URB	0.232	0.170	People living in urban areas	Fractions
TAINV	2881	2227	Total per capita agriculture invest.	Tanzanian Shillings
BREASTF	0.554	0.202	Breastfeeding within 1h after birth	Fractions
IODINE	0.495	0.261	Adequate iodine content of salt	Fractions
MEDU	0.102	0.073	Mothers education	Fractions
VACC	0.823	0.080	Children with vaccination card	Fractions
TWINV	3682	2191	Total per capita water investment	Tanzanian Shillings
TEINV	66382	23886	Total per capita education invest.	Tanzanian Shillings
LABOUR	0.813	0.090	Employed in the previous year	Fractions
LAND	4.266	2.322	Per capita farmland	ha
RAIN	834.706	353.750	Yearly rainfall	Millimetres

Source: author's calculations

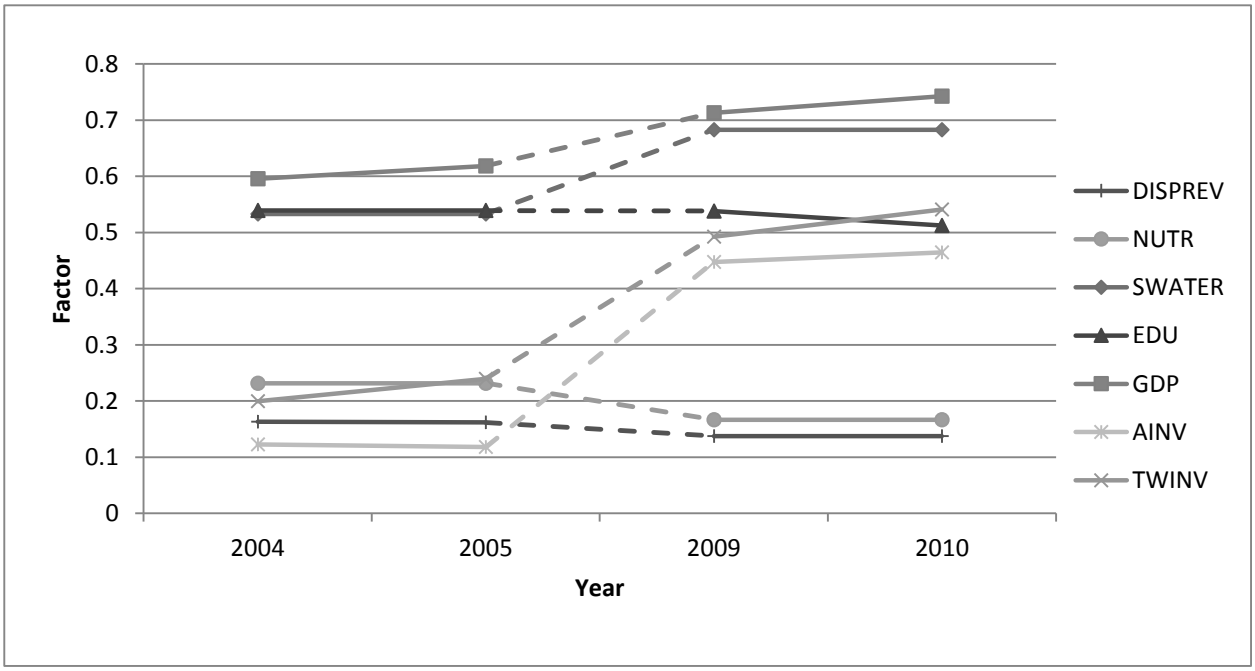


Figure 5: Behaviour of Selected Dependent and Independent Variables Over Time
Source: author's calculations (PTR: divided by factor 100 / AINV, TWINV: divided by factor 10.000)

3.4.2 Model Estimation, Results, and Marginal Returns on Public Investment

According to the model specification described in section 3.3.2, the four endogenous covariates are jointly determined with the dependent variable disease prevalence. Consequently, the problem of endogeneity of explanatory variables arises in the form of simultaneity. All

endogenous, explanatory variables, which are determined simultaneously with disease prevalence, are generally correlated with the error term. Thus, the use of Ordinary Least Squares (OLS) to estimate the SEM would lead to biased and inconsistent estimates. Instead, as with the solution of omitted variables and measurement error problems, the leading method to estimate SEMs is the method of instrumental variables. Exogenous variables appearing anywhere in the system serve as instruments for a particular equation. Three instrumental variable approaches are appropriate to estimate a SEM, namely Two-Stage-Least-Squares (2SLS), Three-Stage-Least-Squares (3SLS), and Generalized Method of Moments (GMM). Under the assumption that all equations are correctly specified, 3SLS produces asymptotically more efficient estimates compared to 2SLS and GMM (Wooldridge, 2010). Thus, 3SLS has been used to solve the model[9].

Table 4 presents the results of the estimated SEM. With some limitations, cross-sectoral investments seem to have enormous effect on the reduction of disease prevalence. The results of the estimated health equation (equation 1) show a significantly positive impact of nutrition, access to safe water sources, and sanitation on health. For every one percent decrease in the number of malnourished children under the age of five, the disease index declines by 0.332 percentage points. This result complements previous research showing a highly significant correlation between nutrition and health in Tanzania (Alderman et al., 2005; Keding, 2010).

Slightly less effective are investments in water quality. The index declines by 0.167 percentage points for every one percent increase of people who have access to safe water sources. This confirms the results of a regional study on waterborne diseases on the Tanzanian side of Lake Victoria (Semili et al., 2005). Improved sanitation has a smaller, but still significant potential to improve public health with a coefficient of 0.027. Unlike the theoretical assumption discussed in section 3.3.1, income seems to have no significant effect on the prevalence of 'under-five' diseases. The abolition of user fees for maternal and child health services in Tanzania might explain this result. However, out-of-pocket payments are still substantial in practice, especially for facility based deliveries (Kruk et al., 2008).

Furthermore, short- and long-term public spending on health are insignificant determinants of health. The weak effect of pure public health expenditure on the prevalence of diseases has widely been shown in the literature. The reason for this weak relationship could be, amongst

[9] See appendix 5 for 2SLS estimates.

others, the fact that more public spending on health doesn't necessarily mean that more public health services are created. Some of these additional health services might have been consumed anyway. Consequently, in order to see a measureable effect of public health spending on disease prevalence, the additional services have to change the total amount of health services consumed. Ultimately, services financed by the government have to be cost-effective in improving public health and consequently reduce the burden of disease (see Filmer & Pritchett, 1999). This can be questioned in the case of Tanzania, ranked 156 among 191 countries in overall health system performance (WHO, 2000).

Table 4: Relationship between Burden of Disease and Intersectoral Health Action, 2004-2010

Dependent Variable	(1) DISPREV	(2) NUTR	(3) SWATER	(4) EDU	(5) GDP
THINV	0.102 (0.06)				
NUTR	0.332 (0.16)**				
SWATER	-0.167 (0.06)**				
SANI	-0.027 (0.01)**				
INFRA	0.053 (0.05)				
GDP	-0.127 (0.10)	-0.009 (0.064)	0.007 (0.19)	-34.927 (7.57)**	
EDU	-0.007 (0.00)**				-0.018 (0.00)**
URB	0.226 (0.46)	-0.137 (0.31)	1.974 (1.07)*	75.571 (41.3)*	2.633 (0.54)**
TAINV		-0.020 (0.01)			
BREASTF		0.075 (0.03)**			
IODINE		-0.040 (0.04)			
MEDU		-0.421 (0.13)**			
VACC		0.028 (0.07)			
DISPREV		0.507 (0.14)**		-35.250 (9.19)**	
TWINV			0.258 (0.09)**		
LTEINV				-3.774 (5.38)	
LABOUR					0.115 (0.13)
LAND					0.120 (0.02)**
RAIN					0.000 (0.00)
R-Squared	0.6512	0.8865	0.6965	0.8338	0.9069
Observations	84	84	84	84	84

Note: The table reports standard errors in parentheses. Statistical significance is noted with the conventional ***p < 0.01, **p < 0.05, *p < 0.10. The coefficients of regional dummies are not reported.

For the evaluation of the "causes of the causes", estimates for equation (2) show that reaching grade 6 at the secondary level, as a proxy for mothers' education, significantly contributes to fight malnutrition with a coefficient of 0.421. Furthermore, the results suggest that decreasing

prevalence of 'under-five' diseases reduces malnutrition, with a coefficient of 0.507 (significant at the 5 percent level). Estimates for equation (3) show that the sum of public spending on water in the current and preceding five budget years and an increasing degree of urbanization are significant factors in determining access to safe water. Growing income is highly correlated with improvements in education (equation 4). However, the relationship between education and urbanization shows an unexpected sign. An increasing degree of urbanization leads to a lower level of education. Reasons for that might be the fact that fast and unplanned urban growth often leads to increased poverty levels and population growth exceeding manageable education infrastructure (Moore et al., 2003). As expected, higher levels of education, urbanization, and land are positive determinants of the regional GDP, with significant coefficients of 0.018, 2.633, and 0.120, respectively.

Bearing in mind the assumed policy objective of maximizing the amount of DALYs averted, table 5 shows the returns in DALYs for every one percent improvement of the corresponding variable. For example, for every one percent decrease in the number of malnourished children under the age of five, 4870 DALYs can be averted[10]. The highest returns on DALYs are obtained by improved nutrition and access to safe water sources, followed by sanitation. Looking at the impact of indirect factors, the health effect of investments in mother education exceeds the effect of additional short- and long-term public spending on water.

Table 5: Returns of Cross-sectoral Health Interventions (DALYs averted for every one percent improvement of the corresponding variable)

Sector-Variable	Total DALYs
NUTR	4870
SWATER	2450
SANI	396
MEDU	2050
DISPREV	2469
TWINV	632

Source: author's calculations

[10] The nutrition coefficient multiplied by the total number of DALYs in the health index (0.332/100*1466805)

3.5 Qualitative Analysis

3.5.1 Methods

In addition to the quantitative model, the qualitative "Diagnosis of Sustainable Collaboration (DISC)" model was modified to analyze cross-sectoral collaboration for health. This model aims at exploring the opportunities and obstacles of collaborative change on the basis of evidence from intersectoral collaboration, organizational behaviour, and planned organizational change (Leurs et al., 2008). It distinguishes between 'perceptions', 'intentions', and 'actions'. Each of these constructs was evaluated by a set of indicators. An analysis according to the DISC model combines semi-structured interviews and the analysis of key documents. In contrast to narrative interviews, the semi-structured form aims at obtaining concrete statements about the object of investigation. Moreover, it allows for the comparison of results due to its clear structure (Mayer, 2009). Key stakeholders working in health related sectors were chosen as interviewees, representing the government, multilateral and bilateral organisations. The triangulation of quantitative analysis, qualitative semi-structured interviews, and document analysis is used to strengthen the reliability and the validity of the conclusions.

3.5.2 Data and Major Findings

According to the DISC-Model, the structured interviews were divided into four categories, namely external factors, change management, collaborative support, and budget allocation. A total of 13 stakeholders were consulted to discuss their experience on IHA[11]. Among these, six interviewees represented different governments institutions acting as, for example, a regional medical officer (Tanga, Pwani and Mtwara) or a headmaster of a secondary school (Mtwara). Furthermore, seven stakeholders from non-governmental institutions (e.g. WHO, Faith-based-organizations, development partners) were interviewed. The selection of stakeholders was made according to their understanding and involvement in IHA. To test for a significant difference between the statements of government and non-government interviewees, a Wilcoxon rank-sum test was applied (Mann & Whitney, 1947).

In category one, stakeholders were asked to specify how hard they work with related sectors and to evaluate the yields of particular collaborations. People working for the health sector tend to cooperate with the education, water, and infrastructure sector rather than the agriculture and employment sector. Both governmental and non-governmental stakeholders

[11] See appendix 6 for the structure of the interview and appendix 7 for a list of all interviewees.

reported to collaborate with the local governance sector. Examples of concrete cross-sectoral programs in place are given in section 3.5.3. As the main drivers of IHA, the MoHSW, Tanzania Commission for AIDS (TACAIDS), the IFAKARA Health Institute (IHI), and PMO-RALG were mentioned. Most of the cross-sectoral collaborations include the private sector and Faith-Based-Organizations (FBOs).

Stakeholders have to be equipped with certain skills for effective health promotion alliances. The second subject of the structured interview, "Change Management", dealt with this issue (see table 6, question I). According to the interviewees, networking-skills, knowledge-sharing-skills, and partnership-creation-skills are all very important for IHA (median: 4). However, partnership-support-skills seem to be less important (median: 3). There are no significant differences between governmental and non-governmental interviewees on this issue. Besides further soft-skills such as joint planning-, negotiation-, consultancy- and organizational skills, hard-skills, such as a technical professional background, are required. Within the third phase of the interview, stakeholders were asked to evaluate certain parameters regarding their influence on collaborative efforts (question II)[12]. The most influencing factor for IHA is the initial distribution of resources among the participants, equal to the relative budget allocated to a certain sector (median: 4). Only slightly less important, referring to efforts in collaboration, are the payoffs of each stakeholder of the coalition and the inclinations to work jointly with the other sectors in terms of interpersonal attraction (median: 3). Again, there are no significant differences between governmental and non-governmental interviewees on this issue.

Certain preconditions have to be fulfilled to make cross-sectoral collaboration successful (see von Braun, 2011). Category three evaluated the importance of these preconditions by questioning their relevance (question III). There is a wide consensus regarding the relevance of having a well-balanced number of stakeholders who respect the different, sector-dependent incentives within the group (median: 4). Moreover, a consensus on common problems and on mutual benefits is required for IHA. To enable people to make efforts to think and act cross-sectorally, capacity building has to be put into place and functional ways of communication have to be in place (both median: 4). In contrast, the recognition of different cultures, tools for analyzing common problems, the dissemination of intersectoral research findings, and individual incentives seem to be slightly less relevant (median: 3.0-3.5). There was a significant difference, between the statements of governmental and non-governmental stakeholders,

[12] Selection of categories according to Gamson, 1961

concerning the two questions on incentives and on the recognition of different cultures. Both the recognition of others incentives and the sufficient own incentives are more important for government actors (p=0.0821/0.0912), whereas the recognition of different cultures matters less for government officials (p=0.0855). Mutual trust was suggested as a further, relevant precondition for IHA.

The last question of construct three evaluated the major and minor challenges for cross-sectoral collaboration[13]. The only major challenge seems to be the predominant sectoral orientation of funding, budget, planning, monitoring, and accountability (median: 4), even if this is a significant greater challenge for government stakeholders (p=0.0139). A lesser problem is that somebody has to assume responsibility for cross-sectoral results, the large differences in paradigms, and the lack of education in multi-sectoral work (median: 3). Furthermore, staff turnover doesn't seem to have a very large effect on IHA. The competition of sectoral results plays no role for cross-sectoral cooperation. As an additional challenge, it was mentioned that there are no proposals for IHA promoted at higher political levels. Stakeholders suggested that improved IHA needs to be driven by the leadership at the different ministries and by the donors who support such initiatives. Moreover, the functionality of existing cross-sectoral forums should be strengthened. Regarding the current allocation of public expenditure to major sectors, the stakeholders requested to allocate at least 15% of the annual budget to the health sector, as committed in the Abuja Declaration in 2000. Furthermore, an increase of the agricultural budget share was seen as a necessary action to improve public health through improved nutrition. The efficiency of spending within a sector was a further issue.

[13] Selection of categories according to von Braun, 2011

Table 6: Qualitative Analysis

Question	Median	Significant difference between governmental and non-governmental interviewees? (Wilcoxon rank-sum test)
I. Please assess the following skills required for effective health promotion alliances (1 = not important / 4 = very important)		
a) Networking-skills	4	No
b) Knowledge-sharing-skills	4	No
c) Partnership-creation-skills	4	No
d) Partnership-support-skills	3	No
II. Which of the following parameters influence collaboration efforts with health related sectors? (1 = not influencing / 4 = very influencing)		
a) Initial distribution of resources among the participants	4	No
b) Payoffs of the coalition	3	No
c) Inclinations to join with other sectors (interpersonal attraction)	3	No
III. Please indicate major preconditions for successful cross-sectoral collaboration (1 = not relevant / 4 = very relevant)		
a) A balanced number of stakeholders in each sector (including relative skills)	4	No
b) Recognition of different incentives	4	Yes (p=0.0821)
c) Recognition of different cultures	3.5	Yes (p=0.0855)
d) Consensus on common problems	4	No
e) Consensus on mutual benefits	4	No
f) Functional ways of communication	4	No

g) Tools for analyzing common problems	3	No
h) Sufficient capacities	4	No
i) Sufficient incentives	3	Yes (p=0.0912)
j) Dissemination of intersectoral research findings	3.5	No
IV: What are the major challenges of IHA? (1 = minor challenge / 4 = major challenge)		
a) Predominant sectoral orientation of funding, budget, planning, monitoring and accountability	4	Yes (p=0.0139)
b) None of the sectors makes efforts to assume responsibility for cross-sectoral results	3	No
c) Large differences in paradigms, worldviews and mindsets across sectors	3	No
d) Competition of sectoral results	2	No
e) Lack of education in multi-sectoral work	3	No
f) High level of staff turnover	3	No

3.5.3 Examples of IHA in Tanzania

Based on the semi-structured interviews and further analysis of key documents, existing programmes of cross-sectoral collaboration for health have been identified. A remarkable initiative is the "Prevention and Awareness in Schools of HIV/AIDS (PASHA)" program, a collaboration between the health and the education sector. Initiated by the Ministry of Education and Vocational Training (MoEVT) in 2003, PASHA is part of the reproductive health component of TGPSH. The initiative aims at the provision of information on Sexual and Reproductive Health (SRH) to young people in primary and secondary schools. For the implementation of PASHA, school counselors are elected by the pupils. These counselors receive peer-to-peer training on reproductive health and HIV/AIDS, adolescence, counselling skills, action planning, and record keeping before they start to teach and advise pupils on SRH. It is a "whole school" development approach, where activities focus on students, teachers, heads of schools and non-teaching staff at the same time. To date, the program has been

implemented in three of the 21 regions in Tanzania, namely Tanga, Mtwara and Lindi (see Swiss Centre for International Health, 2012). However, high fluctuation of trained staff and poor communication between the District Education Officer and the Council HIV/AIDS coordinator weakens the effectiveness of the program. Moreover, it remains a challenge to secure funding for the school based HIV/AIDS activities via the Medium Term Expenditure Framework (TGPSH, 2008).

A second example of implemented IHA in Tanzania is the "Public-Private Partnership for Handwashing with Soap (PPPHW)", a cooperation of the health, water, and sanitation sector. Founded in 2005, the objective of the program is to promote handwashing with soap at critical times among women of reproductive age, care takers of children under the age of five, and children between the ages of 6-14. The initiative aims to strengthen the health impact of the WSDP and the Healthy Village Initiative in 10 selected districts on Tanzania mainland. Activities include focused multi-phased behavior change communication campaigns to entice the target group to wash their hands with soap. Today, 500 community workers have been trained to conduct interpersonal communication. Partners of the program are the MoHSW, MoEVT, the Ministry of Water and Irrigation (MoWI), and others. Furthermore, the work of the PPPHW is complemented by similar initiatives of NGOs and international organizations (PPPHW, 2012).

3.6 Conclusions

3.6.1 Major Findings and Priorities of Future Government Investment

Understanding how IHA contributes to the reduction of the burden of disease in Tanzania is crucial for future decisions on budget allocation. The results of the estimated SEM show a significantly positive impact of nutrition, access to safe water sources, sanitation and education on the reduction of disease prevalence. By comparing these variables, the highest returns on DALYs are obtained by improving nutrition and water, followed by sanitation and education. However, short- and long-term public spending on health turned out not to have a significant positive impact on health. Further evaluation of the "causes of the causes" showed that mothers' education and a decreasing prevalence of 'under-five' diseases significantly reduce the prevalence of malnutrition among children under the age of five. In the case of access to safe water sources, which is a further determinant of the disease burden, public spending on water and an increasing degree of urbanization are significant determinants. Moreover, growing income is highly correlated with improvements in education.

With respect to the qualitative structured interviews conducted with 13 stakeholders, networking-skills, knowledge-sharing-skills and partnership-creation-skills are all very important to begin and maintain cross-sectoral cooperation. Additional skills required are further soft-skills such as joint-planning-, negotiation-, consultancy- and organizational skills and hard-skills such as a technical professional background. The most important factor influencing collaborative efforts is the relative budget allocated to a certain sector. Slightly less important in terms of starting collaborations are the payoffs of each stakeholder and interpersonal attraction. Preconditions to work intersectorally include a well-balanced number of stakeholders, mutual trust, a consensus on common problems and, especially for government actors, sufficient incentives for IHA. A major challenge of working cross-sectorally for public health is the predominant sectoral orientation of funding, budget, planning, monitoring, and accountability, especially for government stakeholders.

Most of the expected and theoretically assumed correlations between investments of health related sectors and the health status of the population are supported by the results of the quantitative model. This encourages the use of budget analysis as a method for analyzing IHA. However, some of the findings need to be further discussed. For example, the insignificant impact of public health spending, predominantly on curative measures, could be understood as a call for more preventive measures, including improvements in nutritional status and drinking water quality. This brings us back to the need for cross-sectoral investments. However, the qualitative analysis shows, for example, that there is not much collaboration in place between the health sector and the agricultural sector[14], even if this is most effective according to the estimated coefficients in the quantitative model[15]. A reason for this might be the lack of proposals for IHA at the higher political level, which is, in turn, a consequence of poor incentives to think and act cross-sectorally among government institutions (see section 3.5.2). This behavior contradicts the consensus for the need of IHA, as stated in the poverty reduction strategy paper of Tanzania, MKUKUTA. Efforts for cross-sectoral collaboration might be more prevalent among non-government institutions and international organizations, due to financial incentives and higher salaries paid in contrast to the government sector.

According to the literature, IHA fails more often than it succeeds. One of the challenges might

[14] People working for the health sector tend to cooperate with the education, water and infrastructure sector rather than the agriculture and employment sector (see section 3.5.2).
[15] The results of the estimated health equation (equation 1) show a significantly positive impact of nutrition on health.

be the fact that the prestigious health sector often expects other sectors to consider health-related issues, within their policies, without regard to the question of how the health sector could support the agendas of related sectors (O'Neill et al., 1997). Appointing particular government employees in each ministry to be in charge of intersectoral work could solve some of the challenges, such as the lack of taking over responsibility for cross-sectoral results. Careful consideration, increased education in multi-sectoral work would be prerequisites for such an approach.

If Tanzania seriously wants to reduce its burden of disease, this study suggests to put more weight on the allocation funds to the agriculture, water, sanitation and education sectors. As the example of the handwashing initiative shows, some first steps in this direction have been made.

3.6.2 Limitations and Future Research Directions

Measuring IHA with the applied methods has some limitations. Firstly, the data might be biased due to incomplete data collection. However, this bias shouldn't influence the results presented, since there is no reason to believe that the degree of incompleteness varies systematically between the regions. Nevertheless, there is much room for improvement regarding the quality and quantity of available data in Tanzania. This should be a priority for the relevant government institutions. Otherwise, impact evaluations of various measures to further develop the country remain difficult. Secondly, the considered investment variables do not include all kinds of donor funds spent in the regions. It is almost impossible to sum up total donor spending in a certain region due to the high number of vertical programs. Only some of the released funds are captured in the government budget. Thirdly, the use of DALYs as an indicator for health status has widely been criticized in the literature. In particular, the assumptions and value judgements such as age-weighting and discounting are seriously questioned (Anand and Hanson, 1997). Fourthly, the policy relevance of budget allocation decisions can be questioned. Donors contribute to more than 40% of the annual budget in Tanzania (Wohlgemuth, 2006). Taking into account that most of these donor funds are earmarked, the scope for flexible budget allocation is limited. More research is needed to identify cross-sectoral determinants of health. A similar analysis could be done to measure the impact of public spending on one specific disease such as HIV/AIDS, Malaria or Diarrhoea. If data allows, other sectors such as roads and housing should be included in future studies.

4. Cost-Effectiveness of Health Interventions – the Case of Malaria

Chapter 4 evaluates whether interventions to combat malaria are prioritized in such a way that the marginal dollar goes to where it has the highest effect on averting DALYs. It is organized as follows: after a brief introduction in section 4.1, section 4.2 summarizes the current status of the Malaria burden in Tanzania. The subsequent section reviews the existing literature on cost-effectiveness analysis of malaria interventions at both the international and the national level including the added value of this study (section 4.3). Section 4.4 discusses the theoretical underpinnings of cost-effectiveness analysis and derives the population model applied in this chapter. The estimates of the quantitative analysis are presented in section 4.5, followed by the results of the structured interviews and some ethical considerations. The final section outlines the conclusions drawn from the analysis.

4.1 Introduction

Malaria is a treatable and preventable disease. Despite huge political and financial efforts, during the last decades, to lower the malaria burden, 655 000 people still died from malaria in the year 2010 worldwide, 91% of them living in Africa and 86% being children under the age of five (World Health Organization (WHO), 2011). Malaria heavily affects the economic productivity of people and slows down the development of a country. To address this challenge, the Millennium Development Goals (MDGs) considered the burden of malaria in two of its objectives: calling to halt and reverse the incidence of malaria by 2015 (MDG 6) and achieving a reduction in child mortality by two-thirds between 1990 and 2015 (MDG 4).

In the case of the United Republic of Tanzania (URT), malaria causes the second largest disease burden after HIV/AIDS (WHO, 2009). The ecological conditions of the country favor the expansion of the anopheles gambiae, which is the most effective mosquito in transmitting malaria parasites. Tanzania has made great progress in scaling up interventions to fight the dreaded disease, including the distribution of insecticide–treated bed nets (ITNs), indoor residual spraying (IRS), intermittent presumptive treatment with Sulphadoxine-Pyrimethamine (SP) during pregnancy, and case management with Chloroquine (CQ), SP and Artemisinin-based combination treatments (ACTs). Since resources for malaria interventions in a developing country like Tanzania are extremely scarce, there is a need for prioritization. The Tanzanian government has already acknowledged the importance of prioritization with respect to the health sector. “ […] prioritisation within these sectors needs to receive

maximum attention to ensure the efficiency and effectiveness of the spending programs" (URT, 2011 II, p. 14). To do so, timely information on health effects and costs of several measures to combat malaria are urgently needed to inform policy makers.

The objective of this analysis is to contribute to the elimination of this deficiency. Assuming the minimization of disability-adjusted life years (DALYs) as a normative measurement concept, this analysis assesses whether interventions to combat malaria are prioritized in such a way that the marginal dollar goes to where it has the highest effect on averting DALYs. The identification of the relative impact of various measures to lower the malaria burden will enable policymakers to understand the trade-offs between different strategies. The prioritization of health interventions depends on the underlying rating criteria. Among others, cost-effectiveness analysis (CEA) is indispensable to optimize the allocation of available funds. Without such an analysis, priorities would be set to improve the health of a small number of people by a minor amount at the expense of a larger number of people whose health status could have been improved by a larger amount (Evans et. al., 2005). Moreover, one must consider that health interventions are not implemented in isolation from each other. Interactions between costs and impacts of health measures, which are implemented simultaneously, should be included in CEA for priority setting. The results from the existing body of literature regarding cost-effectiveness of malaria interventions lack transferability across countries. Thus, a context-specific analysis is unavoidable.

Six individual control interventions designed to reduce the incidence and case fatality rates of plasmodium falciparum malaria have been selected for the present analysis. Moreover, the cost-effectiveness of combined interventions is assessed. The longitudinal population model PopMod serves to estimate the effectiveness of interventions in terms of DALYs. PopMod is a multi-state dynamic life table, which is frequently used in similar studies to simulate the evolution of populations exposed to changing disease states. The costs reflected in the calculation of cost-effectiveness ratios represent the perspective of the society, including indirect and direct treatment costs of the patient in addition to provider costs. Estimates are based on survey data from the NBS, price catalogues, WHO-CHOICE database, existing literature and expert opinion. As a result, cost-effectiveness ratios of each of the interventions are calculated and compared to the current allocation of resources. Moreover, additional qualitative criteria for health priority setting are retrieved from structured interviews with governmental and non-governmental representatives of the health sector.

4.2 The Malaria Burden in Tanzania

4.2.1 Prevalence

According to the World Malaria Report 2011, the impact of malaria control lowered the number of annual malaria cases worldwide from 237 million in 2005 to 216 million in 2010. Almost all cases were due to Plasmodium falciparum (91 percent) and occurred in the African Region (81 percent). Looking at East Africa, most of the countries show a similar trend of decreasing malaria admissions between 2000 and 2010. However, Tanzania mainland is among the few countries reporting constant malaria transmission since 2005. After HIV/AIDS, it is the second largest cause of morbidity and mortality in the country.

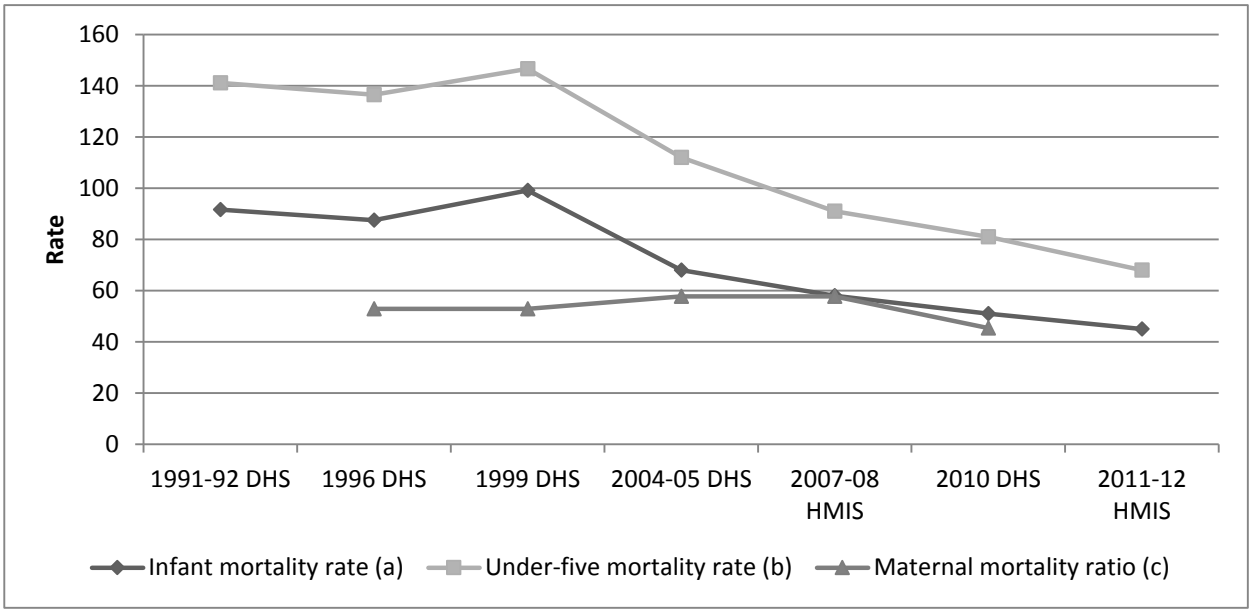


Figure 6: Mortality Rates for Tanzania 1991 - 2012

a) The probability of dying before the first birthday expressed per 1000 live births b) The probability of dying between birth and the fifth birthday expressed per 1000 live births c) Expressed per 10,000 live births; calculated as maternal mortality rate divided by the general fertility rate

Source: Demographic and Health Surveys (DHS) and HIV/AIDS and Malaria Indicator Surveys (HMIS), various years

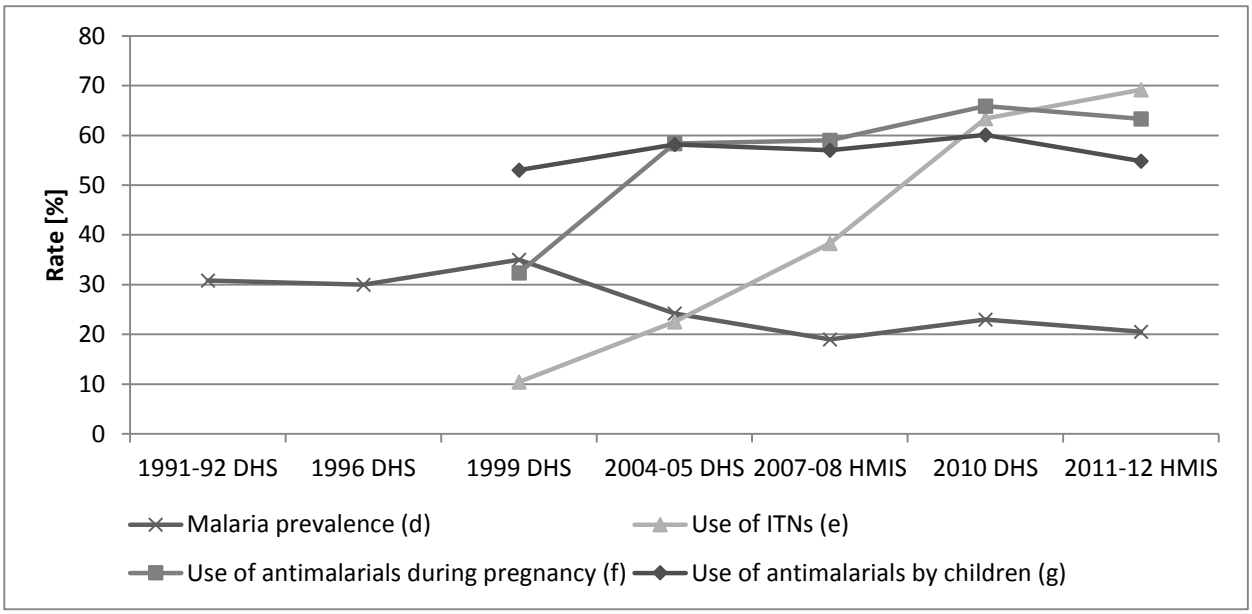
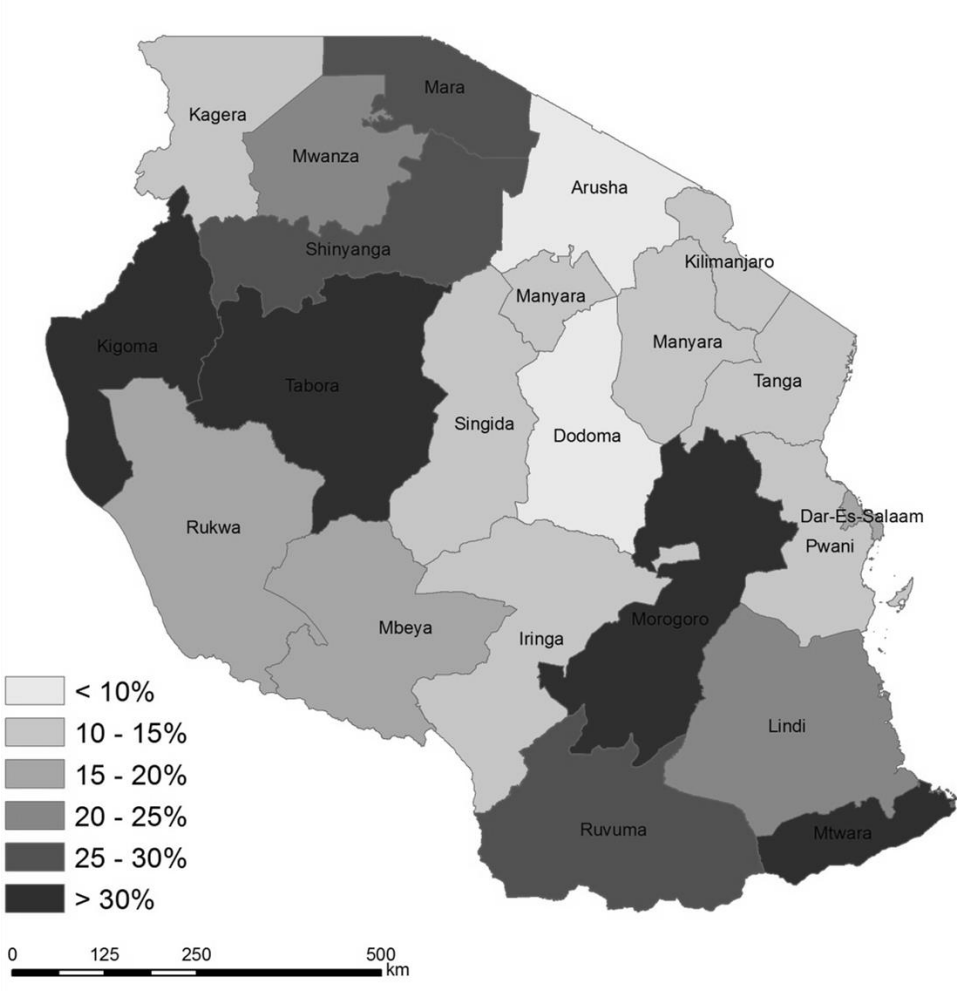


Figure 7: Malaria Indicators for Tanzania 1991 – 2012
d) Percentage of children under age 5 with fever in the two weeks preceding the survey e) Percentage of households with at least one ITN f) Percentage of women who took any antimalarial drugs for prevention during the pregnancy for their last birth in the two years preceding the survey g) Among children under age 5 with fever, the percentage who took antimalarial drugs
Source: Demographic and Health Surveys (DHS) and HIV/AIDS and Malaria Indicator Surveys (HMIS), various years

Most vulnerable to the Malaria are children, due to their insufficient immunity through previous exposure, and pregnant women due to their reduced natural immunity (NBS, 2008). The economic consequences of the disease burden range from low productivity in the workplace to school absenteeism. Tanzania mainland registered a strong decline in infant- and child mortality during the past two decades (figure 6). A potential reason might be the scaling up of preventive and curative measures to combat malaria such as the use of ITNs and antimalarial drugs during that period of time (figure 7). The reduction of deaths was stronger in rural areas compared to urban areas. This possibly indicates that the interventions reach the poor people most vulnerable to malaria. From the year 1999 onwards, the use of antimalarial drugs during pregnancy increased rapidly and could account for the falling maternal mortality rate in the subsequent years. More than 92 percent of the Tanzanian people live in areas where Malaria is transmitted, resulting in approximately 10 million clinical malaria cases annually (MoHSW, 2008 I). As shown on map 3, the prevalence of malaria varies across the regions, depending on seasonal rainfall patterns and further climatic conditions. Prevalence rates vary from more than 20 percent in the regions bordering Lake Victoria (Mwanza, Mara, Kigoma) to less than 10 percent in Arusha and Dodoma.

Map 3: Regional Malaria Prevalence for Children Under the Age of Five 2011/2012[1]



[1] Percentage of children under age 5 with fever in the two weeks preceding the survey
Data source: NBS, 2012 (mapped by the author)

4.2.2 Policies

Various policies are in place to fight the persisting malaria burden shown in section 4.2.2. However, if Tanzania would succeed in eliminating malaria without similar success in the neighbouring countries, malaria would return because of the movements of people across borders. To account for this fact, a regional policy forum was founded, called the African Leaders Malaria Alliance (ALMA). It is an alliance of African Heads of State aiming to keep malaria high on the political agenda and to provide a high-level forum that discusses the most efficient ways to finance, manufacture, and distribute malaria interventions beyond national borders (ALMA, 2013). In addition to these regional efforts, various national policies regulate malaria control and eradication. The strategic objective in the Health Sector Strategic Plan (HSSP) III, for the years 2009 to 2015, is to implement universal access to malaria interventions through effective and collaborative efforts. Achievements will be measured by

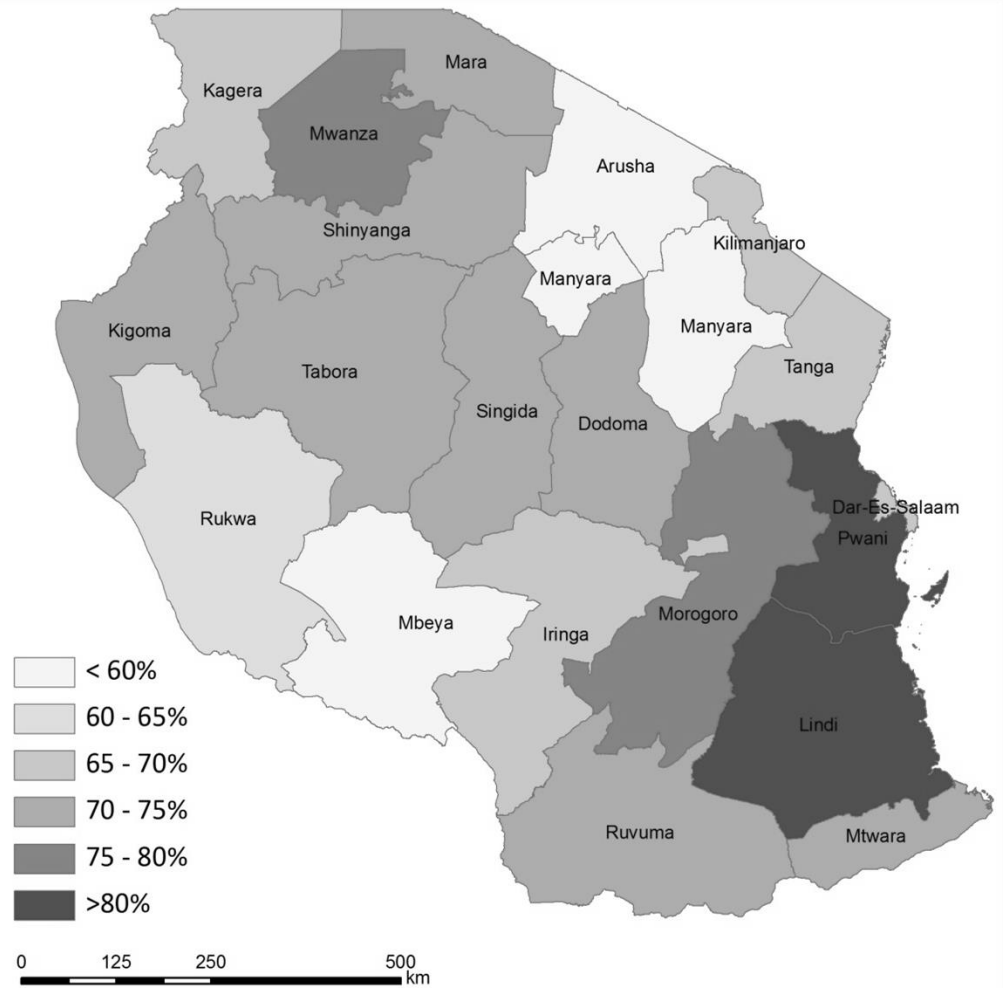
the proportion of pregnant women and children under the age of five sleeping under ITNs, the proportion of structures sprayed by IRS, and the proportion of 'under-5s' with parasitaemia (MoHSW, 2009).

More specific objectives and measures to combat malaria are set in the Malaria Medium-Term Strategic Plan (MMTSP) 2008-2013 (MoHSW, 2008 II) that aims to reduce the malaria burden by 80% by the end of 2013. The baseline for this objective is the year 2008, showing 18 million malaria cases and 80,000 malaria deaths per year. To achieve this objective, the two core strategies are malaria diagnosis and treatment, on the one hand, and malaria prevention, on the other. The National Malaria Control Programme (NMCP) leads the implementation of these strategies and coordinates all national, bilateral and multilateral initiatives. As part of the health sector reform in 1999, malaria was included in the National Package of Essential Health Interventions (MoHSW, 2000). Thus, measures to fight malaria are part of the activities in the Comprehensive Council Health Plans (CCHPs), including planning, budgeting and capacity building for implementation.

4.2.3 Interventions

Four major interventions to combat malaria are currently implemented in Tanzania, including mosquito nets, IRS, case management with antimalarial drugs, and IPTP. Additional measures include environmental management, intermittent preventive treatment in infants (IPTi), communication campaigns, and initial experiments with malaria vaccines. The German colonialists were first in using mosquito nets woven out of cotton to reduce biting intensities at the beginning of the twentieth century. With the help of social marketing campaigns in the nineties, the usage of ITNs had reached 10.4 percent of the households in 1999 (figure 6). To increase the coverage of ITNs, Tanzania started to distribute the nets through the Tanzania National Voucher Scheme (TNVS) whereby vouchers were given to pregnant women and children enabling them to receive an ITN for a small top-up fee. In 2008, ITNs were replaced by long-lasting insecticide-treated nets (LLINs) and given for free to all children under the age of five (Roll Back Malaria Partnership (RBM), 2012). The result of these measures was a substantial increase in coverage, reaching 69.2 percent of households in 2012. Coverage varies substantially among the regions, and those with medium prevalence rates such as Rukwa or Mbeya still lack sufficient ITN coverage (map 4).

Map 4: Use of ITNs 2011/2012[2]



[2] Percentage of the household population who slept under an ITN in the night before the survey
Data source: NBS, 2012 (mapped by the author)

In 1985, IRS was introduced as a second preventive intervention to combat malaria. However, the donor funded program ended after a few years due to insufficient funds to sustain it. After the reintroduction of IRS in 2007, the target of the MMTSP is now to protect 50% of the population with IRS and to scale it up to 60 districts by the end of the year 2013 (MoHSW, 2008 / RBM, 2012). However, this goal will be difficult to achieve. According to the latest HMIS, 11.6 percent of the households on Tanzania mainland had been covered with IRS in 2012 (NBS, 2012). IRS is free to homeowners and is largely carried out by the government.

As with mosquito nets, curative case management with antimalarial drugs had its beginning during the German colonial time, when Quinine was given to the staff and family of colonial officials. Due to growing resistance, Tanzania changed its first line drug to treat malaria several times in history, from CQ to SP in 2001 and again from SP to ACT at the end of the year 2006. With every change of the drug policy, health workers had to be trained on new

guidelines and treatment procedures. To improve the accessibility of antimalarial drugs to the population, the Ministry of Health and Social Welfare (MoHSW) launched the strategy of accredited drug-dispensing outlets (ADDO). With this program, private drug outlets receive subsidized antimalarial drugs under certain conditions regarding storage, sale, and patient consultation (RBM, 2012). Nowadays, former first- and second-line antimalarial drugs are still widespread. In 2008, children under the age of five with fever had been treated with SP (4.9 percent), CQ (0.5 percent), Amodiaquine (18.2 percent), Quinine (11.7 percent), ACTs (21.5 percent) or other antimalarial drugs (1.6 percent). Remarkably, the percentage of children with fever who took ACTs increased to 33.7 percent in 2012 (NBS, 2008/2012). The problems of proper case management include frequent stock-outs of drugs at health facilities and a high number of people who, when infected, do not seek treatment from a formal health provider.

As mentioned in section 4.2.1, women are most vulnerable to malaria infection during pregnancy. According to Steketee et al. (2001), malaria during pregnancy is associated with anemia, low birth weight, intrauterine growth retardation, and infant mortality. IPTP is a preventive measure to avert malaria during pregnancy and includes two doses of SP. The first dose is given to the women during their antenatal care visit in the second trimester of pregnancy and the second one follows in the third trimester (NBS, 2008). In 2012, 32.9 percent of women with a live birth in the two years preceding the survey took at least two doses of SP. This is a small increase compared to 26.7 percent in 2010, but remains well below the coverage target of 80% stated in the MMTSP (NBS 2011, 2012). Problems relating to the scaling up of the intervention include the lack of competence concerning the safe timing of SP provision, inconsistent record keeping, and troubles with data analysis (President's Malaria Initiative (PMI), 2012).

4.2.4 Budget

Most of the malaria control interventions implemented in Tanzania are funded by bilateral and multilateral development partners. These funds increased substantially during the last decade, from 4.9 million US$, in 2003, to 137.9 million US$, in 2010 (figure 7). In relation to the total malaria budget, the government's share remained low at US$ 5.2 million, in the budget year 2006/2007, and US$ 2.0 million, in 2008/2009 (PMI, 2012). The lion's share of the total malaria budget comes from the Global Fund to Fight AIDS, Tuberculosis and Malaria, followed by PMI, the World Bank's Malaria Booster Program, and other donors. Expenditure per person at risk of malaria increased from US$ 0.14 in 2003 to US$ 3.31 in 2010 (RBM, 2012). This level of malaria

expenditures is quite high compared to other African countries such as Ghana (US$ 3.00 per person at risk) or Nigeria (US$ 0.85, WHO, 2011). Looking at the major health programs in the latest Public Expenditure Review for the Health Sector, only 3% of the funds are allocated to the malaria program, compared to 14% for HIV/AIDS and 30% for reproductive and child health (MoHSW, 2012).

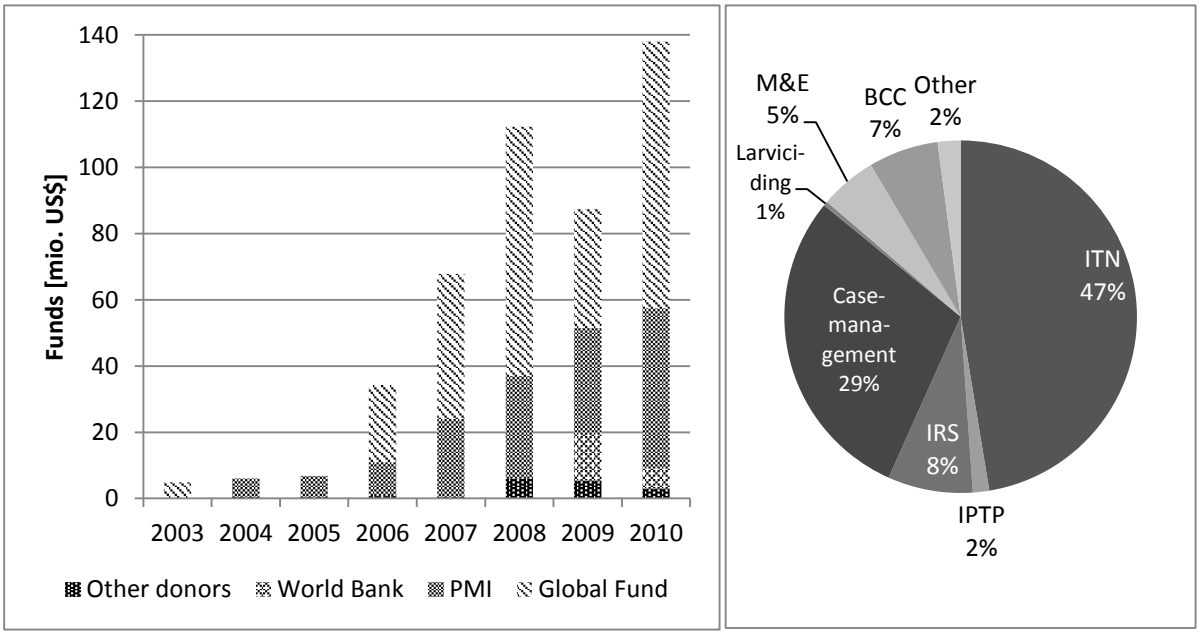


Figure 8: External Funding Sources for Malaria Control and Average Allocation to Interventions 2000-2010
Source: RBM, 2012

Figure 8 shows major interventions' share of the malaria budget. More than half of the funds are allocated to preventive measures, led by ITNs (47%), IRS (8%), Behaviour Change Communication (6%), IPTP (2%), and Larviciding (1%). A smaller share of almost one third of the funds is allocated to malaria case management (RBM, 2012). This analysis serves to prove whether this allocation is also justified on cost-effectiveness grounds.

4.3 Literature Review

The impact of the malaria burden on economic growth, fertility, population growth, saving and investment, worker productivity, absenteeism, and premature mortality has been widely discussed in the literature (Sachs and Malaney, 2002 / Chima et al., 2003). Moreover, various authors examined the cost-effectiveness of strategies to combat malaria for the whole of Sub-Saharan Africa. One of the first studies carried out by Goodman et al. (1999) modelled the effectiveness of the provision of ITNs (US$19-85 per DALY averted), IRS (US$32-58), chemoprophylaxis for children (US$3-12), and IPTP (US$4-29). The authors concluded that cost-effective interventions are available but not affordable in very-low-income countries without substantial donor support. At the same time, Coleman et al. (1999) found that the

long-term use of ITNs, in areas with high infection rates, might lead to a mortality rebound in later childhood, which could lower the cost-effectiveness of the intervention. This is justified by the fact that an infection in the first years of life might allow for the development of immunity. At the beginning of the new millennium, many countries changed the first line drug for malaria treatment from CQ to SP, due to the growing resistance of parasites to the former. A modelling approach was used by Goodman et al. (2001 I) in order to find the optimal year for the switch over.

Furthermore, Utzinger et al. (2001) indicated that environmental management, such as the modification of river boundaries or draining of swamps, has a huge potential to reduce the malaria burden. The short-term costs of this strategy are US$ 524-591 per DALY averted compared to long-term costs of US$ 22-92. Thus, this strategy is cost-effective in the long-term only. Several authors have assessed the impact of antimalarial chemoprophylaxis during pregnancy on the birth weight of newborn babies (Wolfe et al., 2001 / Goodman et al., 2001 II). They agreed that the SP regime is cost-effective in reducing the proportion of newborns weighing less than 2,500 g.

In 1998, the WHO launched a project called “Choosing Interventions that are Cost-Effective” (CHOICE) in order to analyze regional costs and impacts of key health interventions. For southern and eastern Africa, the WHO used a state-transition model to show that case management with ACT, at 90% target coverage, is most cost-effective in lowering the malaria burden (INT$ 12 per DALY averted), followed by the combination with ITNs (INT$ 28), IRS (INT$ 41), and IPTP (INT$ 41, Morel et al., 2005). Further regional estimates for the Kenyan highlands suggest that in various scenarios, IRS would appear to be more cost-efficient than ITNs, with economic costs of $0.88 and $2.34 per person protected, respectively (Guyatt et al., 2002). A similar analysis for Mozambique shows that the economic costs of IRS differ between rural (US$3.48 per person covered) and semi-urban areas (US$2.16, Conteh et al. 2004).

For Tanzania, the following studies explored the efficacy and cost-effectiveness of single malaria interventions. Policy makers were particularly interested in studies on the cost and health implications of changing first line drugs for the treatment of malaria due to growing resistance. By the end of the nineties, the growth rate of CQ resistance accelerated rapidly in many African countries and Tanzania was no exception. Thus, Abdulla et al. (2000) used a

decision tree model to assess the impact of changing the first line drug from CQ to SP for the case of Tanzania. Even under the assumption of a substantial increase in SP resistance, the switch appeared to be highly cost-effective with a cost of US$ 14 per death averted. However, extensive awareness and sensitization campaigns were necessary to implement the policy change, since only 50% of the Tanzanian people were aware the CQ could fail to treat malaria, 57.1% knew of alternative treatment options, and 63.2% knew the reasons for non-response to antimalarial treatment (Tarimo et al., 2001). With rising levels of drug resistance to SP, researchers focused on the cost-effectiveness of new developments for malaria case management, such as ACT. Wiseman et al. (2006) carried out an economic evaluation of drug combinations used to treat Tanzanian children with non-severe malaria. Using a randomised effectiveness trial, the authors found that both artemether-lumefantrine and amodiaquine with artesunate were most cost-effective with gross savings of approximately US$ 1.70 per case averted, compared to monotherapy. The latest results on the cost-effectiveness of preventive measures to combat malaria are presented by Yukich et al. (2007). The authors estimated US$ 21-60 per DALY averted for ITNs and US$ 21 for IRS, based on data from the Tanzanian National ITN program and regional data from southern Mozambique, respectively.

However, all these studies have limited relevance for the priority setting process of a single country, since many factors may alter across settings, e.g. the availability, mix and quality of inputs, local prices, labour costs, demographic structures, and epidemiological characteristics (Hutubessy et al., 2003). Consequently, there is a need for country-specific cost-effectiveness assessments. The few analyses that exist for the case of Tanzania have assessed single malaria interventions with limited specifications only. This study will be the first to analyze several strategies to combat malaria within a standardized modelling framework, making results comparable.

4.4 Theoretical Framework

4.4.1 Theoretical Basis for Cost-Effectiveness Analysis

Due to scarce financial resources to lower the malaria burden in Tanzania, policy makers are forced to prioritize corresponding curative and preventive health interventions. From an economic point of view, improved efficiency should be the major criterion within the health priority setting process.

Health planners have applied two major tools for priority setting during the past decades,

namely CEA and cost-benefit analysis (CBA). With the help of CEA, the relative costs and outcomes of two or more health interventions can be compared. Priority should be set to interventions with the lowest costs per health unit. In contrast to CBA, the gains of the interventions on health do not have to be monetized. Typically, CEA uses the following formula to compare different health interventions (Russell et al., 1996):

$$\textit{Cost per health unit} = \frac{\textit{Changes in resource use (valued in monetary terms)}}{\textit{Changes in health due to the intervention (e.g. DALYs)}}$$

Various methods exist for measuring the health outcomes (denominator). One possibility is to use natural units (e.g. number of cataracts removed). In this case however, only interventions with the same objective can be compared. Furthermore, DALYs, quality adjusted life years (QALYs) or healthy-years equivalents (HYEs) could be applied as a denominator. Each method has its strengths and weaknesses. In this analysis, DALYs are used to ensure the comparability of results to similar studies (see section 4.3).

Two standard CEA concepts are applied to health, in current practice. Firstly, intervention mixed constrained cost-effectiveness analysis (IMC-CEA) evaluates the cost-effectiveness of additional activities to the current mix of interventions. It does not question the effectiveness of the interventions at the starting point of the analysis. Consequently, there might be considerable allocative inefficiency in the on-going allocation of resources and major opportunities to strengthen the cost-effectiveness of the system are not identified. A second approach for CEA is generalized cost-effectiveness analysis (GCEA). In contrast to IMC-CEA, GCEA assesses the costs and effects of health interventions in comparison to the null set of interventions (as explained below). Following the analysis, the interventions are categorized as ‘very cost-effective’, ‘cost-effective’, and ‘cost-ineffective’, and, thus, the optimal combination of interventions can be applied to any given budget. The advantage of this concept and the reason for its use in the ensuing analysis is the increased transferability of the results to different regions in Tanzania, for example, where currently, different mixes of interventions exist (Tan-Torres Edejer et al., 2003).

The null set of interventions is defined as a situation, where a certain group of interrelated interventions (in this case interventions to fight malaria) are eliminated at the beginning of the simulation period. This situation is rather a transition of the epidemiological profile, spread over the time of simulation, than a stable epidemiological state. A prerequisite for this

situation is the possibility of reallocation of all funds within the health sector. Furthermore, the cluster of interventions includes only interventions that affect each other, e.g. the implementation of IRS and the distribution of ITNs to the same household. The cost-effectiveness of all selected interventions is proven in relation to its non-implementation, or the null set of interventions. This includes individual interventions and combinations of the same. In the case of a large number of interrelated interventions, it is a pragmatic decision to increase the number of interventions included in the cluster, given the additional workload (Tan-Torres Edejer et al., 2003).

As mentioned above, CBA would be an alternative approach to analyze the costs and benefits of different health care interventions. In this case, the individual utilities of patients are central. To rank the outcomes of possible health interventions for the priority setting process, the net benefits of each intervention must be calculated in monetary units according to the following formula (Hauck et al., 2004):

Net benefit = sum of individual utilities in monetary units – costs of intervention

To assess the sum of individual utilities, the scope of the benefits has to be identified first. This includes not only the improved health status of a person, but also benefits to third parties (e.g. decreased care time), benefits to all members of the community (e.g. decreased risk of infections due to vaccination campaigns), and economic values such as the availability of work force. A method to convert these impacts into monetary benefits is the willingness to pay (WTP) approach. It measures, for example, the WTP for an increased number of life years in full health. Thus, an intervention is worth implementing if aggregate WTP exceeds costs. However, we opted to not use this approach for two reasons. Firstly, the results obtained through the application of this method are strongly influenced by the design of the questionnaire and the WTP depends on the ability to pay. Secondly, insufficient information is available to value the benefit of a certain health intervention (Hauck et al., 2004; Tan-Torres Edejer et al., 2003).

Within the economic theory of health care evaluation, two general approaches to determine the costs of interventions are discussed. The ‘decision maker’s approach’ is a more pragmatic way of calculation and focuses on the costs incurred by the health provider. In other words, it is the view of the Ministry of Health, without incorporating direct or indirect costs that have to be borne by the patient or family, such as transportation to the hospital or the time forgone while

caring at home for people exposed to malaria. In contrast, all of these non-medical costs are included in the 'welfarist' approach_which determines the costs of interventions from a societal perspective. In this case, it does not matter who bears the costs of the health measure. Health provider costs are combined with the costs of the family or patient. The value of the costs of non-health consumption is determined by the benefits forgone because the patient or family could not use these resources for different purposes (opportunity costs). As far as the data for the realization of this study allowed, the 'welfarist' approach has been used in the following analysis (Brouwer and Koopmanschap, 2000; Wiseman, 2006).

4.4.2 Population Model

The longitudinal population model PopMod developed by Lauer et al. (2003) is employed to compute the effectiveness of selected malaria interventions. In comparison to other population models of the life-table family, PopMod is unique in using separate age and time axis. It is implemented with the help of the Windows based C++ software application 4SPopMod. The model results serve as input in the denominator of the cost-effectiveness formula (see section 4.4.1). PopMod is a multi-state dynamic life table used for the simulation of health and mortality of a given population. In doing this, up to two interacting disease states and other background causes of ill-health and death can be simulated. The population-level impact of selected interventions is calculated by tracking a certain population over a period of 10 years. PopMod is able to compare the evolution of disease prevalence, incidence, remission, and case-fatality in the case of no interventions (the null set) and in the cases of single or combined interventions (at different coverage levels). In the case of malaria, interventions reduce its incidence and case-fatality. As a result, the population health gain due to the interventions in terms of DALYs can be calculated.

Several sub-populations must be built for the analysis. Firstly, the entire population is divided into male and female sub-populations. Secondly, age groups of one-year span are constituted up to the age of 100 years. Figure 9 shows the basic structure of the four-state population model considering births (B), deaths (D), and up to two disease conditions. States are mapped as boxes and flows are shown as arrows.

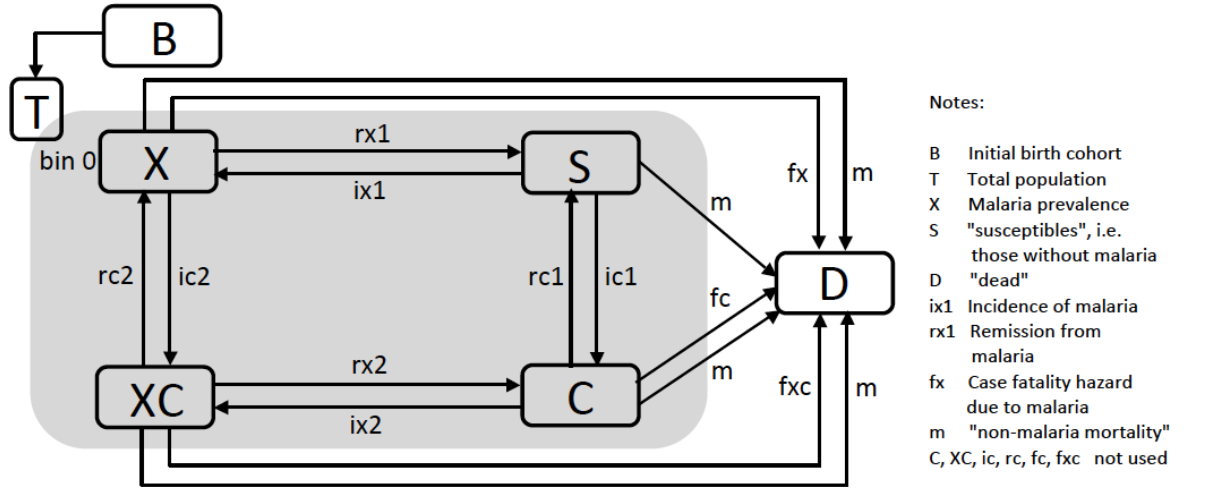


Figure 9: The Four-state Population Model
Source: Lauer et al., 2003

The total population (T) of each age group is divided into four disease states, two with the individual disease condition (X or C), a group with the combined condition (XC), and a group with "healthy people" (S). Similarly to the study on the cost-effectiveness of malaria interventions done by Morel et al. (2005, see section 4.3), only a partial model of PopMod, focusing on one disease condition, has been used in this analysis. The prevalence rates of the groups X (those with malaria) and S (healthy people) are defined as proportions relative to the total population:

(1) $p_X = X/T$ $p_S = S/T$

Population movements between the disease states shown in figure 8 are called transition hazards. In the terminology of PopMod, the population movements from *X* to *D* are divided into two parts. Firstly, f_X stands for the cause-specific fatality hazard or in other words, the case-fatality rate (CFR) of the people suffering from malaria. Secondly, deaths from causes other than malaria are denoted as m (background mortality).

(2) $h_{X \to D} = f_X + m$ $h_{S \to D} = m$

Transition hazards change over time due to, for example, changes in the effectiveness of interventions (e.g. resistance of drugs). Equation 3 expresses the time dependent transition hazard $h(t)$ of the at-risk population dP/P.

(3) $h(t) = -(1/P) \cdot dP/dt$

The population evolution, over time, for the three groups used in the analysis is shown in the differential equation system below. For instance, the group of healthy people *S* is decreased by malaria incidence or background mortality and increased by people who are cured of malaria. Analogously, the changes within the other two groups are explained as follows:

(4) $dS/dt = -(h_{S\to X} + h_{S\to D}) \cdot S + h_{X\to S} \cdot X$

(5) $dX/dt = -(h_{X\to S} + h_{X\to D}) \cdot X + h_{S\to X} \cdot S$

(6) $dD/dt = h_{S\to D} \cdot S + h_{X\to D} \cdot X$

The differential equation system is approximated by a 4^{th}-order Runge-Kutta method (see Lauer et al. (2003) for further details). Moreover, PopMod analyzes all age- and sex classes of the population as separate systems. Interventions to reduce, for example, the malaria burden, are modelled as a change of hazards during a certain time. The evolution of hazards can be described by the following linear function:

(7) $h \to h_{int} = a \cdot h + b$

Using this equation, the initial hazard level *b* and the hazards change rate *a* are required for the analysis. Alternatively, the changes of hazards due to interventions can be supplied manually for all age- and sex groups, as done in the following analysis.

The output of PopMod includes the total amount of population healthy years under the baseline scenario and in the case of selected malaria interventions. The difference of both can be interpreted as the effect of the health measure and will be expressed as DALYs averted. Thus, a DALY can be interpreted as a lost year of "healthy life". It combines the years of life lost *(YLL)* due to premature mortality and the years lost due to disability *(YLD)*:

(8) $DALY = YLL + YLD$

For the calculation of *YLLs* in the total population, the remaining life expectancy at the age of death is multiplied by the number of deaths. In the event of a deadly malaria infection, the basic formula for *YLL* is given by

(9) $YLL = N \cdot L$

N = number of deaths due to malaria
L = life expectancy at the age of death in years

For a certain period of time, *YLD* can be computed by multiplying the number of incident

cases by the average duration of the disease and a weight factor. The following formula shows the calculation of *YLD* in the case of a malaria infection:

(10) $YLD = I \cdot DW \cdot L$

I = number of malaria cases
DW = health state valuation for malaria
L = average duration of the malaria infection until remission or death (years)

The weight factor specifies the severity of the disease and lies between 0 and 1, where 0 is defined as perfect health and 1 as death (WHO, 2013). The deterioration of the health status in the case of malaria infection varies according to age and gender. Thus, PopMod allows for different health-state valuation factors for all age- and gender groups. The inclusion of age weighting into the analysis is controversial. In the literature, there is a distinction between efficiency-based age weighting and equity-based age weighting. The former argues that the relative social value of a person's health differs by age. The age-weight function of this concept increases through childhood, peaks at the beginning of a person's twenties and decreases slowly afterwards. In contrast, equity-based age weighting gives the largest weight to young people and declines continuously with age (but remains below zero). The logic behind this approach is that everybody has the right to a certain span of health, depending on his or her life expectancy. These theories could not be finally confirmed in empirical studies (Tsuchiya, 1999). In particular, very little is known about equity-based age weights. Thus, the following analysis presents both results with and without age weighting.

Recipients of health interventions prefer to obtain the outcome of the measure sooner rather than later. In contrast, the costs of the interventions are paid later rather than sooner. Consequently, there is a broad consensus in the literature to discount costs and a controversial discussion on discounting health effects. The justification of discounting future health consumption is based on three approaches. Firstly, there is a risk that there will be no need for the consumption of a certain health intervention in the future due to, for example, death, climate change, or new technologies. The so-called "pure rate of time preference" is a second reason why people value today's consumption over future consumption. Thirdly, the marginal welfare of consumption is higher today when future increases in income are expected. The basic formula to discount costs is the following:

$$Cost_{presentvalue} = \sum_{t=0}^{T} \frac{Cost}{(1+r)^t} \quad (11)$$

Here, *t* specifies the time period of the costs and *r* the corresponding discount rate (Tan-Torres Edejer et al., 2003). As mentioned above, there is no agreement in the literature on how to discount health effects. In accordance with the time paradox by Keeler and Cretin (1983), costs and benefits have to be discounted with the same rate. Otherwise, if the rate used for health effects were lower than the one used for costs, the cost-effectiveness ratio would increase due to the shift of interventions to the future. Other authors, however, stated that the time paradox is irrelevant, because early and later health effects are not mutually exclusive (Parsonage and Neuburger, 1992). In the basic case of this analysis, a discount rate of 3% is applied to both intervention costs and effects. Sensitivity analysis in section 4.5.5 tests the impact of using different discount rates. Various types of uncertainty occur during the calculation of cost-effectiveness ratios, including parameter uncertainty, model uncertainty, and generalization uncertainty (Tan-Torres Edejer et al., 2003). As for age-weighting and discounting, sensitivity analysis will also be applied in this study to explore the impact of varying input factors (e.g. unit costs, efficacy of interventions etc.) on the cost-effectiveness ratios.

Using the longitudinal population model PopMod for CEA of selected malaria interventions has several limitations. In particular, there are three types of errors in PopMod. Firstly, the results of this analysis are distorted due to a model or projection error. PopMod analyzes a simplified system of interacting disease states instead of a more complex full system closer to reality. For instance, the variable X representing the population group suffering from malaria does not distinguish between severe and non-severe malaria cases. Secondly, PopMod simulates population health with the help of approximate solution values using numerical techniques. This might further distort the estimated results due to numerical errors. Thirdly, there is much uncertainty in observed and derived variable values due to the weak quality and availability of data in Tanzania (see Lauer et al., 2003). Moreover, the model is very simple regarding human behaviour and learning and there is no explicit link to water management.

4.5 Quantitative Analysis: Model Estimation and Results

4.5.1 Data

This study is based on historical data on the effectiveness and costs of selected malaria interventions, covering a ten-year implementation period from 2002 to 2012. Data sources comprise the NBS, price catalogues, WHO-CHOICE database, relevant literature, and expert opinion. The analysis focuses on the national level of Tanzania mainland (i.e. excluding Zanzibar). Table 7 shows the initial or mean values of all variables included in the study. Data on total population levels, population growth, mortality rates, and initial birth cohorts are retrieved from the 2002 Population and Housing Census (NBS, 2006 I) and its future projections (NBS, 2006 II). Mortality rates and population levels are divided into one-year age groups covering age 0 to age 100+, resulting in 101 age bins for both females and males. PopMod takes into account that the data from the census is given as mid-year populations. Since population levels are collected in five-year intervals only, PoPMod smoothens the data accordingly.

For all hazard rates, a certain value is given to each of the age- and gender-specific groups. The incidence rate reflects the occurrence of new malaria cases or, in other words, the transition of people from state *S* to *X*. Its value varies between a minimum of 0.196 and a maximum of 0.409 (Schellenberg et al., 2003; WHO, 2012 II). Stated differently, the remission rate measures the number of people who have been cured of malaria and move back to state *S*. Depending on age and gender, the value of the remission rate varies between 0.072 and 0.183 (WHO, 2012 II). Moreover, the percentage of people who died from malaria in a certain period of time is measured by the CFR. Reyburn et al. (2004) and WHO (2012 II) estimated a rate between 0.020 and 0.107 for Tanzania mainland. Data on malaria prevalence was obtained from the latest HMIS (NBS and Macro International Inc., 2012) and Khatib et al., (2012). Furthermore, age- and gender-dependent disability weights for malaria required for calculating the DALYs were retrieved from the burden of disease database (WHO, 2012 II). In general, the net-effectiveness of selected malaria interventions on malaria incidence (*ix1*) and the case-fatality hazard (f*x*) depends on adherence, compliance, the initial level of drug resistance, and the growth rate of drug resistance. Adherence reflects the estimated proportion of patients who take malaria drugs as prescribed. On the other hand, compliance indicates the probability of successful treatment when the physician's prescription deviates from the official dosing schedule.

Various studies have shown that there is a similar effect of ITNs and IRS in reducing malaria incidence and case-fatality (Curtis and Mnzava, 2000; Lengeler, 2001). Consequently, the data from Lauer et al. (2003) indicates that both ITNs and IRS reduce malaria incidence by 33.0 to 75.0 percent and the CFR, by 13.0 to 30.0 percent (table 7). Incorporating a basic level of CQ drug resistance of 0.71 and, due to the replacement of CQ with SP, a negative resistance growth for CQ of -3.0 percent, case management with CQ is estimated to reduce the CFR by 11.0 to 24.0 percent (Mwai et al., 2009). Based on both a lower level of drug resistance (0.23) and a positive resistance growth rate (0.4), the CFR can be reduced by 19.0 to 43.0 percent through case-management with SP (Alifrangis et al., 2009). However, the CFR might fall the most through active case management with ACT (62.0 percent), due to resistance levels and growth rates close to zero (Mugittu et al., 2006). IPTP is applied to a very small part of the total population and, consequently, reduces the overall CFR by 0.9 to 1.9 percent only.

The cost analysis is done from a societal perspective, including provider costs as well as indirect and direct costs to the patient and family. For comparison, all data on intervention costs were deflated to the common base year 2007 using the GDP deflator (World Bank, 2013). Moreover, economic costs are used instead of financial costs to express the opportunity costs of the intervention. A comprehensive cost review showed that the per capita costs for an ITN in Tanzania lies between US$ 2.32 and US$ 2.77 annually, including costs for the identification of need, training on how to use the net, monitoring, and administration (Guyatt et al., 2002; Yukich, 2007). In accordance with Morel et al. (2005), it was assumed that the average ITN is used by 1.5 persons. The annual per capita costs for IPTP are much lower, ranging between US$ 0.34 and US$ 1.49 and covering expenditure for drugs, staff, and health education (Goodman et al., 2001 II; Wolfe et al., 2001). Since IPTP is done during regular antenatal care (ANC) visits, costs for transportation and the opportunity costs for travel time to the hospital have been excluded at this point.

The costs for IRS comprise insecticides, project management, surveillance and training, and range from US$ 1.04 to US$ 4.97 per person covered per year (Guyatt et al., 2002; Conteh et al., 2004; Yukich, 2007). For malaria case management, the figure for the annual outpatient and inpatient attendance has been obtained from the latest Health Statistical Abstract (MoHSW, 2008 I). Costs include non-drug expenditures on the side of the provider, drug costs, direct costs for the patient's family such as hospital fees, transportation, and miscellaneous, and indirect costs such as the opportunity costs of time spent at the hospital, time for

travelling to the hospital, and time spent caring for sick people at home (see table 7). In an optimal case, further costs as those of the MoHSW, costs for the education of health professionals or even health costs in extended years of life, would have been included in the analysis. However, this was impossible due to data limitation. To our knowledge, we have utilized the most reliable and comprehensive data sources currently available for Tanzania. Various studies have also used some of these data sources, as for example a Lancet article published by Masanja et al. (2008).

Table 7: Descriptive Statistics

a) Population Data

Variable	Description	(Initial) Value	Unit	Sources
T	Total population (m)	16.35	Million	NBS, 2006 I
T	Total population (f)	17.11	Million	NBS, 2006 I
g	Population growth	3.29	Percentage	NBS, 2006 II
B	Initial birth cohort	1.44	Million	NBS, 2006 I
M 0	Age-specific death rate	101	Per 1000 p.	NBS, 2006 I
M 1-4	Age-specific death rate	22	Per 1000 p.	NBS, 2006 I
M 20-24	Age-specific death rate	6	Per 1000 p.	NBS, 2006 I

b) Hazard Data

Variable	Description	Trans.	∅-Value	Unit	Sources*
ix1	Incidence of malaria	$S \rightarrow X$	378.673	Per 1000 p.	Schellenberg et al., 2003
rx1	Remission from malaria	$X \rightarrow S$	177.011	Per 1000 p.	WHO, 2012 II
fx	Case fatality hazard	$X \rightarrow D$	42.230	Per 1000 p.	Reyburn et al., 2004
m	Background mortality	M–mx	34.848	Per 1000 p.	NBS, 2006 I
mx	Case mortality (die of X in T)		0.489	Per 1000 p.	WHO 2012 II
X	Malaria prevalence		128.391	Per 1000 p.	NBS; Khatib et al., 2012
HSV.X	Health-State Valuation X		0.82		WHO, 2012 II

c) Net effectiveness of the interventions

Variable	Adher-ence	Com-pliance	Initial resis-tance	Resis-tance growth	Baseline reduction Inci-dence	Case fatality	Unit	Sources*
ITNs	65.0	0.0			33.0-75.0	13.0-30.0	Percentage	Lauer et al., (2003)
IPTP	80.0	10.0	23.0	0.4	-	0.9-1.9	Percentage	Alifrangis et al., (2009)
IRS	100.0	0.0			33.0-75.0	13.0-30.0	Percentage	Lauer et al., (2003)
CQ	40.0	20.0	71.0	-0.03	-	11.0-24.0	Percentage	Mwai et al., (2009)
SP	90.0	0.0	23.0	0.4	-	19.0-43.0	Percentage	Alifrangis et al., (2009)
ACT	35.0	45.0	0.9	0.05	-	41.0-93.0	Percentage	Mugittu et al., (2006)

d) Patient Cost Ranges (per capita, in 2007 US-dollars)

Variable	Drug costs	Direct costs	Indirect costs	Sources
ITNs		2.32-2.77		Yukich, 2007; Guyatt et al., 2002
IPTP		0.34-1.49		Wolfe et al., 2001; Goodman et al., 2001 II
IRS		1.04-4.97		Guyatt et al., 2002; Yukich, 2007; Conteh et al., 2004
CQ	0.077-0.396	1.87	14.73	Drug Price Indi., 2013; Wisemann et al., 2006
SP	0.011-0.226	1.87	14.73	Drug Price Indi., 2013; Wisemann et al., 2006
ACT	1.651-2.616	1.87	2.20	Drug Price Indi., 2013; Wisemann et al., 2006

* WHO (2012) was used as a complementary data source for all hazard and intervention variables

4.5.2 Model Estimation and Results

Table 8 shows the cost-effectiveness estimates for 6 individual and 11 combined interventions to combat malaria in Tanzania. Three different coverage levels are presented to account for potential economies of scale, which could occur, for example, if the additional amount of DALYs averted, by scaling up certain interventions, exceeds the additional amount of costs. Moreover, coverage levels are calculated relatively to the population at risk (92% in the case of Tanzania). The baseline scenario has been estimated without age-weighting and discounting of health effects and costs. Median drug prices and costs have been used. The sensitivity of the results to these factors is shown in section 4.5.5.

Having a limited malaria budget, the first and second priority should be given to the implementation of preventive interventions such as the distribution of ITNs and IPTP, with costs of US$ 41 per DALY averted, for both of the interventions, at a coverage level of 95%. With growing resource availability, ACT for malaria case management should be added as a third priority at the same coverage level (US$ 53 per DALY averted). The incremental cost-effectiveness ratio was estimated to be 85.3. Finally, IRS at 95% of coverage would be included as a fourth measure with costs of US$ 73 per DALY averted and an incremental cost-effectiveness ratio of 191.1. Due to the growing resistance of parasites to CQ and SP, the health effects of these treatments are comparably low. Consequently, both are not included in the health maximizing combination of interventions. Lower coverage levels lead to less cost-effective interventions in most of the cases.

The WHO has derived certain threshold values for cost-effectiveness analysis in low-income countries. An intervention that costs less than US$ 30 per DALY averted can be referred to as highly attractive. Interventions that cost less than US$ 150 per DALY averted are still attractive. Consequently, all interventions of the aforementioned health maximizing combinations could be referred to as attractive (WHO, 1996).

Table 8: Average and Incremental Cost-effectiveness of Selected Malaria Interventions (in 2007 US-Dollars)

Intervention	Cover-age	Average yearly costs (in Millions)	Average yearly DALYs averted (in Millions)	Average costs per DALY averted	Incremental cost-effectiveness
ITN	95%	58.350	1.421	41	41.0
IPTP	95%	1.355	0.033	41	41.0
IRS	95%	103.300	1.421	73	Dominated
CQ	95%	199.940	0.372	537	Dominated
SP	95%	198.653	0.659	301	Dominated
ACT	95%	79.418	1.504	53	Dominated
ITN&CQ	95%	258.290	1.657	156	Dominated
ITN&SP	95%	257.004	1.836	140	Dominated
ITN&ACT	95%	137.768	2.360	58	Dominated
IRS&CQ	95%	303.239	1.657	183	Dominated
IRS&SP	95%	301.952	1.836	164	Dominated
IRS&ACT	95%	182.717	2.360	77	Dominated
IRS&ACT&IPTP	95%	184.072	2.368	78	Dominated
ITN&ACT&IPTP	95%	139.123	2.368	59	85.3
IRS&ITN	95%	161.650	2.304	70	Dominated
IRS&ITN&ACT	95%	241.068	2.904	83	Dominated
IRS&ITN&ACT&IPTP	95%	242.423	2.908	83	191.1
ITN	80%	491.373	1.183	42	Dominated
IPTP	80%	1.140	0.024	47	Dominated
IRS	80%	86.989	1.183	74	Dominated
CQ	80%	168.370	0.313	538	Dominated
SP	80%	167.287	0.552	303	Dominated
ACT	80%	66.878	1.252	53	Dominated
ITN&CQ	80%	217.508	1.391	156	Dominated
ITN&SP	80%	216.424	1.549	140	Dominated
ITN&ACT	80%	116.016	2.007	58	Dominated
IRS&CQ	80%	255.359	1.391	184	Dominated
IRS&SP	80%	254.276	1.549	164	Dominated
IRS&ACT	80%	153.867	2.007	77	Dominated
IRS&ACT&IPTP	80%	155.008	2.014	77	Dominated
ITN&ACT&IPTP	80%	117.156	2.014	58	Dominated
IRS&ITN	80%	136.126	1.914	71	Dominated
IRS&ITN&ACT	80%	203.005	2.479	82	Dominated
IRS&ITN&ACT&IPTP	80%	204.145	2.483	82	Dominated
ITN	50%	30.711	0.723	43	Dominated
IPTP	50%	0.713	0.015	47	Dominated
IRS	50%	54.368	0.723	75	Dominated
CQ	50%	105.231	0.194	541	Dominated
SP	50%	104.554	0.341	306	Dominated
ACT	50%	41.799	0.764	55	Dominated
ITN&CQ	50%	135.942	0.863	157	Dominated
ITN&SP	50%	135.265	0.969	140	Dominated
ITN&ACT	50%	72.510	1.272	57	Dominated
IRS&CQ	50%	159.600	0.863	185	Dominated
IRS&SP	50%	158.922	0.969	164	Dominated
IRS&ACT	50%	96.167	1.272	76	Dominated
IRS&ACT&IPTP	50%	96.880	1.276	76	Dominated
ITN&ACT&IPTP	50%	73.223	1.276	57	Dominated
IRS&ITN	50%	85.079	1.165	73	Dominated
IRS&ITN&ACT	50%	126.878	1.576	81	Dominated
IRS&ITN&ACT&IPTP	50%	127.591	1.579	81	Dominated

Source: author's calculations

4.5.3 Graphical Analysis

In the following section, a graphical solution to determine the most cost-effective strategy to combat malaria in Tanzania is presented. Figure 10 shows the costs and effects of the 51 individual and combined strategies (black squares). The dotted cost-effectiveness threshold line is derived from the categories defined in the previous section. All strategies at the left of the dotted line are not considered as attractive interventions, since costs exceed US$ 150 per DALY averted. Incremental cost-effectiveness ratios are calculated between the strategies that are not dominated by others (dashed lines). Altogether, these dashed lines form an efficiency frontier. Decision makers move along the efficiency frontier and implement attractive strategies with increasing budgets. The most cost-effective strategy is reached at the tangency of the efficiency frontier and the cost-effectiveness threshold (dotted line), in this case, the implementation of ITN & ACT & IPTP. Moreover, diminishing marginal returns on investments in malaria interventions can be derived from the graph.

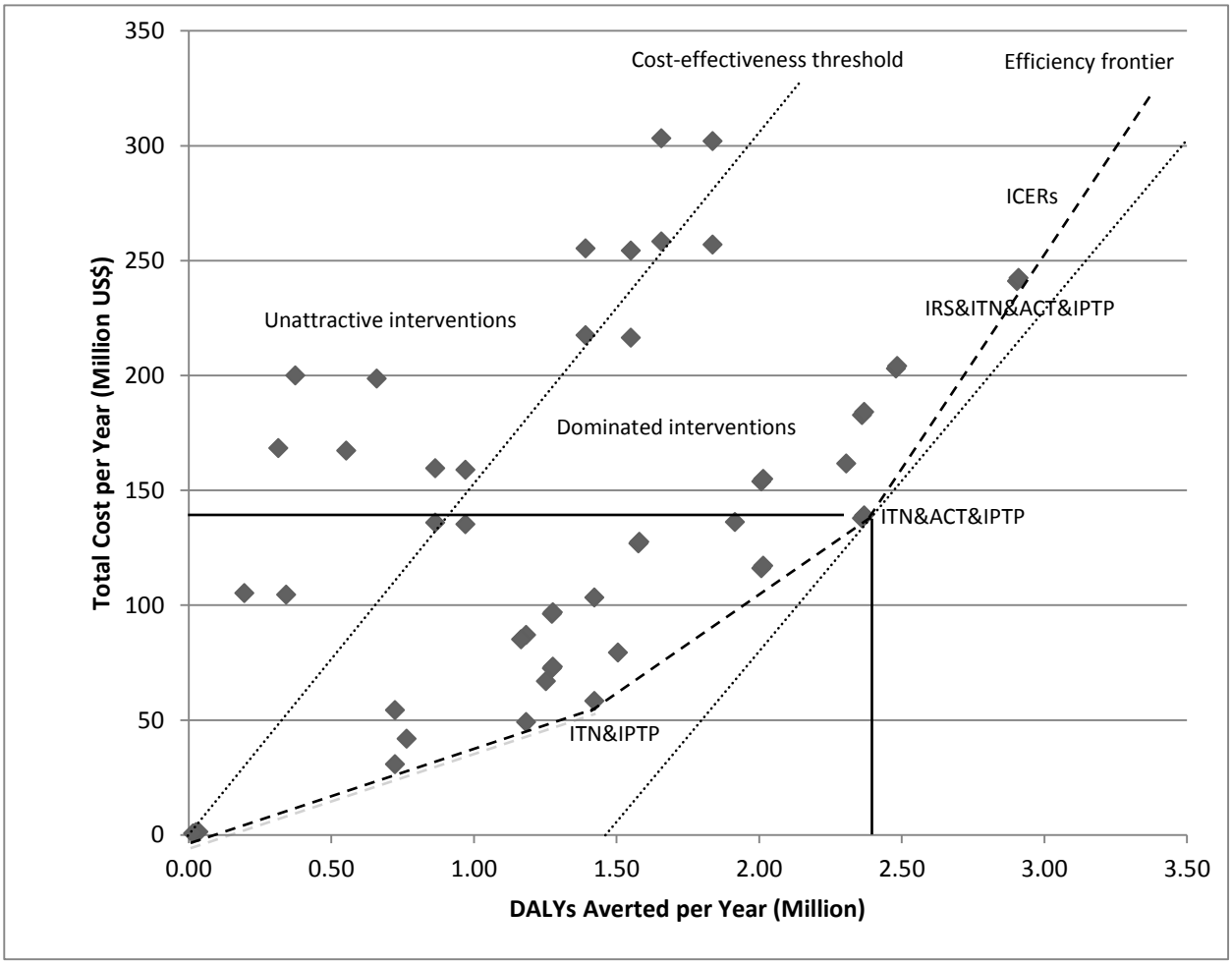


Figure 10: Expansion Path of 51 Strategies to Combat Malaria (Baseline Scenario)
Source: author's calculations

4.5.4 Optimal Budget Allocation

Based on the results of section 4.5.2 and 4.5.3, simple linear programming is used to determine the optimal allocation of funds to the most cost-effective strategies. This method has widely been used by various authors to solve similar optimization problems (see, for example, Fleßa, 2000 or Earnshaw et al., 2002) and ensures that the marginal dollar goes to where it has the highest effect on averting DALYs. In section 4.8, the optimal malaria budget allocation will be compared to the one that is currently implemented in Tanzania.

The following objective function *V* maximizes the amount of DALYs averted subject to several constraints:

$$max\ V = \sum_{i=1}^{4} y_i x_i \qquad (12)$$

Here, *i* is defined as one type of the four cost-effective interventions on the efficiency frontier, y_i the absolute number of DALYs averted per additional dollar spent and x_i the absolute amount of funds spent on a certain strategy. The values for y_i can be derived from table 8:

$$y_{ITN} = 0.024 \quad y_{IPTP} = 0.025 \quad y_{IRS} = 0.014 \quad y_{ACT} = 0.019 \qquad (13)$$

The first constraint reflects the limited budget available for malaria interventions,

$$s.t. \sum_{i=1}^{4} x_i \leq X\,M \qquad (14)$$

where X denotes the total share of the health sector budget allocated to malaria interventions. The multiplier M allows for the calculation of scenarios with increased health sector budgets. Since the maximum amount of DALYs averted due to a certain intervention cannot exceed the potential reduction in the case of full coverage, a second constraint has to be included in the linear program:

$$x_i\, y_i \leq Z_i \qquad (15)$$

Here, Z_i is defined as the total number of DALYs that could be averted based on the maximum of 95% coverage. Moreover, spending a certain budget share *p* on preventive strategies is assumed:

(16) $$\sum x_{iprev} = p \, X \, M$$

Finally, equation 17 constrains the values for x_i and y_i to non-negative values.

(17) $$x_i, y_i \geq 0$$

The simplex algorithm has been used to solve the linear program. Various malaria budget scenarios ranging from US$ 100 million to US$ 240 million are presented in figure 11. As shown in figure 9, US$ 140 million are needed to implement the most cost-effective strategy including ITNs, case management with ACTs and IPTP. To cover all interventions along the efficiency frontier, the budget must be increased to approximately US$ 240 million. Decision makers might decide to spend a certain budget share on preventive strategies, as recommended by the Global Malaria Action Plan (RBM, 2012). To show this effect, all scenarios starting from a budget of US$ 150 million allocate 65 percent of funds to preventive interventions. The budget shares for Larviciding, Monitoring and Evaluation (M&E), Behaviour Change Communication (BCC), and other budget shares were kept constant.

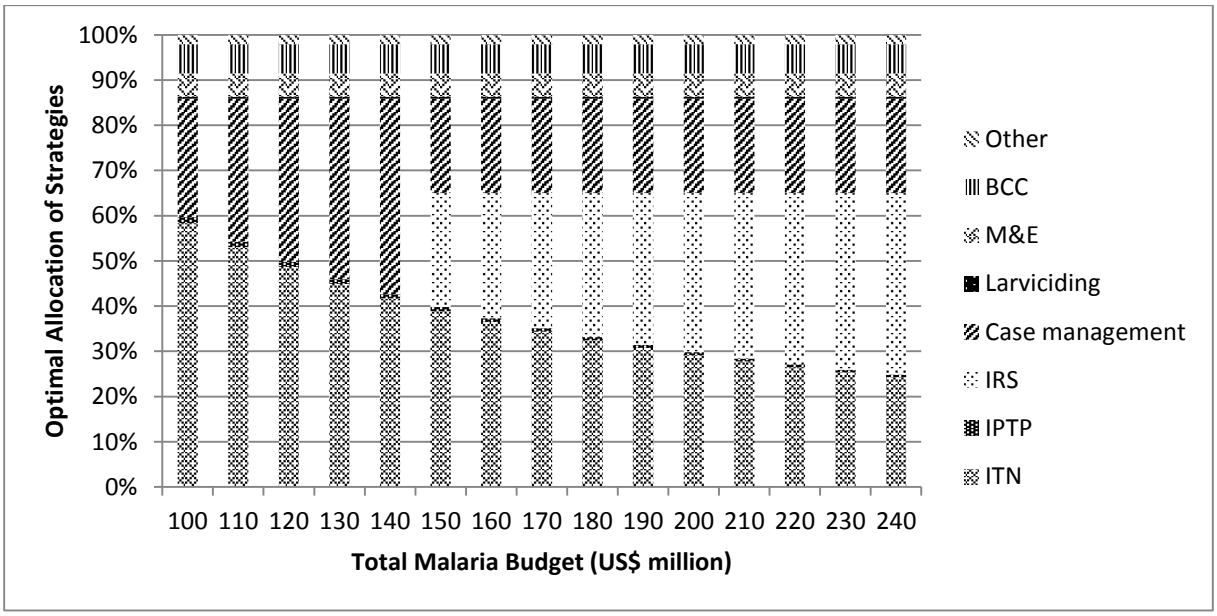


Figure 11: Optimal Budget Allocation Along the Efficiency Frontier
Source: author's calculations

In line with the results of section 4.5.2, the decision maker would start to allocate large budget shares to ITNs, IPTP, and case management with ACTs. The ACT's budget share increases up to the point were the budget share of preventive interventions is set to 65% and the proportion of funds allocated to IRS starts to rise.

4.5.5 Sensitivity and Uncertainty Analysis

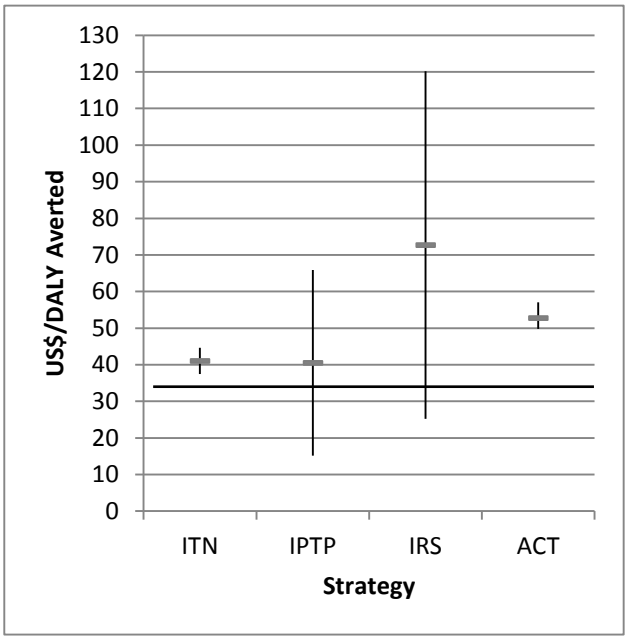
All cost-effectiveness ratios presented are subject to parameter uncertainty, owing to two potential reasons. Firstly, there might be huge variability around observed or derived parameter values. Secondly, the inclusion of specific input parameters depends on value judgements, such as, for example, the use of age-weighting. However, it is important for a decision-maker to identify at which point a certain parameter would make a strategy unattractive, even if it lies on the efficiency frontier in the baseline scenario. To account for that, sensitivity analysis is applied in this study to measure the impact of varying costs, efficacies, discount rates, and the use of age-weighting on cost-effectiveness ratios. Probabilistic uncertainty analysis has been carried out for factors with an underlying probability distribution (e.g. hazards and mortality rates).

In this study, "one-way" sensitivity analysis is implemented by exploring the effect of an individual parameter change while holding other parameters constant. This approach provides more detailed information to the decision-maker compared to "multi-way" sensitivity analysis, where multiple components are varied at the same time (Tan-Torres Edejer et al., 2003). In order to evaluate the sensitivity of cost-effectiveness ratios to varying costs, the attractiveness of strategies has been recalculated using upper and lower extremes from table 7. The results are shown in figure 12. Even with the assumption of maximum costs, all four interventions can still be considered as attractive interventions. In the case of minimum costs, IPTP and IRS reach a very cost-effective point (less than US$ 30 per DALY averted). Looking at the total range of potential cost-effectiveness ratios, the ranking of strategies becomes unclear. However, the implementation of ITNs will always be preferred to case management with ACT. Figure 13 shows the sensitivity of results to upper and lower limits of efficacy. Again, all strategies can still be considered as attractive in the case of minimum efficiency. ITNs can be categorized as very attractive interventions when efficacy reaches its maximum limit. The inclusion of age-weighting and discounting of costs and health effects is presented in figure 14. A discount rate of 3% and equity-based age-weights (giving more weight to the life of young people) do not change the ranking of interventions on cost-effectiveness grounds. Furthermore, the implementation of all interventions is still attractive according to WHO criteria.

To implement the probabilistic uncertainty analysis, a statistical Monte-Carlo method is used. It is integrated in the software package PopMod and varies input parameters randomly around their original values during the execution of N runs. Here, parameters are assumed to be

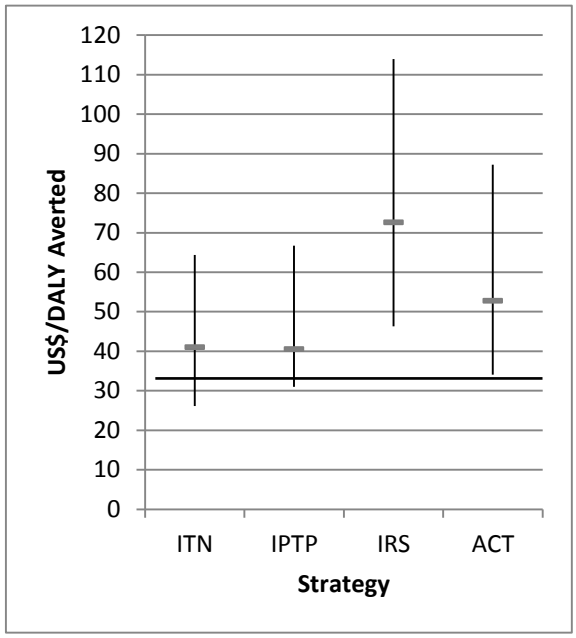
normally distributed with a coefficient of 0.5 variation for all hazards including incidence-, remission-, case-fatality-, and mortality- rates. As an output, PopMod provides estimates for standard deviation and mean. Figure 15 shows that if the variation of parameters is taken into account, overlapping cost-effectiveness ranges make the prioritization of strategies difficult. In any case, ITNs and IPTP would be preferred to IRS.

Figure 12: Sensitivity to Costs (Lower/Upper Limits)



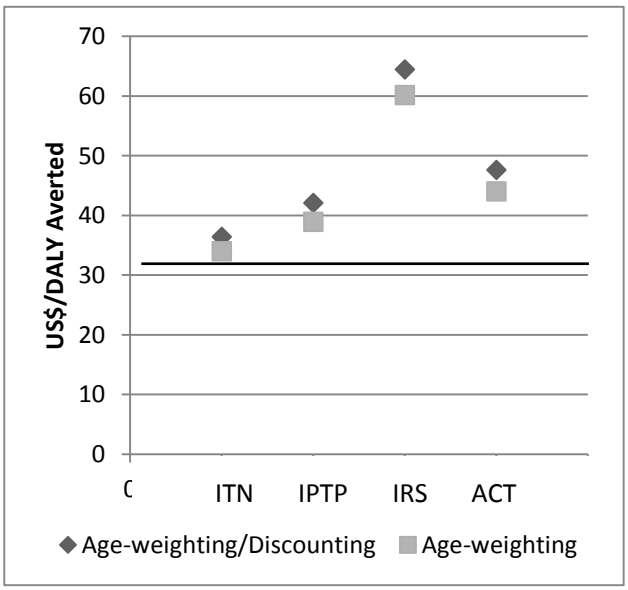
Source: author's calculations

Figure 13: Sensitivity to Efficacy



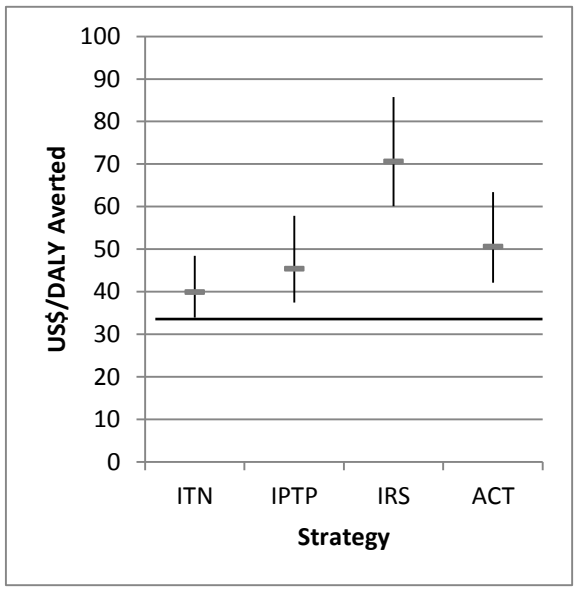
Source: author's calculations

Figure 14: Sensitivity to Age-Weighting/Discounting



Source: author's calculations

Figure 15: Uncertainty of Hazards



Source: author's calculations

In conclusion, three of the four scenarios presented show that, at the extreme parameter values, the effectiveness ranking of the four interventions remains unchanged. The overall cost-effectiveness ranges are US$ 26-64 per DALY averted for ITNs, US$ 15-67 for IPTP, US$ 25-120

for IRS, and US$ 34-87 for case management with ACTs. These interventions are highly cost-effective compared to interventions tackling other major diseases in that region, for example, HIV/AIDS prevention (US$ 6 – 377 per DALY averted), maternal and neonatal care (US$ 82 – 409), or Tuberculosis treatment (US$ 4129 – 5506, Laxminarayan et al., 2006). Currently, prevention and treatment of malaria is the second most cost-effective health intervention in sub-Saharan Africa. The only intervention with higher cost-effectiveness is childhood immunization at a cost of US$ 2 – 24 per DALY averted. These results may encourage decision-makers to put more weight on interventions to combat malaria when allocating the overall health budget. Furthermore, the estimated cost effectiveness ranges are comparable to interventions of related sectors. One example for this are nutrition programs, with US$ 20-105 per DALY averted for the African region (Baltussen et al., 2004).

4.6 Qualitative Analysis

This is a CEA of selected malaria interventions with the objective to optimize the prioritisation of competing measures within the overall malaria budget. However, priority setting in health care has many other dimensions that go beyond CEA: additional criteria are used in priority setting, non-health sectors compete with the funds allocated to health and malaria, various challenges hinder an optimal allocation, and numerous actors are involved in the malaria priority setting process. To account for all these issues, structured expert interviews with governmental and non-governmental stakeholders have been conducted in addition to the quantitative analysis. A total of 11 stakeholders were consulted to discuss their opinion of and experience in health priority setting. Six interviewees, including District Medical Officers (Bukoba and Muleba District) and District Health Secretaries, represented the views of government institutions. Moreover, the opinion of five stakeholders working for non-governmental institutions (e.g. Faith-based-hospitals, research institutions, development partners) was assessed. Stakeholders were selected based on their experience and involvement in the health priority setting process[16]. A Wilcoxon rank-sum test was applied to test for the significance of differences between the opinions of non-governmental and governmental respondents (Mann & Whitney, 1947).

Firstly, the interviewees were asked to elaborate on the health priority setting process in their department or institution. Those who are actually involved in the ranking of health measures

[16] See appendix II for a full list of participants.

stated that the allocation of government funds is based on disease burden assessment and the National Package of Essential Health Interventions. In contrast, it is common to use user-fees to cover the priorities of the corresponding facility, as for example, paying salaries to staff members. Several stakeholders emphasized the involvement of the community through representatives in health facility committees. Question two of the structured interview evaluated the relative importance of certain criteria for health priority setting. In the first section, disease-related criteria were assessed followed by patient-related criteria in section two and society-related criteria in the third section. The quality of evidence on effectiveness and the cost-effectiveness of interventions were ranked as most important within the group of disease-related criteria (median = 4), followed by the severity of a condition (median = 3.5). Among patient-related criteria, the largest weight was applied to age and the urgency of the need for care (median = 4), favoring the treatment of young people. Less important criteria include the responsibility for causing own illness, social status, and place of residence (median = 2.5-3). However, in cases were social status and place of residence matter, priority should be given to interventions for poor people living in rural areas. The results in the category of society-related criteria show that the health budget should be allocated to health interventions with the objective to achieve equity of health care access (median = 4). The view of the community and political attitude are considered as less important criteria (median = 2.5-3).

Several policies on how to allocate health funds to certain priorities are currently in place. In the context of malaria, examples of these include the regional policy ALMA or the national MMTSP (see section 4.2.2). The stakeholders contributing to the development of these policies vary according to the government level. Question four of the structured interview deals with this issue and asked the respondents to rank the actors who should be involved in developing these policies for health priority setting. There was a wide consensus that the inclusion of representatives from the central and local government level and health professionals is most important (median = 4). Less important is the participation of donors, representatives from the international level (e.g. WHO), non-governmental organizations (NGOs), health insurance companies, and the general public (median = 3). The involvement of patients in the priority setting process has little relevance (median = 2). In contrast, the representation of community members and researchers was highly requested by the interviewees.

Even if policies and regulations to structure health priority setting are in place, several problems hinder the allocations of resources to interventions with the highest impact on

health. Consequently, in question five, stakeholders were requested to name the major challenges of the health priority setting process. According to the interviewees, the weak quality of health data and indicators is the major challenge when trying to compare the costs and effects of several interventions (median = 4). Besides the results of the irregularly implemented DHS/HMIS and the Health Demographic Surveillance System (HDSS), carried out by the Ifakara Health Institute (IHI), little high-quality health data is available. The respondents further criticized the availability of health data and indicators in general (also low-quality data), the lack of awareness of the impact of certain health interventions, the weak personal capacity for priority setting, the lack of incentives to carry out an appropriate priority setting process, and earmarked funding from both the donor and the government side (median = 3). In contrast, political constraints including dominant interest groups and multiple government levels as well as discrepancies in people's values are only minor challenges in the process of optimal resource allocation (median = 2). Furthermore, the interviewees mentioned that insufficiencies in the medical supply system are a further constraint. For all questions, there was no significant difference between the answers from governmental interviewees compared to non-governmental interviewees.

The final section of the structured interview dealt with the question of how health priority setting could be improved in future. Firstly, respondents requested a better harmonization of representatives and institutions involved in the process with regards to the health SWAP. Secondly, when setting priorities for health, much more emphasis was advised to be put on the participation at the community level. As mentioned as a response to the previous question, the incentives to carry out an appropriate allocation of resources play a large role and should be strengthened, in particular, for medical practitioners. It was further requested that health professionals' and politicians' ideas should be given equal weight. Within the same context, interviewees suggested to delegate more power to health professionals, in the decision making process, compared to their political counterparts.

Table 9: Qualitative Analysis

Question	Median	Significant difference between governmental and non-governmental interviewees? (Wilcoxon rank-sum test)
2. Please rate the importance of the following criteria for health priority setting (1 = not important criteria / 4 = very important criteria)		
2.1 Disease-related criteria		
a) Severity of a condition	3.5	No
b) Cost-effectiveness of intervention	4	No
c) Quality of evidence on effectiveness	4	No
2.2 Patient-related criteria		
a) Urgency of need for care	4	No
b) Responsible for causing own illness	2.5	No
c) Age	4	No
d) Social Status	3	No
e) Gender	3	No
f) Place of residence	3	No
2.3 Society-related criteria		
a) Equity of health care access	4	No
b) Community's views	3	No
c) Political views	2.5	No
4. Who should be the main actors in health priority setting? (1 = not important actor / 4 = very important actor)		
a) Health professionals	4	No
b) Donors	3	No
c) International level (e.g. WHO)	3	No
d) Central government level	4	No
e) Local government level	4	No
f) General public	3	No
g) Patients	2	No
h) NGOs	3	No
I) Health insurance companies	3	No

4. What are the major challenges of the health priority setting process? (1 = minor challenge / 4 = major challenge)		
a) Availability of health data/indicators	3	No
b) Quality of health data/indicators	4	No
c) Not aware of the impact of certain health investments	3	No
d) No personnel capacity for priority setting	3	No
e) No incentives to carry out an appropriate priority setting process	3	No
f) Earmarked funding (Government)	3	No
g) Earmarked funding (Donors)	3	No
h) Political constraints (dominant interest groups, multiple government levels)	2	No
i) Discrepancy in values	2	No

Sources: author / Kapiriri et al., 2004 / Kapiriri and Norheim, 2004

4.7 Ethical Considerations

In times of scarce resources for health improvement, prioritization of malaria interventions is unavoidable and will consequently lead to the situation where some people do not receive the required health care. Allocating malaria funds on the basis of CEA, however, entails some justice and equity considerations that are criticized here. Using the words of Brock (2003), this criticism can be grouped into two categories, the construction of CEA, on the one hand, and the use of CEA, on the other.

The first issue concerning the construction of CEA is the use of DALYs. As explained in section 4.4.2, DALYs are calculated with the help of certain disability weights (DWs). Ethical criticism addresses the source of these DWs. Whose perspectives should be taken into account when estimating the health state valuation for malaria? The patient's who is suffering from malaria, the medical doctors' perspective, or the view of other health professionals? Moreover, malaria health state valuation depends on adaptation, coping, and adjustment strategies of the patient and differs between certain economic, ethnic, and cultural groups. A second variable that is frequently criticized within the calculation of DALYs is the life expectancy (L). In principle, higher life expectancy produces a higher amount of DALYs. There are huge differences in life expectancy between different regions, genders, ethnic and racial groups, and socio-economic groups in Tanzania. Consequently, preference is given to interventions that predominantly serve, for example, rich people since their life expectancy might be higher comparatively to the

poor. A third issue relates to the inclusion of indirect non-health benefits into the analysis. Malaria infection prevents people from pursuing their daily work, which is associated with a substantial economic loss. However, including the non-health benefit due to the prioritized treatment of these persons would discriminate against very young and old people who are outside the working age.

Using CEA as an instrument for malaria resource prioritization maximizes benefits without taking into account the distribution of health. There is a large discussion whether resources should be allocated to give small benefits to many people (e.g. distribution of ITNs) or to distribute the funds in such a way that only a few people receive high benefits (e.g. case-management with ACT in the case of severe malaria). The results of this analysis show that, optimally, a mixture of both should be implemented. This was only a selection of ethical criticism with regards to the construction and use of CEA. However, all these issues show that CEA should be seen as only one input into the policy debate on priorities.

4.8 Major Findings, Recommendations, and Future Research Directions

CEA is an essential instrument to assess whether scarce resources are allocated to interventions with the highest possible health benefits to the population. Estimates based on a population model for Tanzania mainland show that preventive interventions such as ITNs and IPTP would be the first choice when setting priorities, with costs of US$ 41 per DALY averted for both of the interventions (coverage level: 95%). The estimates for ITNs are identical to those for the whole Southeast African Region (US$ 41 per DALY averted, see Morel et al., 2005). However, huge differences exist in the case of IPTP, which was estimated to cost, on average, US$ 352 per DALY averted in Southeast Africa. Potential reasons for these discrepancies include the time lag between the two studies, differences in the availability, access and quality of inputs, varying local drug prices and labour costs, demographic structures, and epidemiological characteristics. With growing budgets, the additional amount of funds available should be invested in case management with ACTs. The costs per DALY averted are US$ 53 in Tanzania compared to US$ 12 for the whole Southeast African region at a coverage level of 95%. The shift from the two preventive measures (ITNs and IPTP) to the inclusion of ACTs results in an incremental cost-effectiveness ratio of 85.3. As a fourth priority, IRS at 95% coverage should be included with costs of US$ 73 per DALY averted and an incremental cost-effectiveness ratio of 191.1. This estimate is roughly comparable to the result of the whole Southeast African region (US$ 41 per DALY averted). The ranking of

interventions is robust to variations in key input parameters, as shown in the sensitivity and uncertainty analysis.

All these individual measures and combinations can be considered as attractive interventions according to WHO thresholds. The graphical analysis shows diminishing marginal returns on malaria investments with increasing budgets. The most cost-effective strategy is implemented when covering ITNs, IPTP, and case management with ACT at a level of 95%. The budget needed to finance this combination of interventions is almost identical to the funds available in the year 2010 (US$ 140 million, see section 4.2.4). However, the current budget does not prioritize certain interventions in such a way that the marginal dollar goes to where it has the highest effect on averting DALYs. The results of the budget analysis show that a budget share of 41.7% would be sufficient to provide ITNs to all Tanzanian people exposed to the risk of malaria (current allocation: 47%). To reach a more optimal budget allocation, funds from the overfunded ITN program and the less cost-effective IRS should be shifted to make ACTs available and affordable to the poor population. The current allocation of funds to ACTs is 29% compared to 43.3% optimally. In line with the proposed budget allocation, IPTP is fully funded in the current budget.

As a result of the qualitative analysis, CEA was rated as one of the most important criteria for health priority setting. A second criterion that has received much approval is the age of the patient. This could be understood as a preference for the inclusion of age-weighting when calculating cost-effectiveness ratios. However, CEA should only be seen as the second stage of a "medical-social triage". During the first stage, priorities in health are set according to medical, ethical, and socio-legal issues (which are not covered by pure CEA) and divided in groups of "must treats" and "desirable treats". In the course of the second stage, all possible interventions are ranked again according to CEA. Measures of the "must-treat"-group will be implemented, even if they are less cost-effective than others (e.g. case-management with ACTs). Regardless of the implementation of such a two-stage approach, social, and ethical dimensions have to be considered. Moreover, the standardization of the methods used within CEA is a precondition to increase the comparability of health interventions analyzed in different studies (Terry, 2004).

Beyond the interventions assessed in this analysis, broader opportunities for malaria control should be taken into account. This includes increasing the availability and appropriate use of

rapid diagnostic tests (RDTs). With the help of these tests, a large amount of money could be saved by giving appropriate treatments to non-malarial fevers instead of expensive ACTs. Moreover, spatial targeting of malaria interventions might help to save malaria funds in low-risk settings (Wilson and Aizenman, 2012).

Increasing the malaria budget to approximately US$ 240 million would allow scaling up of all interventions on the efficiency frontier to their maximum level. However, this could only be done at the expense of the budgets of other sectors, where some of these might be more effective in improving population health. Thus, the total amount currently spent on malaria interventions in Tanzania might be close to the optimum, but there is a huge potential to allocate these funds in a more cost-effective way.

Future research should take into account some broader aspects of malaria control, as for example, the question of how to replace worn-out ITNs in an efficient manner. On the one hand, replacing ITNs that are still functional, and thus, can still protect people, would be a waste of resources. On the other hand, not replacing worn-out nets would decrease their effectiveness (Wilson and Aizenman, 2012). As a second issue, more research is needed on implementation barriers such as procurement processes for malaria drugs, especially for remote regions in Tanzania.

5. Political Economy of Health Care Provision

Chapter 5 positively assesses how political party competition and the access to mass media directly affect the distribution of district resources for health improvement. It is organized as follows: section 5.2 describes the development of the political and electoral system in Tanzania, including the role of the media. The subsequent section 5.3 reviews the existing literature on determinants of government responsiveness including the added value of this study. Section 5.4 discusses the theoretical underpinnings of government responsiveness and explains the corresponding regression models, which will be used to identify causal effects of the political economy and mass media on the provision of public health services. The corresponding estimates of the quantitative analysis are presented in section 5.5. Finally, conclusions, policy recommendations, and limitations of the study are presented at the end of this chapter.

5.1 Introduction

In addition to education and training, health care is the most crucial factor to increase the productive capacity of people. Thus, having the objective of strengthening the development and growth of a nation in poverty, governments should at least provide a minimum level of public health services to its citizens. However, the provision of public services, strongly depends on the resources available at lower government levels. Since these resources are extremely scarce in the majority of developing countries, there is a need for prioritization. Distributing resources for health improvement to regions in a manner reflecting the relative burden of disease can reduce inefficiencies in the allocation of these resources.

Similarly to other countries, the United Republic of Tanzania (URT) allocates government and non-government resources for health improvement from the national to the district level according to an official allocation formula, taking into account population patterns, poverty, remoteness, and the burden of disease. However, it remains questionable whether these are the only determinants of local resources for health improvement, since politicians have different incentives to provide public health services and to reduce poverty. Democratic theory suggests that governments are responsive through the electoral process (Downs 1957). Consequently, the amount of district health spending is also based on various political factors, such as the competition among political parties. Beyond political factors, mass media affects the level of district resources for health improvement, owing to their role of transmitting

politically relevant information to the electorate and monitoring of politicians' efforts to provide public services (Besley, Burges and Prat 2002, Strömberg 2004). However, measuring to what extent political factors and mass media influence local level health spending has been a widely neglected field in the literature, especially in the developing world.

The objective of this study is to contribute to the elimination of this shortcoming. How the access and use of mass media and political party competition directly affects the distribution of district resources, for health improvement, in the case of Tanzania, will be positively assessed. Moreover, indirect effects of mass media on health spending via voter turnout are explored. This information is needed to understand the mechanisms of government responsiveness within the health sector and to emphasize the importance of democratic structures for an efficient allocation of scarce resources. The study benefits from Tanzanian secondary data on social indicators, public spending, and the results of the last two parliamentary elections in 2005 and 2010. Cross-sectional and panel data regression analysis is used to estimate the intended effects for the 134 districts on Tanzania mainland.

5.2 Politics and the Media in Tanzania

5.2.1 Political and Electoral System

Following its independence in 1961, Tanzania became a one-party state under the lead of Julius Nyerere. As a member of the Chama Cha Mapinduzi (CCM) party, Nyerere installed a socialist model of economic development and focused on the education of the countries' citizens. Following his retirement and various political and economic reforms during the late eighties, the country adopted a multi-party system in 1992 and had its first multi-party parliamentary elections in 1994. Today, Tanzania is a presidential democratic republic with Jakaya Kikwete serving as president since 2005. Kikwete is a member of CCM and acts as both, head of state and head of government, simultaneously. The Government of Tanzania has the executive power in the country and shares legislative power with the parliament. In turn, the parliament consists of the president and the national assembly. It is responsible for monitoring the programs and plans of the government and approves the funds for administration. In particular, the parliament is in charge of making laws and discussing proposals on public expenditure for major government sectors (URT, 2013). Persisting corruption has weakened the political system of Tanzania for decades. Although various mechanisms, such as the Prevention and Combating of Corruption Bureau (PCCB) or the

Presidential Commission Against Corruption (PCAC) have been installed to fight corruption in the country, the so-called 'old guard' has managed to stay in power due to high personal and financial influence (Kelsall, 2002).

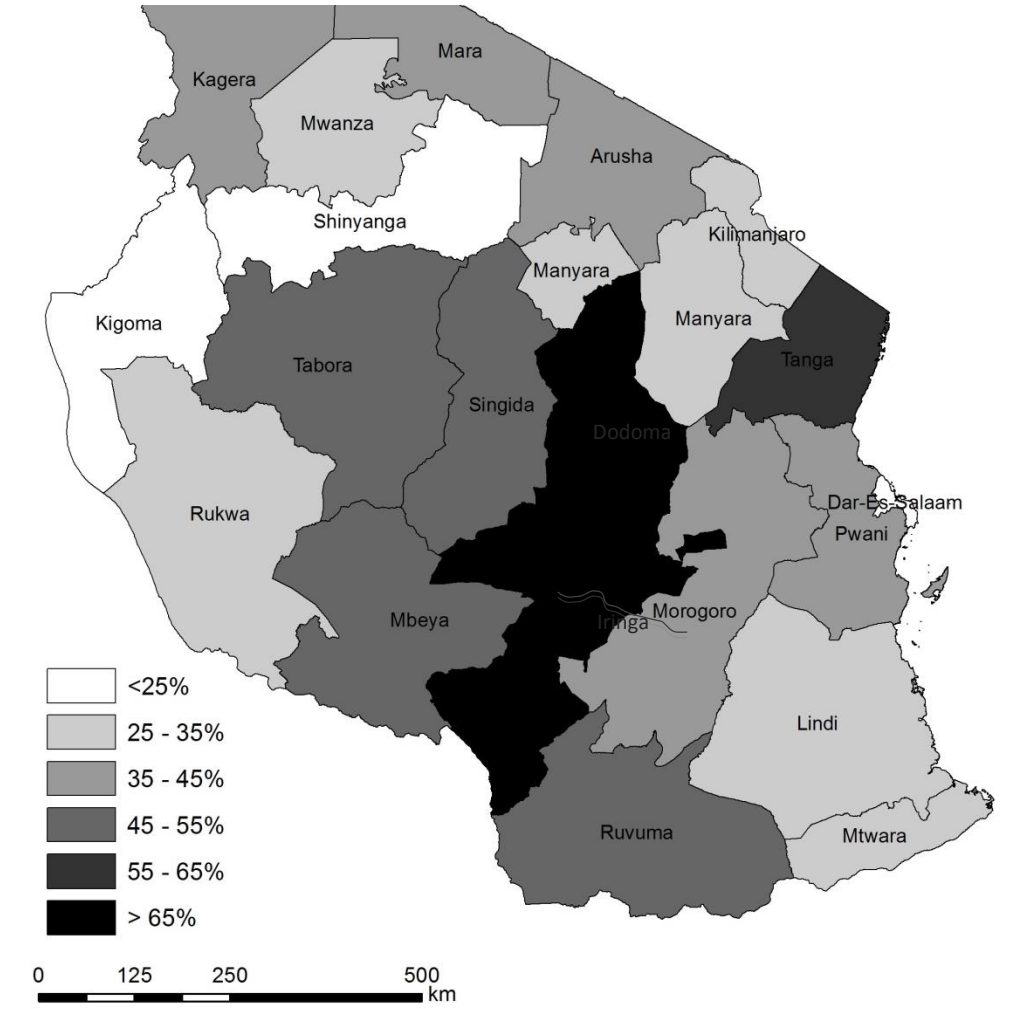
Despite the introduction of a multi-party system in the nineties, CCM has continued to dominate the political landscape. The party managed to transform the economy from socialism to a more neoliberal approach without losing much of its political power. One reason for this was the slow emergence of opposition parties due to weak leadership and little public demand for political competition. Other constraints include legal and illegal methods used by the governing party to suppress its opponents, such as a bureaucratic registration process for new parties (Hoffman and Robinson, 2009). Nevertheless, a few opposition parties consistently won a considerable amount of votes in parliamentary elections. Amongst others, the Civic United Front (CUF) is a major competitor of CCM and is particularly strong on the semi-autonomous island Zanzibar. An increasing share of votes is also won by Chama cha Demokrasia na Maendeleo (CHADEMA), the party for democracy and progress. Since some districts are already governed by opposition parties which may lead to a different allocation of resources for social sectors, the model in section 5.4.2 includes a control variable that considers the type of party in power.

The electoral process in Tanzania includes the presidential elections, the parliamentary elections, and the local government elections. Since the parliament is the institution in charge of decisions on health budget allocation (see chapter 2.3.1), the following analysis is based on the results of the two previous parliamentary elections. Tanzania has introduced a first-past-the-post electoral system, meaning that the candidate with the majority number of votes wins the election. The National Electoral Commission of Tanzania (NEC) carries out all three elections. Among other tasks, the independent NEC is responsible for the coordination and the supervision of the registration of voters, the establishment and review of constituencies' boundaries, and the provision of education to the voters. To be eligible to vote in Tanzania, people have to be aged 18 and registered in the Permanent National Voters Register (PNVR). All voters registered in the PNVR are notified about the location of their polling station via the short message system (SMS). Local radio stations and newspapers inform the population about the electoral process and election results. However, the electoral process is facing several challenges. Firstly, poor road construction makes it difficult to allocate election materials and

hinders a timely submission of ballot boxes to higher government levels. Secondly, there is a lack of funds for the training of polling staff (NEC, 2011).

A special feature of the Tanzanian system is the representation of women in parliament through quotas. The objective of this system was to strengthen the voices of a particular part of the population rather than compensating a historical imbalance (Meena, 2003). Political parties that have won at least five percent of the total votes in parliamentary elections are eligible to nominate members of parliament for special seats allocated only to women. The number of appointed women is proportional to the number of votes won by the corresponding party (NEC, 2011). To elect women for special seats, each of the political parties has its own individual mechanisms. Since the introduction of quotas, women have pushed for several laws concerning women issues. First, a draft bill regarding maternity leave for both married and unmarried mothers was brought into parliament and accepted by its members. Furthermore, women representatives achieved the revision of a law concerning the access of women to tertiary level education. Prior to the implementation of this revision, female high school leavers were requested to stay home for a period of two years before they could be allowed into university. The consequence was a significant increase of women enrolment at universities. However, the introduction of female gender quotas also has some negative impacts. The election of women for special seats is a way to exclude strong female leaders from competitive politics and to diminish the pressure to nominate them for parliamentary elections (Meena, 2003). To take into account the effect of women participation, a control variable measuring the gender of the political head has been included in the empirical model. After dominating the political sphere for decades, CCM had to give up a significant amount of seats to its only serious competitor CHADEMA after the parliamentary elections in 2010. The number of directly elected seats won by CCM decreased from 206 in 2005 to 187 in 2010, while CHADEMA managed to increase its share from 5 seats, in 2005, to 22 seats, in 2010 (Reith, 2011). However, large differences of political competition exist among the regions in Tanzania. Map 5 measures political competition as the percentage of votes for the winning party less the percentage won by the second-place party (see Cleary, 2007). Thus, regions with the lowest difference are the ones with the highest amount of political competition, such as Dar es Salaam, Shinyanga and Kigoma.

Map 5: Regional Political Party Competition, 2012



Source: NEC 2013 (mapped by the author)

5.2.2 Mass Media

Mass media improves the monitoring of politicians' efforts to provide public health services and supplies most of the information used by the population in electoral processes. In addition, media channels are used to spread health information to specific target groups. However, it is important to note that mass media is not able to transmit information uniformly to the population. The type and scope of media that a certain population group uses in a developing country like Tanzania largely depends on the costs of the product and the income of its consumers. In principle, major types of mass media in Tanzania include radio, newspapers, television and internet, but in most parts of the country, radio and newspapers are the only affordable and used forms of media. The latest Demographic and Health Survey (DHS) confirmed the limited relevance of the media by collecting data on the exposure of men and women to various types of mass media. According to the results, 36.4 percent of women and

19.0 percent of men on Tanzania mainland do not use any type of mass media at least once per week (NBS, 2011).

The privatization and liberalization of the media sector in the nineties led to a tremendous increase in the number of newspapers, FM and community radio stations and television broadcasters. In the past several years, media stakeholders have lobbied and pushed to enact media laws to improve people's access to media. One of these laws was the Right of Information Act (RTI), which was discussed after Tanzania joined the Open Government Partnership Initiative (OGP). The objective of the multilateral OGP is to promote an increase in transparency, to contribute to the empowerment of citizens, to fight corruption, and to reinforce good governance. However, until today, the RTI and similar laws have not passed parliament due to a lack of consensus among its members (Media Council of Tanzania (MCT), 2013).

The education and training of journalists is necessary for a high-quality media landscape. Despite several initiatives of Western donor organisations, this has been a neglected area in East Africa during the past decades. Currently, there is a trend to formalize and merge corresponding courses at universities and colleges, as seen recently in Tanzania and Ethiopia (Skjerdal and Ngugui, 2007). An initial success in this field was the approval of a competency-based journalism curriculum prepared by the MCT after a 2-years formulation period in January 2012 (MCT, 2013). Major challenges of these programmes include a lack of qualified staff (relying on expatriate teaching), out-of-date equipment, little research, and modest recognition of the journalism profession. Moreover, journalists in the Horn of Africa have to fight against government corruption and various forms of state action against the media. In this respect, one cannot speak of freedom of the media in Tanzania. Independent and critical reporting is often seen as raising a voice against the governing party (Skjerdal and Ngugui, 2007). A total of 45 violations of media freedom had been recorded by the MCT in 2012. These include kidnappings, denial of access to information, threats, interference by the state, and the harassment, assault, and murder of journalists (MCT, 2013). Nevertheless, the journalists' work has led to the today's situation where many Tanzanians have access to various types of mass media, as elaborated in the following sections.

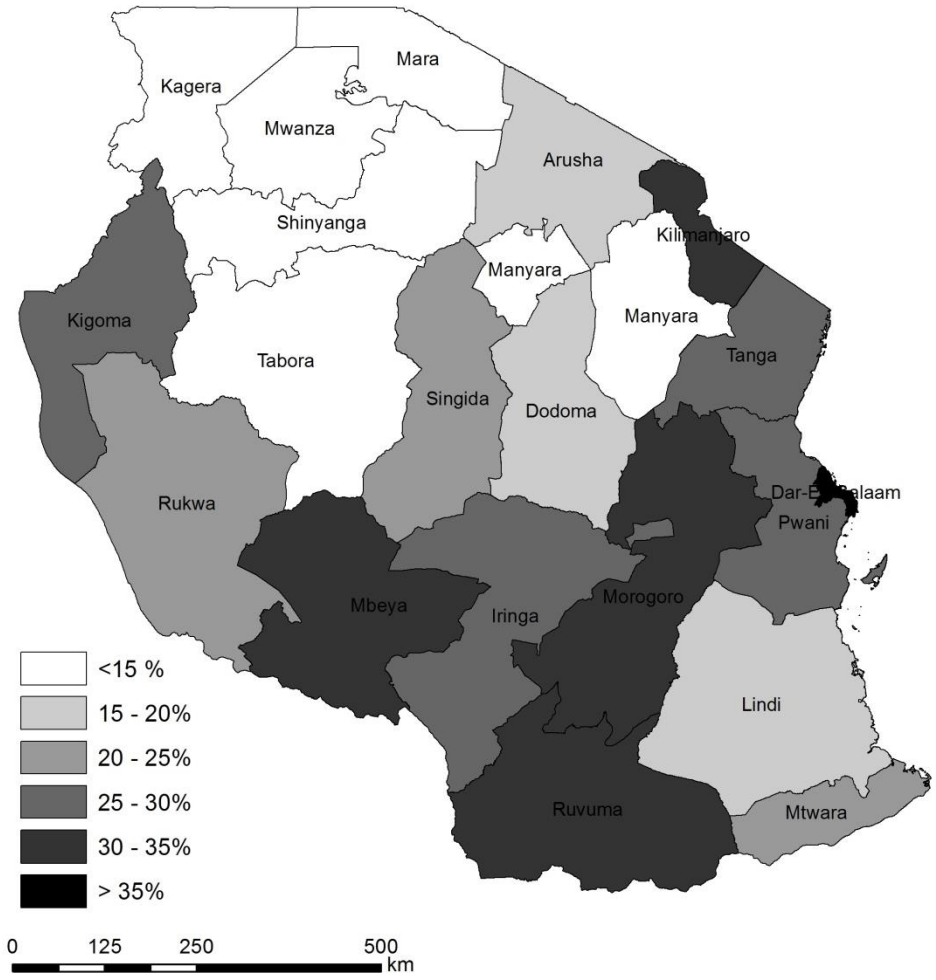
Today, radio is the most common type of mass media used in Tanzania. The first radio station on air was 'Radio Tanzania' in 1993. According to the Tanzania Communications Regulatory

Authority (TCRA), the number of licensed radio stations increased steadily from 14, in the year 2000, to 47, in 2006, and again to 86, by the end of 2012. Out of the total number of radio stations, five are national, 20 operate regionally, 58 are district-radio stations, and three operate at the community level. Almost half of all stations are commercial broadcasts, while the other half is more non-commercially oriented (MCT, 2013). To review the usage and dissemination of information provided by these radio stations, the latest DHS asked its respondents how often they listen to radio within a period of one week. In 2010, 57.1 percent of women and 76.3 percent of men stated that they follow radio programs at least once a week (NBS, 2011). Despite the rise in the number of operating radio stations, this is a small decrease compared to the year 2005, where 61.6 percent of women and 79.6 percent of men listened to radio on a weekly basis (NBS, 2005). The reason for this might be a switch to other types of mass media, for example, television or Internet. For both, men and women, the exposure to radio is higher in urban than in rural areas.

Television is the second most frequently used mass media in Tanzania, at least in urban areas. A major challenge in this sector is to fulfill a quota imposed by TCRA, stating that 60 percent of the programme must be filled with local productions (MCT, 2013). The logic behind the introduction of this quota was to lower the program share of, for example, soap operas produced by foreign companies, and to increase the information on local news and politics. The average number of Tanzanian people watching television at least once a week has grown from 20.4 percent in 2005 to 30.9 percent in 2010. However, there are large differences between rural and urban areas. Due to limited access to electrical power and low income, only 18.05 percent of the rural population watches television at least once a week in comparison to 66.25 percent in urban areas (NBS, 2005, 2011). The third most widespread type of mass media is the newspaper. According to Reuster-Jahn (2008), every newspaper bought in Tanzania is read by four to six persons. Newspaper penetration varies substantially among the 21 regions, reaching from 58% of people reading a newspaper at least once a week in Dar es Salaam to only 8% in Shinyanga (see map 6). This variation will be further explored in the econometric analysis. For the whole of Tanzania mainland, the percentage of people reading a newspaper at least once a week declined from 28.5 percent in 2005 to 24.2 percent in 2010 (NBS, 2005, 2011). For all types of mass media, the majority is produced and published in Kiswahili language, only a few English newspapers and television channels are available. Internet access as a new form of

mass media is almost exclusively available in urban centres and only affordable for the upper class of the population.

Map 6: Regional Exposure to Newspapers, 2010[1]



[1] Percentage of women and men age 15-49 reading a newspaper at least once a week
Source: NBS 2011 (mapped by the author)

5.3 Literature Review

Despite various clear-cut reasons to assume that political competition and access to mass media affect the responsiveness of governments to a large extent, research on this issue has been limited. Empirical investigations can be grouped into studies focusing on political determinants, on government responsiveness, mass media effects, and literature examining the joint effect of political and mass media variables on political attention.

Within the literature on pure political determinants, Soroka and Wlezien (2005) found that policy makers in Great Britain are responsive to public preferences, especially in the health sector. Based on time-series data on budgetary policy and public opinion, the authors

concluded that an increase in public expectations on health services led to a statistically significant rise of health spending. Subsequent studies have emphasized the importance of the electoral process to hold governments accountable and responsive. An analysis of twentieth-century political patterns of nine American cities showed that the allocation of government benefits changes substantially when dominant regimes are in power (Trounstine, 2006). During these times, resources were shifted to benefits for core coalition members and governing elites at the expense of a 6.4% decline of spending on public goods such as health and welfare. However, findings on the impact of political and electoral competition on government responsiveness show an unclear picture. For the case of Mexico, Cleary (2007) showed that there is no effect of electoral competition on the performance of municipal governments. According to the author, municipal performance might rather be improved through non-electoral participation. On the other hand, studies of government responsiveness in Britain, Denmark, and the United States showed that political attention is indeed higher when under pressure (Hobolt and Klemmensen, 2007). A very recent literature review on participatory government reforms in developing countries suggests that more research is needed to judge whether increased community participation can increase the provision of public services (Speer, 2012).

Very few studies on the sole impact of mass media on government responsiveness have emerged. In general, there is a clear consensus that democratic institutions, combined with a free and independent press, result in a government that is more responsive in providing public goods to its citizens (Besley et al., 2002). More specifically, a study carried out by Strömberg (2002) tested the impact of access to television on government attention. Using cross-sectional data on intergovernmental transfers in the United States after the expansion of television in 1962, the results indicate that access to television significantly increased the ability of the population to attract government funds, especially for African-Americans. Strömberg (2004) further analyzed whether access to radio can discipline the government to increase the amount of relief funds spent in a certain county, based on cross-section data of 2500 U.S. counties. Indeed, the author found that for every percentage point increase in the share of households with access to radio, politicians raised per capita relief spending by 0.6 percent. Strömberg showed that this total effect can be divided in a direct effect of access to radio on spending of 0.54 percent and an indirect effect of access to radio on spending, through increased voter turnout, of 0.07 percent.

Besley and Burgess (2001) published one of the first empirical investigations taking into account both political and mass media factors. The authors used annual data on 16 Indian states to examine the responsiveness of state governments to food shortages via public food distribution between 1958 and 1992. According to the results, newspaper circulation, literacy, and electoral turnout are significant positive determinants of a government's responsiveness to food shortages. Surprisingly, poorer states are not less responsive than richer states. Further work of Besley and Burgess (2002) explored again the influence of newspaper circulation on calamity relief expenditure in India, but now disaggregating newspapers into nineteen different languages. Based on the same panel data mentioned above, the results indicate that regional newspapers in local languages are larger drivers of government responsiveness than English or Hindi presses. In addition, the authors found that newspaper circulation is higher when non-governmental societies and associations own the media.

Almost all of the above-mentioned studies use regression analysis as a method to explore government responsiveness. Moreover, most of the previous studies, with the exception of Besley and Burgess (2001 and 2002) and Speer (2012), focus on the political economy of developed countries and, in particular, the United States. Since institutional arrangements and electoral systems are at an earlier stage in the developing world, mechanisms of government attention might differ. As a contribution to close this research gap, the following analysis aims at answering the question whether similar effects of political factors and mass media on government responsiveness also exist in a very low-income country. Furthermore, the study is unique in focusing exclusively on political economy effects within the health sector.

5.4 Theoretical Framework

5.4.1 Conceptual Framework and Theory of Government Responsiveness

Various political and societal institutions such as official allocation rules determine the distribution of local resources for health improvement. The development of institutions is based on multiple factors, including history, societal choices and chance. However, institutional arrangements differ, and, thus, lead to varying distributions of resources. The choice of institutions, in turn, depends on political power, since groups with the highest amount of political power will secure their preferred type of institution. Whenever political power exceeds political institutions due to, for example, tremendous economic resources of a certain group,

the allocation of resources for health improvement is likely to change in favor of these people (Acemoglu, Johnson and Robinson, 2004; Acemoglu and Robinson, 2005). Moreover, using the words of North (1990, p.3), institutions "[…] structure incentives in human exchange, whether political, social, or economic." This analysis examines whether institutional arrangements such as the electoral process influence the incentives of politicians to provide public services.

Mechanisms and institutions determining local expenditure on health care in Tanzania include the official resource allocation formula, political factors, the impact of mass media, and additional factors. A corresponding theoretical framework is presented in figure 15. In general, health-related finances from government and non-government sources are allocated from the national to the district level according to an official allocation formula. To recognize the people as the major recipients of health and social welfare services, 70% of funds are allocated in proportion to the district population. An additional 10% of the total funds are distributed to cover the special needs of places with a disproportionally high share of poor people. The formula also takes into account increased expenditure needs for health care provision in remote areas (10%). Here, ambulances have to travel long distances to reach patients and the operational costs for drug distribution, immunization, and supervision are exceptionally high. The final 10% of resources are allocated to the districts according to their disease burden. Due to the difficulty of measuring the disease burden of a district, the 'under-five' mortality rate has been used as a proxy variable (MoHSW, 2007).

However, it remains questionable whether these factors are the only determinants of local resources for health improvement. Firstly, democratic theory suggests that governments are responsive through the electoral process (Downs 1957). Consequently, the amount of district health spending is also based on various political factors, as shown in figure 16. One of the key factors of interest is the competition among political parties. If losing power is a threat, in the upcoming elections, incumbents have the incentive to increase their overall effort and, in particular, to be more responsive to their citizens in terms of providing public goods, such as health services (Mani and Mukand, 2007; Besley and Burges, 2002). Increasing power concentration frequently leads to a situation, where the needs of the local population are less represented and social services are weak. However, political competition can only be seen as a driver of government responsiveness as long as re-election possibilities exist for the current political head. Otherwise, the incentives of politicians to serve their citizens are less obvious. A further common precondition for greater political competition is the participation of the

population in the election process. Thus, the government might allocate more per capita funds to districts with great electoral turnout (Strömberg, 2004). Theory also suggests a link between the gender of the political head and the provision of certain public services. Female-headed districts are more likely to create a political atmosphere that is sensitive to "women's issues" (Atkeson and Carrillo, 2007). Since many health services, such as prenatal care and child health, fall into this group, a positive correlation might exist between district health spending and the representation of women in leading political positions. Furthermore, scholars have shown that the level of government responsiveness in terms of health services depends on the type of political party in power (Soroka and Wlezien, 2005). Parties with socially oriented values might be more interested in the redistribution of income and the provision of public goods than their liberal counterparts.

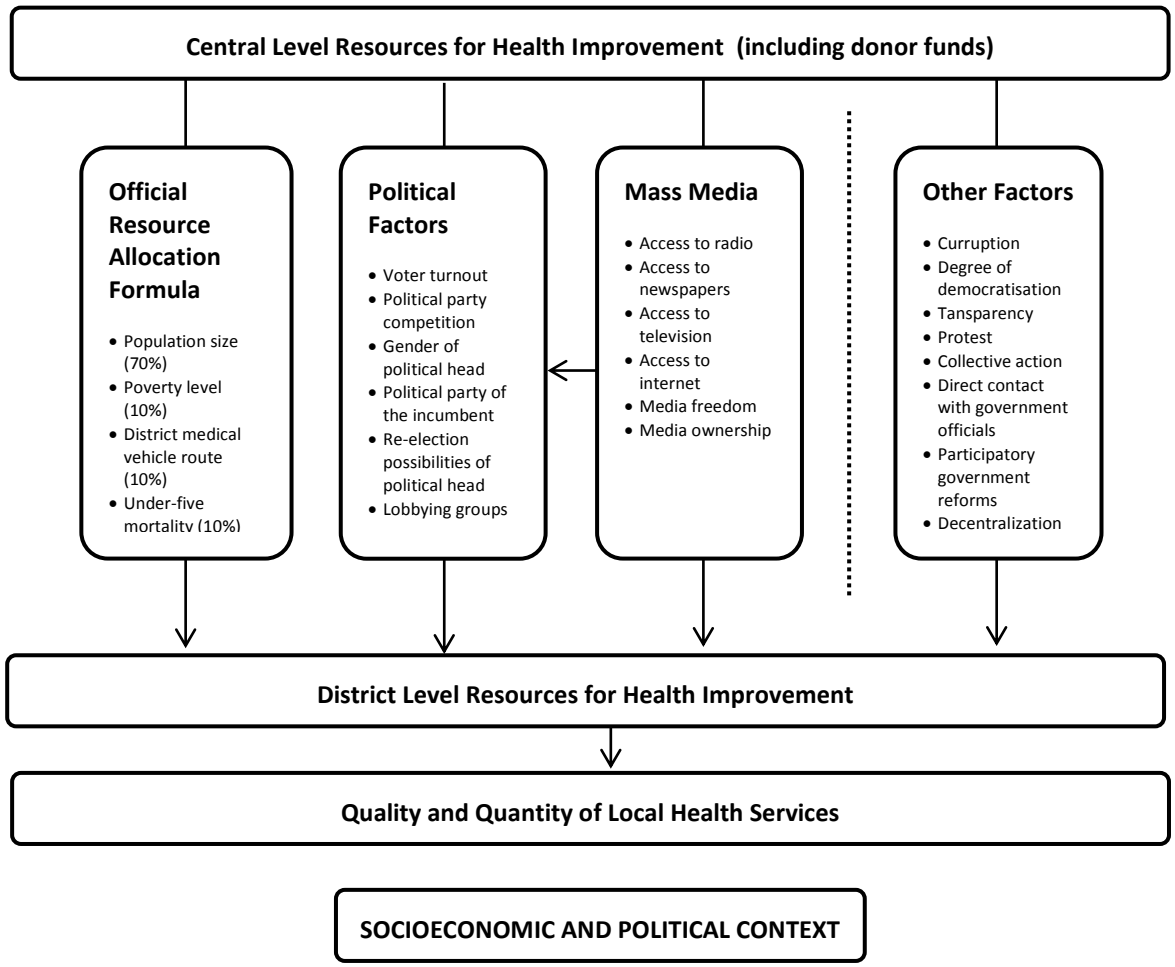


Figure 16: Theoretical Framework of the Allocation of Resources for Health Improvement in Tanzania
Source: author

Beyond political factors, mass media affects the level of district resources for health improvement due to their role of transmitting politically relevant information to the

electorate and monitoring of politicians' efforts to provide public services (Besley Burges and Prat, 2002; Strömberg, 2004). To analyze this relationship in a theoretical manner, the principal-agent theory can be applied to electoral processes. Here, the citizens of a district act as principals paying taxes and user fees to finance the health system. Moreover, they have to comply with various health regulations. The agents are the representatives in parliament who have been elected by the districts' population and now decide on the allocation of resources for health improvement. Due to a variety of interests and lobbying groups, the agents do not exactly know which actions are expected by their constituencies. On the other hand, principals have to deal with limited information on current and future policies introduced by the corresponding candidate. The refusal of re-election is the only mechanism available to sanction the actions of the politicians in power.

Four potential problems arise. Firstly, a moral hazard might occur when district representatives in power bribe or accept a bribe in the process of allocating resources for health improvement to lower government levels. Secondly, the problem of adverse selection could arise due to the fact the voters do not know whether the candidate actually has the motivation and competence to improve the provision of public services in a certain district. Thirdly, voters might be rationally ignorant about district health policies, since the costs of being informed on certain policies for single voters far exceed the expected benefits. Fourthly and similarly to the previous point, citizens could have the perspective that a single vote would not make any difference in the election results, the so-called free-riding problem (Besley, Burges and Prat, 2002). Mass media can help to solve, at least, the first two problems. Having access to radio, newspapers, or television weakens the issue of asymmetric information by providing news on current health initiatives and election programs of potential candidates, at low costs. However, the functionality of this mechanism strongly depends on media freedom and ownership. Otherwise, sensitive information on the allocation of resources to finance health services, for example, might not be public. As a result, politicians might pay more attention to districts where many people have access to mass media. Access to radio, newspapers, or television affects financing health services either directly or indirectly via political factors, such as increased voter turnout (Strömberg, 2004). Other factors, which are not the subject of this analysis, might influence the allocation of resources for health improvement from higher to lower government levels. This includes, for example, corruption, protests, or direct contact with government officials.

5.4.2 Modelling Government Responsiveness

A statistical model is applied to analyze the impact of political factors and mass media on government responsiveness. As suggested in the literature, public health expenditure is used as a proxy for policy behaviour (e.g. Hobolt and Klemmensen, 2007). Equations (1) to (5) specify basic regression models to test the theoretically expected direct effect of political factors and mass media on health spending. Equation (6) estimates the indirect effect of mass media on responsiveness via voter turnout. There is no reason to expect any non-linearities.

The formal structure of equation (1) for districts i and year t is the following:

$$(1) \qquad log\ E_{it+1} = \alpha + \beta_1 T_{it} + \beta_2 C_{it} + \beta_3 R_{it} + \beta_4 N_{it} + \beta_5 V_{it} + \varepsilon$$

On the left hand side of equation (1), log E_{it+1} , captures the logarithm of deflated public per capita spending on health in the post-election year, since the literature recommends using at least a 1-year time lag for the public preference predictor (Hobolt and Klemmensen, 2007; Soroka and Wlezien, 2005). The lag is used to account for the fact that it usually takes at least one year from budget planning to its execution. Log E_{it+1} aggregates development spending on health, such as the construction of hospitals and dispensaries, as well as recurrent spending on, for example, salaries of health staff and drug costs. One of the key explanatory variables on the right hand side of equation (1) is voter turnout T_{it}. It represents the total of valid and spoilt votes divided by the number of registered voters during the previous election. Districts with unopposed candidates were excluded from the sample. To account for the assumed correlation of political party competition and health spending, the variable C_{it} has been included as an additional covariate. It captures the percentage of votes for the winning party less the percentage won by the second-place party. This indicator is also known as the 'Margin of Victory' (Cleary, 2007; Trounstine, 2006). The lower the value of C_{it}, the more political party competition is present in a certain constituency. Again, districts with no opposition parties participating in the election were excluded from the sample.

The nexus of mass media and health spending is reflected by two independent variables in equation (1). Firstly, R_{it} measures the percentage of women and men aged 15-49 listening to the radio, at least once a week. Similarly to this, the second media variable, N_{it} , takes into account the percentage of women and men, aged 15-49, reading a newspaper at least once a week. Access to television and the use of Internet has not been included in equation (1) due to low coverage levels in rural areas. The indirect effect of mass media on health spending via

electoral turnout will be analysed in equation (6).

A set of ten control variables known as predictors of government responsiveness is captured in V_{it}. Firstly, the lagged logarithm of deflated public per capita spending on health is included in order to maintain the assumption that budget figures strongly depend on their value in the previous year. In many cases, earlier budgeted amounts are proportionally adjusted to increases of the total health budget only. Before taking into account the official flow of resources from central to district level, it must be controlled on the four factors of the official resource allocation formula, namely: population size, poverty level, the length of the district medical vehicle route, and 'under-five' mortality (see section 2.3). However, since per capita values are used for all spending variables, there is no need to add the population size as a control variable here. The logarithm of deflated per capita GDP serves as a proxy for the poverty level in a certain district. Due to the lack of data on the exact length of the district medical vehicle route, the degree of urbanization has been used as a proxy. It is defined as the percentage of the population living in urban areas. The 'under-five' mortality rate has been included as a control for funds which have been allocated as a consequence of a disproportionately high burden of disease. It measures the number of children who die before the age of five, per thousand live births per year.

Beyond variables accounting for the resource allocation formula, several additional controls are included. A gender dummy serves to distinguish whether a certain district is headed by a male or female representative, as theoretically discussed in section 5.4.1. A second dummy variable measures the impact of the type of party in power on health spending. In particular, it reflects whether the current party in power in a district is the CCM or an opposition party. The unemployment variable indicates the number of women and men aged 15-49, employed in the 12 months preceding the survey, divided by the total population in that age span. The logic behind the inclusion of this variable is that a lack of employment opportunities may affect political activism, which, in turn, might influence the responsiveness of the government.

Scholars have shown that higher educational attainment is likely to be positively correlated with interest in policy making (see for example Delli Carpini, 1996). Thus, the literacy rate has been included as an additional control variable in equation (1), measuring the number of literate women and men aged 15-49 divided by the total population in that age span. Furthermore, a population density variable reflects the logarithm of the number of people per

square kilometer, since it is easier to provide public health services to densely populated districts compared to dispersed ones. Access to health infrastructure is a final control variable for the existing stock of health infrastructure, indicating the percentage of women and men, aged 15-49, who reported serious problems in accessing health care due to the distance to the next health facility.

To test the robustness of the model, equation (2) analyzes the impact of political economy issues and mass media on the change of public per capita health spending, in the first year after elections. Here, the same independent variables are used as in equation (1):

$$(2) \quad log\ \Delta E_{it+1} = \alpha + \beta_1 T_{it} + \beta_2 C_{it} + \beta_3 R_{it} + \beta_4 N_{it} + \beta_5 V_{it} + \varepsilon$$

A further specification includes an interaction term of the 'under-five' mortality M_{it} as a measure of need for health interventions and political party competition. The idea of equation (3) is to test whether governments are more responsive to electoral pressure in less healthy districts. The dependent variable and other covariates are the same as in equation (1).

$$(3) \quad log\ E_{it+1} = \alpha + \beta_1 T_{it} + \beta_2 R_{it} + \beta_3 N_{it} + \beta_4 C_{it} x\ M_{it} + \beta_5 V_{it} + \varepsilon$$

To investigate how these correlations evolve over time and more or less close to elections, equation (4) and (5) specify an alternate model analyzing the impact of political economy issues and mass media on the absolute value and change of public per capita health spending in the second year after elections, respectively. Again, the same covariates are used as in equation (1).

$$(4) \quad log\ E_{it+2} = \alpha + \beta_1 T_{it} + \beta_2 C_{it} + \beta_3 R_{it} + \beta_4 N_{it} + \beta_5 V_{it} + \varepsilon$$

$$(5) \quad log\ \Delta E_{it+2} = \alpha + \beta_1 T_{it} + \beta_2 C_{it} + \beta_3 R_{it} + \beta_4 N_{it} + \beta_5 V_{it} + \varepsilon$$

In a second step, equation (6) models the indirect effect of mass media on government responsiveness via voter turnout. In comparison to equation (1), the lagged logarithm of deflated public per capita spending on health and access to health infrastructure are excluded from the set of control variables.

$$(6) \quad T_{it} = \alpha + \beta_2 C_{it} + \beta_3 R_{it} + \beta_4 N_{it} + \beta_5 V_{it} + \varepsilon$$

For all models, the variables that are not shared are in logs to simplify the interpretation of results. Consequently, all coefficients can be interpreted as elasticities, showing the

percentage response of different dependent variables to a percentage change of a covariate. With these models it is possible to perform a robust test of whether political factors and mass media play a role in being responsive to the health needs of poor populations in Tanzania.

5.5 Quantitative Analysis: Model Estimation and Results

5.5.1 Data

All equations are estimated based on district-level data on Tanzania mainland. Excluding the semi-autonomous state Zanzibar, Tanzania has a total of 134 districts. Due to the lack of systematic secondary data at the district level, a dataset was generated by aggregating survey and budget data for the years 2005-2010, covering the last two elections on Tanzania mainland, in 2005 and 2010. As mentioned in section 5.4.2, some districts had to be excluded due to missing opposition parties or errors in data collection. As a result, a total number of 94 to 110 observations have been used in the cross-sectional analysis (section 5.5) and 220 observations in the estimation of a panel data set in section 5.6.

Data on public health spending comes from regional budget books for the year 2005 and from the Local Government Information database for the years 2006 to 2010 (LOGIN Tanzania, see URT, 2012 II). The MoFEA and PMO-RALG jointly provide this database for public use. The figures include recurrent and development health spending of the government and, partly, donor funds allocated to the regions. For comparison, all data on government expenditures were deflated to the common base year 2010 using the GDP deflator retrieved from the World Bank's development indicators (World Bank, 2013). Population data used for computing per capita amounts was generated from the projections of the population and housing census 2002 (NBS, 2006 II). According to LOGIN Tanzania, population variables are inflated uniformly across all regions by 2.9% per annum. Since 2005, the NEC of Tanzania publishes electoral results for council, parliamentary, and presidential elections at the regional, district, and constituency level online (NEC, 2013). These data sets include the names of the corresponding candidates, party affiliation, and the percentage of votes received. This information has been used to build the variables on voter turnout, political party competition, gender of political head, and type of party in power. In particular, the results of parliamentary elections in 2005 and 2010 are included. Data on access to mass media and the control variables of 'under-five' mortality rate, employment, literacy and access to health infrastructure were retrieved from DHS (NBS, 2005/2011). The NBS conducts

these nationally representative surveys every few years, since the beginning of the nineties, using the same methodological approach. In the latest of a series of eight surveys, 10,300 households were interviewed from 475 sample points in Tanzania. In addition to data on the health status of the population, extensive information on health related issues is collected in these surveys, such as family planning and nutrition.

The above-mentioned projections of the Population and Housing Census 2002 also served as a data source to determine the district values for the degree of urbanisation and population density. It is the fourth population census for the whole of Tanzania and is carried out every 10 years by NBS and several development partners. The latest edition provides reliable estimates on population levels, population growth, life expectancy at birth, and fertility rates up to the year 2025. However, all projections are based on certain assumptions concerning mortality, fertility, migration, and HIV/AIDS. Information about per capita GDP was obtained from national accounts and deflated like public health spending (URT, 2011 I). The data sources used are the most reliable and comprehensive ones currently available for Tanzania and have frequently been used for analyses published in peer-reviewed journals. Table 10 shows an overview of all variables.

Table 10: Descriptive Statistics

Variable	Mean	Standard Deviation	Min	Max	Unit of Measurement
Exp. (1st year)	4494	3423	635	32933	Tanzanian Shillings
Exp. Change (1st year)	1301	3129	-4661	30108	Tanzanian Shillings
Exp. (2nd year)	5372	2806	958	23353	Tanzanian Shillings
Exp. Change (2nd year)	2179	1970	-5692	12314	Tanzanian Shillings
Voter Turnout	61.1	16.0	25.1	108.7	Fractions
Political Party Competition	42.2	25.4	0.3	91.6	Fractions
Access to Radio	67.8	8.4	49.3	84.7	Fractions
Access to Newspapers	24.1	10.6	7.9	59.7	Fractions
Under-five Mortality Rate	0.111	0.264	0.058	0.153	Number of Children/1000
Gender of Political Head	0.054	0.227	0	1	0 = male / 1 = female
Political Party	0.149	0.357	0	1	0 = CCM / 1 = other
Degree of Urbanisation	21.8	13.5	7.8	96.0	Fractions
Employment	81.7	8.3	51.8	96.8	Fractions
GDP	0.665	0.213	0.357	1.736	Million Tanzanian Shillings
Literacy	74.3	8.2	55.2	93.0	Fractions
Population Density	330	877	2	6057	People per km^2
Access to Infrastructure	30.7	13.7	7.3	55.9	Fractions

Source: author's calculations

5.5.2 Model Estimation

The following section presents the estimation method used for equations (1) to (5) and the empirical results. Assuming all right-hand side variables being uncorrelated with the error term, the coefficients can be consistently estimated by OLS. However, there were various reasons to expect the problem of multicollinearity among the media variables, since they measure a similar variable. For example, access to electricity allows people to listen to radio and to watch television. Consequently, these two media variables might be correlated. A widely accepted indicator to detect problems of multicollinearity is the Variance Inflation Factor (VIF). As a rule of thumb, the reciprocal of this factor, 1/VIF, should remain above 0.1. Otherwise, the estimation merits further investigation. Using all three media variables including access to television, access to radio, and access to newspapers in the regressions (1) to (5), the VIF-values for access to television falls below the 0.1. Thus, in addition to other reasons mentioned in section 5.4.2, the variable measuring access to television has been excluded from the model specifications. No further problems of multicollinearity, among other independent variables, arose.

Model specification errors constitute a second potential cause for concern. These errors are the result of including one or more additional variables not relevant to the model specification or excluding one or more relevant variables. In the case of a model specification error, the error term might be inflated. A potential reason for biased results might be the fact that some variables of the theoretical framework (see section 5.4.1) are excluded from the empirical model due to data limitations, such as corruption, decentralization, protest, or transparency. To detect whether or not a model specification error does exist, two tests have been performed. Firstly, the linktest has been carried out, assuming that in the case of proper specification, no additional covariates should be significant except by chance. After adding random variables to equations (1) to (5), through the linktest, the results showed that none of the coefficients of these additional variables has been significant at the five percent level. Ovtest, a second test to detect model specification errors, confirmed these results. In contrast to linktest, ovtest creates additional variables based on the predictors and refits the model with these new covariates. Again, none of these variables had explanatory power. In conclusion, it can be stated that model specification errors do not constitute any potential cause for concern and that all coefficients can be consistently estimated using OLS.

5.5.3 Results

Results based on the parliamentary elections in 2005 are presented in table 11. In the first column, the corresponding variables from the theoretical model are shown. The expected relationship between the variables of the theoretical model and the estimated coefficients is indicated in the second column. Exact definitions of all variables used are presented in Appendix 10. In general, the empirical analysis suggests that politicians are responsive to political factors. The impact of mass media on the provision of public health services is less clear.

Using per capita health expenditure in the first year after the election as a dependent variable, the estimates of equation (1) imply that a one-percentage point smaller difference between the winning party and the second-place party leads to a 0.151 percentage points increase in public health spending. In other words, the theoretical assumption that there is a positive correlation between political party competition and government responsiveness is confirmed by the model estimations in the first column of table 11. The result is significant at the five-percent level. However, it turns out that there is no significant effect of mass media on health spending in this model specification. Certain control variables are significantly correlated with the dependent variable in the expected way. Firstly, the lagged logarithm of per capita health expenditure has a positive effect on health spending, with a highly significant coefficient of 0.645. This confirms the assumption that budget figures strongly depend on their value in the previous year. Secondly, a higher degree of urbanisation is significantly associated with higher health spending, contradicting the official allocation formula indicating that more resources would be allocated to rural districts with longer medical vehicle routes. The positive effect of urbanisation on health spending further increases when urbanisation is used as an interaction variable with political party competition (see Appendix 11).

The second model was specified to test the robustness of these results when using the logarithm of per capita changes in health expenditure instead of absolute amounts as a dependent variable. Here, the positive effect of political party competition on government responsiveness is even stronger. A one-percentage point increase in competition leads to a 0.667 percentage points increase in public health spending. This result is significant at the one percent level. In contrast to the first model specification, the estimation of equation (2) confirms our expectation that mass media is positively related to health spending. For every

one-percentage point increase of people having access to radio, per capita health expenditure increases by 2.233 percentage points. The insignificance of newspaper access might be explained by its much lower circulation compared to radio (see section 5.2.2). Again, the degree of urbanisation is positively related to public health spending. A further significant control variable is access to health infrastructure, indicating that more resources have been allocated to areas where people have serious problems in accessing health care.

To further evaluate whether these results are still valid for districts with varying disease burdens, the third specification includes an interaction term of 'under-five' mortality and political party competition[17]. Indeed, a one-percentage point increase of the interaction variable leads to a 1.023 percentage point increase in public health spending, significant at the five percent level. This result suggests that governments are more responsive to electoral pressure in less healthy districts. In other words, high demand for health services might force political activism and, in turn, increases the pressure on politicians to provide public services. The lagged logarithm of per capita health expenditure has again a positive effect on health spending, with almost the same coefficient as in equation (1). Moreover, literacy is a significant control variable in this model specification stating that higher educational attainment in a district is related to improved government responsiveness.

To test the robustness of these results over time, model (4) and (5) examine the same specifications as used in (1) and (2) for the second year after the election. As shown in table 11, the impact of political competition on health spending decreases over time. This is in line with the expectation that, on the one hand side, the provision of public services directly affecting voters has its peak during election times to appease the electorate. On the other hand, the attention of the population to politics, and, in turn, the need for governments to be responsive decreases in post-election years. Using the logarithm of per capita health expenditure as a dependent variable in specification (4), a one-percentage point increase of political party competition leads to a 0.107 percentage point increase in public health spending, significant at the five percent level. As in previous years and simulations, government responsiveness is related to the lagged logarithm of health expenditure and to literacy. In parallel to the second model, equation (5) regresses the logarithm of health expenditure change on the same covariates as used before. Again, the estimations show a clearly smaller effect of political party competition on health spending in the second year

[17] Interaction Variable = (1-Political Party Competition) x Under-five Mortality

after the election. A one-percentage point increase of political party competition leads to a 0.177 percentage point increase in public health spending, significant at the ten percent level only. Looking at the control variables, a significantly positive determinant is the lagged logarithm of per capita health spending.

Table 11: Government Responsiveness in the Health Sector of Tanzania

			Dependent Variables				
			1st Year After the Election			2nd Year After the Election	
		Independent Variables	(1) log Health Expenditure (per capita)	(2) log Health Expenditure Change (per capita)	(3) log Health Expenditure (per capita) Interaction Variables	(4) log Health Expenditure (per capita)	(5) log Health Expenditure Change (per capita)
		Objective Variables					
T_{it}	+	Voter Turnout	-0.096	-0.464	-0.052	0.177	0.525
			(0.29)	(0.91)	(0.29)	(0.19)	(0.43)
C_{it}	-	Political Party Competition	-0.151	-0.667		-0.107	-0.177
			(0.06)**	(0.24)***		(0.05)**	(0.10)*
R_{it}	+	Access to Radio	0.355	2.233	0.327	-0.416	-1.064
			(0.32)	(1.30)*	(0.32)	(0.32)	(0.80)
N_{it}	+	Access to Newspapers	0.009	-0.170	0.114	0.204	0.620
			(0.23)	(0.88)	(0.20)	(0.19)	(0.42)
		Interaction Variable					
	+	Political Party Competition x Under-five Mortality			1.023		
					(0.49)**		
V_{it}		*Controls*					
	+	Lagged log Health Expenditure (per capita)	0.645	-0.171	0.648	0.649	0.431
			(0.11)***	(0.26)	(0.11)***	(0.11)***	(0.20)**
M_{it}	+	Under-five Mortality	-2.146	-5.913		1.811	3.326
			(2.00)	(5.59)		(0.96)*	(2.05)
	+/-	Gender of Political Head (dummy)	-0.007	-0.072	-0.013	-0.012	-0.018
			(0.04)	(0.12)	(0.04)	(0.04)	(0.09)
	+/-	Political Party (dummy)	-0.060	-0.169	-0.047	0.061	0.145
			(0.04)	(0.11)	(0.04)	(0.05)	(0.11)
	-	Degree of Urbanisation	0.369	1.308	0.239	0.022	-0.103
			(0.21)*	(0.65)**	(0.22)	(0.19)	(0.37)
	+	Employment	0.616	2.435	0.216	-0.281	-0.837
			(0.37)	(1.36)*	(0.37)	(0.32)	(0.75)
	+	log GDP (per capita)	-0.341	-1.230	-0.331	0.032	0.358
			(0.30)	(1.17)	(0.31)	(0.19)	(0.48)
	+	Literacy	0.331	1.201	0.388	0.442	0.365
			(0.22)	(0.77)	(0.22)*	(0.24)*	(0.37)
	+	log Population Density	-0.033	-0.069	-0.030	0.007	0.036
			(0.04)	(0.10)	(0.04)	(0.02)	(0.05)
	+	Access to Health Infrastructure	0.101	1.647	0.180	-0.100	-0.083
			(0.16)	(0.79)**	(0.15)	(0.17)	(0.31)
		Valid N	110	94	110	110	106
		R-squared	0.4768	0.2539	0.4606	0.5866	0.2496

Note: The table reports standard errors in parentheses. Statistical significance is noted with the conventional ***p < 0.01, **p < 0.05, *p < 0.10.

5.6 The Impact of Mass Media on Voter Turnout

As discussed in the theoretical framework, access to mass media affects health spending, either directly or indirectly, via political factors. This section is devoted to the analysis of the indirect effect via voter turnout. In general, radio and newspaper penetration increases people's knowledge of politics and election cycles, and, in turn, the likelihood that people vote. Subsequently, it has been widely shown in the literature that increased voter turnout is related to higher public spending (Strömberg, 2004 etc.).

In contrast to previous simulations in section 5.5, the estimation of equation (6) is based on a panel data set including information on the last two parliamentary elections of 2005 and 2010. The same data sources and variables are used as in equation (1) to (5). However, the lagged logarithm of deflated public per capita spending on health and access to health infrastructure is excluded from the set of control variables. Generalized least-squares (GLS) random-effects have been used as an estimation method for the panel data regression. This assumes that we have a random sample from a large population and it can consequently be supposed that the time-constant unobserved effect (as for example, the colonial history of a district) is not correlated to all the covariates of equation (6) (see Wooldridge, 2009).

With a few exceptions, the results of the panel data regression shown in table 12 are consistent with the theoretical expectations. A one-percentage point increase of access to newspapers leads to a 0.336 percentage point increase in voter turnout, significant at the one percent level. Most of the control variables included show large and significant coefficients with the expected signs.

Table 12: The Impact of Mass Media on Voter Turnout

A	B	Independent Variables	(5) Dependent Variable: Voter Turnout
		Objective Variables	
C_{it}	+	Political Party Competition	0.026 (0.03)
R_{it}	+	Access to Radio	-0.064 (0.11)
N_{it}	+	Access to Newspapers	0.336 (0.10)***
V_{it}		*Controls*	
	+	Under-five Mortality	4.940 (0.35)***
	+/-	Gender of Political Head (dummy)	0.030 (0.03)
	+/-	Political Party (dummy)	0.042 (0.02)*
	+/-	Degree of Urbanisation	-0.239 (0.09)**
	-	Employment	-0.623 (0.11)***
	-	log GDP (per capita)	-0.234 (0.10)**
	+	Literacy	0.092 (0.14)
	+	log Population Density	-0.030 (0.02)*
		Valid N	220
		R-squared	0.8302

Note: The table reports standard errors in parentheses. Statistical significance is noted with the conventional ***p < 0.01, **p < 0.05, *p < 0.10.

5.7 Conclusions

5.7.1 Major Findings and Recommendations

The allocation of resources for health improvement from central to lower government levels is not solely a process of applying certain rules and guidelines regulating the distribution mechanisms. It is a more complex system where the incentives of politicians, electoral processes, and other external factors play a major role. Based on a dataset combining socioeconomic, electoral, and public-financial indicators for all districts of Tanzania mainland, this analysis suggests that politicians are responsive to electoral competition. Using per capita health expenditure, in the first year after the election, as a dependent variable, the estimates of equation (1) imply that a one-percentage point difference between the winning party and the second-place party leads to a 0.151 percentage point increase in public health spending, significant at the five percent level. The robustness of this result is confirmed in repeated simulations using the same dependent variable for the second year after the election and using the change of per capita health expenditure in both the first and the second year after the election. These findings contribute to clarify the picture on the effect of electoral competition on government responsiveness, at least for the health sector. The results are in line with those of Trounstine (2006) or Hobolt and Klemmensen (2007), showing that, for Britain, Denmark, and the United States, political attention to the provision of public services is indeed higher when under pressure.

The direct effect of mass media on district level health spending is less clear. Only the second model specification confirms our expectation that mass media is positively related to health spending. For every one-percentage point increase of people having access to radio, per capita health expenditure increases by 2.233 percentage points. The estimated effect is even larger than the one found by Strömberg (2004) for public spending in the United States. Here, the author found that for every percentage point increase in the share of households with access to radio, politicians raised per capita relief spending by 0.6 percent. However, looking at all other model specifications of table 11, no significant impact on government responsiveness of both access to radio and newspapers can be validated. In contrast, the indirect effect of mass media on health spending, via voter turnout, is more obvious. A one-percentage point increase of access to newspapers leads to a 0.336 percentage point increase in voter turnout, significant at the one percent level. Thus, the theoretical assumption that mass media affects the level of district resources for health improvement, due to their role of transmitting politically relevant

information, cannot be finally confirmed.

Governments provide a multiplicity of public health services. Knowing that health spending increases during election times, the question arises as to which interventions these additional resources are allocated. Scholars found that the visibility of public goods and services plays a major role (Mani and Mukand, 2007). Government representatives have a tendency to give more weight to those interventions that are more visible to the electorate. This tendency increases with the level of democracy, or, as measured in this analysis, political competition. On the one hand, the consequence for the health sector would be an increased allocation of funds to hospital buildings, dispensaries, and health centres, for example. On the other hand, the equipment for these buildings, drugs, and appropriate staffing would be neglected cost centres. Unfortunately, datasets for Tanzania do not allow to test whether additional resources for health improvement were allocated to more or less visible goods.

A second issue relates to the question of how the increased health spending is financed, during times of electoral pressure. Increases in certain district health budgets are either at the expense of other sectors, other districts, or due to an increase of the total government budget. Looking at time-series data on government expenditure on major sectors for Tanzania, during the last decade, none of these sectors can be identified as a source of funds for the increased health budget. Further analysis is needed to clarify whether additional funds have been reallocated from other districts or are based on total budget increases.

This analysis serves to improve the understanding of allocative processes in the health sector of a developing country. Several conclusions can be derived from the analysis. Firstly, an official resource allocation formula is only one determinant of district level health spending. Additional key factors are the incentives of politicians to provide public services – mainly driven by political competition. Secondly, as a consequence of the first point, an effectively functioning democracy and the access to mass media are unavoidable to ensure a certain level of public services for poor populations. Otherwise, there is less opportunity to sanction the actions of incumbents that do not reflect the preferences of the people. These results are in line with recent calls to strengthen good governance in poor health resource settings. Although this empirical analysis is narrowly focused on the allocation of resources for health improvement in a single developing country, the theoretical framework and estimation methods could be used to draw a broader picture of the determinants of government responsiveness in any country.

5.7.2 Limitations and Future Research Directions

This analysis has several limitations. Firstly, public health expenditure has been used as a proxy for government responsiveness. However, increased spending does not necessarily mean that more public health services are created and that, in turn, the government is more responsive to the needs of its citizens. One possible reason for this might be an inadequacy of local capacity to implement budgeted health measures. Moreover, some of the funds might be allocated to cost centres such as administration or buildings without influencing the total amount of health services consumed. Alternatively, the actual usage of health services or the burden of disease could have been used as a dependent variable, but data for these indicators, on district level, is limited in the case of Tanzania. Secondly, this analysis focuses on the government's responsiveness through the provision of health services. However, policy makers might also have an incentive to satisfy the electorate through the provision of other public services such as education, access to safe water sources, or energy. Thus, political competition might also be related to the increased provision of these services.

The impact of political competition and mass media on the responsiveness of policy makers is just beginning to be understood. Further research is needed to understand the mechanics behind the allocation of scarce resources from central to lower government levels. As mentioned above, the relationship between political competition and the provision of services in other major sectors should be a first subject for further analysis. These results could then be compared to those of the health sector. Secondly, it would also be valuable to see how access to the Internet, as an additional information dissemination tool, influences political competition compared to other forms of mass media. Unfortunately, it was not possible to include this type of mass media in the present study due to data limitations. Thirdly, it would be important to understand to what kind of health interventions additional resources are allocated in times of elections, and, in particular, whether these are the more visible ones. All these questions need to be answered at lower and upper government levels, at different stages of decentralization and in diverse institutional settings. These and other issues are left for future elaboration.

6. Summary and Conclusions

Closing the gap between actual and optimal resource allocation for health is a complex matter. Various sectors, government levels, institutions, and interventions have the potential to use current resources for health improvement in such a way, that a larger amount of Disability-Adjusted Life Years (DALYs) can be averted and, in other words, the health status of a larger population is improved. To use this potential, decision makers, at all levels, have to be aware of the health effects and costs of the interventions they plan to implement. This dissertation focused on three selected areas where decisions on health resource allocation are made.

Firstly, an empirical investigation has been carried out to answer the research question on the marginal health returns on cross-sectoral government expenditure (Q1). The results of the estimated SEM show a significantly positive impact of nutrition, access to safe water sources, sanitation, and education on the reduction of disease prevalence. When comparing these variables, the highest returns on DALYs are obtained by improving nutrition and water, followed by sanitation and education. However, short- and long-term public spending on health turned out not to have a significant positive impact on health. Further evaluation of the “causes of the causes” showed that mothers’ education and a decreasing number of 'under-five' diseases significantly reduce the prevalence of malnutrition among children under the age of five. In the case of access to safe water sources, which is a further determinant of the disease burden, public spending on water and an increasing degree of urbanization are significant determinants. Moreover, growing income is highly correlated with improvements in education.

With respect to the qualitative structured interviews, networking-skills, knowledge-sharing-skills, and partnership-creation-skills are all very important to establish and maintain cross-sectoral cooperation. Additional skills required are further soft-skills such as joint-planning-, negotiation-, consultancy-, and organizational skills, and hard-skills such as a technical professional background. The most important factor influencing collaborative efforts is the relative budget allocated to a certain sector. Slightly less important in terms of starting collaborations are the payoffs of each stakeholder, and interpersonal attraction. Preconditions to work intersectorally include a well-balanced number of stakeholders, mutual trust, a consensus on common problems and, especially for government actors, sufficient incentives for IHA. A major challenge of working cross-sectorally for public health is the predominant sectoral orientation of funding, budget, planning, monitoring, and accountability, especially for government stakeholders. Considering these qualitative results and the fact that up until today

only a few cross-sectoral initiatives have been identified, hypothesis one (H1) cannot be verified. It remains unclear whether IHA already leads to significant synergies in allocating resources for health improvement in the case of Tanzania.

Secondly, moving from cross-sectoral thoughts to the health sector itself, the objective of the fourth chapter was to test the hypothesis that interventions to combat malaria are prioritized in such a way that the marginal dollar goes to where it has the highest effect on averting DALYs. Estimates based on a population model for Tanzania mainland show that preventive interventions such as Insecticide-Treated Nets (ITNs) and Intermittent Presumptive Treatment with Sulphadoxine-Pyrimethamine in Pregnancy (IPTP) would be the first choice when setting priorities, with costs of US$ 41 per DALY averted for both of the interventions. With increasing budgets, the additional amount of funds available should be invested in case management with Artemisinin based Combination Treatment (ACT, US$ 53 per DALY averted). The shift from the two preventive measures (ITNs and IPTP) to the inclusion of ACTs results in an incremental cost-effectiveness ratio of 85.3. As a fourth priority, Indoor Residual Spraying (IRS) at 95% coverage should be included with costs of US$ 73 per DALY averted and an incremental cost-effectiveness ratio of 191.1.

Graphical analysis shows diminishing marginal returns on malaria investments with increasing budgets. The most cost-effective strategy is implemented when covering ITNs, IPTP and case management with ACT at a level of 95%. The budget needed to finance this combination of interventions is almost identical to the funds available in the year 2010 (US$ 140 million, see section 4.2.4). However, the current budget does not prioritize certain interventions in such a way that the marginal dollar goes to where it has the highest effect on averting DALYs. The results of the budget analysis show that a budget share of 41.7% would be sufficient to provide ITNs to all Tanzanian people exposed to the risk of malaria (current allocation: 47%). To reach a more optimal budget allocation, funds from the overfunded ITN program and the less cost-effective IRS should be shifted to make ACTs available and affordable to the poor population. The current allocation of funds to ACTs is 29% compared to 43.3% optimally. Thus, hypothesis two (H2) has to be invalidated. As a result of the qualitative analysis, cost-effectiveness analysis was rated as one of the most important criteria for health priority setting.

Thirdly, the impact of the political economy has to be considered when analyzing the allocation of resources for health improvement. To account for that, the objective of chapter five was to

positively assess how political party competition and the access to mass media directly and indirectly affect the distribution of district resources for health improvement. Based on a dataset combining socioeconomic, electoral, and public-financial indicators for all districts of Tanzania mainland, this analysis suggests that politicians are responsive to electoral competition. Using per capita health expenditure in the first year after the election as a dependent variable, the estimates imply that a one-percentage point smaller difference between the winning party and the second-place party leads to a 0.151 percentage point increase in public health spending, significant at the five percent level. The robustness of this result is confirmed in repeated simulations using the same dependent variable for the second year after the election and using the change of per capita health expenditure in both the first and the second year, after the election. The direct effect of mass media on district level health spending is less clear. Only the second model specification confirms our expectation that mass media is positively related to health spending. For every one-percentage point increase of people having access to radio, per capita health expenditure increases by 2.233 percentage points. Based on these results, hypothesis three (H3) can be partially verified. Political factors directly affect the distribution of district resources for health improvement in Tanzania.

In this dissertation, three selected areas of health resource allocation have been reviewed. To narrow the gap between the actual and a more efficient allocation of resources for health improvement, however, various other aspects of resource allocation must be considered. Firstly, in an optimal way, all interventions to combat other major diseases in Tanzania must be prioritized as it has been done, in this analysis, for malaria interventions. Secondly, the right mix of curative and preventive medicine has to be found for major diseases in this country. Based on a linear programming model for Tanzania, Fleßa (1999) called for a reallocation of resources for health improvement from curative to preventive services in order to increase the overall efficiency of the health care system. Thirdly, decision-makers have to be aware of the health effects and costs of interventions implemented at different levels of health facilities. This is necessary to decide on the budget share allocated to primary, secondary, and tertiary health facilities. Fourthly, this study has shown that political mechanisms and institutions play a major role in health resource allocation. Besides political party competition and other institutional variables included in the model, further political aspects need to be explored. One of these aspects would be to better understand what determines the allocation of resources to health and non-health sectors. These and other issues are left for future work.

This dissertation addressed the problem of resource allocation from a societal perspective using interdisciplinary research approaches. Based on the results of the three analyses, the health status of an entire population can be strengthened by allocating resources for health improvement in a more efficient manner. In particular, the following three policy recommendations can be given:

- Thinking cross-sectorally, the highest health returns are obtained by improving nutrition and access to safe water sources, followed by sanitation and education

- Moving from cross-sectoral thoughts to the health sector itself, the current malaria budget does not prioritize certain interventions in such a way that the marginal dollar goes to where it has the highest effect on averting DALYs. Preventive interventions such as ITNs and IPTP would be the first choice when setting priorities, followed by case management with ACTs and, finally, IRS

- The reality of political economy needs attention in health finance and planning. The official allocation formula is not the only determinant of financial resources available at lower government levels. Political party competition and, in some cases, mass media, are positively related to health spending

These empirical analyses focused on the mechanisms behind the allocation of resources for health improvement in a single developing country. However, the theoretical frameworks, estimation methods, and structures of the qualitative parts could be used to draw a broader picture of the determinants of resource allocation in any country. For this, certain variables and model structures would have to be adapted to other settings and the availability of data. At the same time, a process of learning how resources can be allocated in a more efficient manner has to be continued at different government levels as well as on the donor side.

The implementation of the given policy recommendations is less straightforward. A complex system of various political factors and incentives lead to political choices and priorities that might not be the ones with the highest health benefit for the population. However, we must not forget that even today's developed countries have spent decades creating a basis for a more efficient public health sector and remain far from reaching optimality.

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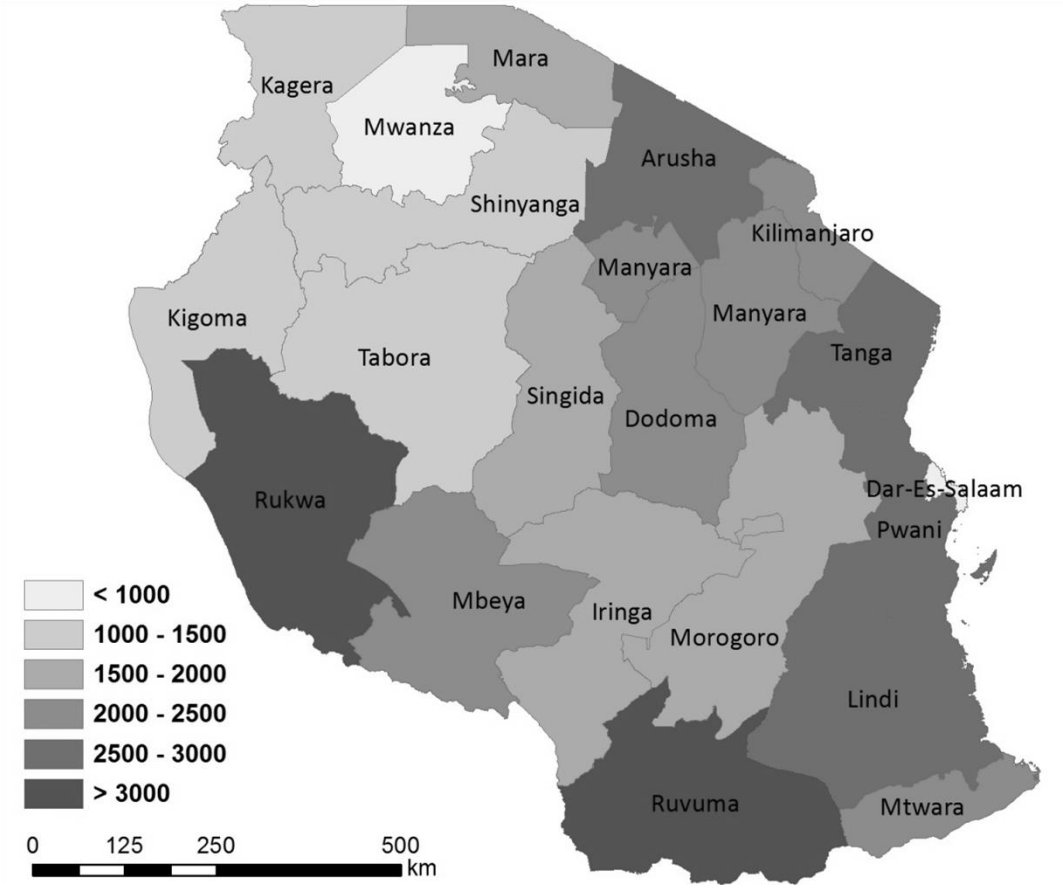
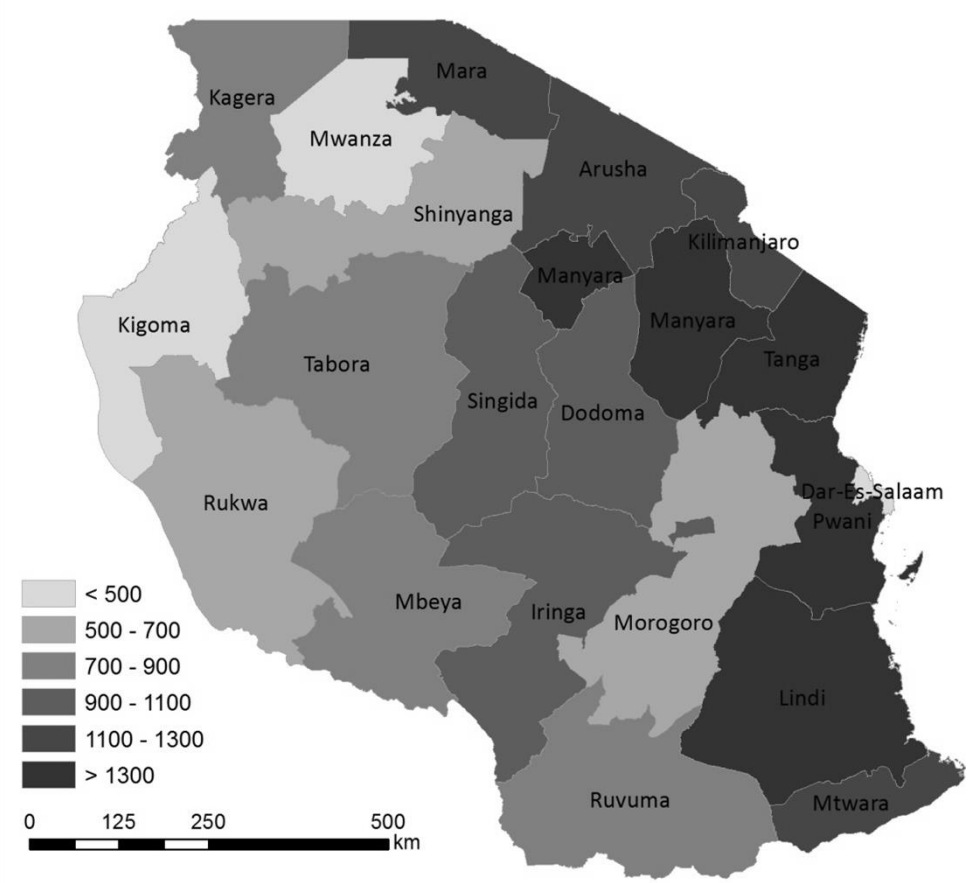
Appendix 1: Map of Regional per Capita Agriculture Investment at Current Prices, 2010 (in Tanzanian Shillings)



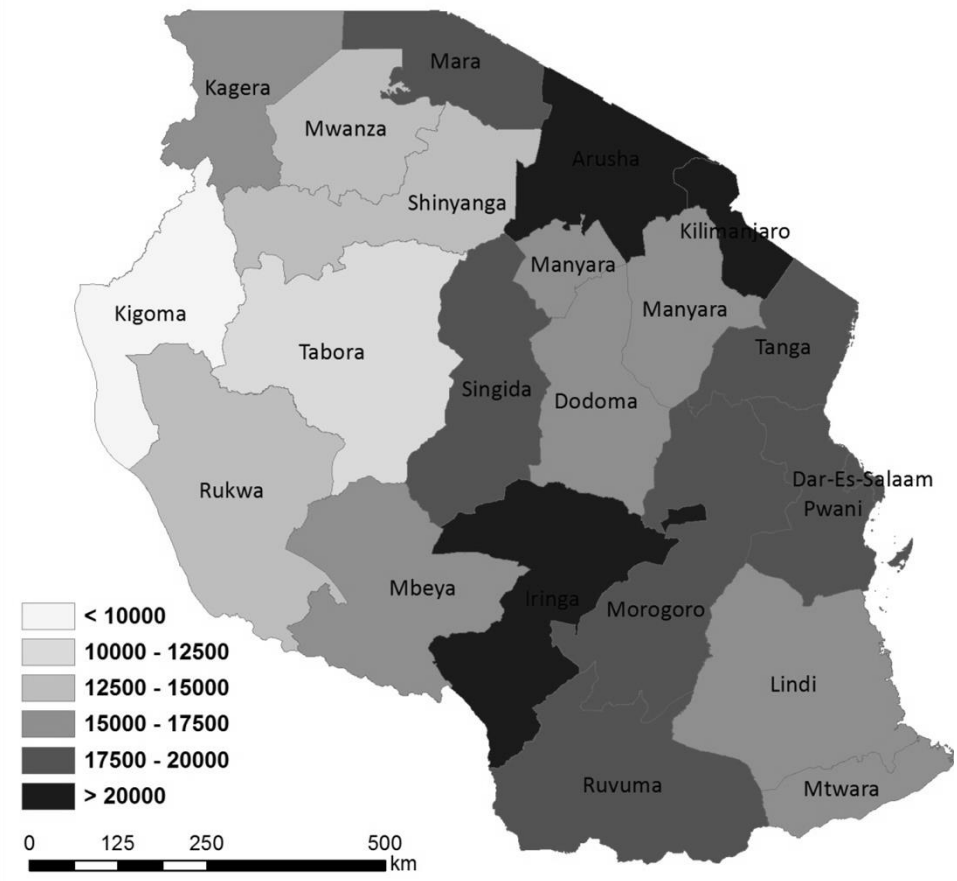
Data source: Login Tanzania Database 2011 (mapped by the author)

Appendix 2: Map of Regional per Capita Water Investment at Current Prices, 2010 (in Tanzanian Shillings)



Data source: Login Tanzania Database 2011 (mapped by the author)

Appendix 3: Map of Regional per Capita Education Investment at Current Prices, 2010 (in Tanzanian Shillings)



Data source: Login Tanzania Database 2011 (mapped by the author)

Appendix 4: Definitions of Variables (Chapter 3)

Variable	Definition
Exogenous variable	
THINV	Logarithm of deflated public per capita spending on health in the short- and long term (total spending of the current and the last five budget years)*
SANI	Latrines per 100 pupils
INFRA	Percentage of women and men age 15-49 who reported serious problems in accessing health care due to the distance to the next health facility
URB	Percentage of people living in urban areas
TAINV	Logarithm of deflated public per capita spending on agriculture (current and previous budget year)*
BREASTF	Percentage who started breastfeeding within 1 hour of birth, among the last children born in the five years preceding the survey
IODINE	Percentage of households with adequate iodine content of salt (15+ ppm)
MEDU	Percentage of women age 15-49 who completed grade 6 at the secondary level
VACC	Percentage of children age 12-23 months with a vaccination card
TWINV	Logarithm of deflated public per capita spending on water in the short- and long term (total spending of the current and the last five budget years)*
TEINV	Logarithm of deflated public per capita spending on education in the short- and long term (total spending of the current and the last five budget years)*
LABOUR	Percentage of women and men employed in the 12 months preceding the survey
LAND	Per capita farmland in ha (including the area under temporary mono/mixed crops, permanent mono/mixed crops and the area under pasture)
RAIN	Yearly rainfall in mm
Endogenous variables	
DISPREV	Health-Index: prevalence of the following diseases, weighted by DALYs according to WHO, 2009: *Malaria:* Percentage of children under age 5 with fever in the two weeks preceding the survey *Diarrhoea:* Percentage of children under age 5 who had diarrhoea in the two weeks preceding the survey *Acute Respiratory Infection (ARI):* Among children under age 5, the percentage who had symptoms of acute respiratory infection (ARI) in

	the two weeks preceding the survey
NUTR	Percentage of children under age 5 classified as malnourished according to weight-for-age (below -2 standard deviation units (SD) from the median of the WHO Child Growth Standards adopted in 2006)
SWATER	Percentage of households with access to safe water sources
EDU	Number of primary school pupils divided by the number of primary school teachers (Pupils-Teacher-Ratio, PTR).
GDP	Deflated per capita GDP, in million Tanzanian Shillings*

* base year: 2010

Appendix 5: Estimation Variations (2SLS) (Chapter 3)

Dependent Variable	(1) DISPREV	(2) NUTR	(3) SWATER	(4) EDU	(5) GDP
THINV	0.085 (0.08)				
NUTR	0.216 (0.24)				
SWATER	-0.123 (0.08)				
SANI	-0.038 (0.02)**				
INFRA	0.094 (0.08)				
GDP	0.010 (0.13)	0.095 (0.08)	0.010 (0.23)	-17.523 (11.74)	
EDU	-0.004 (0.00)**				-0.014 (0.00)**
URB	-0.118 (0.60)	-0.358 (0.40)	2.086 (1.28)	31.286 (59.29)	2.685 (0.66)**
TAINV		-0.026 (0.02)			
BREASTF		0.047 (0.04)			
IODINE		-0.023 (0.05)			
MEDU		-0.588 (0.17)**			
VACC		0.012 (0.09)			
DISPREV		0.369 (0.18)**		-22.60 (15.84)	
TWINV			0.247 (0.11)**		
LTEINV				-2.805 (8.50)	
LABOUR					0.255 (0.21)
LAND					0.081 (0.03)**
RAIN					0.000 (0.00)
R-Squared	0.7416	0.9003	0.6966	0.8643	0.9248
Observations	84	84	84	84	84

Note: One/two asterisk indicate that coefficients are statistically significant at the 10/5 percent level, based on the statistics reported in respective parentheses. The coefficients of regional dummies are not reported.

Appendix 6: Interview Structure (Chapter 3)

Structured Expert Interviews

Challenges and Opportunities of Intersectoral Health Action (IHA)

Most of the common diseases in Tanzania have multifaceted causes, led by malnutrition and poor water supply. Thus, cross-sectoral and interdisciplinary action is needed to strengthen the health status of the population. According to the Government of Tanzania, the "recognition of cross-sectoral contribution to outcomes and inter-sectoral linkages and synergies" are one of the major prerequisites for the implementation of MKUKUTA II.

Example: The transport sector includes questions regarding the reduction of pedestrian and vehicle accidents in their proposal for a new freeway (Egan et al., 2003)

I: External factors / Context

a) Please state the major objectives of your organisation/ministry:

_____

_____

_____

b) Please elaborate on examples of IHA in your organization/ministry:

_____

_____

_____

c) The table below shows some possible cooperation sectors for IHA. Specify how much you work with these sectors (column H) and how high your benefits are from this particular collaboration (column I). Your own sector can be left blank. If one or more partners are missing, you can add yourself.

(1 = not intensive, low yield / 4 = very intensive, high yield)

Partner-sectors for IHA		H: Intensity				I: Yield			
		1	2	3	4	1	2	3	4
c1)	Health Sector	☐	☐	☐	☐	☐	☐	☐	☐
c2)	Education Sector (e.g. HIV/AIDS prevention)	☐	☐	☐	☐	☐	☐	☐	☐
c3)	Agriculture/Nutrition Sector (e.g. balanced diets)	☐	☐	☐	☐	☐	☐	☐	☐

c4)	Water/Sanitation/Hygiene Sector (e.g. waterborne diseases)	☐	☐	☐	☐	☐	☐	☐	☐
c5)	Infrastructure Sector (e.g. medical vehicle route)	☐	☐	☐	☐	☐	☐	☐	☐
c6)	Employment Sector (e.g. generating income for health expenditure)	☐	☐	☐	☐	☐	☐	☐	☐
c7)		☐	☐	☐	☐	☐	☐	☐	☐
c8)		☐	☐	☐	☐	☐	☐	☐	☐

d) Who are the main funders of the stated interventions?

_____

_____

_____

e) Are you starting to cooperate with health-related sectors that you have not previously maintained collaborative contacts with?

☐ No ☐ Yes, namely: _____

f) Which organizations/ministries are currently the main drivers for IHA?

_____

_____

_____

g) Which organizations/ministries are you missing at this time as drivers for IHA?

☐ No ☐ I miss: _____

h) In your case, does IHA include the private sector and faith based organizations?

_____

_____

_____

II: Change Management / Project Management

a) Please assess the following skills required for effective health promotion alliances

(1 = not important / 4 = very important)

		1	2	3	4
a1)	Networking-skills	☐	☐	☐	☐
a2)	Knowledge-sharing-skills	☐	☐	☐	☐
a3)	Partnership-creation-skills	☐	☐	☐	☐
a4)	Partnership-support-skills	☐	☐	☐	☐
a5)	Other (please specify): _____	☐	☐	☐	☐

III: Support Based on Intersectoral Collaboration: Perceptions, Intentions, and Actions

a) Which of the following parameters influence collaborative efforts with health-related sectors?
(1 = not influencing / 4 = very influencing)

		1	2	3	4
a1)	Initial distribution of resources among the participants	☐	☐	☐	☐
a2)	Payoffs of the coalition	☐	☐	☐	☐
a3)	Inclinations to join with other sectors (interpersonal attraction)	☐	☐	☐	☐
a4)	Other (please specify): _____	☐	☐	☐	☐

b) Please indicate major preconditions for successful cross-sectoral collaboration:

(1 = not relevant / 4 = very relevant)

		1	2	3	4
b1)	A balanced number of stakeholders in each sector (including relative skills)	☐	☐	☐	☐
b2)	Recognition of different incentives	☐	☐	☐	☐
b3)	Recognition of different cultures	☐	☐	☐	☐
b4)	Consensus on common problems	☐	☐	☐	☐
b5)	Consensus on mutual benefits	☐	☐	☐	☐
b6)	Functional ways of communication	☐	☐	☐	☐
b7)	Tools for analyzing common problems	☐	☐	☐	☐
b8)	Sufficient capacities	☐	☐	☐	☐
b9)	Sufficient incentives	☐	☐	☐	☐
b10)	Dissemination of intersectoral research findings	☐	☐	☐	☐
b11)	Other (please specify): _____	☐	☐	☐	☐

c) What are the major challenges of IHA?

(1 = minor challenge / 4 = major challenge)

		1	2	3	4
c1)	Predominant sectoral orientation of funding, budget, planning, monitoring, and accountability	☐	☐	☐	☐
c2)	None of the sectors make efforts to take responsibility for cross-sectoral results	☐	☐	☐	☐
c3)	Large differences in paradigms, worldviews, and mindsets across sectors	☐	☐	☐	☐
c4)	Competition of sectoral results	☐	☐	☐	☐
c5)	Lack of education in multi-sectoral work	☐	☐	☐	☐
c6)	High level of staff turnover	☐	☐	☐	☐
c7)	Other (please specify): _____	☐	☐	☐	☐

d) Do you have further suggestions to improve IHA in your Organization/Ministry? Please elaborate:

_____

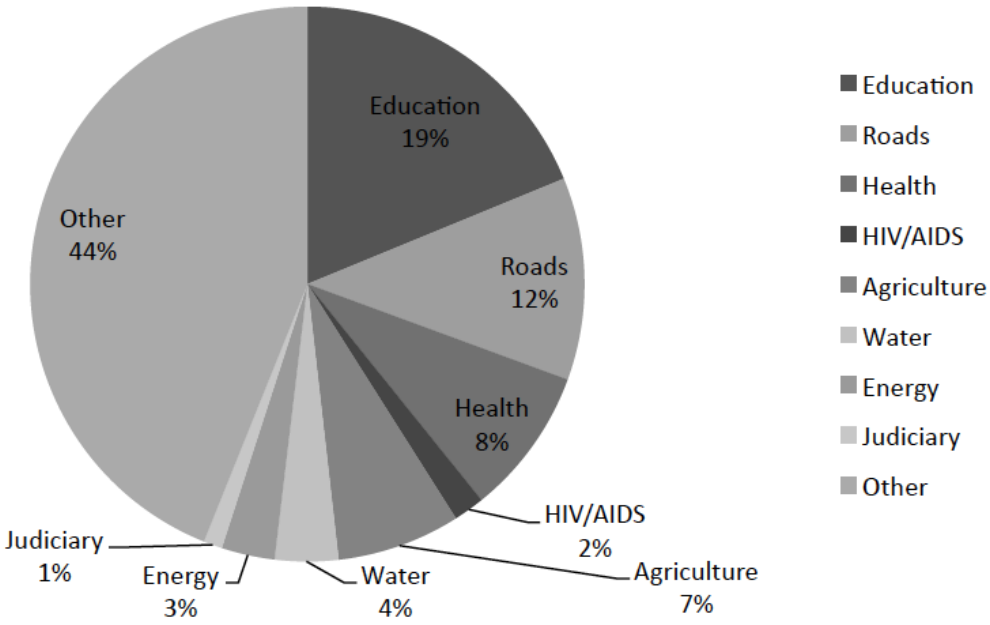
_____

_____

_____

IV: Budget Allocation

This graph shows the current allocation of public expenditures to major sectors for the financial year 2009/2010 (Source: Ministry of Finance).



Do you think the proportions should be changed? If so, relatively more / less on what sector?

Appendix 7: List of Interviewees (Chapter 3)

No.	Name	Position	Organisation
1	Jamal Msami	Researcher	Research on Poverty Alleviation (REPOA)
2	Dr. Baltazar Ngoli	Former Regional Medical Officer Coast Region	Government of Tanzania – Pwani Region
3	Prof. Samuel Wangwe	Director	Research on Poverty Alleviation (REPOA)
4	Dr. Axel Dörken	GIZ Country Director	GIZ
5	Dr. Obelin Kisanga	Former Regional Medical Officer Tanga	Government of Tanzania – Tanga Region
6	(not known)	Regional Medical Officer Mtwara	Government of Tanzania – Mtwara Region
7	Noel Kahise	Second Master	Umoja Secondary School, Mtwara
8	Maximillian Mapunda		World Health Organization (WHO)
9	Daniel Albrecht		MEDA
10	Marion Lieser		CSSC
11	Janet Macha		IFAKARA
12	John Msuya	Associate Professor in Nutrition and Development Economics	Sokuine University of Agriculture (SUA)
13	Tiba	Former District Health Accountant	Government of Tanzania

Appendix 8: Interview Structure (Chapter 4)

Structured Expert Interviews: Health Priority Setting Process

Priority setting in health care is defined simply as the process of determining how health care resources should be allocated among competing interventions or people. This process is necessary in a developing country like Tanzania, given the scarce financial resources and a tremendous burden of disease.

1. Please elaborate on the health priority setting process in your institution/department:

_____

_____

_____

_____

2. Please rate the importance of the following criteria for health priority setting:

(1 = not important criteria / 4 = very important criteria)

2.1 Disease-related criteria

		1	2	3	4
a)	Severity of a condition	☐	☐	☐	☐
b)	Cost-effectiveness of intervention	☐	☐	☐	☐
c)	Quality of evidence on effectiveness	☐	☐	☐	☐

2.2 Patient-related criteria

		1	2	3	4
a)	Urgency of need for care	☐	☐	☐	☐
b)	Responsible for causing own illness	☐	☐	☐	☐
c)	Age	☐	☐	☐	☐
	if rated 3 or 4: ☐ favoring young people ☐ favoring old people				
d)	Social status	☐	☐	☐	☐
	if rated 3 or 4: ☐ favoring wealthy people ☐ favoring poor people				
e)	Gender	☐	☐	☐	☐
	if rated 3 or 4: ☐ favoring female ☐ favoring male				
f)	Place of residence	☐	☐	☐	☐
	if rated 3 or 4: ☐ favoring rural areas ☐ favoring urban areas				

2.3 Society-related criteria

		1	2	3	4
a)	Equity of health care access	☐	☐	☐	☐
b)	Community's views	☐	☐	☐	☐
c)	Political views	☐	☐	☐	☐

3. Do you think investing in non-health sectors should be given priority? (e.g. improving access to save water sources) Please elaborate.

_____

_____

_____

4. Who should be the main actors in health priority setting?

(1 = not important actor / 4 = very important actor)

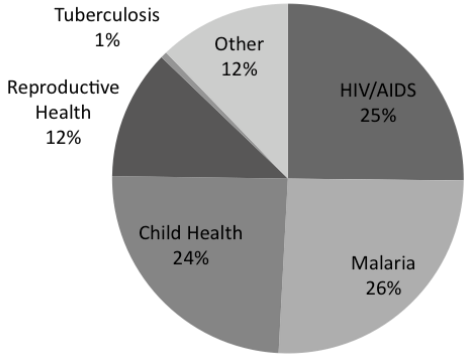
		1	2	3	4
a)	Health professionals	☐	☐	☐	☐
b)	Donors	☐	☐	☐	☐
c)	International level (e.g. WHO)	☐	☐	☐	☐
d)	Central government level	☐	☐	☐	☐
e)	Local Government level	☐	☐	☐	☐
f)	General public	☐	☐	☐	☐
g)	Patients	☐	☐	☐	☐
h)	NGOs	☐	☐	☐	☐
i)	Health insurance companies	☐	☐	☐	☐
	Other (please specify): _____	☐	☐	☐	☐

5. What are the major challenges of the health priority setting process?

(1 = minor challenge / 4 = major challenge)

		1	2	3	4
a)	Availability of health data/indicators	☐	☐	☐	☐
b)	Quality of health data/indicators	☐	☐	☐	☐
c)	Not aware of the impact of certain health investments	☐	☐	☐	☐
d)	No personnel capacity for priority setting	☐	☐	☐	☐
e)	No incentives to carry out an appropriate priority setting process	☐	☐	☐	☐
f)	Earmarked funding (Government)	☐	☐	☐	☐
g)	Earmarked funding (Donors)	☐	☐	☐	☐
h)	Political constraints (dominant interest groups, multiple government levels)	☐	☐	☐	☐
i)	Discrepancy in values	☐	☐	☐	☐
	Other (please specify): _____	☐	☐	☐	☐

6. This graph shows the current allocation of public health expenditures to major disease areas in Tanzania. Do you think the proportions should be changed? If so, relatively more / less on which disease?



Source: National Health Accounts, 2008

7. Do you have further suggestions to improve the health priority setting process?

Appendix 9: List of Interviewees (Chapter 4)

No.	Name	Position	Organisation
1	Daniel Albrecht	Manager, Projects & Business Development Tanzania National Voucher Scheme	MEDA Economic Development Associates, Tanzania
2	Max Mapunda	Health Service Delivery	World Health Organization (WHO), Tanzania Office
3	Dr. Tausi Kida	Director of Programmes – ESRF/REPOA/ISS Capacity Building	Economic and Social Research Foundation (ESRF)
4	Meinolf Kuper	Head of Health Financing	Tanzanian-German Programme to Support Health (TGPSH)
5	Modest Rwakahemula	Doctor in Charge	St. Joseph Kagondo Hospital
6	Justus Magongo	Councillor Muleba District	United Republic of Tanzania
7	Dr. Leontine	District Medical Officer, Muleba District	United Republic of Tanzania
8	(not known)	Health Administrator, Muleba District	United Republic of Tanzania
9	(not known)	Health Administrator, Muleba District	United Republic of Tanzania
10	Dr. Joseph	District Health Secretary, Bukoba Rural District	United Republic of Tanzania
11	Dr. Raphael Kiula	District Medical Officer, Bukoba Municipal	United Republic of Tanzania

Appendix 10: Definitions of Variables (Chapter 5)

Variable name	Definition
Health Expenditure (first year after the election)	Logarithm of deflated public per capita spending on health in 2006 (budgeted amounts)*
Health Expenditure Change (first year after the election)	Logarithm of deflated public per capita spending on health in 2006 - logarithm of deflated public per capita spending on health in 2005 (budgeted amounts)*
Health Expenditure (second year after the election)	Logarithm of deflated public per capita spending on health in 2007 (budgeted amounts)*
Health Expenditure Change (second year after the election)	Logarithm of deflated public per capita spending on health in 2007 - logarithm of deflated public per capita spending on health in 2005 (budgeted amounts)*
Voter Turnout	Number of valid votes divided by the number of registered voters
Political Party Competition	= margin of victory: percentage of votes for the winning party less the percentage won by the second-place party (see Cleary 2007)
Access to Radio	Percentage of women and men aged 15-49 listening to radio at least once a week
Access to Newspapers	Percentage of women and men aged 15-49 reading a newspaper at least once a week
Under-five Mortality	The probability of dying between birth and the fifth birthday, per 1,000 live births
Gender of Political Head	Dummy variable: male / female
Political Party	Dummy variable: leading party CCM / other party
Degree of Urbanisation	Percentage of the population living in urban areas
Employment	Number of women and men aged 15-49 employed in the 12 months preceding the survey divided by the total population in that age span
GDP	Logarithm of deflated per capita GDP, in million Tanzanian Shillings*
Literacy	Number of women and men aged 15-49 literate divided by the total population in that age span
Population Density	Logarithm of the number of people per square kilometer
Access to Health Infrastructure	Percentage of women and men age 15-49 who reported serious problems in accessing health care due to the distance to the next health facility

* base year: 2010

Appendix 11: Interacting Political Party Competition and Urbanization

			Dependent Variable (1st Year After the Election)
		Independent Variables	log Health Expenditure (per capita)
		Objective Variables	
T_{it}	+	Voter Turnout	-0.076 (0.40)
R_{it}	+	Access to Radio	0.118 (0.42)
N_{it}	+	Access to Newspapers	0.088 (0.21)
		Interaction Variable	
	+	Political Party Competition x Degree of Urbanisation	0.412 (0.17)**
V_{it}		*Controls*	
	+	Lagged log Health Expenditure (per capita)	0.692 (0.11)***
	+	Under-five Mortality	0.550 (1.62)
	+/-	Gender of Political Head (dummy)	-0.010 (0.04)
	+/-	Political Party (dummy)	-0.043 (0.04)
	+	Employment	-0.362 (0.52)
	+	log GDP (per capita)	-0.420 (0.23)
	+	Literacy	0.381 (0.19)
	+	log Population Density	-0.030 (0.04)
	+	Access to Health Infrastructure	0.108 (0.14)
		Valid N	110
		R-squared	0.4805

Note: The table reports standard errors in parentheses. Statistical significance is noted with the conventional ***p < 0.01, **p < 0.05, *p < 0.10.

Appendix 12: Data (selected variables)

Complete data sets for all variables used can be downloaded from:

https://www.dropbox.com/sh/uzby8qsk35gyriw/AAAlHavg5rDeUL5N2KyZ3Qira

For the exact definition of variables see Appendix 4 and 10.

REGION	YEAR	TEINV	THINV	TWINV	TAINV	GDP	RAIN	EDU	URB
Arusha	2004	52720	11211	1748	1357	0,688	478,7	48	0,313
Arusha	2005	57619	12811	1953	952	0,745	530,3	48	0,313
Arusha	2009	84688	23749	5095	5596	0,899	793,4	42	0,313
Arusha	2010	98958	26952	5794	6646	0,972	793,4	42	0,313
Manyara	2004	45668	10503	2224	1486	0,602	478,7	61	0,127
Manyara	2005	50907	12600	2630	1503	0,684	530,3	61	0,130
Manyara	2009	86597	24150	5530	6287	0,801	793,4	52	0,142
Manyara	2010	93082	26156	6591	5939	0,822	793,4	49	0,144
Pwani	2004	50919	18097	3792	2518	0,479	883,4	45	0,219
Pwani	2005	55132	21233	4681	2241	0,465	691,0	45	0,223
Pwani	2009	94139	36729	8912	6180	0,506	820,4	42	0,240
Pwani	2010	103660	38550	9278	6220	0,547	860,6	41	0,244
Dodoma	2004	41582	10160	2148	1378	0,374	687,6	49	0,142
Dodoma	2005	45081	11598	2636	1319	0,376	329,7	49	0,150
Dodoma	2009	72822	19063	5095	3878	0,443	394,6	56	0,182
Dodoma	2010	79701	21560	5507	4800	0,482	394,6	53	0,190
Iringa	2004	52239	10799	1846	1370	0,733	682,5	48	0,182
Iringa	2005	56548	12458	2198	1296	0,771	481,1	48	0,187
Iringa	2009	90396	26170	5431	5013	0,867	417,9	45	0,208
Iringa	2010	102179	28246	5940	4657	0,908	417,9	45	0,213
Kigoma	2004	32676	8098	1552	685	0,407	867,7	72	0,174
Kigoma	2005	35598	9122	1722	597	0,407	742,2	72	0,183
Kigoma	2009	56009	13680	2257	1532	0,441	865,6	59	0,220
Kigoma	2010	58346	14794	2501	2369	0,431	865,6	59	0,229
Kilimanjaro	2004	74641	16934	3192	2201	0,699	0,0	42	0,217
Kilimanjaro	2005	79915	18735	3709	2259	0,752	0,0	42	0,221

Kilimanjaro	2009	129332	35046	7203	6624	0,830	512,6	36	0,238
Kilimanjaro	2010	141009	38043	7693	6509	0,831	512,6	34	0,242
Lindi	2004	47744	16034	3997	1255	0,545	1171,2	52	0,182
Lindi	2005	51450	18095	4806	1155	0,530	511,5	52	0,193
Lindi	2009	79773	28895	7978	7248	0,580	841,4	55	0,237
Lindi	2010	87736	31206	9003	6879	0,628	841,4	55	0,247
Mara	2004	52698	9461	2699	1302	0,624	729,6	59	0,200
Mara	2005	55758	10860	3380	1817	0,624	815,7	59	0,206
Mara	2009	93478	21100	7282	4979	0,680	1006,2	61	0,230
Mara	2010	101396	23678	7873	5262	0,683	1006,2	58	0,235
Mbeya	2004	49798	9455	1066	1477	0,668	678,3	56	0,207
Mbeya	2005	54259	12047	1237	1407	0,729	678,3	56	0,209
Mbeya	2009	83902	22340	2621	2453	0,880	678,3	55	0,215
Mbeya	2010	89537	23806	3135	3462	0,917	678,3	51	0,217
Morogoro	2004	44522	9443	1345	1383	0,639	921,5	51	0,278
Morogoro	2005	47919	11015	1835	1223	0,652	444,8	51	0,283
Morogoro	2009	83500	21526	3388	4476	0,690	751,0	48	0,300
Morogoro	2010	92961	23585	3636	3625	0,714	751,0	46	0,304
Mtwara	2004	47607	11099	2103	1032	0,486	1485,3	49	0,212
Mtwara	2005	52580	12532	2599	1029	0,471	754,1	49	0,217
Mtwara	2009	76874	19622	4783	3452	0,522	1230,8	52	0,235
Mtwara	2010	83045	21052	5544	4465	0,656	1230,8	51	0,239
Mwanza	2004	34583	7714	995	502	0,593	1094,6	69	0,208
Mwanza	2005	37556	9013	1133	623	0,609	1060,1	69	0,209
Mwanza	2009	70186	19742	2446	2586	0,778	1144,7	61	0,215
Mwanza	2010	77139	21555	2640	2443	0,803	1144,7	57	0,216
Ruvuma	2004	56548	12982	2095	1298	0,704	1097,4	40	0,157
Ruvuma	2005	61078	14427	2397	1245	0,775	716,1	40	0,159
Ruvuma	2009	94091	23263	4307	9210	0,872	955,6	48	0,169
Ruvuma	2010	103147	25298	4638	7622	0,851	955,6	48	0,171
Shinyanga	2004	29458	6414	1086	905	0,447	601,5	74	0,096

Shinyanga	2005	33453	7663	1204	778	0,431	601,5	74	0,098
Shinyanga	2009	70833	19423	5753	3225	0,528	601,5	71	0,105
Shinyanga	2010	76682	21364	6099	2947	0,557	601,5	62	0,107
Singida	2004	42257	12240	2475	1428	0,391	460,1	54	0,150
Singida	2005	45315	13745	2687	1318	0,357	460,1	54	0,156
Singida	2009	80952	22564	6795	3360	0,402	460,1	58	0,181
Singida	2010	90606	25607	7447	4249	0,484	460,1	53	0,187
Tabora	2004	37144	8820	1594	861	0,471	1200,6	54	0,149
Tabora	2005	40356	10000	1995	859	0,531	683,0	54	0,160
Tabora	2009	66288	17974	3776	2557	0,586	850,4	67	0,201
Tabora	2010	69118	19523	4252	2160	0,578	850,4	64	0,211
Tanga	2004	48862	13169	1948	1483	0,664	1196,8	40	0,185
Tanga	2005	52944	14753	2421	1449	0,747	821,0	40	0,186
Tanga	2009	86610	25992	5500	6595	0,716	1155,9	53	0,188
Tanga	2010	96095	29192	6263	6259	0,730	1155,9	50	0,189
Kagera	2004	36178	6179	1202	310	0,434	1934,9	59	0,074
Kagera	2005	45035	7672	1583	398	0,420	1953,6	59	0,078
Kagera	2009	80458	16363	3917	3198	0,485	1989,6	60	0,094
Kagera	2010	86921	18607	4337	3498	0,495	1989,6	58	0,097
Dar	2004	32682	9118	1027	567	1,241	1094,8	47	0,944
Dar	2005	35335	9499	1226	540	1,277	900,6	47	0,947
Dar	2009	62353	19972	1206	565	1,714	964,2	44	0,957
Dar	2010	74490	24241	1180	476	1,736	964,2	37	0,960
Rukwa	2004	30540	10113	1772	897	0,621	805,6	63	0,181
Rukwa	2005	38222	12557	2249	722	0,638	805,6	63	0,183
Rukwa	2009	74224	22307	4170	4987	0,754	805,6	65	0,193
Rukwa	2010	79656	22967	4277	7091	0,765	805,6	63	0,195

DISTRICT	YEAR	POLITICAL PARTY COMPETITION	VOTER TURNOUT	POPULATION DENSITY
Arusha Urban Council	2010	0,192	0,429	3614,3
Arusha Urban Council	2005	0,066	0,587	4169,6
Arusha Arumeru	2010	0,279	0,459	188,2
Arusha Arumeru	2005	0,442	0,737	217,1
Arusha Monduli	2010	0,838	0,492	13,8
Arusha Monduli	2005	0,894	0,668	15,9
Arusha Karatu	2010	0,215	0,682	57,1
Arusha Karatu	2005	0,016	0,875	65,9
Manyara Babati	2010	0,016	0,615	64,4
Manyara Babati	2005	0,278	0,841	74,3
Manyara Hanang	2010	0,215	0,501	63,1
Manyara Hanang	2005	0,823	0,829	72,8
Manyara Kiteto	2010	0,282	0,426	9,9
Manyara Kiteto	2005	0,146	0,755	11,4
Manyara Mbulu	2010	0,278	0,589	57,7
Manyara Mbulu	2005	0,377	0,848	66,6
Manyara Simanjiro	2005	0,550	0,678	9,1
Pwani/Coast Region Kibaha Urban Council	2010	0,139	0,460	76,7
Pwani/Coast Region Kibaha Urban Council	2005	0,262	0,690	88,5
Pwani/Coast Region Bagamojo	2010	0,713	0,435	24,6
Pwani/Coast Region Bagamojo	2005	0,692	0,753	28,4
Pwani/Coast Region Kisarawe	2010	0,641	0,463	22,6
Pwani/Coast Region Kisarawe	2005	0,341	0,774	26,1
Pwani/Coast Region Mkuranga	2010	0,457	0,330	81,4
Pwani/Coast Region Mkuranga	2005	0,292	0,745	93,9
Pwani/Coast Region Mafia	2010	0,178	0,659	82,9
Pwani/Coast Region Mafia	2005	0,177	0,832	95,6
Pwani/Coast Region Rufiji	2010	0,207	0,693	16,0
Pwani/Coast Region Rufiji	2005	0,141	0,808	18,5

Dodoma Dodoma Urban Council	2010	0,497	0,399	132,7
Dodoma Dodoma Urban Council	2005	0,739	0,664	153,1
Dodoma Dodoma District Council	2010	0,497	0,348	33,2
Dodoma Dodoma District Council	2005	0,877	0,790	38,3
Dodoma Kondoa	2010	0,459	0,582	34,3
Dodoma Kondoa	2005	0,350	0,803	39,6
Dodoma Kongwa	2005	0,870	0,812	75,2
Dodoma Mpwapwa	2010	0,790	0,449	35,9
Dodoma Mpwapwa	2005	0,786	0,798	41,4
Iringa Urban Council	2010	0,061	0,612	702,6
Iringa Urban Council	2005	0,496	0,653	810,6
Iringa Disctrict Council	2010	0,877	0,541	13,0
Iringa Disctrict Council	2005	0,594	0,761	15,0
Iringa Ludewa	2005	0,914	0,766	28,0
Iringa Makete	2010	0,702	0,585	35,2
Iringa Makete	2005	0,916	0,790	40,7
Iringa Mufindi	2005	0,786	0,791	55,8
Iringa Njombe	2010	1,000	0,543	45,0
Iringa Njombe	2005	0,660	0,750	51,9
Iringa Kilolo	2010	0,848	0,484	31,8
Iringa Kilolo	2005	0,828	0,801	36,7
Kigoma Urban Council	2010	0,028	0,473	1193,3
Kigoma Urban Council	2005	0,144	0,719	1376,7
Kigoma District Council	2010	0,076	0,473	44,9
Kigoma District Council	2005	0,173	0,734	51,8
Kigoma Kasulu	2010	0,126	0,302	72,7
Kigoma Kasulu	2005	0,243	0,766	83,9
Kigoma Kibondo	2010	0,196	0,559	27,9
Kigoma Kibondo	2005	0,646	0,794	32,1
Kilimanjaro Moshi Urban Council	2010	0,259	0,470	5250,4
Kilimanjaro Moshi Urban Council	2005	0,146	0,689	6057,1

Kilimanjaro Moshi District Council	2010	0,206	0,542	278,0
Kilimanjaro Moshi District Council	2005	0,289	0,761	320,7
Kilimanjaro Hai	2010	0,095	0,606	115,7
Kilimanjaro Hai	2005	0,442	0,757	133,5
Kilimanjaro Mwanga	2010	0,615	0,498	56,2
Kilimanjaro Mwanga	2005	0,616	0,681	64,8
Kilimanjaro Rombo	2010	0,032	0,552	175,6
Kilimanjaro Rombo	2005	0,629	0,739	202,5
Kilimanjaro Same	2010	0,467	0,510	39,8
Kilimanjaro Same	2005	0,552	0,726	45,9
Lindi Urban Council	2010	0,067	1,087	64,9
Lindi Urban Council	2005	0,194	0,744	74,9
Lindi District Council	2010	0,435	0,482	34,0
Lindi District Council	2005	0,383	0,803	39,2
Lindi Kilwa	2010	0,137	0,621	13,5
Lindi Kilwa	2005	0,228	0,762	15,6
Lindi Ruangwa	2010	0,492	0,492	49,0
Lindi Ruangwa	2005	0,638	0,787	56,5
Lindi Liwale	2010	0,205	0,696	2,1
Lindi Liwale	2005	0,148	0,857	2,4
Lindi Nachingwea	2010	0,432	0,493	28,4
Lindi Nachingwea	2005	0,745	0,797	32,7
Mara Musoma Urban Council	2010	0,215	0,531	4078,6
Mara Musoma Urban Council	2005	0,125	0,693	4705,3
Mara Musoma District Council	2005	0,125	0,693	101,2
Mara Bunda	2010	0,353	0,604	98,5
Mara Bunda	2005	0,090	0,776	113,7
Mara Serengeti	2010	0,163	0,517	17,0
Mara Serengeti	2005	0,208	0,747	19,7
Mara Tarime	2010	0,010	0,486	133,7
Mara Tarime	2005	0,447	0,701	154,3

Mbeya Urban Council	2010	0,299	0,471	1520,1
Mbeya Urban Council	2005	0,559	0,641	1753,6
Mbeya District Council	2010	0,225	0,505	14,1
Mbeya District Council	2005	0,714	0,720	16,3
Mbeya Ileje	2010	0,693	0,540	61,0
Mbeya Ileje	2005	0,450	0,773	70,3
Mbeya Kyela	2010	0,802	0,486	139,2
Mbeya Kyela	2005	0,887	0,732	160,6
Mbeya Mbarali	2010	0,352	0,434	13,0
Mbeya Mbarali	2005	0,609	0,701	15,0
Mbeya Mbozi	2010	0,110	0,477	56,2
Mbeya Mbozi	2005	0,838	0,706	64,8
Mbeya Rungwe	2005	0,443	0,748	169,3
Morogoro Urban Council	2010	0,383	0,382	928,2
Morogoro Urban Council	2005	0,371	0,663	1070,8
Morogoro District Council	2010	0,600	0,429	38,0
Morogoro District Council	2005	0,702	0,785	43,9
Morogoro Kilombero	2010	0,055	0,414	22,8
Morogoro Kilombero	2005	0,581	0,704	26,3
Morogoro Kilosa	2010	0,659	0,403	36,3
Morogoro Kilosa	2005	0,674	0,785	41,9
Morogoro Ulanga	2010	0,540	0,579	8,3
Morogoro Ulanga	2005	0,393	0,822	9,6
Morogoro Mvomero	2010	0,387	0,451	23,4
Morogoro Mvomero	2005	0,775	0,770	27,0
Mtwara Urban Council	2010	0,217	0,525	598,6
Mtwara Urban Council	2005	0,317	0,705	690,6
Mtwara District Council	2010	0,380	0,532	60,1
Mtwara District Council	2005	0,560	0,808	69,3
Mtwara Masasi	2010	0,528	0,485	52,2
Mtwara Masasi	2005	0,671	0,822	60,3

Mtwara Newala	2010	0,356	0,611	91,3
Mtwara Newala	2005	0,625	0,919	105,3
Mtwara Tandahimba	2010	0,015	0,582	114,0
Mtwara Tandahimba	2005	0,471	0,841	131,5
Mwanza Urban Council	2010	0,112	0,356	1182,6
Mwanza Urban Council	2005	0,577	0,531	1364,3
Mwanza Geita	2010	0,361	0,396	110,8
Mwanza Geita	2005	0,329	0,691	127,8
Mwanza Kwimba	2010	0,224	0,434	85,4
Mwanza Kwimba	2005	0,433	0,768	98,6
Mwanza Magu	2010	0,355	0,497	143,1
Mwanza Magu	2005	0,469	0,730	165,1
Mwanza Sengerema	2010	0,529	0,358	158,4
Mwanza Sengerema	2005	0,306	0,670	182,8
Mwanza Ukerewe	2010	0,161	0,434	431,5
Mwanza Ukerewe	2005	0,104	0,690	497,8
Mwanza Misumgwi	2010	0,727	0,400	139,3
Mwanza Misumgwi	2005	0,690	0,757	160,7
Ruvuma Songea Urban Council	2005	0,901	0,745	351,7
Ruvuma Songea District Council	2005	0,901	0,745	4,9
Ruvuma Songea District Council	2010	0,812	0,417	5,7
Ruvuma Mbinga	2005	0,840	0,770	37,5
Ruvuma Mbinga	2010	0,721	0,424	43,3
Ruvuma Tunduru	2005	0,087	0,752	13,9
Ruvuma Tunduru	2010	0,181	0,520	16,1
Shinyanga Urban Council	2005	0,223	0,706	259,9
Shinyanga Urban Council	2010	0,003	0,490	299,9
Shinyanga District Council	2005	0,417	0,739	69,5
Shinyanga District Council	2010	0,439	0,401	80,2
Shinyanga Bariadi	2005	0,103	0,765	65,4
Shinyanga Bariadi	2010	0,082	0,568	75,4

Shinyanga Bukombe	2005	0,337	0,669	38,6
Shinyanga Bukombe	2010	0,270	0,251	44,5
Shinyanga Kahama	2005	0,652	0,635	66,6
Shinyanga Kahama	2010	0,308	0,354	76,8
Shinyanga Maswa	2005	0,145	0,758	117,8
Shinyanga Maswa	2010	0,080	0,512	135,9
Shinyanga Meatu	2005	0,170	0,742	29,6
Shinyanga Meatu	2010	0,145	0,479	34,2
Shinyanga Kishapu	2005	0,732	0,766	58,5
Shinyanga Kishapu	2010	0,491	0,387	67,4
Singida Urban Council	2005	0,863	0,721	185,1
Singida Urban Council	2010	0,678	0,418	213,5
Singida District Council	2005	0,807	0,825	34,9
Singida District Council	2010	0,375	0,531	40,2
Singida Iramba	2005	0,583	0,788	49,2
Singida Iramba	2010	0,678	0,423	56,8
Singida Manyoni	2005	0,868	0,693	7,6
Singida Manyoni	2010	0,433	0,355	8,7
Tabora Urban Council	2005	0,409	0,629	9,9
Tabora Urban Council	2010	0,485	0,406	11,4
Tabora Igunga	2005	0,686	0,692	50,6
Tabora Igunga	2010	0,497	0,301	58,3
Tabora Nzega	2005	0,405	0,691	63,2
Tabora Nzega	2010	0,469	0,297	72,9
Tabora Sikonge	2005	0,459	0,627	6,7
Tabora Sikonge	2010	0,337	0,266	7,7
Tabora Urambo	2005	0,495	0,643	18,4
Tabora Urambo	2010	0,372	0,342	21,2
Tanga Urban Council	2005	0,306	0,643	542,0
Tanga Urban Council	2010	0,221	0,475	625,3
Tanga Handeni	2005	0,721	0,724	43,1

Tanga Handeni	2010	0,564	0,338	49,7
Tanga Korogwe Urban Council	2005	0,713	0,691	73,4
Tanga Korogwe Urban Council	2010	0,704	0,444	84,6
Tanga Lushoto	2005	0,780	0,742	126,7
Tanga Lushoto	2010	0,750	0,402	146,1
Tanga Muheza	2005	0,563	0,758	61,2
Tanga Muheza	2010	0,629	0,490	70,6
Tanga Pangani	2005	0,193	0,797	45,6
Tanga Pangani	2010	0,313	0,642	52,6
Tanga Kilindi	2005	0,744	0,762	21,5
Tanga Kilindi	2010	0,871	0,419	24,8
Kagera Bukoba Urban Council	2005	0,004	0,777	1070,3
Kagera Bukoba Urban Council	2010	0,142	0,559	1234,8
Kagera Bukoba District Council	2005	0,637	0,741	53,6
Kagera Bukoba District Council	2010	0,747	0,572	61,9
Kagera Biharamulo	2005	0,512	0,745	42,9
Kagera Biharamulo	2010	0,023	0,455	49,5
Kagera Karagwe	2005	0,213	0,850	58,2
Kagera Karagwe	2010	0,183	0,628	67,2
Kagera Muleba	2005	0,466	0,751	38,0
Kagera Muleba	2010	0,810	0,515	43,8
Kagera Ngara	2005	0,496	0,821	80,0
Kagera Ngara	2010	0,315	0,461	92,3
Dar es Salaam Ilala Urban Council	2010	0,237	0,252	3201,4
Dar es Salaam Ilala Urban Council	2005	0,461	0,616	3693,3
Dar es Salaam Temeke Urban Council	2010	0,254	0,358	1248,0
Dar es Salaam Temeke Urban Council	2005	0,290	0,616	1439,7
Dar es Salaam Kinondoni Urban Council	2010	0,146	0,394	2161,4
Dar es Salaam Kinondoni Urban Council	2005	0,386	0,605	2493,5
Rukwa Sumbawanga Urban Council	2005	0,787	0,663	88,7
Rukwa Sumbawanga Urban Council	2010	0,006	0,452	102,3

Rukwa Sumbawanga District Council	2005	0,362	0,719	30,7
Rukwa Sumbawanga District Council	2010	0,628	0,367	35,4
Rukwa Nkansi	2005	0,158	0,736	16,7
Rukwa Nkansi	2010	0,102	0,403	19,3
Rukwa Mpanda	2005	0,476	0,640	9,1