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# Inequalities in Public Services in the Sudan

Using a perceptions-informed view to drive policy in education, health and water provision

**LSE Master of Public Administration (MPA) Capstone Report**
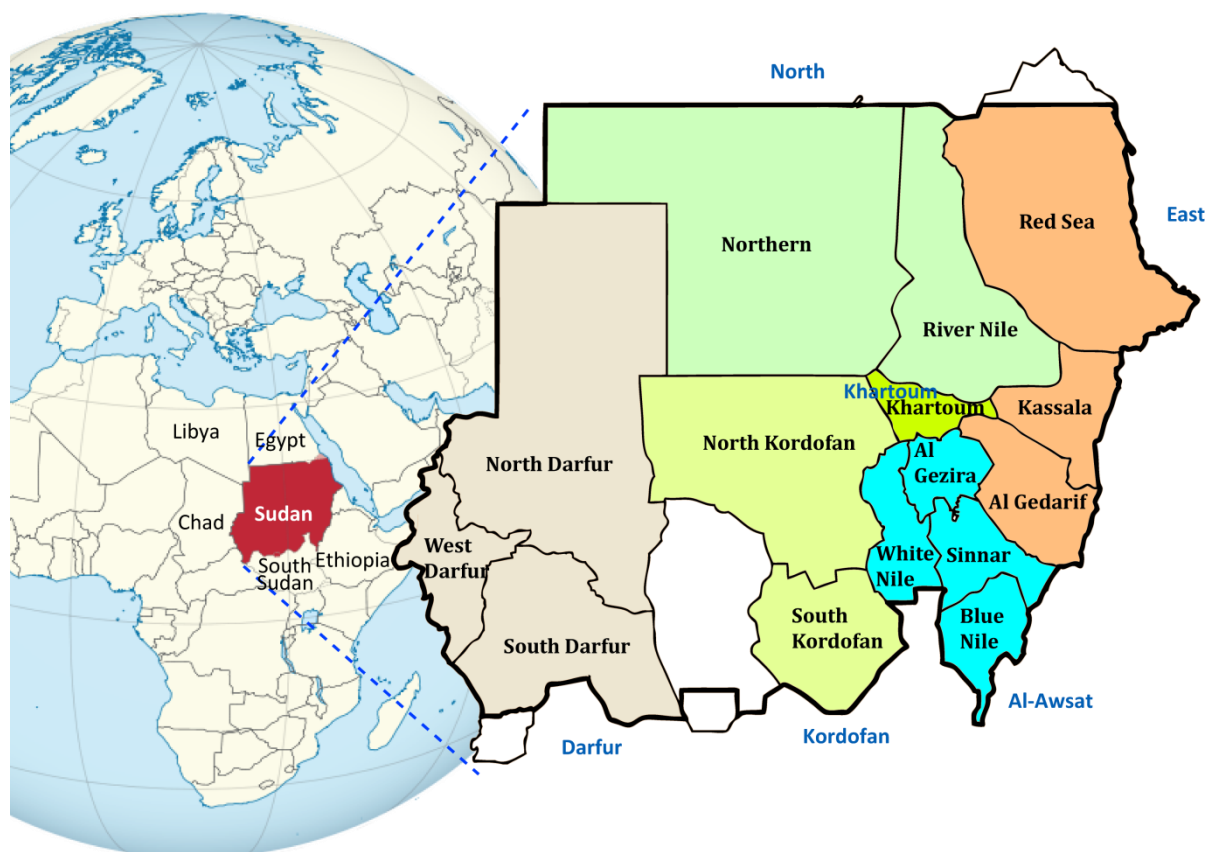
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## Map of Sudan



**Figure 1 - Map of Sudan.**

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The choropleth maps within this report were created using GIS data from the GADM spatial database and reflect data from March 2009. We were not able to access more recent data. As is clear from the map, this data does not reflect changes made to the boundaries of Sudanese states following 2005; specifically, West Kordofan was abolished in 2005 and incorporated into North and South Kordofan, but appears in our choropleth maps as a state. This area is shown in white, it can be assumed that the data for this area was collected and is captured within North and South Kordofan. With respect to Darfur, our GIS data reflects the borders when the region was comprised of three states: North, South, and West Darfur, and the DFID 2012 and 2013 household survey data also report responses in these terms.

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# Abbreviations

| | |
|---|---|
| AfDB | African Development Bank |
| DFID | Department for International Development |
| EFA | Explanatory Factor Analysis |
| FGC | Female Genital Cutting |
| FMoFNE | Federal Ministry of Finance and National Economy |
| LR | Likelihood Ratio |
| LSE | London School of Economics |
| MDGs | Millennium Development Goals |
| MoGE | Ministry of General Education |
| NGO | Non-governmental Organisation |
| OLS | Ordinary Least Square |
| PHC | Primary Health Care |
| SDG | Sudanese Pound |
| SEM | Structural Equation Modelling |
| SMoE | State Ministry of Education |
| SMoF | State Ministry of Finance |
| SMoH | State Ministry of Health |
| SPSC | Sudan Polling Statistics Centre |
| WAS | Water and Sanitation |

# Executive Summary

1. This report provides one of the first detailed analyses of comprehensive and representative survey data on perceptions of public services and trust in public institutions in Sudan. Our analysis provides a foundation for evidence-based policymaking for DFID and other policymakers in Sudan.

2. We highlight the importance of considering perceptions and trust in the conflict-context and based on our analysis argue that a balanced view incorporating both provision and perceptions of public services should be considered when devising policy.

3. In Sudan, both horizontal (that is group-based) and vertical (at the individual-level) inequalities have persisted in public services. Based on our examination of the determinants of perceptions of service quality, including socioeconomic and demographic variables and levels of actual provision, we find that cross-cutting horizontal and vertical inequalities drive variation in perceptions of public service quality in education, health and WAS.

4. By developing a theoretical model of the determinants of perceptions, we highlight the role of trust as a measure of individuals' predisposition towards government and service providers. This model, in which trust factors are hypothesised to "mediate" the effects of people's socioeconomic and demographic factors on their perception of service quality, is based on discussion of the relevant literature as well as intensive descriptive data analysis. Using the DFID survey data, we develop two latent trust variables to serve as these "mediators".

5. Results from our regression analyses testing this model indicate that it is well supported by the data; namely, as hypothesised, gender, education and geographic inequalities measured by the rural-urban dynamic influence perceptions through our trust mediator. These results are found across all three sectors.

6. Given the importance of actual service provision in our model, we conduct regression analyses incorporating provision data, which is only available at the state level. Results of the state level regressions reveal more nuanced findings across the three sectors. For instance, higher education spending is negatively associated with perceptions of school quality, holding all other variables constant, whereas we find a positive association between perceptions of public hospitals and higher treatment of diseases. These results suggest that better outcomes (by way of service provision), as opposed to access, are more likely to increase perceptions of quality. Horizontal and vertical inequalities found to be significant at the state level include geographical inequality, now measured by the centre-periphery dynamic, and education.

7. Our results motivate us to propose two new indicators that will better measure and address inequalities in perceptions of public service provision: (1) the average perception of service quality for specific groups of interest, primarily those identified as having unequal access; (2) the ratio of the average perceptions of service quality for the group identified as having unequal access and its relevant counterpart. DFID would aim to increase the absolute value of indicator (1) to improve perceptions of provision, while also observing indicator (2) over time, with convergence to one indicating a reduction in the inequality. These would act as complementary indicators within DFID's Operational Plan.

# 1 Introduction

This report investigates the role of horizontal inequalities, including gender, rural-urban and centre-periphery, as well as vertical inequalities, including income, in the variation in perceptions of public service quality and in the actual provision of public services in Sudan.

Our focus stems from the fact that well-targeted public services[1] are essential to poverty alleviation strategies; it being clear that access to free or subsidised education, health and WAS services can go a long way towards improving individual welfare and enhancing economic growth via the contributions of a healthier[2] and more educated population[3]. We also focus on the effect of inequality in service provision. This is particularly important for the education, health and WAS sectors, where access and quality are often influenced by horizontal inequalities as a result of political manoeuvring. The politicised aspects of service delivery highlight the need for sensitive policy that does not "exasperate existing political tensions".[4]

In the conflict setting and in situations where inequality is historically embedded, the form that inequality takes and how this manifests is important, particularly for international aid policy. In Sudan, we see these inequalities in public services coming from variation in the level of provision, and variation in perceptions: differences in what people think about the quality of public services. Perceptions and the reality of service provision are both important for outcomes, as well as stability. With this in mind, we argue that due to the nature of horizontal and vertical inequalities in Sudan, a perceptions-informed view should drive policy, not one that relies solely on provision-based data.

This report investigates the role of inequalities by first developing a model of the determinants of perceptions of public service quality informed by theoretical and context-specific literature. This model, presented in Chapter 2, considers both horizontal and vertical inequalities and other relevant determinants of perceptions of public services, including additional socioeconomic and demographic indicators and trust in public institutions. Chapter 3 then investigates these determinants at the individual-level using DFID Sudan's 2013 household survey data, and, where relevant, 2012 household survey data, using regression analysis. Chapter 3 then addresses the role of actual provision in determining perceptions by incorporating provision data for each service into the regression models at the state-level. In Chapter 4, we discuss the limitations of both the survey data and our analysis, providing suggestions for further analysis. Finally, in Chapter 5 we use the results of our analyses to provide DFID Sudan with strategic and evidence-based policy recommendations that address inequalities in both perceptions and actual provision of education, health and WAS services.

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[1] These public services must be well-targeted to have the ultimate outcomes by way of poverty reduction. As a seminal report by the World Bank in 1999 indicated, those policies that are not well-targeted only enhance inequality by supporting those who are already 'better off' (Castro-Leal et. al, 1999).

[2] Psacharopoulos and Patrinos, 2004; Bloom et al., 2004.

[3] What's more, growth is expected to increase as the spatial concentration of industry decreases and infrastructural inequalities are reduced (Martin, 1999).

[4] DFID, 2010.

## 2 Developing a theoretical framework

In Chapter 2 we explore the potential determinants of perceptions of quality in public services, including horizontal and vertical inequalities, socioeconomic and demographic factors, and individuals' predisposition, focusing on trust.

We begin in sub-chapter 2.1 by exploring the background of horizontal and vertical inequalities in the Sudan and their persistence over the last century. Sub-chapter 2.2 considers what is being done to address these inequalities at the national and international level. We then continue, in sub-chapter 2.3, to outline the institutional structure of the three public services for which we investigate these inequalities and make initial observations about the divergence between perceptions and actual provision of these services. Sub-chapter 2.4 further explores the role of these cross-cutting inequalities in perceptions of public service quality, using the DFID household survey data. In sub-chapter 2.5 we identify individuals' predisposition as another key determinant of perceptions of public service quality and explore trust in public institutions as one of the key proxies of this predisposition. Sub-chapter 2.6 presents our theoretical framework, which incorporates inequalities and trust into a model of determinants of peoples' perceptions on public service quality.

### 2.1 Entrenched vertical and horizontal inequalities

Sudan suffers from widespread inequalities in its service provision on a number of dimensions. Firstly, we see the existence of state-based inequalities when we consider the share of the population living below the poverty line in each state (Figure 2). Nearly 70% of those living in Northern Darfur are seen to live below the poverty line compared to approximately 30% in Khartoum.
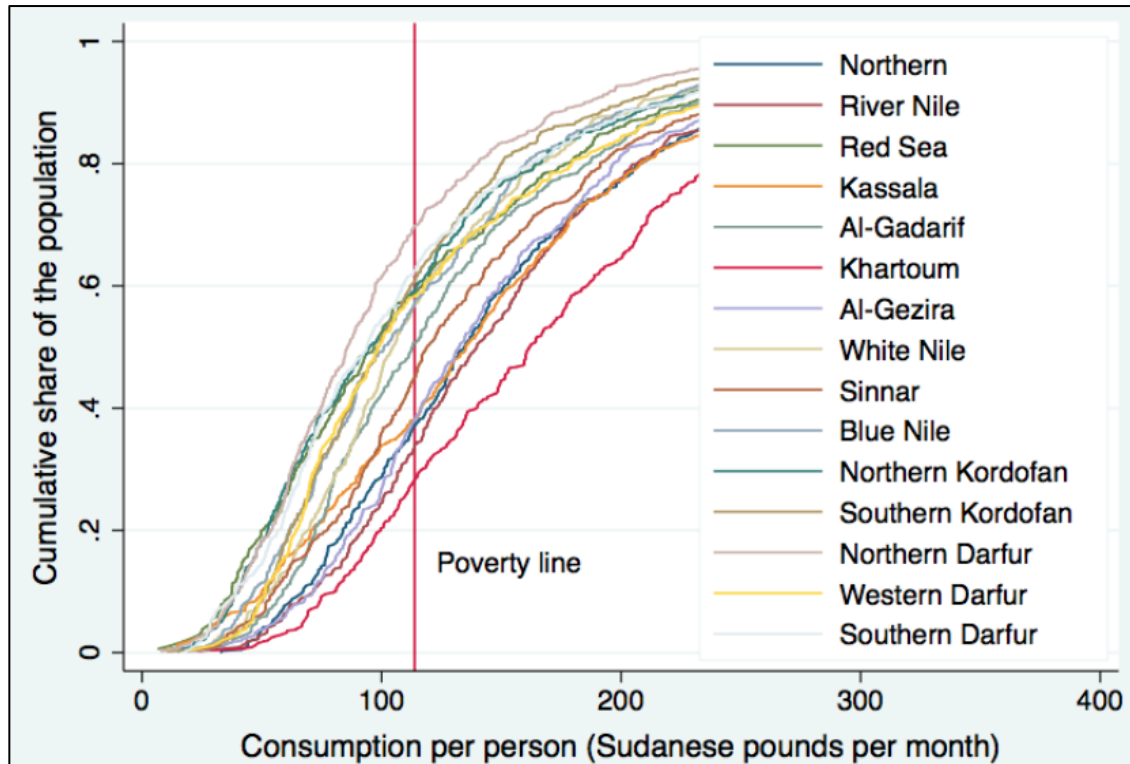


**Figure 2- Poverty Incidence, by state, based on consumption data.**
**Source: Castro (2010).**

This illustrates the existence of interacting vertical inequalities (by consumption) and horizontal inequalities (across states). We define horizontal inequalities as group level inequalities: these are not understood in individual terms ("vertical" inequalities) but are instead "conceived of as inherently multidimensional…encompass[ing] economic, social, cultural status and political dimensions".[5] In the case of Sudan, it is important to consider both vertical and horizontal inequalities since the latter take account of "political and social entitlements"[6] which are likely to play a significant role in the conflict setting. Indeed, studies have shown that rising horizontal inequalities increase the probability of conflict.[7]

Furthermore, both types of inequality can act as a barrier to economic growth since "inequitable institutions"[8] generate economic costs. At the same time, systematic inequalities are informed by institutional design; this design supports their progression and establishment. An entrenched course of peripheral subjugation coincided with elite empowerment in Khartoum and the Northern states in the early 1900s. Although the effect of these inequalities was often seen by comparison to the South of Sudan,[9] significant disparities also existed within the North. Those who benefited most during the Anglo-Egyptian rule were those in the central Nile valley,[10] with many outside of this region enduring economic neglect. These trends of peripheral marginalisation continued following independence, with the relationship between political neglect and civil war further highlighting the importance of equity in the system.

Though different processes of decentralisation have been enacted (see Appendix 2.2), it is evident that the system was often manipulated, allowing the 'use of grants by the national government in authoritarian ways'.[11] Thus, despite the devolution of powers to regional governments, it is contested as to whether the Islamist federalist structure[12] represents a genuine federal system, particularly in light of the level of responsibility given to regional and state governments.[13] These institutional and political forms of marginalisation emphasise the need for a dynamic view of inequality that enables a horizontal, as well as a vertical, perspective.

## 2.2 Identifying DFID's role in addressing public service inequality

In understanding DFID Sudan's role within this context, we are also interested in understanding the focus of the international development community in addressing inequality by way of public service provision; here, we see a significant focus on what has been termed "pro-poor" policies,[14] those that look to foster economic growth and simultaneously raise the income of the poor. The main purpose of these policies, particularly in fragile states, is "to reduce social exclusion and close horizontal inequalities".[15] As a result, coordinated international strategies have been undertaken which look to establish global goals associated with education, health and WAS[16]; these initiatives include the Millennium Development Goals (MDGs) and the Education

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[5] Brown and Langer, 2010.

[6] Stewart et. al, 2005.

[7] Brown and Langer, 2010.

[8] Nour, 2013.

[9] Throughout this paper we focus solely on the Republic of Sudan, the South having seceded in 2011.

[10] Johnson, 2003.

[11] Fegley, 2011

[12] This was officially established through the Revolutionary Command Council's Fourth Constitutional Decree in 1991 (Salih, et. al, 1995).

[13] El-Gaili, 2004.

[14] This "pro-poor" focus was highlighted in the 2004 World Bank Development Report, titled 'Making Basic Services Work for Poor People'.

[15] DFID, 2010. Horizontal inequalities first gained purchase following the work of Francis Stewart who theorised their relationship with ethnic conflict and socioeconomic dynamics (Brown and Langer, 2010).

[16] DFID's programmes in this area are running under the label "WASH", including Hygiene, which is not the focus of our report as we concentrate on public services only. However, these aspects are closely related to water and sanitation access. In this report, we specifically concentrate on water provision.

For All (EFA) targets.[17] In the case of WAS services, for example, Sudan is not on target to meet these goals. Amongst the most significant problems is the broad usage of unimproved drinking water[18] and the lack of sanitation. These have overlapping consequences for the health sector with "lack of safe drinking water and sanitation, compounded with poor hygiene practices, are among the leading causes of child mortality in Sudan".[19] More broadly, Sudan regularly falls behind its neighbours and other Middle-Eastern countries in terms of public service expenditure and accessibility (see Appendix 2.3).

DFID Sudan's current focus also prioritises service delivery, this being informed by its operational plan which, as one of its principal components, looks to tackle "unequal access to basic services".[20] Therein, it focuses primarily on improved access by way of education, health and clean water. DFID Sudan has paid particular attention to gender inequality.[21] In health, it has focused specifically on maternal and infant health, and malnutrition, particularly in the humanitarian context, with respect to women and children and in rural areas,[22] as well as implementing a large-scale programme focused on ending female genital cutting (FGC).[23] The results of DFID survey data collected on the subject of FGC can be found in Appendix 2.4. In line with its strategy, DFID Sudan has an opportunity to address inequality in public service provision via their programming. We recommend a view which promotes evidence-based policy by exploring the influence of inequalities within each of our public service areas, in terms of both provision and perceptions of quality, building to a view that gives credence to both dimensions.

## 2.3 Provision and perceptions in education, health and water provision

In this sub-chapter we outline the existing systems of provision for public services. We then discuss how people perceive the quality of these public services using the DFID household survey data. This analysis is driven by an understanding that:

> "It is perceptions as much as reality that is relevant to outcomes, both with respect to what differences actually are, as well how much group members mind about the differences".[24]

In exploring these perceptions, we highlight the similarities and differences between actual provision and perceptions, noting that perceptions are strongly correlated with, though not analogous to, the actuality of public service provision.[25] These differences are important for our proceeding analysis as we consider the other determinants of perceptions of public service quality and how inequalities inform these perceptions.

### Systems of provision

In accordance with Sudan's decentralised system, public service provision follows a devolved structure consisting of federal, state and local levels. The federal level is primarily responsible for policy, planning, coordination, the formation of international partnerships and the monitoring and evaluation of services. The state government's remit puts more detailed focus

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[17] UNDG, 2010.
[18] Improved sanitation facilities refers to those, in terms of MDG monitoring, which hygienically separate human excreta from human contact. An improved drinking-water source is defined as one which is, by its construction, protected from outside contamination, particularly with reference to faecal material.
[19] DFID 2013.
[20] DFID, 2013.
[21] DFID, 2012.
[22] DFID, 2012.
[23] DFID, 2013.
[24] Stewart, 2002.
[25] For more discussion of this relationship, see theory of sub-chapter 2.4.

on local programming and project development, whereas the local government is concerned with policy implementation and service delivery.

The governmental structure and public resource flow for education is shown in Figure 3 (corresponding diagrams for health and WAS can be found in Appendix 2.5). This structure is similar across the public services with some distinct differences, particularly in the WAS sector where outcomes are cross-cutting[26] and no specified ministry focuses on these services alone. For all services, the federal government provides transfers to state ministries, some earmarked for specific public services and some which are at the discretion of state government. In addition, states have their own income generation, through local taxes,[27] though the capacity of a specific state to raise finances in this way is dependent on a number of external factors. Fundamentally, many states rely on federal transfers and have limited state-level tax revenue to enhance education, health and WAS budgets.
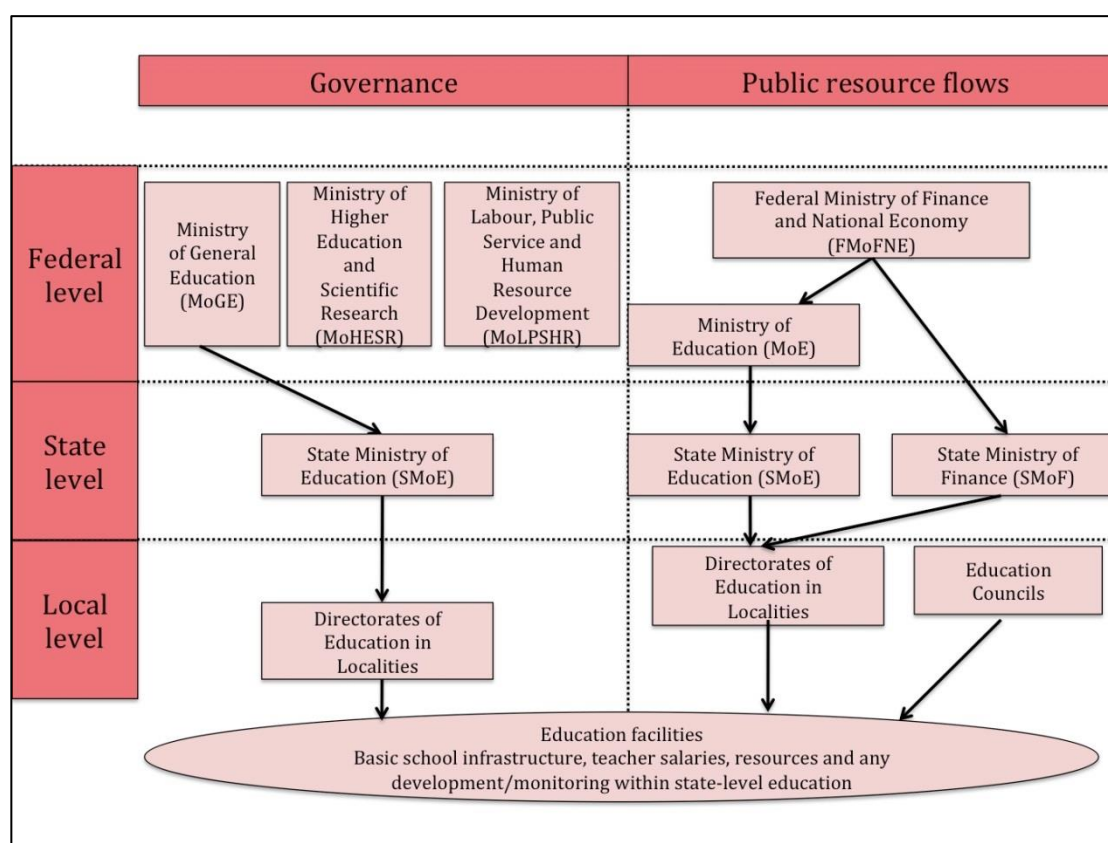


**Figure 3 - Structure of governance and public resource flows in the education sector.**
**Source: Authors of this report using World Bank (2012) and Ministry of General Education (2012).**

Some nuances in provision exist at the local level across the different service sectors. An interesting facet of the education system[28] is the existence of education councils, determined at the school-level and normally consisting of locally elected boards; at this level, additional funding is often provided by the local community to support resources, teacher accommodation and other aspects not afforded by governmental spending. In some locations, these education

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[26] WAS outcomes include health benefits from improved hygiene and non-health benefits from, for example, water supply for agriculture or reduced water collection time.

[27] These local taxes include income taxes, taxes on locally-manufactured products, income from investments, rents, licences and permits (Hamid, 2002).

[28] The system in the Sudan allows for thirteen years of education, including two years of pre-school, eight years of basic education and three years of secondary school. All of these are coordinated by the MoHESR. Beyond this, higher education and vocational education come under different federal agencies.

councils are more influential than the directorates of education in the localities.[29] Health relies on the primary health care (PHC) concept.[30] This PHC focus allows for health care services to be provided in a decentralised manner; the village level consists of PHC units that are the first level of health access for the community whereas secondary health care is accessed through rural hospitals and urban health centres at the town level. In the WAS sector, there is greater reliance on private companies to implement programming at the local level, as well as significant involvement by international organisations.

The decentralised structure of public services is often cited as contributing to several governance issues because it relies on limited local human resource capacity and is associated with significant financial leakages in the budgeting systems.[31] In education, the majority of the budget is spent on teacher's salaries, leaving little remaining for infrastructure, resources, training or monitoring.[32] In the health sector, current resource allocations are not sufficient to support the large human resource and material requirements demanded by the government's five-year strategy. The World Bank reflected, furthermore, that only 27 percent of total shares and locality expenditure reach the facility level, compared to the state and locality level claim of 45.4 percent.[33] Similar issues abound in the WAS sector, where de-facto governance has become increasingly problematic. Prior to 2002, local communities were likely to have access to a share of the WAS service fee, however, there is no longer a standard set of regulations to ensure appropriate distribution of this resource.[34] In addition, a lack of adequate system controls has meant that WAS outsourcing has led a significant increase in corruption.[35]

Inequalities in public services are widely institutionalised, this is illustrated by a diverse range in organisational capabilities at the state-level and often exacerbated by budgetary limitations. This goes some way to explaining the differences in state-level provision. These structural influences indicate the need for international organisations, such as DFID Sudan, to carefully consider the focus of their interventions.

## The relationship between provision and perceptions

Horizontal and vertical inequalities, as discussed in sub-chapter 2.1, can be illustrated using the 2013 DFID survey data.[36] This survey is discussed in sub-chapter 3.1. We also make use of data other than DFID survey data,[37] hereafter referred to as provision data, to act as provision indicators that provide proxies for the actual level of provision by way of quality and access (see Table 1).

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[29] For example, in Darfur, the under-capacity directorates in the localities are often bypassed meaning that education councils liaise directly with state ministries of education.

[30] Ministry of Health of the Sudan, 2007.

[31] Ministry of Health of the Sudan, 2007; World Bank, 2011.

[32] World Bank, 2012.

[33] World Bank, 2011.

[34] Zakieldeen, 2009.

[35] Beckedorf, 2011.

[36] Here we refer to a number of questions which asked respondents to consider their view on the quality of public schools, public hospitals and water, giving a rating between 1-10 (1 being the lowest quality and 10 the highest).

[37] Non-DFID survey data used for each public service is that which is we believe best reflects actual provision of the service. We use the most recent indicators, using sources and data according to reliability and justification.
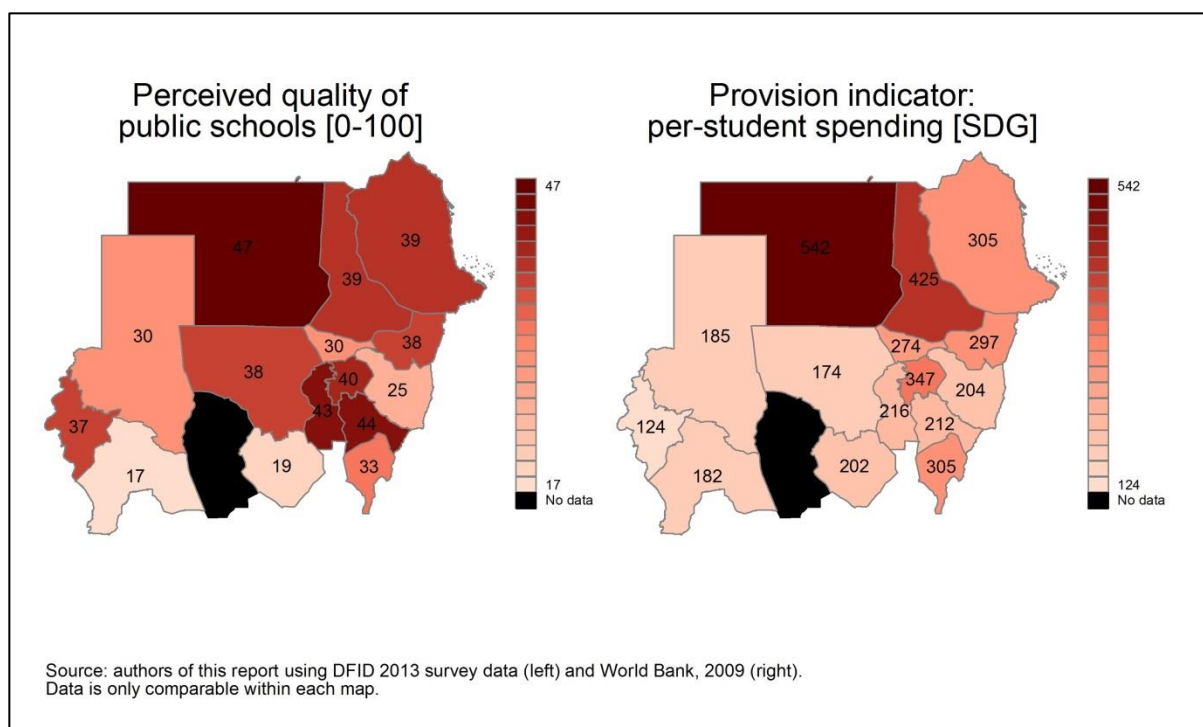
| | Indicator | Source | Additional explanation |
|---|---|---|---|
| **Education** | Student-teacher ratio in basic schools in the Sudan | World Bank 2012; Data based on FMoGE data from 2008-10 and on expert opinion of the WB Office. | Indicator used to proxy for the quality of education with the student-teacher ratio giving some indication of classroom conditions and support. |
| | Per student spending (basic school) in 2009 in Sudanese Pounds (SDG) | World Bank 2012; Data based on FMoGE data from 2008-10 and on expert opinion of the WB Office. | Indicator use to proxy for the quality of education with higher spending per pupil expected to enhance the quality of basic education delivered. |
| | Number of public schools per capita | World Bank 2012; Data based on FMoGE data from 2008-10 and on expert opinion of the WB Office. | Indicator used to proxy for access to education, with a higher number of public schools per capita corresponding to higher levels of accessibility. |
| **Health** | % of non-treated children with acute respiratory infections (ARI) | World Bank (2011b); WB staff own calculations using data of the Sudan Household Survey 2006 and other inputs. | ARI is recognised as a "major cause of morbidity and mortality in children worldwide" and the Sudan average indicates that 42.4 percent of those with an ARI did not access health services. By using this measure of actual provision we go some-way towards recognising those who do not access health services. |
| | % of non-immunised children | World Bank (2011b); WB staff own calculations using data of the Sudan Household Survey 2006 and other inputs. | Indicator used to proxy for access to health services by considering those who are not immunised, on average, at the state-level. |
| | Number of public hospitals per capita | World Bank (2011b); based on data from the Ministry of Health. | Indicator used to proxy for access to health services. It should be noted that access to public hospitals is relatively limited in Sudan, with only 364 public hospitals (World Bank, 2011). |
| | Number of health centres per capita | World Bank (2011b); based on data from the Ministry of Health. | Health centres are, according to the Ministry of Health, the first referral for lower-level facilities and meet the minimum requirements to be a Basic Health Unit, which is able to provide all PHC services. |
| **Water** | Perception of water accessibility | DFID Sudan household survey 2012. | The DFID Sudan survey 2012 asked a question on whether respondents had access to piped water. This indicator gives us direct information on access. |
| | Mean time to source of water | Federal Ministry of Health (2010); based on Sudan Household Health Survey. | The remaining three indicators used for the provision of water have been widely cited in publications on the topic, for instance in UNICEF (2012) or UN (2012). Although it is likely that there have been changes in the access to water over the past years, these changes are not expected to have been large, taking into account the relatively slow change of water and sanitation services. This indicator acts as a proxy for accessibility. |
| | % using improved water sources | Federal Ministry of Health (2010); based on Sudan Household Health Survey. | An improved drinking-water source is defined as one which is, by its construction, protected from outside contamination, particularly with reference to faecal material. It can refer both to village wide access as well as to individual access. This indicator proxies for quality of water provision. |
| | % using water on premises | Federal Ministry of Health (2010); based on Sudan Household Health Survey. | This indicator is likely to proxy for access, however, we may also infer that water access on someone's premises is also, generally, of a higher quality. |

**Table 1 – Provision data, used as indicators, by way of access and quality.**
**Source: Authors of this report using indicators from relevant sources.**

As a first view of how these inequalities play out, we show graphically how perception of the quality of public services and actual provision vary across states. Figure 4[38] shows a graphical representation, by state, of the differences in the perceptions on the quality of public schools and the average spending per pupil. We see higher funding levels and relatively higher perceptions for the quality of education in the Northern, River Nile and Red Sea states. Interestingly, in some states, Sinnar and White Nile for example, we see relatively lower levels of spending per pupil, 212 SDG and 216 SDG respectively, though the perception of the quality of public schools remains comparably higher (around 40/100).[39] Two major outliers are North Kordofan and West Darfur where there are relatively higher perceptions of the quality of public schools (around 40/100) despite relatively lower funding per student, 174 SDG and 124 SDG respectively. More generally, conflict-affected states have the lowest spending per pupil and relatively lower perceptions for the quality of public schools.

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[38] The DFID Sudan survey data contains results for 15 states. This is despite the fact that by 2013, when the data was collected, the Darfur region had been divided into 5 states. Please see page 2 for the predominant map used throughout the report.

[39] The public service ratings used in the remainder of this report, including for the analysis in Chapter 3, rely on a normalised construction from 1-100 (translated from the 1-5 ratings scale used in the questionnaire). They are used in this way throughout all analyses except for the cluster analysis results in sub-chapter 2.5.

Source: authors of this report using DFID 2013 survey data (left) and World Bank, 2009 (right).
Data is only comparable within each map.

**Figure 4 - Perceived quality of public schools and provision indicator measured by spending per student (state mean).**

These initial trends suggest that some measure of the provision of public services, here measured by spending per pupil, affects perceptions, though the two are not analogous. We see a similar effect with respect to health provision, see Figure 5. The Al-Awsat states have relatively high ratings for the quality of public hospitals though they do not have similarly high relative provision of health services in terms of health centres. This is also true of the Darfur states, where the perception of the quality of public hospitals is relatively high in comparison to the actual provision of health centres. Here, we make the assumption that there is likely to be some positive relationship between the quality of public hospitals and the quality of local health centres.
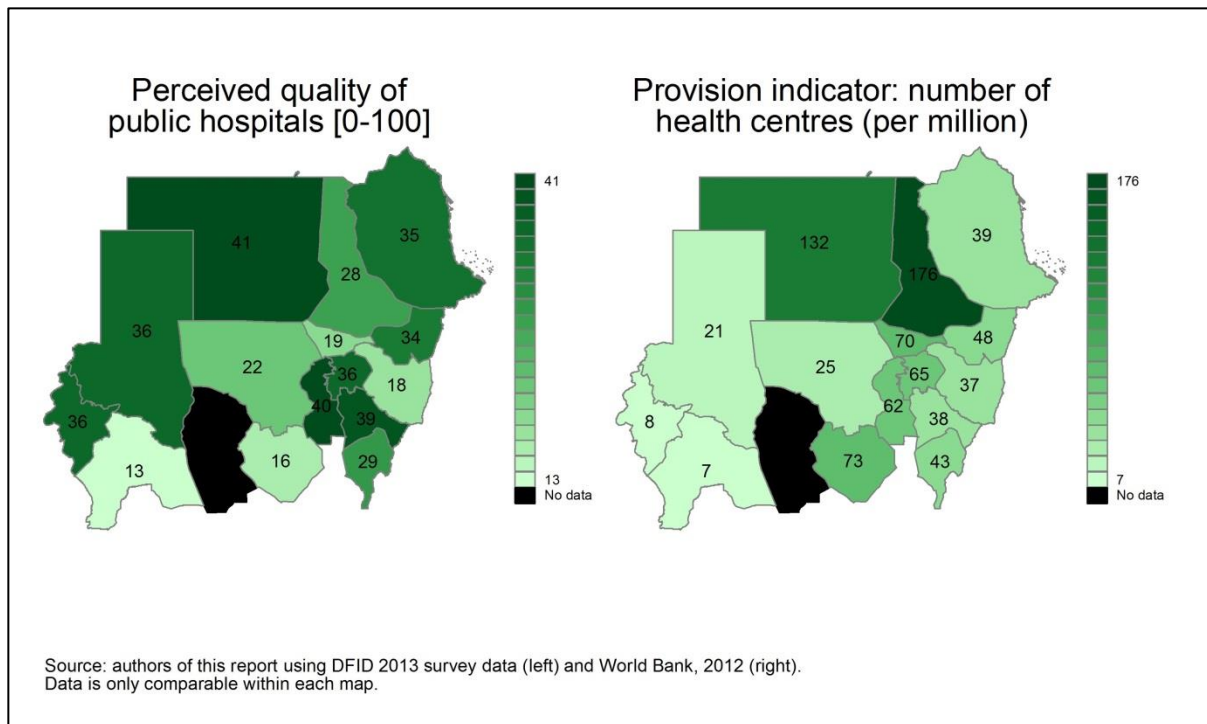
**Figure 5 - Perceived quality of public hospitals and provision indicator measured by number of health centres per million residents (state mean).**

Data from the 2012 and 2013 DFID Sudan household surveys[40] also support this trend with respect to water. As shown in Figure 6, accessibility to improved drinking water differs significantly between states, with Khartoum, River Nile, Northern State, Al-Gezira and Sinnar providing nearly universal access, all having over 90 percent accessibility, whereas in conflict-affected states, such as South Darfur and South Kordofan, fewer than one third of respondents they have access to drinking water. Again, we note a disparity between the perception of quality and the reality of provision, particularly in the Eastern states where water is perceived to be accessible but has correspondingly low perceptions by way of quality. In general, the Sudan lies below the Sub-Saharan African average of WAS service accessibility (see Appendix 2.6).

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[40] The actual provision data for water supply stems from the 2012 DFID Sudan household survey, where respondents were asked if they had access to piped water in their house.
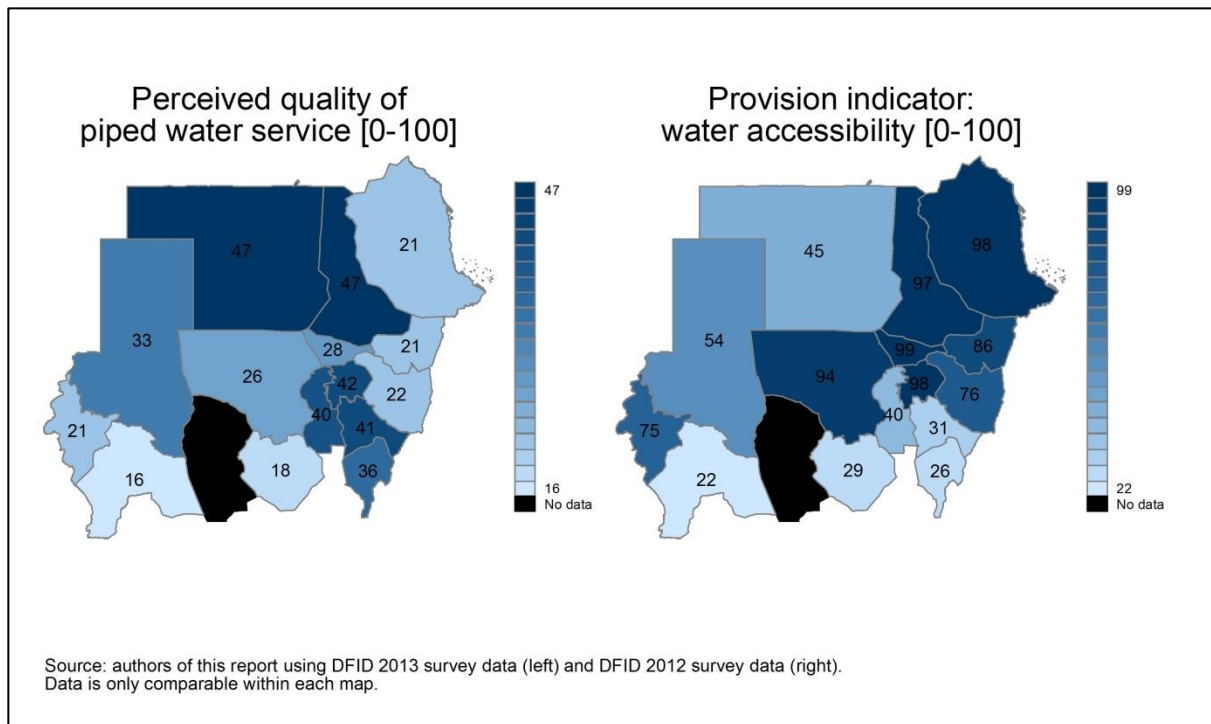
**Figure 6 - Perceived quality of piped water service and provision indicator measured as provision of water service (state mean).**

To further investigate these findings in each of the service areas, we consider scatter plots using the provision indicators and the perceptions of quality of each service. For education (Figure 7), we consider the relationship between the average perception of the quality of public schools for each state alongside the student-teacher ratio; this shows a negative relationship, as per the trend line[41]. The main outlier appears to be West Darfur, having a student-teacher ratio of over 60 students per teacher but with an average perception indicator of 2.5 out of 4. West Darfur also exhibits relatively higher completion rates for basic education,[42] which may be a factor in producing this result. These findings suggest that a lower student-teacher ratio is positively correlated with better perceptions of public schools, though we will need to further examine the mechanism that determines this relationship in more detail.

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[41] Trend lines were added by excluding obvious outliers, in the case of education, West Darfur was excluded.
[42] World Bank, 2012
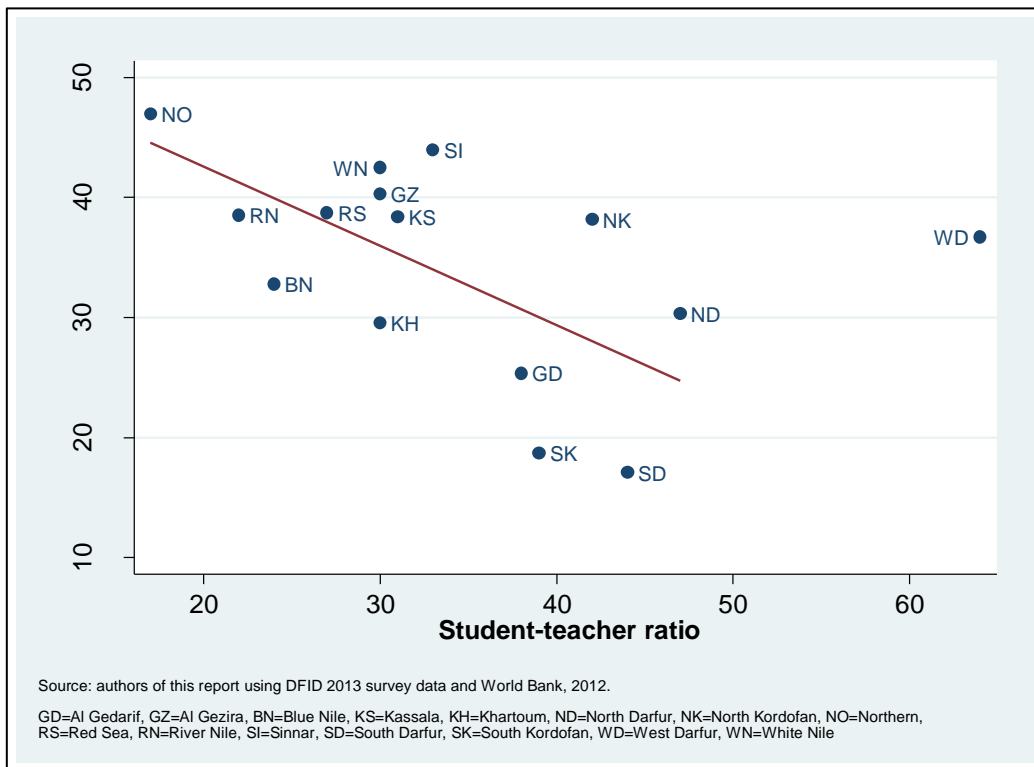
**Figure 7 - Perception of public school quality versus student-teacher ratio (state mean).**

We find similar trends using different provision indicators for health and WAS provision (see Figures 7-8), particularly with respect to conflict-affected states where both provision and perceptions tend to be lower. Khartoum is also an outlier in both cases: accessibility being markedly higher than in other states but perceptions of the service quality low in relative terms. More generally, these correlations between provision data and perceptions of quality infer that the higher the accessibility or quality of a service, the higher the perception of that service is likely to be. As with education, the mechanisms supporting these trends will need to be examined in more detail in Chapter 3.

Source: authors of this report using DFID 2013 survey data and World Bank, 2011.

GD=Al Gedarif, GZ=Al Gezira, BN=Blue Nile, KS=Kassala, KH=Khartoum, ND=North Darfur, NK=North Kordofan, NO=Northern, RS=Red Sea, RN=River Nile, SI=Sinnar, SD=South Darfur, SK=South Kordofan, WD=West Darfur, WN=White Nile
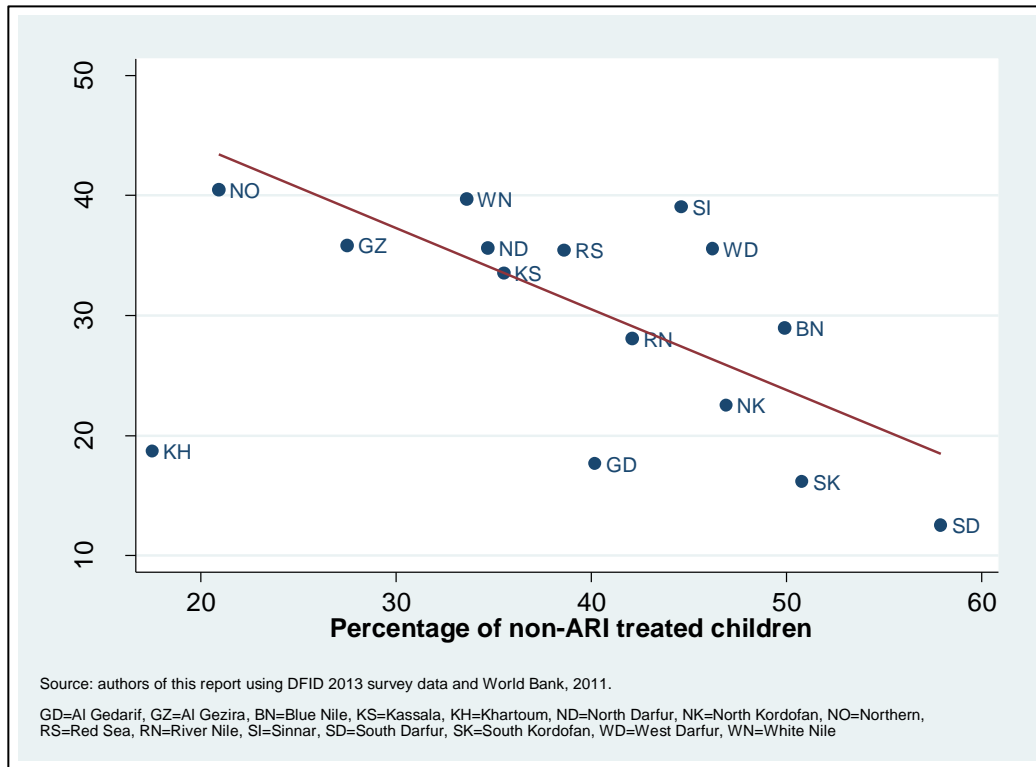
**Figure 8 - Perception of public hospital quality versus non-ARI treated children (state mean).**



Source: authors of this report using DFID 2013 survey data and Federal Ministry of Health, 2010.

GD=Al Gedarif, GZ=Al Gezira, BN=Blue Nile, KS=Kassala, KH=Khartoum, ND=North Darfur, NK=North Kordofan, NO=Northern, RS=Red Sea, RN=River Nile, SI=Sinnar, SD=South Darfur, SK=South Kordofan, WD=West Darfur, WN=White Nile
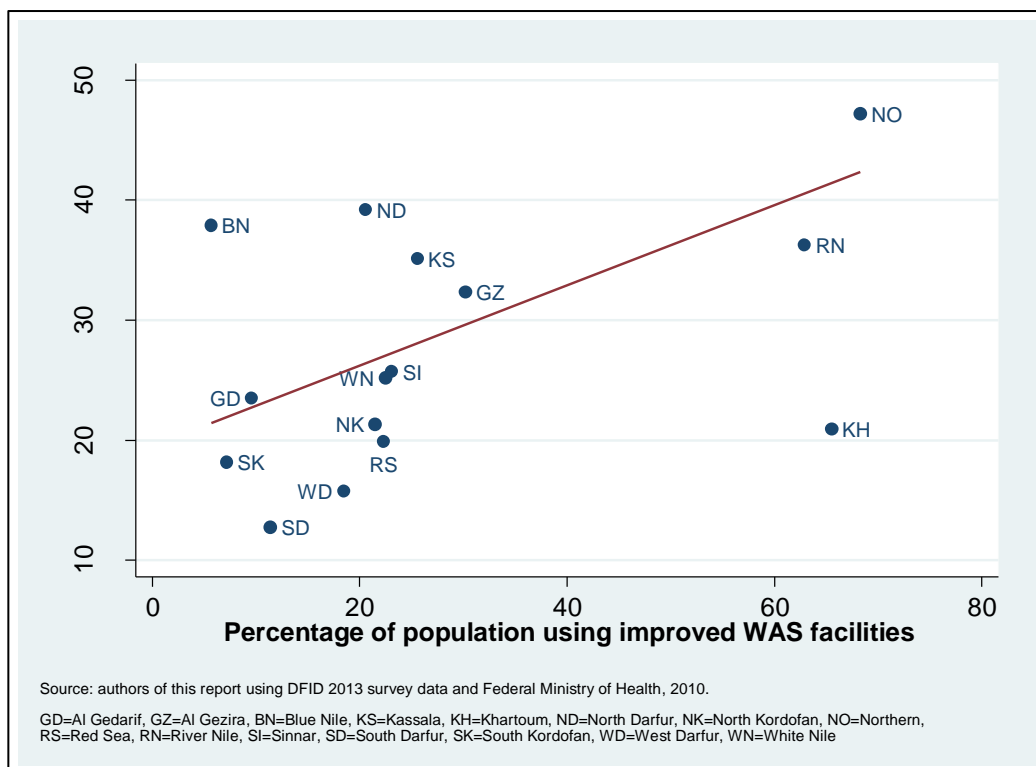
**Figure 9 - Perception of water service quality versus service accessibility (state mean).**

We now reflect in more detail on the dimensions of horizontal and vertical inequality found in education, health and WAS services. Our findings thus far raise several issues, namely:

why is it that perceptions often diverge from actual provision? In order to answer this question, we need to have a clearer understanding of how inequalities are influencing perceptions of public service provision and what other determinants exist.

## 2.4 Cross-cutting inequalities as a determinant of perceptions of service quality

In examining each of these service areas: education, health and WAS, we noted distinct geographical variation in perceptions and our provision indicators. We now explore how this geographical variation, as well as a number of other interacting horizontal and vertical inequalities, differ by way of perceptions of quality for each public service.

### Horizontal inequalities: Centre-periphery, rural-urban and gender

One of the most significant inequalities seen in the prior analysis is a geographical difference in both provision and perceptions. This partly represents the centre-periphery dynamic where power, the elite and wealth are concentrated in Khartoum and the Northern states of Sudan.

The neglect of the periphery by the central government in Khartoum has often dictated prospects for development, both economic and social. Consecutive Sudanese governments have done little by way of remedying the processes of centralisation established in the colonial period:

> "the exploitative nature of the central state towards its rich…the coercive power of the army in economic as well as political matters, the prerogative of the leader in redistributing revenues to the peripheries, the ambiguous status of persons who are not fully part of central heritage".[43]

In order to capture this effect in our data, we create a binary variable, based on the proportion of the population in each state below the poverty line. We define the centre as being comprised of states that have less than 40 percent of the population below the poverty line and the periphery as states where greater than 40 percent of the population are over the poverty line.[44] Though this classification is derived from a vertical inequality in consumption, it is also verified by extensive context-informed literature and qualitative research by way of interviews with experts on Sudan.[45]

Figure 10 shows the different ratings given for perceptions in the quality of public services for each of public schools, public hospitals and water from the DFID household survey data by the centre-periphery variable. Here, we see that this horizontal inequality, where groups are defined by their state, results in significant differences in the average perception of service quality. Those at the periphery have significantly lower scores across all of the services compared to those at the centre. This is particularly pronounced for water provision.

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[43] Johnson, 2003.

[44] The Centre-Periphery dummy variable is comprised of centre, defined as Khartoum, River Nile, Northern state, Kassala and Al-Gezira; the periphery is comprised of the remaining states included in the sample.

[45] These interviews took place over the course of February and March 2014 and are detailed in Appendix 2.2

Source: authors of this report using DFID 2013 survey data.
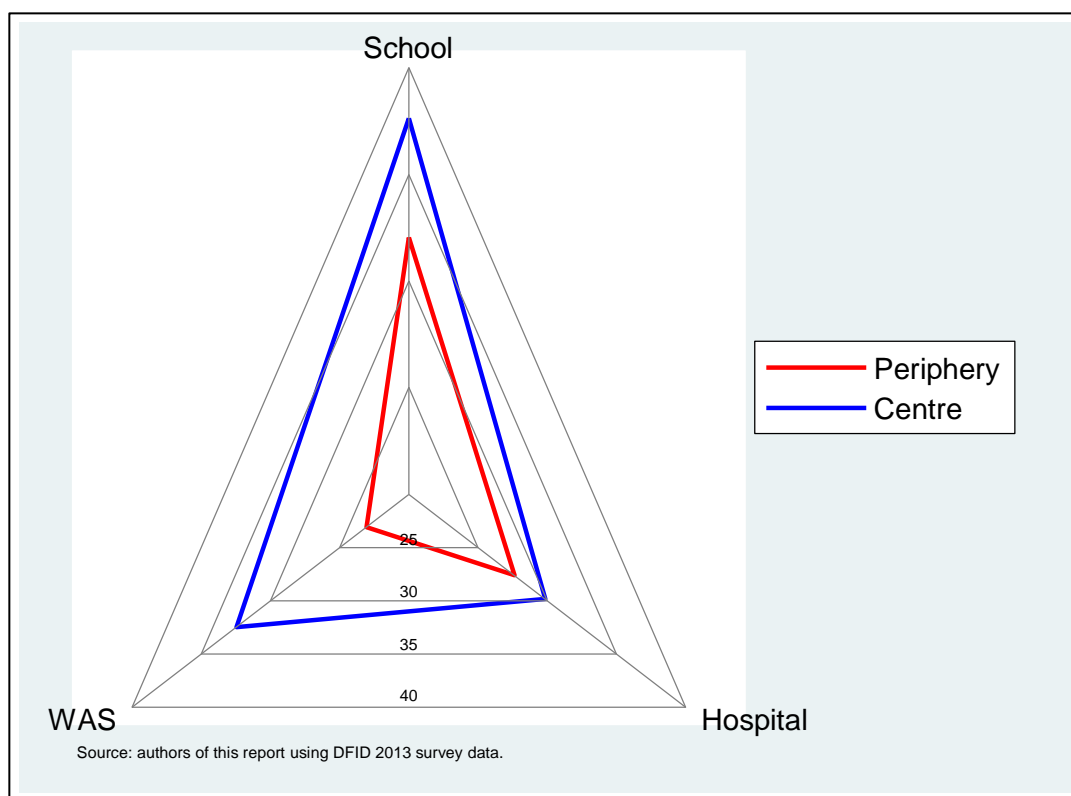
**Figure 10 - Perception of service quality by centre-periphery (mean values).[46]**

This geographical variation also captures, to an extent, ethnic and identity-based variation and variation in the degree to which citizens are affected by conflict. Sudan's high level of ethnic and identity-based diversity, with "Arabs and non-Arabs, Muslims and non-Muslims, city dwellers, nomads and sedentary farmers" [47] also represents specific geographical concentrations. As such, what we capture by way of state-based inequality will be intrinsically linked to ethnicity and different forms of identity across Sudan. Similarly, conflict is also aligned to geography. Politically, Sudan has been plagued by instability with a succession of civil wars, with the marginalisation of peripheral regions of the country exacerbating tensions. As such, though the country is classified by the World Bank as a lower middle-income country,[48] Sudan paradoxically falls 171st out of 186 countries in the 2013 Human Development Index (HDI). The relationship then, between conflict and horizontal inequalities, is also in some ways examined by an exploration of geographical marginalisation. To some extent, horizontal inequalities, by way of centre-periphery, will proxy for identity and conflict.

Another important form of geographical inequality is by way of the rural-urban divide, defined in our data set to distinguish state capitals from the rest of Sudan. Figure 11 shows the rural-urban distinction for each of the service areas. We note, again, distinct differences in the perception of service quality based on this definition, though here lower perceptions are associated with urban areas, perhaps representing more interaction with government agencies, and thus higher expectations of state provision. This finding is much less marked for schools in comparison to public hospitals and water suggesting that perceptions of the quality of education are not seen to differ so significantly in the rural setting.

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[46] This triangle represents the normalised average score for service provision, the lower scores located at the centre and the higher scores coming out to each side of the triangle. Each point of the triangle shows the average result for one of the three public services, with the coloured lines therein representing some form of inequality we examine (in this case, the centre-periphery dynamic).

[47] Ryle/Willis, 2011.

[48] World Bank, 2012.
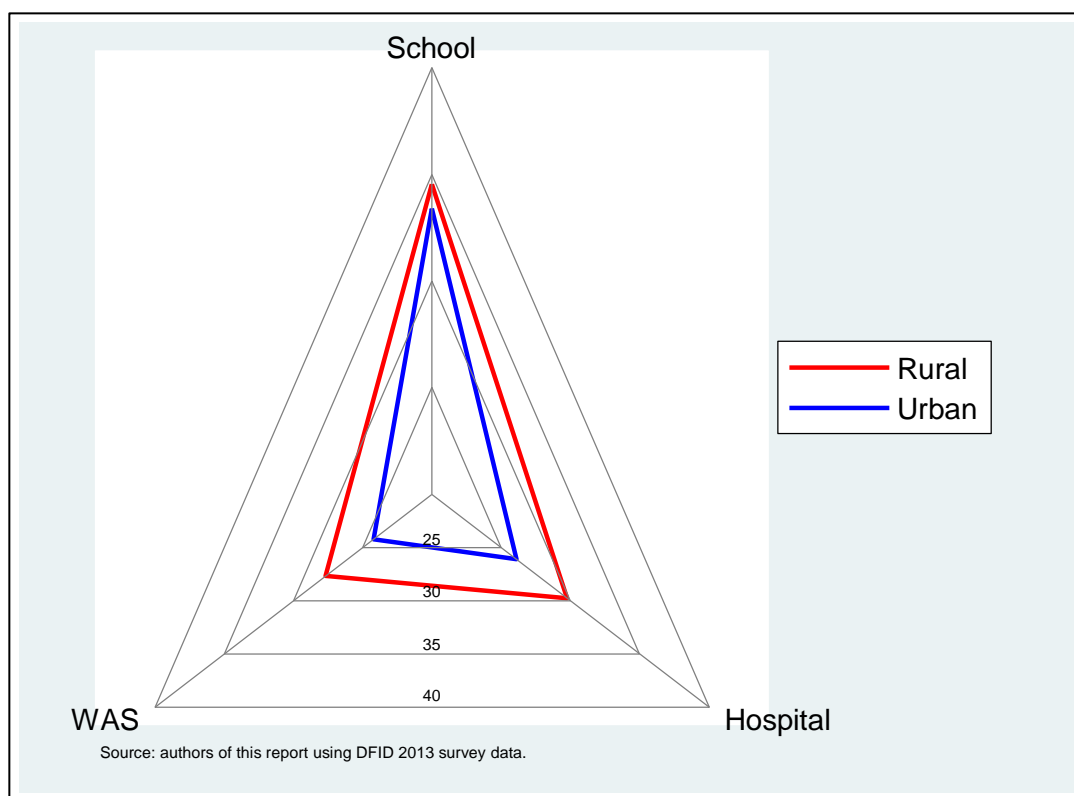
**Figure 11 - Perception of service quality by rural-urban (mean values).**

These centre-periphery and rural-urban dynamics are also inextricably linked to gender. Figure 12 shows average perceptions of quality for men and women. This shows us that, on average, women tend to perceive the public services examined more favourably than men. These differences across gender are relatively minimal, especially for public schools and hospitals and particularly compared to the more stark differences exhibited by the centre-periphery and rural-urban inequalities.
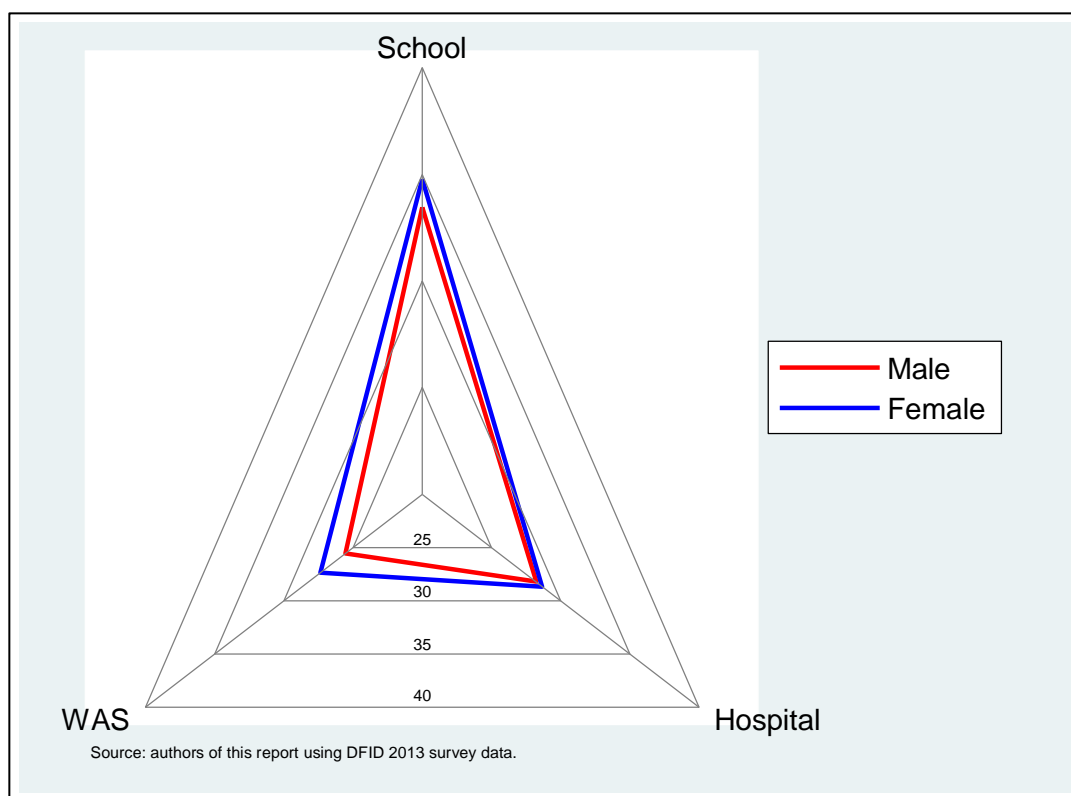
**Figure 12 - Perception of service quality by gender (mean values).**

The seeming lack of substantive difference between the perceptions of men and women could be driven by the different experiences of women depending on whether they are part of the urban educated elite or the 'grassroots' poor. As discussed by Tonnessen, it is the urban and educated elite who have led the debate on women's rights in the Sudan.[49] Further research has also shown that women in rural regions of the country often feel that their views and priorities are under-represented in Khartoum.[50] This is likely to be reflected by the differences in perception between women outside of Khartoum or other urban centres, rather than the gender divide in isolation.

Furthermore, understanding the role of gender in Sudan relies on recognising the goals and ideologies of female activists and of gender divides therein. There are two competing factions focused on women's rights in Sudan. Some women activists demand gender equality (musawah),[51] while many female legislators demand gender equity (insaf). Currently, the dominant gender ideology represented in the National Parliament is the one advocated by the ruling party: an Islamist ideology emphasising principles of equity rather than equality. Both sides frame their argument around Islam only through different interpretations of the religious texts.

Taking this into account, the argument that women have the same interests simply because they are women does not represent the politically polarised or geographically sensitive environment in which women's rights are discussed. It is also essential that the role of women is not viewed in isolation since we have identified that gender effects are likely to interact with other horizontal, and as we will see, vertical, inequalities.

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[49] Tonnessen, 2011.

[50] Tonnessen/Kjostvedt, 2010.

[51] The liberal position is that there is no contradiction between Islam and gender equality. The conservative position rejects equality in family law and upholds that gender equality is neither necessary nor desirable.

## Vertical inequalities: Income and education

A predominant vertical inequality influencing perceptions of quality is likely to be income. Nafziger discusses the effects of income inequality in contributing to emergencies and also considers the interaction between emergencies, war and state-violence, and large-scale expenditure on military resources, all relevant factors in Sudan. In this sense, we see income inequality as being strongly linked to different forms of identification, war and political elites. Control over resource at the federal level plays a significant role in establishing and reinforcing income inequality: "class rules primarily by its means of production over the state"'.[52] As such, states which are seen to support the government are rewarded by way of financing from the centre. This is not to say that income inequality exists on a purely geographical basis: there is likely to be wide variation in income within states, often exasperated by remittances.

Figure 13 shows the differences in perceptions of quality by different income brackets (Low-income = 100-500 SDG, Mid-income = 500-1,000 SDG, and High-income = more than 1,000 SDG of monthly household income). Interestingly, there seems to be very little difference in average perceptions in quality between the mid-income and high-income groups for any service. However, for the low-income group we see significantly lower perceptions in public schools and water, though not for public hospitals where the average across all income groups appears relatively consistent.



Source: authors of this report using DFID 2013 survey data.
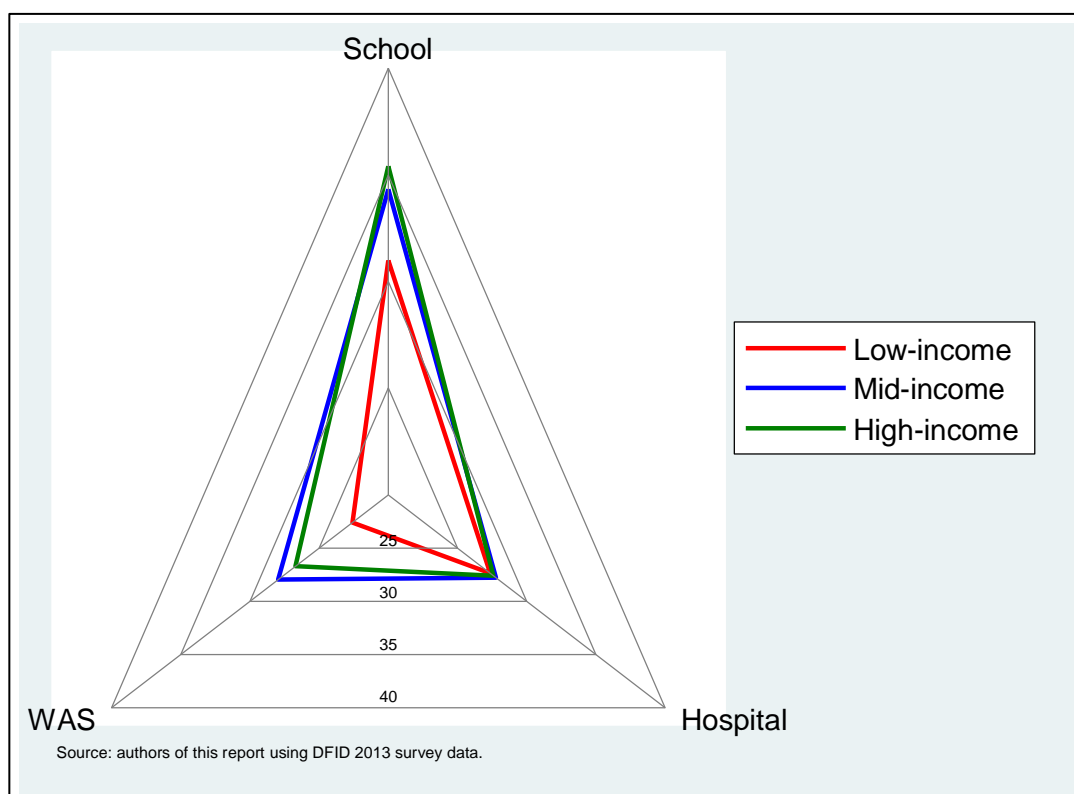
**Figure 13 - Perception of service quality by income (mean values).**

Income inequality is strongly linked to inequality across service provision.[53] We see this as being particularly pertinent in terms of health provision, thus it is surprising there is such limited variation in perceptions by income groups for public hospitals. With the rapid expansion of the private health sector within Sudan in recent years[54] a significant number of hospitals are

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[52] Nafziger, 1988
[53] Wagstaff and Doorlaer, 2000; Park, 1996.
[54] Badr, 2010.

now private, over 40 percent of all hospitals in Sudan. We might speculate that due to the low number of hospitals nationwide and limited experience of public hospitals by wealthy individuals (who are more likely to access private hospitals), there is convergence of perceptions with respect to income. The effects of privatisation in health have also placed further emphasis on rural-urban divides in health provision since many private hospitals are concentrated in the urban centres. Similarly, there has been a proliferation of private schooling in Khartoum, though the spread to urban localities outside of the capital has been more limited. What's more, these issues are confounded by the limited engagement between the private and public sector.[55] This is representative of how income disparities can play out on a wider scale with higher income groups accessing private services and thus reducing demand for the access and quality of public services.

At the micro-level, income also has a specific role to play with respect to access and quality of public services: medicine is costly, additional resources are often required at the school level and there are strong links between higher levels of education (as correlated with income) and better WAS practices. Each of these aspects of provision require access to finance at the household level.

As with centre-periphery dynamics, there are significant links between these income categories and different forms of national and ethnic identity in Sudan. For example, Nomadic communities and pastoralist communities are likely to have significantly lower income levels.[56] The representation of these communities within our data is discussed in Chapter 4.

Figure 14 shows the influence of different levels of education on perceptions of service quality across the sectors. This may provide some explanation for the seemingly insignificant role of income in determining variation in perceptions of public hospitals, especially since our income categories are likely to be more or less salient in different state-contexts whereas this measure of education is outcome based. Here we see individuals with higher levels of education having, on average, correspondingly lower perceptions of quality.

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[55] International Health Partnership, 2013.
[56] Dyson-Hudson, 1980.
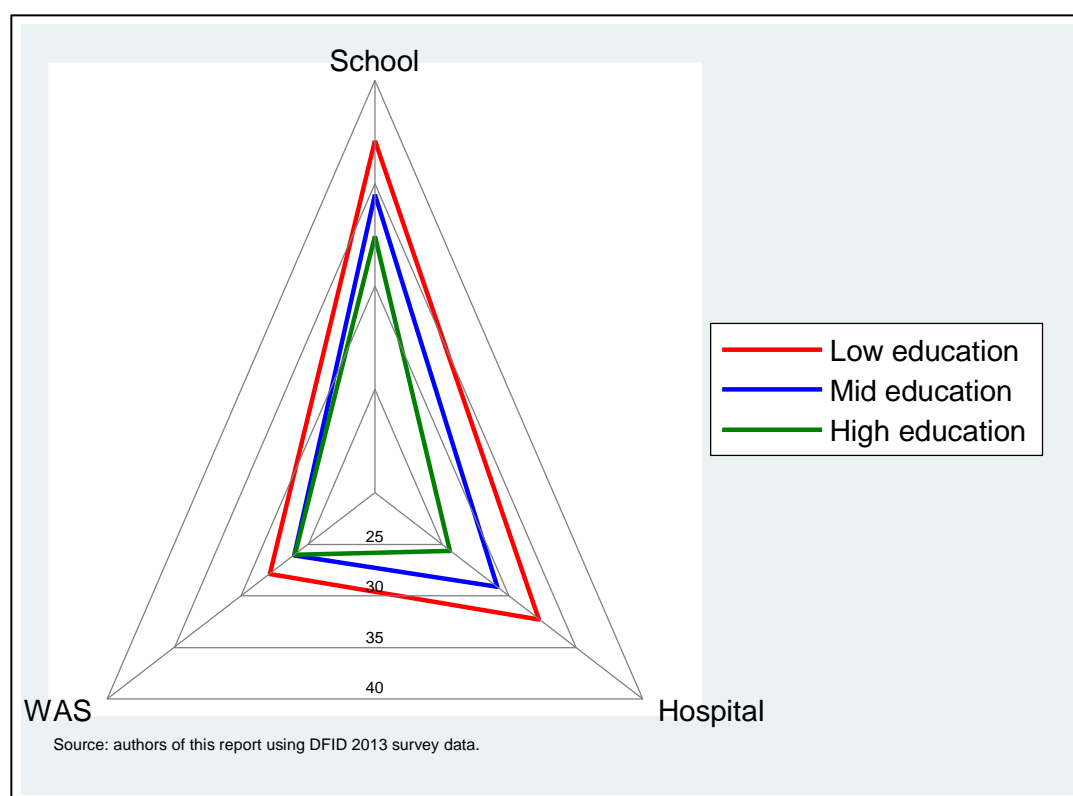
**Figure 14 - Perception of service quality by respondents' level of education (mean values).**


## Interacting horizontal and vertical inequalities

Essentially, as we have seen in our descriptive analysis, geographical disparities, income-inequality and gender are inherently linked. As such, it is also important to gain some view on the prism of these cross-cutting inequalities.

In Figure 15 we see the income distribution, by gender, for both the centre and the periphery. Though we see relatively little difference in the gender split across the centre-periphery or by income bracket, we do see distinct differences in the proportion of people in the low-income bracket at the periphery, 60 percent of men compared to only 24 percent of men at the centre. This chart emphasises the interactions between these different inequalities and highlights the need to identify the predominant influences of perceptions of service quality in determining the most valid policy recommendations.
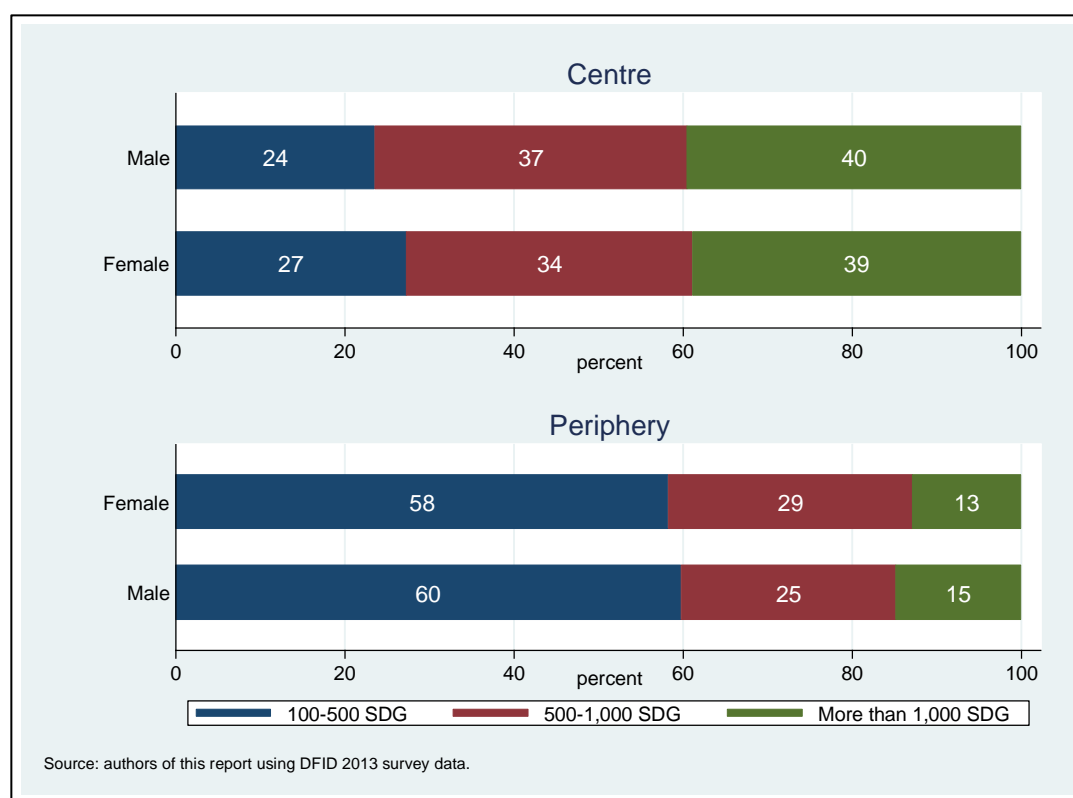
**Figure 15 - Monthly household income by gender and centre-periphery.**

## 2.5 Trust as a determinant of perceptions of service quality

Having discussed the most significant influences of our horizontal and vertical inequalities on perceptions of public service quality, as well as the influence of measures of provision, we must now focus on other potential determinants of these perceptions. We have already shown that there are observable relationships between indicators of provision and people's perceptions but it is clear that these are not analogous. Variation is also induced by horizontal inequalities; what's more, there may be less tangible influences. One of these, apparent in the literature, infers that some latent view of trust in government may influence someone's perception of service provision.

In a recent study, Kampen et al. have postulated that citizens' trust in government could represent a meaningful proxy of a positive or negative predisposition that biases ratings of service quality.[57] While trust in government is a complex construct in itself, scholars posit that it develops over a longer period, and is closely linked to the belief system of a person in a broader sense.[58] Empirical evidence suggests that higher trust in government is positively correlated with a higher service quality rating.[59] Based on our analysis, we postulate that the trust factors influencing perceptions may take on two different forms: one which may be linked explicitly to trust in government, and another which may be related to trust in public services, these forming different aspects of predisposition. In Sudan, we see this as a fundamental distinction since there is limited contact between citizens and state institutions in many regions. As a result, the predisposition of trust aligned to government is more likely to be informed by non-rational theories whereby "emotion makes a central contribution to trust".[60] We expect the trust in

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[57] Kampen et al., 2006.
[58] Harding, 2013; Sztompka, 2001; Schmalz-Bruns, 2002.
[59] Harding, 2013.
[60] Taylor-Gooby, 2006.

service providers to be based on trust in institutions with which people are in closer contact on an everyday basis.

Including trust in government and trust in service providers in a model aims to add further explanatory power to the other determinants of the service quality rating and could partly control for predisposition. A scatter plot of Sudanese people's overall trust in public institutions and government services, against their overall perception of service quality, is shown in Figure 16. Indeed, there appears to be a positive relationship between these dimensions.[61] It is also implicative to look at this relationship at the state-level, see Figure 17. Again, there appears to be a positive relationship between perception of quality and trust, though South Kordofan and North Darfur appear to be relative outliers.
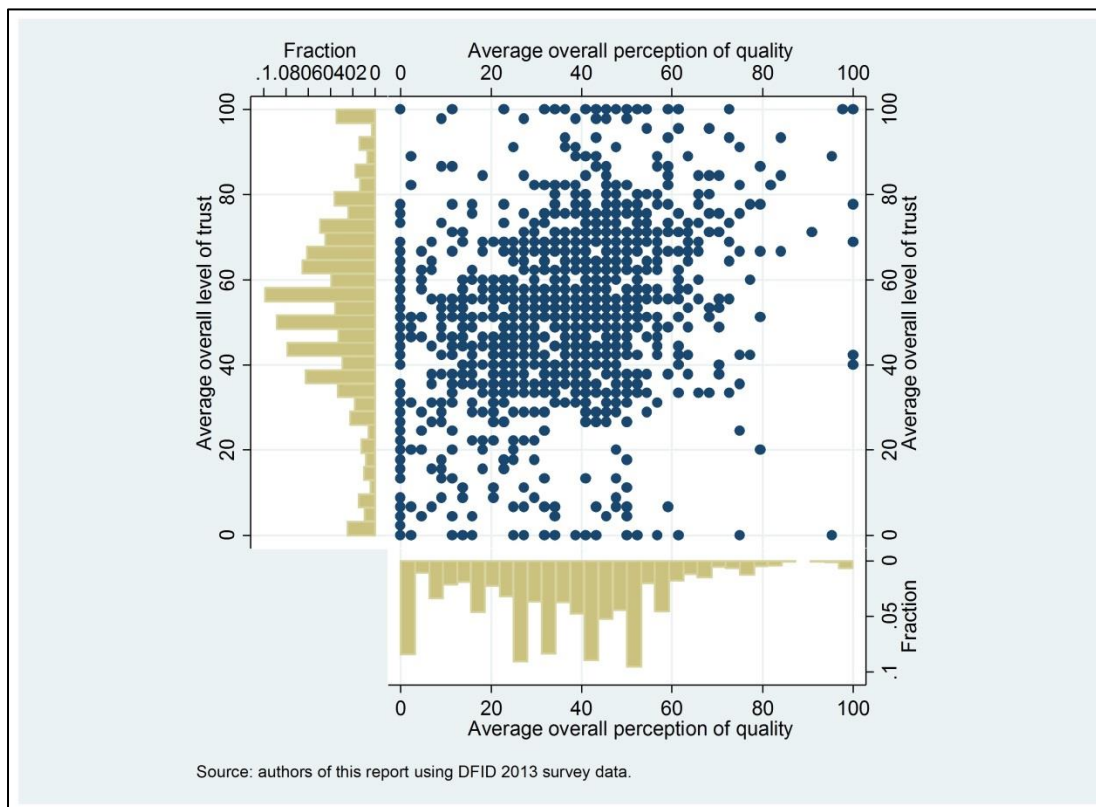


**Figure 16 – Average overall perception of quality versus average overall level of trust, at the individual level.**

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[61] In the DFID Sudan 2013 survey, there are 11 categories for which people's perception of service quality was asked, and 15 categories for which their level of trust was asked; "overall" here means that we take the simple average of all scores for these 11 or 15 categories.

Source: authors of this report using DFID 2013 survey data.

GD=Al Gedarif, GZ=Al Gezira, BN=Blue Nile, KS=Kassala, KH=Khartoum, ND=North Darfur, NK=North Kordofan, NO=Northern, RS=Red Sea, RN=River Nile, SI=Sinnar, SD=South Darfur, SK=South Kordofan, WD=West Darfur, WN=White Nile
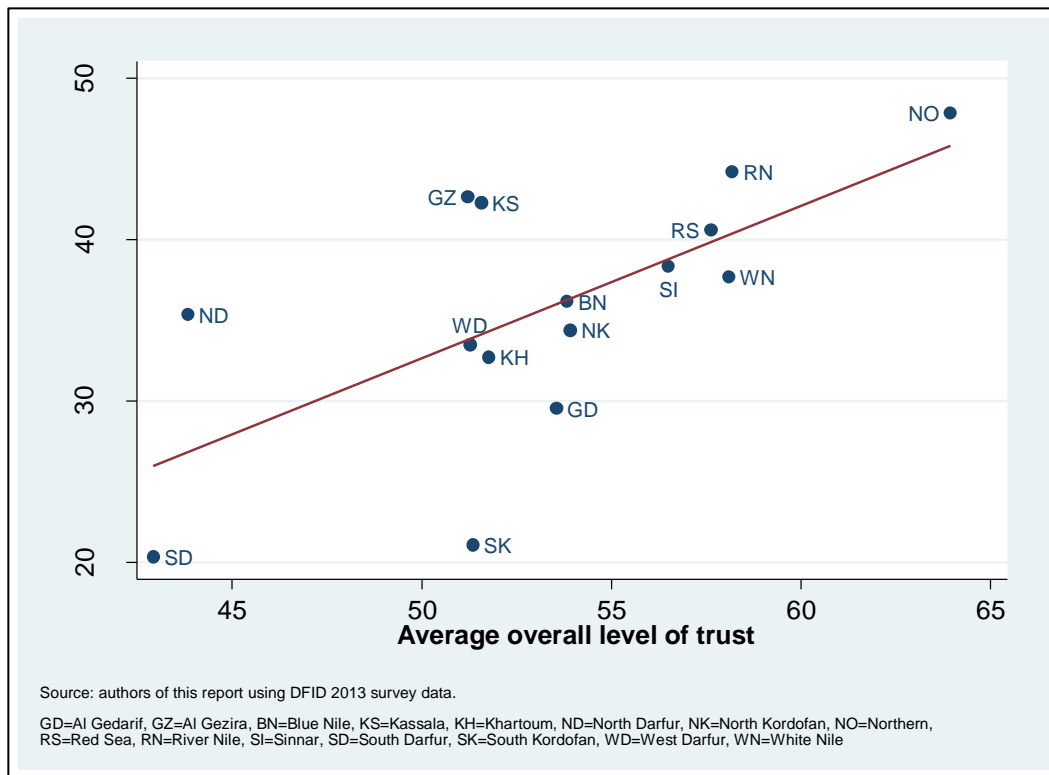
**Figure 17 – Average overall perception of quality versus average overall level of trust, at the state-level.**

In Figure 18, we explore the relationship between perceptions of public service quality and a calibrated measure of trust in government and public service providers using a statistical technique called cluster analysis (see Appendix 2.7). This descriptive method groups people into three different categories: group one (red) represents individuals with low levels of both trust and perceptions of public services, group two (blue) represents individuals with high levels of trust and low scores for the perception of quality of public services and group three (orange) represents individuals with higher perceptions of the quality of public services. Figure 19 shows how these "clusters" are distributed at the state-level.

Source: authors of this report using DFID 2013 survey data.
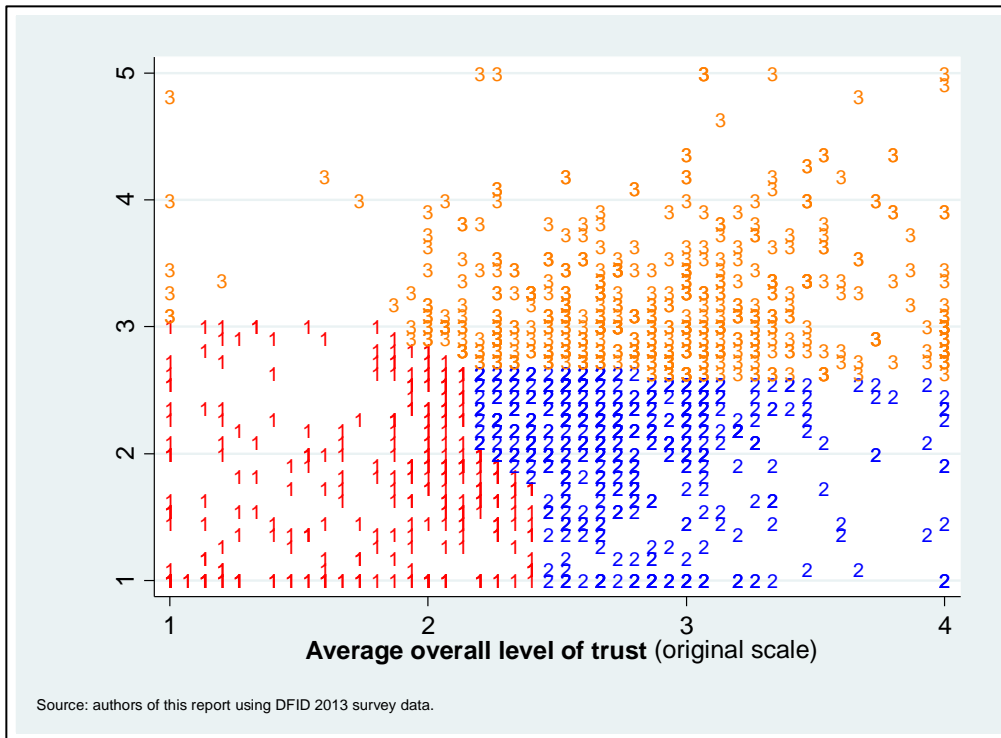
**Figure 18 – Cluster analysis of average overall perception and average overall level of trust, at the individual level.**



Source: authors of this report using DFID 2013 survey data.
Pie chart size proportional to state population.
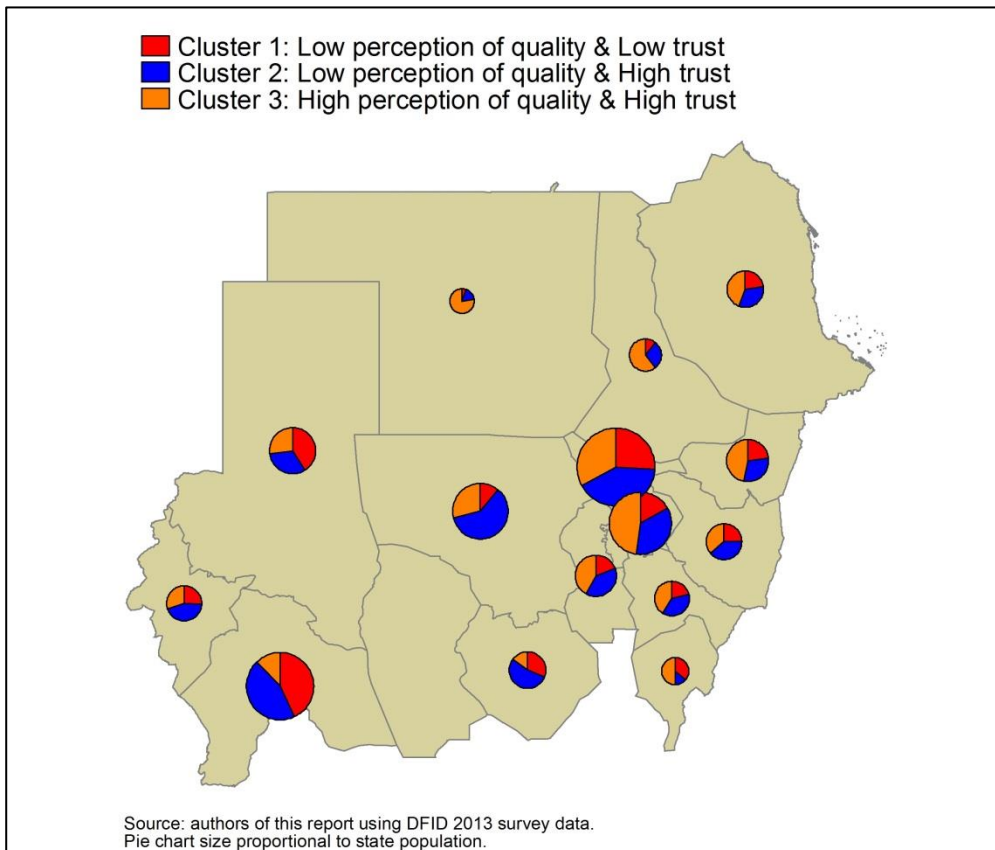
**Figure 19 - Profile of each state in terms of the three clusters exhibited in Figure 18.**

Both the scatter plots of average overall perceptions and trust, as well as these clusters, identify, based on specified dimensions, trust as a disposition that is aligned with perceptions of the quality of public services. The strong links identified here indicate that some of the variation in perceptions of quality is likely to be explained by some trust variable.

## 2.6 A theoretical framework for the determinants of service quality

Throughout Chapter 2, we have so far explored descriptive data on the inequality related to the experience of public services in the Sudan, using both survey data on the perception of public service quality as well as relevant provision data. We have established that there are a number of particularly salient horizontal and vertical inequalities in both public service provision as well as perceptions of public services.

We have also identified an additional determinant of perceptions of the quality of public services, this being trust as a measure of the predisposition held by individuals, which is in turn also likely to be influenced by the inequalities we have examined. Before analysing inequalities and trust in more detail, it is important to shed light on existing theories about the relationship between service provision and quality ratings.

While there is evidence that people's ratings of public service quality are positively correlated with the reality of service performance[62] one of the main challenges is that this rating seems to be determined by a wide array of factors beyond actual service provision. In their landmark study, Bouckaert and van der Walle argue that current measurement attempts "are misleading if they claim to be measuring good governance; as [perceptions are] difficult to measure and very service-specific".[63] Prior research on public services shows that service quality ratings generally represent a function of the respondent's perception of a service outcome and some expectation towards the service.[64] However, beyond actual service performance both perceptions and expectations are influenced by socioeconomic and demographic characteristics, the nature of the public service itself, as well as individual predisposition.[65]

While one can control for public service provision, the nature of a given public service and socio-demographic characteristics, the relationship between ratings and predisposition towards public institutions at the individual-level is less clear, and there is relatively limited research investigating this issue to date.

Figure 20 outlines a framework on the determinants of service quality ratings informed by our analyses in the previous sub-chapters and the aforementioned literature. We will use this to inform our methodological approach in Chapter 3.

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[62] Im/Lee, 2012.
[63] Bouckaert and van der Walle, 2003.
[64] Maister, 1995.
[65] Kampen et al, 2006.
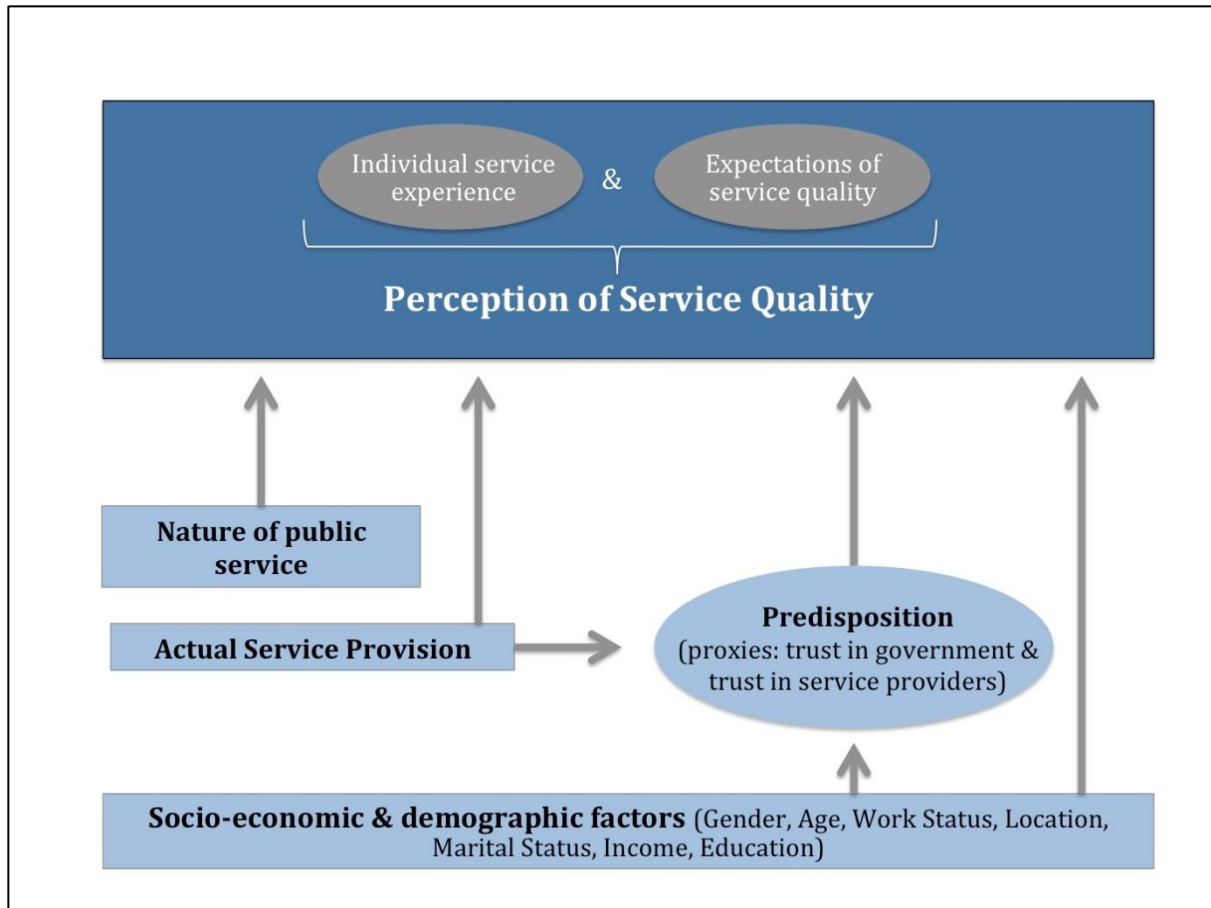
**Figure 20 - Theoretical framework for determinants of perceptions of service quality.
Source: Authors of this report.**

# 3 Determinants of perceptions of public services

This chapter presents a quantitative analysis of the determinants of perceptions of service quality using the 2013 DFID Sudan household survey data, and, in the latter part of the chapter, the relevant provision data for each of the services. We focus our analysis on the horizontal and vertical inequalities introduced in Chapter 2: by geography, gender, income and education-based, and determine whether these inequalities are pronounced in any of our services.

In sub-chapter 3.1 we provide an introduction to the data set. In sub-chapter 3.2, we identify the other variables expected to impact perceptions of service quality based on the theoretical framework we introduced in sub-chapter 2.4. This includes the use of exploratory factor analysis to identify trust factors and the inclusion of other relevant socioeconomic and demographic variables, apart from the measures of inequalities that we already discussed. In 3.3 we present the baseline regression models and methodology used. Finally in sub-chapters 3.4 and 3.5 we present our regression results at the individual- and state-levels, respectively, with the latter incorporating the provision data.

## 3.1 The DFID Sudan household survey data

The data used in this report comes from a household public opinion survey conducted by DFID Sudan in July 2013.[66] The Sudan Polling Statistics Centre (SPSC) collected the data from 2,365 citizens in a stratified random sample over 15 states.[67] The sample frame was generated using 2008 Sudan National Census data and updated following the 2010 general election. Table 2 below indicates the actual samples collected in the survey. The actual samples collected differ from those in the SPSC's original survey design with respect to the number of observations and the sample sizes for some states; see notes in Table 2 for more details. [68]

### Sampling strategy

The SPSC used a multi-stage cluster sampling strategy[69]; the survey was stratified on 11 states, with four localities randomly selected from each stratum, probability of selection proportional to size. A three-stage sampling process was then used to randomly select respondents. In the first stage, one cluster was randomly selected from each of the four localities in each state, with probability of selection again proportional to size. In the second stage, households were randomly selected using systematic random sampling. Finally in the third stage, an individual of 18 years of age or older was selected from within each household using the Kish table method.[70] While all adults in a given household had the same chance of being selected, the survey design ensured gender representativeness in each cluster by rotating the respondent gender in

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[66] DFID Sudan conducted an initial household survey in November 2012. However, because the 2012 survey does not include questions on public service quality, which is the primary focus of this report, this report primarily uses 2013 survey data. It refers to the 2012 data where relevant, bearing in mind that the 2012 survey consists of different questions compared to the 2013 survey and questions that are similar to those in 2013 but that are worded differently.

[67] Though at the time of data collection Sudan was composed of 17 states, the SPSC sampling strategy retained the 15 state demarcation and the responses from the Darfur states were labelled as coming from one of three states: North Darfur, South Darfur, or West Darfur. Those individuals surveyed in what is now East Darfur or Central Darfur would have been categorised as respondents from West Darfur or South Darfur (the two states that were partitioned to form East and Central Darfur).

[68] Prior to any analysis of the data, we "cleaned" the original data provided by the SPSC in order to insure both validity and convenience. This procedure included renaming and/or relabeling variables, recoding certain responses and missing values.

[69] The SPSC provided this information to us in a sampling strategy report, however, we are unsure as to how accurate it is in detailing the sampling strategy undertaken by the company to collect this data.

[70] The Kish table method is a method to randomly select an individual from a household for survey data collection. Details of this method can be found by referring to WHO, 2008.

alternating households. Booster samples were collected for Khartoum, Gezira, North Darfur and South Darfur. The data was collected by the SPSC through personal interviews.[71]

| Region (population in 000's) | State | DfID Sudan 2013 survey | | | 2008 census | Geographical weights |
|---|---|---|---|---|---|---|
| | | Number of sampled localities | Number of sampled clusters | Number of sampled households | Population (in 000's) | |
| TOTAL | | 70 | 238 *k | 2,365 *j | 30,894 | - |
| North (1,820) | Northern | 2 | 15 | 150 | 699 | 0.357 |
| | River Nile | 3 | 15 | 150 | 1,120 | 0.572 |
| East (4,534) | Red Sea | 6 | 15 | 150 | 1,396 | 0.713 |
| | Kassala | 2 | 14 *a | 140 *e | 1,790 | 0.979 |
| | Al Gedarif | 4 | 15 | 150 | 1,348 | 0.688 |
| Khartoum | Khartoum | 6 | 26 | 258 *f | 5,274 | 1.565 |
| Al-awsut (7,423) | Al Gezira | 6 | 18 *b | 172 *g | 3,575 | 1.591 |
| | White Nile | 4 | 16 *c | 150 | 1,731 | 0.883 |
| | Sinnar | 4 | 16 *d | 150 | 1,285 | 0.656 |
| | Blue Nile | 2 | 15 | 150 | 832 | 0.425 |
| Kurdufan (4,327) | North Kordofan | 3 | 15 | 150 | 2,921 | 1.491 |
| | South Kordofan | 6 | 15 | 143 | 1,406 | 0.753 |
| Darfur (7,515) | North Darfur | 9 | 10 | 102 | 2,114 | 1.586 |
| | West Darfur | 2 | 15 | 151 *h | 1,308 | 0.663 |
| | South Darfur | 11 | 20 | 199 *i | 4,094 | 1.575 |

* It should be noted that these numbers are different from the original survey design by the Sudan Polling Statistics Centre (SPSC), where the design stipulated that a=15, b=17, c=15, d=15, e=150, f=257, g=174, h=150, i=200, and j=2,375.
Furthermore, in the collected data, some clusters belonged to different states, possibly due to coding errors.
Therefore, the sum of the numbers for the clustered samples does not exactly match the total number of clusters (k).

**Table 2: DFID Sudan's 2013 survey design.**
**Source: Authors of this report using data from DFID Sudan's 2013 survey data and the 2008 Sudan National Census.**

## Sampling weights

In order to address the fact that different individuals within the Sudanese population had different chances of being selected for this survey, we constructed sampling weights for survey respondents reflecting their probabilities of being selected. The sampling weights used in this report, represented in Table 3 below, reflect the stratification of the population based on gender and state. For example, the sampling weight of a man living in the Northern state is 0.36, meaning he is underrepresented in our sample, whereas for a man living in Khartoum it is 1.64, meaning he is overrepresented. For limitations on this weighting strategy, see Appendix 4.1.

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[71] 32 interviewers conducted the interviews over the course of 15 working days in December.

| Region | State | 2008 census | | | | | DfID Sudan 2013 survey | | | | | Sampling weight (Gender x State) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Population (in 000's) | Male | | Female | | No. of samples | Male | | Female | | Male | Female |
| TOTAL (number of people) | | 30,894 | 15,767 | (51%) | 15,127 | (49%) | 2,365 | 1,181 | (50%) | 1,184 | (50%) | - | - |
| North | Northern | 699 | 354 | (1.1%) | 345 | (1.1%) | 150 | 76 | (3.2%) | 74 | (3.1%) | 0.3563 | 0.3572 |
| | River Nile | 1,120 | 572 | (1.9%) | 549 | (1.8%) | 150 | 72 | (3.0%) | 78 | (3.3%) | 0.6080 | 0.5385 |
| East | Red Sea | 1,396 | 801 | (2.6%) | 595 | (1.9%) | 150 | 74 | (3.1%) | 76 | (3.2%) | 0.8283 | 0.5997 |
| | Kassala | 1,790 | 991 | (3.2%) | 799 | (2.6%) | 140 | 75 | (3.2%) | 65 | (2.7%) | 1.0113 | 0.9410 |
| | Al Gedarif | 1,348 | 670 | (2.2%) | 679 | (2.2%) | 150 | 73 | (3.1%) | 77 | (3.3%) | 0.7024 | 0.6746 |
| Khartoum | Khartoum | 5,274 | 2,800 | (9.1%) | 2,474 | (8.0%) | 258 | 131 | (5.5%) | 127 | (5.4%) | 1.6362 | 1.4914 |
| Al-awsut | Al Gezira | 3,575 | 1,724 | (5.6%) | 1,851 | (6.0%) | 172 | 85 | (3.6%) | 87 | (3.7%) | 1.5530 | 1.6287 |
| | White Nile | 1,731 | 849 | (2.7%) | 881 | (2.9%) | 150 | 74 | (3.1%) | 76 | (3.2%) | 0.8784 | 0.8878 |
| | Sinnar | 1,285 | 626 | (2.0%) | 659 | (2.1%) | 150 | 74 | (3.1%) | 76 | (3.2%) | 0.6473 | 0.6641 |
| | Blue Nile | 832 | 422 | (1.4%) | 410 | (1.3%) | 150 | 73 | (3.1%) | 77 | (3.3%) | 0.4423 | 0.4080 |
| Kurdufan | North Kordofan | 2,921 | 1,407 | (4.6%) | 1,514 | (4.9%) | 150 | 75 | (3.2%) | 75 | (3.2%) | 1.4357 | 1.5458 |
| | South Kordofan | 1,406 | 695 | (2.2%) | 712 | (2.3%) | 143 | 74 | (3.1%) | 69 | (2.9%) | 0.7188 | 0.7894 |
| Darfur | North Darfur | 2,114 | 1,080 | (3.5%) | 1,034 | (3.3%) | 102 | 51 | (2.2%) | 51 | (2.2%) | 1.6210 | 1.5516 |
| | West Darfur | 1,308 | 640 | (2.1%) | 668 | (2.2%) | 151 | 77 | (3.3%) | 74 | (3.1%) | 0.6362 | 0.6914 |
| | South Darfur | 4,094 | 2,138 | (6.9%) | 1,956 | (6.3%) | 199 | 97 | (4.1%) | 102 | (4.3%) | 1.6872 | 1.4678 |

**Table 3- Sampling weights based on gender and geographical strata.**
**Source: Authors of this report using data from 2013 DFID Sudan survey data and the 2008 Sudan National Census.**

## Respondents

Table 4 below presents the breakdown of the respondent population by key demographic variables: age (ranging from 18 to 87), monthly household income (1= 100-500 SDG, 2=500-1,000 SDG, 3= over 1,000 SDG), educational attainment (1= illiterate, 2= primary, 3= intermediate, 4= secondary, 5= diploma, 6=BSc, 7= high diploma, 8= MSc or PhD), and urban status (urban= 1 if respondent resides in a capital city of his or her state or in Khartoum).[72] Table 4 also presents the breakdown after weighting using the weights provided in Table 3.

| | Before weighting | | | | | | After weighting | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gender | Male | | Female | | Total | | Male | | Female | | Total | |
| N= | 1,181 | (50%) | 1,184 | (50%) | 2,365 | (100%) | 1,207 | (51%) | 1,158 | (49%) | 2,365 | (100%) |
| Variable | Mean | S.D. | Mean | S.D. | Mean | S.D. | Mean | S.D. | Mean | S.D. | Mean | S.D. |
| **Age** (min:18, max:87) | 36.2 | 13.4 | 32.8 | 11.2 | 34.5 | 12.5 | 36.6 | 13.3 | 32.8 | 10.9 | 34.7 | 12.4 |
| **Income** (1-3 scale) | 1.8 | 0.8 | 1.7 | 0.8 | 1.8 | 0.8 | 1.8 | 0.8 | 1.8 | 0.8 | 1.8 | 0.8 |
| **Married** (=1 if married) | 59% | 0.5 | 66% | 0.5 | 62% | 0.5 | 60% | 0.5 | 66% | 0.5 | 63% | 0.5 |
| **Education** (1-8 scale) | 4.1 | 1.8 | 3.9 | 1.8 | 4.0 | 1.8 | 4.3 | 1.8 | 4.0 | 1.8 | 4.1 | 1.8 |
| **Urban** (=1 if urban) | 36% | 0.5 | 35% | 0.5 | 36% | 0.5 | 39% | 0.5 | 37% | 0.5 | 38% | 0.48 |

**Table 4 - Descriptive data summary of respondent population by demographics.**
**Source: Authors of this report using data from 2013 DFID Sudan survey data.**

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[72] Note that this differs from the definition of urban status that is used in the 2008 Sudan National Census. The Census considers a respondent to reside in an urban area if that area has a population of at least 20,000 and has some available services.

## Data analysis strategy

All data is analysed using STATA 12/13 software. We created frequency tables, cross tabulations, graphs inclusive of scatter plots, bar or pie charts and choropleth maps, as well as conducting cluster analysis, exploratory factor analysis (EFA), regression analyses and structural equation modelling (SEM). In our analysis we use the conventional significance level of 0.05 when evaluating our results. Cronbach's alpha is used to verify the internal reliability of constructs formed from multiple-scale items, with the generally agreed-upon lower limit of 0.60. In all statistical work, including summarising descriptive data, examining reliabilities of constructs and performing SEMs, we accounted for the sampling weights in Table 3 to compensate for the sample design that may have over or under-represented various segments within the population.

## 3.2 Developing baseline regression models

Before undertaking a full quantitative analysis of our data, in this sub-chapter we identify relevant variables within our data that we expect to have an impact on perceptions of service quality. These include socioeconomic and demographic variables, as well as trust as a proxy for individuals' predisposition towards government.

### Identifying relevant socioeconomic and demographic factors

Accounting only for our inequalities of interest in a regression analysis would fail to control for other relevant socioeconomic and demographic variables that are potentially correlated both with these three inequalities and perception of service quality, resulting in biased regression coefficients. We hypothesise that relevant variables include: age, marital status, education, urban status, work status and state of residence. These are the socioeconomic and demographic factors are commonly included in literature investigating the determinants of public service quality ratings.[73] In Chapter 2 of the report we make the argument that these socioeconomic and demographic factors affect the perception of public service quality directly and indirectly, the latter via trust in public institutions. [74]

### Investigating "trust" using factor analysis

Predisposition, as elaborated in sub-chapter 2.5, impacts both the service experience that individuals have and their expectations of the quality of that service. These are in turn impacted by socioeconomic and demographic factors and the actual service access and quality available. To explore the concept of predisposition we investigate the relevance of trust in public institutions as an explanatory factor in the variation of perceptions of service quality.

To investigate the underlying structure of trust in public institutions data, we conduct exploratory factor analysis (EFA). Factor analysis seeks to identify general, underlying variables from a set of intercorrelated variables. It is a technique that reduces the number of dimensions to those explaining the variance of underlying fundamentals. In order for EFA to be a valid technique, the data matrix must exhibit a sufficient level of intercorrelations. To investigate the suitability of the trust data for factor analysis we examine the correlation matrix, use the Bartlett's test of sphericity and calculate the Keiser-Meyer-Olkin (KMO) Index. The polychoric correlation matrix of the 15 trust variables in our data set is shown in Figure 21.

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[73] See Castillo, Miranda, Torres 2011; Askvic/Jamil 2011; Vigoda/Yuval 2003 as examples.
[74] Askvic/ & Jamil, 2011.

| | Variable | Mean | S.D. | % DK | % NR | t1 | t2 | t3 | t4 | t5 | t6 | t7 | t8 | t9 | t10 | t11 | t12 | t13 | t14 | t15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| t1 | National parliament | 2.3 | 1.0 | 8.8% | 1.2% | 1.00 | | | | | | | | | | | | | | |
| t2 | Judiciary | 2.7 | 1.0 | 5.8% | 1.0% | 0.63 | 1.00 | | | | | | | | | | | | | |
| t3 | Political parties | 1.9 | 1.0 | 7.7% | 1.3% | 0.50 | 0.34 | 1.00 | | | | | | | | | | | | |
| t4 | Armed forces | 3.0 | 1.1 | 3.9% | 0.9% | 0.48 | 0.61 | 0.25 | 1.00 | | | | | | | | | | | |
| t5 | Public adm. (federal) | 2.3 | 1.0 | 11.0% | 1.4% | 0.52 | 0.49 | 0.43 | 0.48 | 1.00 | | | | | | | | | | |
| t6 | Local government | 2.2 | 1.0 | 6.6% | 1.3% | 0.56 | 0.48 | 0.44 | 0.43 | 0.62 | 1.00 | | | | | | | | | |
| t7 | The Imam of the mosq | 3.3 | 1.0 | 5.5% | 1.3% | 0.31 | 0.48 | 0.19 | 0.53 | 0.44 | 0.39 | 1.00 | | | | | | | | |
| t8 | Local hospital | 2.4 | 1.0 | 3.5% | 1.0% | 0.44 | 0.38 | 0.42 | 0.33 | 0.50 | 0.50 | 0.38 | 1.00 | | | | | | | |
| t9 | Local school | 2.8 | 1.0 | 3.8% | 0.9% | 0.42 | 0.44 | 0.32 | 0.39 | 0.47 | 0.44 | 0.50 | 0.68 | 1.00 | | | | | | |
| t10 | Electricity company | 2.6 | 1.0 | 4.7% | 0.9% | 0.40 | 0.45 | 0.24 | 0.40 | 0.39 | 0.36 | 0.36 | 0.45 | 0.53 | 1.00 | | | | | |
| t11 | Federal Government | 2.3 | 1.0 | 9.7% | 1.8% | 0.58 | 0.54 | 0.36 | 0.49 | 0.58 | 0.56 | 0.38 | 0.46 | 0.47 | 0.52 | 1.00 | | | | |
| t12 | Police | 2.6 | 1.0 | 4.5% | 0.9% | 0.52 | 0.56 | 0.35 | 0.54 | 0.50 | 0.50 | 0.47 | 0.46 | 0.49 | 0.46 | 0.62 | 1.00 | | | |
| t13 | Journalists | 2.3 | 1.0 | 11.1% | 1.2% | 0.32 | 0.36 | 0.43 | 0.29 | 0.40 | 0.43 | 0.32 | 0.43 | 0.40 | 0.43 | 0.43 | 0.43 | 1.00 | | |
| t14 | Private companies | 2.5 | 1.0 | 10.8% | 1.2% | 0.28 | 0.33 | 0.31 | 0.22 | 0.33 | 0.32 | 0.27 | 0.37 | 0.36 | 0.40 | 0.32 | 0.31 | 0.48 | 1.00 | |
| t15 | My local tribal chief | 2.8 | 1.1 | 12.1% | 2.8% | 0.35 | 0.34 | 0.29 | 0.35 | 0.30 | 0.33 | 0.38 | 0.42 | 0.38 | 0.33 | 0.35 | 0.34 | 0.37 | 0.38 | 1.00 |

**Figure 21 - Correlation matrix of trust in public institutions.**
**Source: Authors of this report using 2013 DFID Sudan survey data.**

The overall significance of the correlation matrix is assessed using the Bartlett test of sphericity, providing the statistical probability that the correlation matrix has significant correlations among at least some of the variables. This test produced a statistically significant result ($p < 0.001$, $\chi^2 = 8{,}358$, $df = 105$), confirming that the data is suitable for factor analysis.[75] Furthermore, the KMO measure of sampling adequacy, which helps to quantify the degree of intercorrelations among the variables, is 0.93. This result makes the data highly appropriate for factor analysis, according to Kaiser's criteria.[76]

We specified that the EFA has two factors, anticipating that two dimensions of trust correspond to government and service provision respectively, as identified in sub-chapter 2.5. The resulting pattern matrix is shown in Table 5; these two factors account for 54% of the total variation. The first factor identified contains variables related to central government institutions, reflecting previous empirical studies on trust in institutions.[77] The composition of this "trust in government" factor is also theoretically justified; it assumes that there is "one opinion of trust in [central] government because people do not make distinctions" between governmental institutions.[78] The second factor identified includes three variables on public service providers, as well as a variable on trust in private companies. This appears justifiable in Sudan, where many public services are increasingly provided by private firms or NGOs, particularly in the three sectors on which we focus. For example, state governments have outsourced the collection of water and sanitation fees to private firms, and health services are increasingly delivered through private providers.[79] Furthermore, the government often aligns itself with NGO public services, making the distinction between public and private less clear in the mind of respondents. We thus call this factor "trust in service providers."[80] These two trust factors will be used in the following regression analyses presented in sub-chapters 3.3 and 3.4.

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[75] Bartlett's test for sphericity evaluates the null hypothesis that all of the variables in the population correlation matrix are uncorrelated; statistical significance of results indicates that the null hypothesis can be rejected in favour of the alternative hypothesis that the population correlation matrix is correlated.

[76] Kaiser (1974) states that the validity for factor analysis for the following KMO values: 0.00 to 0.49 is "unacceptable" for factor analysis; 0.50 to 0.59 is "miserable,"; 0.60 to 0.69 is "mediocre,"; 0.70 to 0.79 is "middling,"; 0.80 to 0.89 is "meritorious,"; and 0.90 to 1.00 is "marvellous".

[77] Bouckaert et al., 2002.

[78] Ibidem.

[79] World Bank, 2011.

[80] In interpreting the dimensions, we excluded items with a uniqueness larger than 0.5. Uniqueness is made up of all the variance in an observed variable not predicted by a factor. A high uniqueness of an item indicates that the item is less relevant to the latent factor.

| | Variable | Rotated factor loadings | | Uniqueness | Coefficients | | KMO |
|---|---|---|---|---|---|---|---|
| | | Factor 1 | Factor 2 | | Factor 1 | Factor 2 | Overall=0.9 |
| t1 | **National parliament** | 0.697 | 0.294 | 0.428 | 0.188 | -0.069 | 0.91 |
| t2 | **Judiciary** | 0.784 | 0.200 | 0.346 | 0.257 | -0.153 | 0.92 |
| t3 | **Political parties** | 0.285 | 0.556 | 0.610 | -0.072 | 0.222 | 0.90 |
| t4 | **Armed forces** | 0.809 | 0.060 | 0.342 | 0.315 | -0.241 | 0.93 |
| t5 | **Public administrations (federal)** | 0.647 | 0.376 | 0.440 | 0.140 | -0.005 | 0.94 |
| t6 | **Local government** | 0.609 | 0.408 | 0.463 | 0.113 | 0.027 | 0.95 |
| t7 | **The Imam of the mosque** | 0.627 | 0.218 | 0.559 | 0.186 | -0.089 | 0.91 |
| t8 | **Local hospital** | 0.378 | 0.667 | 0.413 | -0.071 | 0.254 | 0.91 |
| t9 | **Local school** | 0.467 | 0.570 | 0.457 | -0.001 | 0.168 | 0.90 |
| t10 | **Electricity company** | 0.447 | 0.498 | 0.552 | 0.016 | 0.133 | 0.94 |
| t11 | **Federal Government** | 0.694 | 0.356 | 0.392 | 0.167 | -0.033 | 0.94 |
| t12 | **Police** | 0.716 | 0.309 | 0.392 | 0.191 | -0.067 | 0.96 |
| t13 | **Journalists** | 0.232 | 0.721 | 0.427 | -0.149 | 0.334 | 0.92 |
| t14 | **Private companies** | 0.099 | 0.742 | 0.440 | -0.212 | 0.392 | 0.92 |
| t15 | **My local tribal chief** | 0.284 | 0.552 | 0.615 | -0.071 | 0.220 | 0.94 |

**Table 5 - Factor analysis of trust in public institutions.**
**Source: Authors of this report using 2013 DFID Sudan survey data.**

## 3.3 Regression results I: Individual level analysis

### Baseline regression models

In the previous sub-chapters we explored the variables to be considered in developing a causal model of public service quality. In this sub-chapter we introduce the three baseline regression models that will be used in our analyses upcoming sub-chapters.

Model I, presented in Figure 22, attempts to explain the variation in service quality ratings for each of the public services using variation in socioeconomic and demographic factors. It does not, at this stage, account for some predisposition towards government.
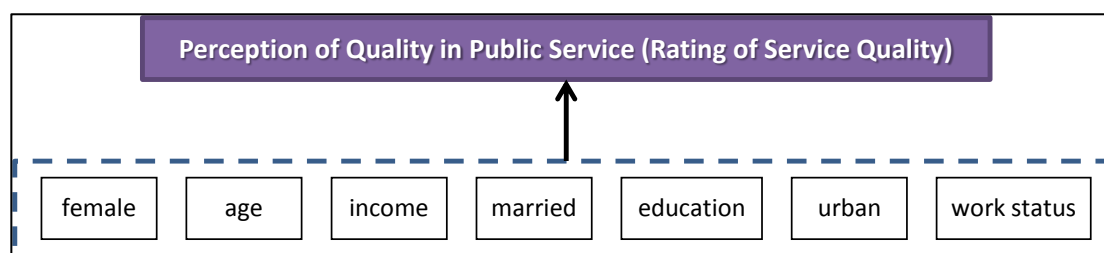


**Figure 22 - Model I: Regression of service quality rating on socioeconomic and demographic variables (schematic path-diagram).**
**Source: Authors of this report.**

A further refinement of the model accounts for our two trust factors, representing some predisposition towards government and services and linking back to the discussion on trust and inequalities in sub-chapter 2.5. The specification, discussed as Model II and illustrated in Figure 23 below, accounts for the impact of these two trust factors, used as independent variables, on perceptions of service quality. It does not, however, account for the relationship between demographic or socioeconomic variables and trust.
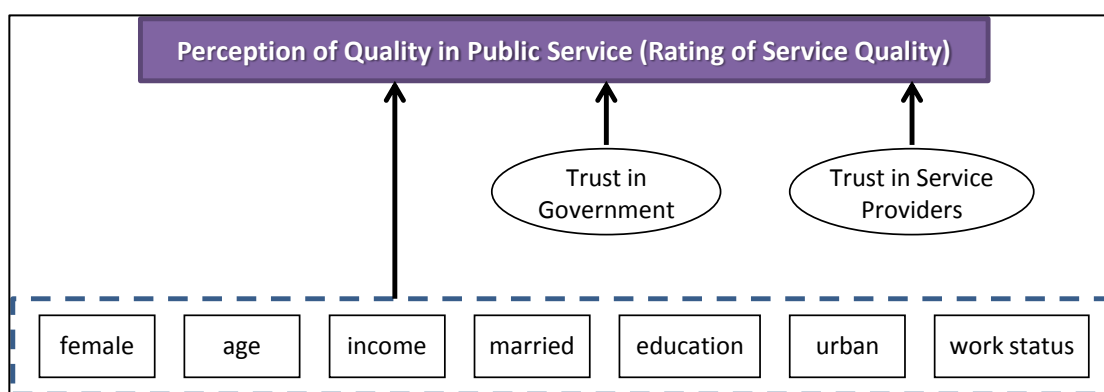
**Figure 23 - Model II: Regression of service quality rating on socio-economic and demographic variables and trust factors (schematic path-diagram).**
**Source: Authors of this report.**

Finally, Figure 24 presents Model III, which explores the determinants of the perception of service quality at the individual level. In Model III we see the two trust factors, as developed in sub-chapter 3.2, acting as "mediators" for the socioeconomic and demographic variables. This is to say that these trust factors mediate the effect of the socioeconomic and demographic indicators on the perception of service quality; trust is taken as a factor that is both a dependent variable, with respect to its relationship with the demographic and socioeconomic factors, and an independent variable, with respect to its relationship with perception of service quality. Since this mediation model most closely realises our hypothesis by way of the theoretical framework posited in sub-chapter 2.5, we expect this model to provide the best understanding of the mechanisms by which perceptions of service quality are formed.
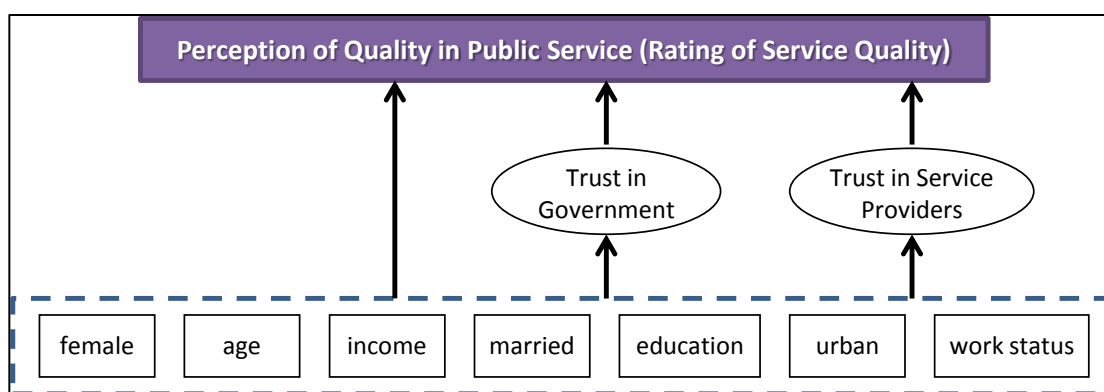


**Figure 24 - Model III: Regression of service quality rating on demographics and trust factors, with trust factors as "mediators" (schematic path-diagram).**
**Source: Authors of this report.**

Having examined the variables of interest, those to be included in the regression analysis, and developed the models, we now present our regression analysis. Our dependent variable is perception of public service quality and has five categories: 1="Extremely poor quality", 2="Poor quality", 3="Adequate quality", 4="Good quality" and 5="Excellent quality").[81] This implies that the most common Ordinary Least Square (OLS) estimation method, which assumes the dependent variable is continuous, is not an appropriate option for our analysis. Rather, we need to rely on a model that allows for more than two response categories and

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[81] The "don't know" and "refuse" responses were dropped prior to the regression analysis. The details on how many of the responses were in this category are included in Chapter 4.

where the values of each category have a meaningful sequential order. As such, we employ the Ordered Logit model,[82] which uses the maximum likelihood estimation method. Note also that we linearly rescaled the 1-5 scale for the perception of service quality responses, using a 0-100 scale, as indicated in Chapter 2.

## (A) Education

Table 6 shows the regression results with perceptions of school quality as a dependent variable. The first column shows the results of Model I, the Ordered Logit regression model solely accounting for the role of socioeconomic and demographic factors. The Likelihood Ratio (LR) Chi-Square, which tests whether at least one of the regressors' regression coefficients is nonzero, is $\chi^2(21)=220$ with log-likelihood of -2721 and $p < 0.001$; this leads us to conclude that the model is valid for further analysis. Based on this specification we find that "education" is the only regressor whose coefficient is statistically significant (at the one percent level). The Ordered Logit estimate of -0.123 for education thus implies that a one "level" increase in education (for example, from 3= intermediate to 4= secondary) is associated with a 0.12 decrease in the ordered log-odds of having a higher level of perception of quality,[83] holding the other regressors constant. Or, equivalently, a one "level" increase in education corresponds to 0.88 times greater odds of having a higher level of perception of quality of public schools.

The second specification, Model II, includes the two trust factors as additional regressors (LR test: $\chi^2(23)=228$ and $p < 0.001$). The trust factors are, as per our theoretical framework and hypothesis in Figure 20, positively and significantly related to the perception of quality of local schools (both at the one percent level). This indicates that, on average, those who have higher trust in government or service providers also have a higher perception of public school quality. In contrast to Model I, Model II indicates that income is statistically significant in explaining the perception of public school quality (at the five percent level), while education is no longer significant. This is a result of the statistically significant correlation between education and the two trust factors and suggests Model I suffered from omitted variable bias. Thus, the explanatory power of education in explaining the variation of the perception of public school quality has now been "absorbed" by the newly added trust factors, which, in turn, have significant explanatory power of perception of quality. Comparing the goodness-of-fit indicator of pseudo $R^2$, the Model II Ordered Logit model has a pseudo $R^2$ of 0.80 compared to Model I where the corresponding value is 0.04. Based on this comparison we conclude that the second model better explains determinants of the perception of quality for public schools.[84]

Model III presents the results for the Mediation model using SEM, which incorporates factor analysis and path analysis, allowing us to account for the trust factor as a mediator between our socioeconomic and demographic variables and perception of service quality. SEM is a multi-equation technique that enables simultaneous estimation of all direct and indirect interrelationships and multiple regression equations in a single framework. It is also a confirmatory procedure, where a complete structure of the model, known as a path-diagram, must be specified in advance of statistical analyses. Data is used within SEM to examine how closely the analysis fits the expectations from the theoretical model.

As we discussed previously, this model uses the same set of variables as Model I and Model II, but the way variables are assumed to be related differs in that the two trust factors play the role of "mediators". Methodologically, we see three types of equations, or sub-models,

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[82] It can be thought of as an extension of the Logit model that applies to dichotomous dependent variables.

[83] "Having higher level of service quality" here means that, for those people who rated the service quality as $S$, having the service quality rating of more than $S$ and less than or equal to 100 (after rescaling).

[84] For a non-linear model such as the Ordered Logit model used here it is generally not easy to evaluate the degree of goodness-of-fit, and many other pseudo $R^2$ indicators have been proposed and utilised by researchers.

within this single model: (i) the Ordered Logit model which tries to explain the direct effect of socioeconomic and demographic variables on the perception of quality of public schools, (ii) the Ordered Logit model which tries to explain the effect of trust factors on the perception of quality of public schools, and (iii) the OLS model which tries to explain the effect of socioeconomic and demographic variables on the trust factors. The combination of paths (ii) and (iii) represent the indirect effect of socioeconomic and demographic variables on the perception of quality of public schools.

It should be emphasised that, in contrast to the previous two regression specifications, the Mediation model was conducted using a confirmatory approach[85]. We take this confirmatory approach so as to base our analysis on the hypothesis developed in sub-chapter 2.6; each equation (that is each arrow in Figure 20) represents hypotheses developed throughout this report.

The results for sub-model (i) and sub-model (ii) are the same insofar as income and the two trust factors are statistically significant in both, with a negative sign on income and positive sign on each of the two trust factors. The Mediation model relies on a combination of sub-models (ii) and (iii). We find three socioeconomic and demographic variables to be statistically significant in explaining trust in service providers: gender, education and rural-urban. Education is negatively related to trust in service providers, as per our findings in a comparison of the first and second specifications in Table 6.

These results indicate that education is more likely to be associated with the perception of quality of public schools through our trust factor for service provision, rather than having a direct association. In other words, this confirms coefficients for education were overestimated in the first regression specification due to the crucial omitted variable bias of some predisposition to trust (or more precisely, trust in public service providers).

The variable "urban" (=1 if lives in urban area and =0 if rural) is also positively associated with trust in service providers, while the variable "female" (=1 if female and =0 if male) is negatively associated, both at the conventional significance level. In fact, as we will see below, these features are common across each of the three public services, implying robustness in the structure of our baseline, Model III. These features were anticipated when we explored and discussed how these variables, acting as horizontal inequalities, were likely to influence perceptions of the quality of public schools (see sub-chapter 2.3; Figures 10-14). As seen in the descriptive analysis, across all three services, higher levels of education, those living in urban areas and men are more likely to have lower perceptions of the quality of public schools; this suggests that those with higher expectations and more experience of public institutions are more likely to have negative perceptions of schools.

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[85] It should be noted that SEM always relies on a confirmatory approach.

| Dependent variable:<br>**Perception of Quality in Public Schools** | (I)<br>Ordered Logit | (II)<br>Ordered Logit | (III)<br>Ordered Logit<br>+<br>Mediation | Mediators in (III) | |
| --- | --- | --- | --- | --- | --- |
| | | | | **Trust in Govern't** | **Trust in Serv. Prov.** |
| female<br>(=1 if female, =0 if male) | -0.0349<br>(-0.34) | 0.0178<br>(0.14) | 0.0311<br>(0.27) | 2.915<br>(1.52) | **5.239**\*\*<br>(2.63) |
| age<br>(min:18, max:87) | -0.00884<br>(-1.94) | -0.00386<br>(-0.67) | -0.00148<br>(-0.28) | -0.0649<br>(-0.74) | 0.110<br>(1.21) |
| income<br>(1="100-500", 2="500-1,000", 3=">1,000 STG") | 0.127<br>(1.78) | **0.179**\*<br>(2.04) | **0.198**\*<br>(2.49) | 0.769<br>(0.59) | 0.894<br>(0.66) |
| married<br>(=1 if married, =0 otherwise) | -0.0387<br>(-0.35) | -0.0368<br>(-0.26) | 0.0116<br>(0.09) | 1.681<br>(0.79) | -0.960<br>(-0.43) |
| education<br>(1-8) | **-0.123**\*\*\*<br>(-4.05) | -0.0555<br>(-1.45) | -0.0416<br>(-1.19) | 0.264<br>(0.46) | **-1.699**\*\*<br>(-2.84) |
| urban<br>(=1 if urban, =0 if rural) | 0.0894<br>(0.95) | 0.111<br>(0.95) | 0.0798<br>(0.68) | 3.401<br>(1.72) | **-6.022**\*\*<br>(-2.94) |
| workstatus<br>(=1 if in work, =0 if not in work) | -0.0473<br>(-0.45) | 0.0271<br>(0.20) | -0.0259<br>(-0.21) | 3.883<br>(1.91) | 2.510<br>(1.19) |
| *(14 state dummies are omitted from display.)* | | | | | |
| Trust in Government | | **0.0169**\*\*\*<br>(8.60) | **0.0185**\*\*\*<br>(10.47) | | |
| Trust in Service Provider | | **0.00799**\*\*\*<br>(4.14) | **0.00812**\*\*\*<br>(4.92) | | |
| *N* | 2,002 | 1,312 | 1,320 | | |

*t*-statistics in parentheses
Complete information including all states dummies is provided in Appendix 3.
\* $p < 0.05$, \*\* $p < 0.01$, \*\*\* $p < 0.001$

**Table 6 - Estimates for the determinants of perception of quality in public schools, at the individual level.**

## (B) Health

Table 7 shows the results of our baseline models for the perceptions of the quality of public hospitals. Notable differences are seen with respect to the education and urban variables which are always significant in explaining the perception of service quality of public hospitals, in a negative and positive direction respectively. Interestingly, income is not significant in any of the health-related models, even after holding trust factors constant, whereas the opposite is true for public schools. This result is supported by our descriptive analysis and discussion in sub-chapter 2.4 and might be explained by the fact that Sudanese with higher income rarely make use of public health facilities, particularly with the increasing number of private hospitals. Though we find some nuances between the results for education and health, the results for both sectors show strong similarities.

| Dependent variable: **Perception of Quality in Public Hospitals** | (I) Ordered Logit | (II) Ordered Logit | (III) Ordered Logit + Mediation | Mediators in (III) | |
| --- | --- | --- | --- | --- | --- |
| | | | | **Trust in Govern't** | **Trust in Serv. Prov.** |
| female (=1 if female, =0 if male) | -0.0795 (-0.80) | -0.140 (-1.12) | -0.0548 (-0.47) | 2.915 (1.52) | **5.239**\*\* (2.63) |
| age (min:18, max:87) | -0.00764 (-1.66) | -0.00959 (-1.69) | -0.00488 (-0.92) | -0.0649 (-0.74) | 0.110 (1.21) |
| income (1="100-500", 2="500-1,000", 3=">1,000 STG") | 0.104 (1.54) | 0.138 (1.66) | 0.113 (1.42) | 0.769 (0.59) | 0.894 (0.66) |
| married (=1 if married, =0 otherwise) | -0.130 (-1.13) | 0.0291 (0.21) | 0.0684 (0.53) | 1.681 (0.79) | -0.960 (-0.43) |
| education (1-8) | **-0.142**\*\*\* (-4.51) | **-0.108**\*\* (-2.58) | **-0.0841**\* (-2.33) | 0.264 (0.46) | **-1.699**\*\* (-2.84) |
| urban (=1 if urban, =0 if rural) | 0.0419 (0.41) | **0.370**\*\* (2.93) | **0.288**\* (2.41) | 3.401 (1.72) | **-6.022**\*\* (-2.94) |
| workstatus (=1 if in work, =0 if not in work) | -0.164 (-1.59) | -0.180 (-1.34) | -0.163 (-1.31) | 3.883 (1.91) | 2.510 (1.19) |
| *(14 state dummies are omitted from display.)* | | | | | |
| Trust in Government | | **0.0176**\*\*\* (8.78) | **0.0161**\*\*\* (9.15) | | |
| Trust in Service Provider | | **0.0110**\*\*\* (5.70) | **0.00939**\*\*\* (5.69) | | |
| *N* | 1,998 | 1,314 | 1,320 | | |

*t*-statistics in parentheses
Complete information including all states dummies is provided in Appendix 3.
\* $p < 0.05$, \*\* $p < 0.01$, \*\*\* $p < 0.001$

**Table 7 - Estimates for the determinants of perception of quality in public hospitals, at the individual level.**

## (C) WAS

In WAS[86], the results of the models are similar to those displayed for education and health, the only difference being that here we do not find any significant direct relationship between the basic variables included in our baseline analysis (Model III) and the quality rating; for water and sanitation we only see an effect via the Mediation model. This could be because experience of WAS as a service is likely to be less complex, with fewer personal interactions than in health and education. Consequently, perceptions of quality might be less divergent across different groups of people. Furthermore, perception of the quality of water services is likely to be strongly linked to access to pipelines, as there are few other ways in which citizens interact with this service.

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[86] The original questionnaire asked one question about water and one question about sanitation, using the same rating scale. WAS here, used as a dependant variable, is a simple average of these two questions.

| Dependent variable:<br>**Perception of Quality in<br>Water and Sanitation Services** | (I)<br>Ordered<br>Logit | (II)<br>Ordered<br>Logit | (III)<br>Ordered<br>Logit<br>+<br>Mediation | Mediators in (III) | |
|---|---|---|---|---|---|
| | | | | **Trust in<br>Govern't** | **Trust in<br>Serv.<br>Prov.** |
| female<br>(=1 if female, =0 if male) | 0.0399<br>(0.40) | -0.00255<br>(-0.02) | 0.100<br>(0.85) | 2.915<br>(1.52) | **5.239**<br>(2.63) |
| age<br>(min:18, max:87) | -0.00663<br>(-1.41) | -0.00444<br>(-0.73) | -0.00508<br>(-0.93) | -0.0649<br>(-0.74) | 0.110<br>(1.21) |
| income<br>(1="100-500", 2="500-1,000", 3=">1,000 STG") | **0.160***<br>(2.30) | **0.193***<br>(2.31) | 0.133<br>(1.67) | 0.769<br>(0.59) | 0.894<br>(0.66) |
| married<br>(=1 if married, =0 otherwise) | -0.208<br>(-1.77) | -0.222<br>(-1.54) | -0.190<br>(-1.44) | 1.681<br>(0.79) | -0.960<br>(-0.43) |
| education<br>(1-8) | -0.0588<br>(-1.84) | -0.0230<br>(-0.57) | 0.0230<br>(0.64) | 0.264<br>(0.46) | **-1.699**<br>(-2.84) |
| urban<br>(=1 if urban, =0 if rural) | **-0.294**<br>(-2.87) | -0.135<br>(-1.09) | -0.128<br>(-1.07) | 3.401<br>(1.72) | **-6.022**<br>(-2.94) |
| workstatus<br>(=1 if in work, =0 if not in work) | -0.134<br>(-1.27) | -0.168<br>(-1.26) | -0.139<br>(-1.11) | 3.883<br>(1.91) | **5.239**<br>(2.63) |
| *(14 state dummies are omitted from display.)* | | | | | |
| Trust in Government | | **0.0117***<br>(6.10) | **0.0127***<br>(7.25) | | |
| Trust in Service Provider | | **0.00840***<br>*<br>(4.51) | **0.00665***<br>(3.98) | | |
| *N* | 1,998 | 1,314 | 1,320 | | |

*t*-statistics in parentheses
Complete information including all states dummies is provided in Appendix 3.
\* *p* < 0.05, \*\* *p* < 0.01, \*\*\* *p* < 0.001

**Table 8 - Estimates for the determinants of perception of quality in water and sanitation provision services, at the individual level.**

## 3.4 Regression results II: State-level analysis

In this sub-chapter, we make use of "state-averaged" and "state-specific" data to investigate how the perception of quality of public services is formed at the state-level. The "state-averaged" data represents a set of variables that are defined by the mean values for each variable of interest, this applies to both the dependent variable (perception of quality) but also to the socioeconomic and demographic variables over each state. Thus, in contrast to the individual-level regression analysis in sub-chapter 3.3, we only have 15 observations: the 15 states of Sudan that were polled in the DFID survey. The "state-specific" data is that which reflects provision of services, collected at the state-level and compiled by government bodies or international institutions such as the World Bank. One major advantage of analysing the state-

level mechanism in the formation of perceptions of public service quality is that it allows us to incorporate data on the actual provision of public services in education, health and water.

From a methodological point of view, a clear distinction with respect to the regression analysis at the individual-level (sub-chapter 3.3) and the state-level, is that we do not have any theoretical framework or prediction as to how the state-averaged perception of service quality is determined by state-averaged socioeconomic and demographic variables, nor for the provision data. This feature prevents us from relying on a confirmatory technique, such as SEM. We infer that, Model III, which applied for the individual-level analysis, does not necessarily apply since the use of state averages in the regression analysis masks the individual variation in both dependent and independent variables. In other words, average quantity behaves differently than at the individual-level. However, as indicated by Figure 16 and 17, we expect trust to be positively correlated with perceptions of quality at both the individual- and state-levels.

Another difference in the methodological approach at the state-level is that we use a simple OLS model instead of the Ordered Logit model used at the individual-level. Though the dependent variable is not necessarily normally distributed, we chose to use the OLS model since we only have 15 observations (15 states of Sudan). Furthermore, the dependent variable, the perception of service quality, is a state mean and is therefore no longer a categorical variable but continuous. See Chapter 4 for a more detailed discussion of the limitations of this approach and possible future improvement. In the OLS model, the use of state-averages for the independent regressors, namely the socioeconomic, demographic and trust variables, appears logical since these variables represent those regional characteristics or demographic features which we believe explain some part of the variation for the state-averaged perception of public service quality. Tables 9-11 show the results of the state-level OLS regression analyses for each public service sector, we now explore these results independently.

## (A) Education

As in the previous sub-chapter, the dependent variable for the education sector is the perception of quality in public schools, only this time we take the average for each state as our observation. We also make use of provision indicator data (cf. Table 1, Chapter 2.3) proxying for education access and quality. Table 9 displays the regression estimates for six specifications.

The first specification, Model 1, represents the result of the OLS regression, excluding the provision data as regressors. In this case, we find that none of the regression coefficients are statistically significant. Models 2, 3 and 4 represent the results from including each of the provision data indicators as an additional regressor, adding these to Model 1 in separate specifications. In each case, we find that none of the coefficients are statistically significant, while the adjusted $R^2$ remains low.

In Model 5, we incorporate all three indicators of provision as regressors. We now find that trust in government is statistically significant, suggesting that those people with higher levels of trust in government are, on average, more likely to rate the quality of public schools higher, holding other regressors constant. The number of public schools per capita is also statistically significant, though with a negative coefficient. This could imply that the greater access people have to public schools, the lower is their perceived quality of these schools, holding other factors constant. This is consistent with our theoretical argument that an increased exposure to public services often makes people more critical about those services. The regression specification shown in Model 6 provides the highest adjusted $R^2$ (0.87). Both trust in government and trust in public service providers are positively significant.

| Perception of Quality in Public Schools | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 |
|---|---|---|---|---|---|---|
| Trust in Government | 0.647 (0.389) | 0.718 (0.440) | 0.714 (0.347) | 0.816 (0.433) | **1.371**[*] (0.283) | **1.319**[***] (0.193) |
| Trust in Service Provider | 0.420 (0.381) | 0.400 (0.427) | 0.606 (0.474) | 0.573 (0.308) | 1.820 (0.485) | **1.313**[***] (0.211) |
| age (min:29.9, max:37.9) | -1.593 (2.222) | -0.912 (4.167) | -2.314 (2.620) | -0.629 (3.419) | -1.700 (2.120) | |
| income (min:1.1, max: 2.5) | 1.794 (9.718) | 3.235 (12.80) | -0.0728 (9.364) | 1.783 (10.53) | -10.20 (9.057) | |
| married (min: 45%, max: 75%) | 29.78 (63.96) | 16.96 (92.76) | 40.34 (79.57) | 17.20 (71.19) | 53.38 (59.05) | |
| education (min: 2.8, max: 5.1) | 0.0180 (6.404) | -1.069 (7.910) | 0.834 (8.036) | -1.817 (6.197) | -2.267 (5.216) | **-5.212**[**] (1.240) |
| urban (min: 20%, max: 81%) | -17.29 (15.46) | -18.78 (17.87) | -22.06 (16.85) | -24.68 (19.45) | -61.81 (18.49) | **-54.19**[***] (6.142) |
| centre[*1] | 10.43 (11.46) | 9.858 (14.05) | 12.74 (10.88) | 16.44 (11.03) | 51.21 (18.44) | **33.40**[***] (4.556) |
| workstatus (min: 34%, max: 64%) | -10.27 (52.93) | -6.936 (56.75) | -9.691 (54.75) | -8.329 (49.92) | -14.72 (26.50) | |
| Student-teacher ratio[*2] | | 0.134 (0.405) | | | -0.652 (0.639) | |
| No of public schools per capita[*2] | | | -4.481 (4.091) | | **-11.78**[*] (2.242) | **-11.88**[***] (1.408) |
| Per-student education spending[*2] | | | | -0.0448 (0.0673) | -0.238 (0.0990) | **-0.144**[***] (0.0263) |
| _cons | 14.86 (50.19) | -7.866 (104.8) | 28.81 (50.87) | -9.402 (77.55) | 33.73 (76.99) | -22.11 (16.91) |
| N | 15 | 15 | 15 | 15 | 15 | 15 |
| adj. $R^2$ | 0.245 | 0.079 | 0.206 | 0.156 | 0.732 | 0.866 |

Standard errors in parentheses
[*] $p < 0.05$, [**] $p < 0.01$, [***] $p < 0.001$
[*1] Dummy variable which is one if the state is classified as "centre" and zero otherwise. See sub-chapter 2.4 for the definition of centre/periphery.
[*2] See Table 1 in sub-chapter 2.3 for the description of the variable from non-survey data.

**Table 9 - OLS estimates for the determinants of perception of quality in public schools, at the state-level.**

## (B) Health

Table 10 show the OLS regression results for the health sector (using provision data, cf. Table 1, Chapter 2.3). The specification scheme of regressors is comparable to that used for the education sector: Model 1 uses socioeconomic and demographic variables (state means),

Models 2-5 alternate the provision data as additional regressors and Model 6 uses all three provision data indicators.[87]

With respect to the health sector, Model 5, which uses the "% Non- ARI-treated children" was shown to be the specification with the highest adjusted $R^2$ (0.93); in this specification many regressors are identified as being statistically significant. Surprisingly, trust in service providers is found to be negatively statistically significant. This is in contrast to what we saw at the individual-level analysis in sub-chapter 3.3. However, this can be reasonably understood by observing that trust in service providers also shows a significant negative correlation with the provision data regressor "% Non- ARI-treated children". This implies that a significant part of the explanatory power of trust in service providers in explaining the perception of service quality in public hospitals has been "absorbed" by the provision data, with which trust in service providers is negatively correlated. Thus, in turn, the indicator for the "% Non- ARI-treated children" negatively impacts the perception of service quality for public hospitals. Interestingly, the percentage of non-ARI treated children is the only indicator of provision found to be significant in our analysis for health. This is imperative when we consider what forms of provision are most influential in determining perceptions, with this result indicating that, for health at least, outcome-based provision is particularly important.

This result highlights one of the main benefits of state-level analysis using provision data; with only the DFID Sudan individual survey data in sub-chapter 3.3, we were only able to interpret somewhat abstract implications about the relationship between trust and the perception of quality, offering more limited implications for specific evidence-based policy linked to each of the public services. Here, the inclusion of provision data has allowed us to gain a more informed understanding of the role of trust in explaining the perception of service quality, as well as offering a platform for the use of provision data.

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[87] The negative values of adjusted $R^2$ (or $\bar{R}^2$) may also seem puzzling, but are nothing to be surprised of; it can be negative when $R^2$ is small relative to the ratio of the number of regressors to the number of observations ($N$), as is clear from its definition:
$$\bar{R}^2 = 1 - (1 - R^2)\frac{N-1}{N-p-1} = R^2 - (1 - R^2)\frac{p}{N-p-1}.$$

| Perception of Quality in Public Hospitals | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 |
|---|---|---|---|---|---|---|
| Trust in Government | 0.322 (0.653) | 0.837 (0.670) | 0.817 (0.773) | 0.336 (0.714) | 0.0142 (0.116) | -0.0289 (0.402) |
| Trust in Service Provider | 0.209 (0.622) | 0.586 (0.560) | 0.668 (0.640) | 0.112 (0.712) | **-0.840**[*] (0.187) | -0.881 (0.532) |
| age (min:29.9, max:37.9) | -0.426 (2.737) | 0.649 (2.553) | 0.652 (2.780) | 0.231 (3.392) | 0.759 (0.712) | 0.618 (1.373) |
| income (min:1.1, max: 2.5) | 8.965 (18.38) | 6.681 (14.44) | 15.25 (17.43) | 6.928 (22.18) | **13.15**[*] (4.472) | 15.90 (9.647) |
| married (min: 45%, max: 75%) | -31.24 (95.21) | -78.10 (94.78) | -52.17 (98.54) | -40.34 (112.8) | **-116.0**[*] (26.49) | -113.3 (60.00) |
| education (min: 2.8, max: 5.1) | -4.822 (9.429) | -8.180 (8.370) | -7.295 (6.890) | -7.387 (13.08) | **-12.17**[**] (2.303) | -11.66 (3.955) |
| urban (min: 20%, max: 81%) | -24.46 (21.13) | -28.62 (16.11) | -36.26 (19.34) | -22.19 (23.17) | **-28.17**[**] (4.632) | -30.63 (12.05) |
| centre[*1] | 2.717 (16.50) | 11.56 (12.94) | 4.859 (16.10) | -1.513 (17.00) | **-24.14**[**] (4.142) | -26.38 (12.40) |
| workstatus (min: 34%, max: 64%) | 9.005 (76.19) | 60.54 (55.58) | -3.748 (62.65) | 18.15 (92.15) | -30.58 (17.08) | -50.61 (44.59) |
| No. of Health Centres per capita[*2] | | -0.182 (0.0824) | | | | 0.0408 (0.0822) |
| No. of Hospitals per capita[*2] | | | -11.35 (8.327) | | | -2.293 (5.596) |
| % Non-immunised Children[*2] | | | | -0.413 (0.645) | | 0.131 (0.277) |
| % Non- ARI-treated children[*2] | | | | | **-1.315**[***] (0.122) | -1.415 (0.310) |
| _cons | 39.79 (79.58) | -17.34 (77.29) | -13.42 (95.95) | 50.32 (92.03) | **222.4**[**] (30.71) | 235.1 (75.45) |
| N | 15 | 15 | 15 | 15 | 15 | 15 |
| adj. $R^2$ | -0.401 | -0.094 | -0.340 | -0.607 | 0.933 | 0.809 |

Standard errors in parentheses
[*] $p < 0.05$, [**] $p < 0.01$, [***] $p < 0.001$
[*1] Dummy variable which is one if the state is classified as "centre" and zero otherwise. See sub-chapter 2.4 for the definition of centre/periphery.
[*2] See Table 1 in sub-chapter 2.3 for the description of the variable from non-survey data.

**Table 10 - OLS estimates for the determinants of perception of quality in hospitals, at the state-level.**

## (C) Water[88]

We use provision data for water from the Sudan Household Survey 2010 and data on accessibility from the DFID Sudan survey 2012. Interestingly, only the provision of water on household premises has a significant effect on perceptions of water service quality (Table 11,

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[88] Note that, in the state-level analysis, we refer only to water since provision data is specifically related to this aspect of WAS.

Model 6). This indicates that people have a preference for access to improved drinking water in their own homes above access from community sources.

| Perception of Quality in Water Service | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 |
|---|---|---|---|---|---|---|
| Trust in Government | 0.432 (0.380) | -0.154 (0.886) | 0.506 (0.566) | 0.506 (0.402) | -0.137 (0.314) | -0.188 (0.268) |
| Trust in Service Provider | 0.370 (0.419) | -0.269 (0.731) | 0.321 (0.457) | 0.384 (0.420) | -0.540 (0.403) | -0.448 (0.422) |
| age (min:29.9, max:37.9) | 0.622 (2.127) | 4.085 (3.647) | 0.918 (2.840) | 0.116 (1.997) | 1.157 (1.084) | |
| income (min:1.1, max: 2.5) | 7.049 (10.23) | 28.78 (26.04) | 6.934 (9.727) | 7.354 (9.839) | 18.59* (5.893) | 16.74 (8.091) |
| married (min: 45%, max: 75%) | -53.86 (59.33) | -166.7 (110.0) | -55.99 (62.54) | -49.57 (53.53) | -83.94* (21.20) | -49.57 (24.50) |
| education (min: 2.8, max: 5.1) | -1.465 (5.958) | -6.430 (5.718) | -2.900 (7.766) | -0.956 (5.742) | -11.61* (3.941) | -8.173 (5.569) |
| urban (min: 20%, max: 81%) | -37.05* (12.80) | -56.58 (23.54) | -36.73 (14.31) | -27.36 (18.45) | -42.61** (7.949) | -39.87** (7.961) |
| Centre[*1] | 7.717 (12.06) | -17.58 (30.63) | 7.561 (13.36) | 2.223 (17.04) | -13.66 (6.527) | -11.52 (7.331) |
| workstatus (min: 34%, max: 64%) | 42.98 (51.47) | 17.18 (68.53) | 51.44 (62.01) | 35.01 (51.87) | 29.58 (17.82) | |
| Perception of Accessibility | | 0.214 (0.218) | | | | |
| Mean time to source of water[*2] | | | -0.0633 (0.206) | | | |
| % Using improved water sources[*2] | | | | 0.143 (0.204) | | |
| % Using water on premises[*2] | | | | | 0.516 (0.193) | 0.514* (0.201) |
| _cons | -19.28 (69.35) | -5.796 (79.00) | -26.27 (86.20) | -17.88 (71.80) | 76.24 (53.25) | 96.35 (50.34) |
| N | 15 | 15 | 15 | 15 | 15 | 15 |
| adj. R² | 0.398 | 0.360 | 0.261 | 0.289 | 0.797 | 0.827 |

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
[*1] Dummy variable which is one if the state is classified as "centre" and zero otherwise. See sub-chapter 2.4 for the definition of centre/periphery.
[*2] See Table 1 in sub-chapter 2.3 for the description of the variable from non-survey data.

**Table 11 - OLS estimates for the determinants of perception of quality in water provision service, at the state-level.**

## 3.5 Vertical and horizontal inequalities in our results

In Chapter 3 we find, using individual-level analysis, that there is a strong relationship between our indicators of inequality: geographic, gender, income and education-based inequalities, and perceptions of service quality. For example males, higher educated individuals and individuals in urban areas were found to have lower levels of trust in service providers than their counterparts, and, with trust in service providers as a mediator, lower perceptions of service quality across the sectors. Thus we also saw how these inequalities are, by themselves, "mediated" via trust in government and trust in public service providers. We also noted that certain inequalities have a direct relationship with perceptions of service quality, for example higher income was found to be directly correlated with higher perceptions of public school quality. However, we also noted that certain inequalities have a direct relationship with perceptions of service quality, for example higher income is directly associated with higher perceptions of public school quality.

To account for the role of actual provision in determining perceptions, we incorporated data from other sources, available at the state-level, into our regression analysis. For each service, we identified at least one proxy for provision expected to influence perceptions. We found that at the state-level, results were more nuanced across the services but horizontal and vertical inequalities were still relevant in explaining variation in perceptions. For example, in the case of public hospitals, we found that states with higher levels of trust, lower incomes, higher levels of education and those located in the centre reported lower perceptions of hospital quality than their counterparts, holding other characteristics constant. We also find that certain proxies for provision are relevant factors in explaining variation in perceptions, confirming our hypothesis from the theoretical model devised in sub-chapter 2.6.

These results are critical for understanding what drives perceptions of service quality in the Sudan, and for highlighting in particular the role of inequalities within and across service sectors. In Chapter 4, we discuss some of the primary limitations associated with our data and analysis, as well as providing some suggestions for how we might overcome these difficulties.

# 4 Survey and data analysis limitations

This chapter aims to discuss the limitations to our analysis in Chapters 2 and 3 and provide methods of accounting for and overcoming these limitations. First, in sub-chapter 4.1 we address the limitations of the DFID 2012 and 2013 household survey data by discussing the data collection problems, response bias, and question content and phrasing. Then, in sub-chapter 4.2, we discuss the limitations of the models we produced in Chapter 3 with respect to reverse causality between trust in public institutions and perceptions of service quality and political affiliation and ethnicity as omitted variables. We offer in this sub-chapter methods to overcome these limitations in part and discuss the implications of these limitations in formulating policy recommendations from our analyses.

## 4.1 Limitations of the survey data[89]

### Data collection

Though the survey design was constructed to ensure the representativeness of the sample, problems of data collection still serve as a limiting factor. This is especially problematic in conflict-affected areas, as well as more generally in countries with authoritarian regimes. Cohen and Arieli characterise the methodological problems with data collection in conflict environments as follows: lack of contact information, lack of system information, cultural differences, legal, political, and ideological constraints, technical accessibility and an atmosphere of fear and distrust.[90] Of these problems, the SPSC reported technical constraints in their field report, stating that in some states, including South Kordofan, Blue Nile, and the Darfur states, security conditions prevented the data collectors from meeting their initial targets for the sample. Technical accessibility problems also pose obstacles in designing appropriate sampling frameworks and actually locating individuals to interview in specific regions.[91] Authoritarian regimes, moreover, further exacerbate the existing technical constraints through restrictive practices on researchers wishing to collect and use public opinion survey data.

It should be noted that Nomadic communities are concentrated in specific areas of the Sudan and are not widely represented in the DFID survey data, primarily due to sample size. Similarly, other ethnic groups prevalent in Sudan are also relatively under-represented.[92] As such, we will not be able to make direct inferences about policy recommendations for these marginalised groups and any inferences we make come from the strong links we observe between socioeconomic variables and ethnic identity.

### Response Bias

The nature of the political system in Sudan also impacts the substantive validity of the data, especially when it reflects politically sensitive information. Respondents may feel pressured to provide responses that do not reflect their views due to societal pressures and fear of reprehension. Tests can be used to determine the substantive validity of survey data by comparing the responses to "critical questions" in which the respondent can express criticism of the regime and "non-critical questions" in which the respondent does not have an opportunity to do so, in terms of the variance of response and non-response.[93] These issues are in part

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[89] Due to the limited scope of this paper we have included limitations with respect to sampling weights in Appendix 4.
[90] Cohen/Ariele, 2011
[91] Alexander Hamilton, the DFID Sudan Statistics Advisor, raised similar concerns regarding data collection in conflict-affected areas at a lecture given at the LSE in 2013 (Hamilton, 2013).
[92] Dyson-Hudson/Dyson-Hudson, 1980; Ryle/Willis, 2011.
[93] Horne/Baker, 2009; Horne, 2011.

investigated by analysing the non-responses to key questions used in our analysis. According to the questionnaire used for the DFID Sudan 2013 survey, respondents were given an option of responding to the question on service rating with "don't know." If respondents did not rate or select "don't know," their responses were coded as "refuse to answer." It should be noted that because the question is phrased, "For those services that you do access..." it is possible that some respondents who refused to answer did so because they do not have access to the service. Table 12 indicates that the non-response for public schools and public hospitals is similar, with 0.9 percent "don't know" responses for each and 0.2 and 0.3 "refuse to answer" responses, respectively. Non-response for WAS, at least the "don't know" responses, was significantly higher at 2.5 percent.

| Rating of service quality | (score) | Public Schools | | Public hospitals | | Water & Sanitation | |
|---|---|---|---|---|---|---|---|
| | | n | % | n | % | n | % |
| Extremely poor | (0) | 623 | 26.3 | 765 | 32.4 | 925 | 39.1 |
| Poor | (25) | 653 | 27.6 | 787 | 33.3 | 630 | 26.6 |
| Suitable | (50) | 737 | 31.2 | 545 | 23.0 | 478 | 20.2 |
| Good | (75) | 241 | 10.2 | 181 | 7.7 | 205 | 8.7 |
| Excellent | (100) | 86 | 3.6 | 60 | 2.5 | 57 | 2.4 |
| Don't know | (N/A) | 21 | 0.9 | 20 | 0.9 | 58 | 2.5 |
| Refuse to answer | (N/A) | 4 | 0.2 | 7 | 0.3 | 12 | 0.5 |
| Total | | 2,365 | 100 | 2,365 | 100 | 2,365 | 100 |

**Table 12 - Non-respondents in the DFID Sudan 2013 survey.**

## Question content and phrasing

With respect to the content of the questions, we believe that several additional questions could be added to household survey in order to improve the data collected.[94]

The translation of the English questionnaire into Arabic for the purposes of the data collection, and the use of the English rather than Arabic questionnaire for the interpretation of results, reflects cultural differences in terms of language that may lead to misinterpretation or misunderstanding of the results.

Further consideration should also be given to the question ordering in the survey. This would go some way towards recognising that this is particularly important in public service related questionnaires. Evidence from recent experiments "suggests that the order of questions in a citizen survey has important effects on reported satisfaction with specific public services as well as overall citizen satisfaction".[95] For example, in our survey data, the question on what respondents believed is the biggest issue facing Sudan today gave respondents an option to choose three out of 22 possible responses. The ordering of these possible responses would make it likely that respondents choose responses at the top rather than at the bottom of the list ceteris paribus.

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[94] These include: 1. Actual access to a public service (respondents were only asked to rate the public service and the gap in access between Khartoum and their respective hometown); 2. Frequency of usage of a public servce; 3. Categorical ethnicity questions excluding the possible answer "Sudanese" (80 percent of the respondents in the 2013 survey answered that they see themselves as Sudanese; it would be more interesting to find out about their primary self-identification beyond this).
[95] Van de Walle/Van Ryzin 2011.

## 4.2 Limitations of the models

Having discussed our concerns regarding the validity of the survey data, we will now elaborate on the limitations of the models that we developed in Chapter 3.

### Reverse causality between trust and perceptions of service quality

There is an existing academic polemic as to the direction of causality between trust in public institutions and the perception of public services.[96] It is therefore relevant to consider that the perception of public services is likely to play a role in determining peoples' trust in public institutions, in addition to trust being a determinant of perceptions. In our theoretical model, developed in sub-chapter 2.5, we hypothesised the following:

$y = f(\{x_j\}, \{p_k\})$, where

$\quad\quad y \quad$ = indicator of the rating of public service quality,

$\quad\quad \{x_j\}$ = socioeconomic and demographic variables,

$\quad\quad \{p_k\}$ = predispositions towards service qualities (including "trust" factors).

If a second causal relationship between the perception of public services and trust in the reversed order: $p_k = g(\{x_j\}, y)$, could exists then our resulting estimates of the effect of trust on perceptions of public service quality would be biased and we will not be able to correctly capture the true effect of other variables.

A potential method to overcome this reverse causality is to use an instrumental variable to capture only the variation in trust that is exogenous to the model, which could then be used to explain variation in perceptions of service quality. Several authors propose and use instruments to separate endogenous and exogenous variation in trust.[97]

The use of ethnic heterogeneity of a society as an instrument for trust in public institutions is particularly compelling. Several papers have shown a correlation between the ethnic complexity in a given society and the level of trust in public institutions held by individuals living in that society, finding that homogenous societies tend to have higher levels of generalised trust than heterogeneous societies.[98] If this held true, and ethnic diversity were exogenous to perceptions of service quality, then ethnicity at a locality or higher level could serve as an instrument for individual-level trust.

The exogeneity has yet to be thoroughly investigated. First, it should be analysed whether regions within the Sudan with more heterogeneous ethnic composition receive different levels of actual service provision compared to more homogenous regions. Second, whether ethnic diversity changes perceptions of service quality independent of actual provision. Limited research has found that people do have strong preferences towards ethnic minorities in the utilisation of public services.[99] It should be noted however, that the studies cited here must be examined more closely for external validity.

It is likely, however, that there will be data collection problems in the effort to collect longitudinal data. In the event that DFID cannot collect panel data in which the same observations are surveyed in each year, it may be possible to exploit the idea of a "state-averaged" ethnicity measure in which each state is considered to have unique characteristics in terms of socioeconomic and demographic factors. Following valid justification, we may be able to utilise this instrument to analyse the relationships between "state-average perception of service quality", "state-average trust" and "state-average socioeconomic and demographic variables." In either of these cases, a more appropriate measure of ethnicity needs to be collected in the survey data to extrapolate the ethnic heterogeneity of the locality- or state-level.

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[96] Christensen/Leigreid, 2005, for a review.
[97] Horvath 2012; Tabellini 2005; Guiso et al, 2003, 2006; Putnam 1993; and Blum/Dudley, 2001.
[98] Knack/Keefer, 1997; Hakansson/Sjoholm, 2005; Alesina/La Ferrara, 2000
[99] Chan and Wong, 2009

## Highlighting potential key omitted variables

A key limitation of our analysis is that there is potential omitted variable bias that could be correlated with both perceptions of service quality and trust or one of the demographic or socioeconomic independent variables. These could include ethnicity of the respondent, religious conservatism, private opinion on the optimal level of state interventionism and political affiliation. We focus here on political affiliation and religious conservatism, as being relatively unique, seem to be key concerns in the context of Sudan.

There may be a correlation between political affiliation and trust in public institutions. A recent survey, conducted by Ipsos Mori on the needs of citizens in terms of public service provision, found that "views on how involved the state should be are strongly linked to party political affiliation, and it is clear that these political views will shape expectations of public services."[100] Though these studies may be limited in their external validity, the importance of politics in perceptions of service quality in Sudan were highlighted in our qualitative interviews, where financial support at the state-level was often contingent on political affiliation. Though political affiliation was relevant to consider in our analysis, there were several limitations to the survey data on individuals' political preferences; first, as previously, questions on political preferences within the survey are subject to severe response bias. Second, the interpretation of these variables was not always straightforward and, in most cases, these variables were not significant in explaining perceptions of service quality.

The Sudan is a predominantly Muslim state and all schools are required to provide Islamic education from preschool through university; public schools are not required to provide religious education to non-Muslims[101]. Hommel and Calzato[102] find that early religious exposure impacts perceptions, they term this as attentional bias: the tendency of our perception to be affected by recurring exposure and thoughts. The authors discuss how neo-Calvinist theology emphasises individualism and Catholic theology emphasises collectivism. After controlling for ethnicity, culture, age and IQ they find that neo-Calvinists display a bias towards local perceptions whereas Catholics are more inclined to notice global events. This study, and the Sudan context, indicates that religious affiliation could be an omitted variable affecting both perceptions of public services and being correlated with socioeconomic factors and demographics.

## Use of provision data

In our state-level regression analyses in sub-chapter 3.4, we used provision data as explanatory variables of perceptions of service quality. The fact that these data were collected by different survey bodies in different years than the 2013 DFID Sudan data could have resulted in threat of internal validity, or the consistency of the data, in our regression analyses.[103]

Moreover, limited availability of background information on the provision data prevented us from examining the most up-to-date and accurate status of the actual provision of services. Furthermore the data itself should be treated prudently given the subjectivity of provision data to political influence. Although we assumed the validity of these provision data when we used them in our regression analyses, it would be desirable to have a careful examination of the validity and consistency of the data any future studies, as it would allow further triangulation and thus validation of the methodology, as well as further potential refinement and extension of the model.

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[100] Ipsos Mori, 2010.
[101] Berkey Centre, 2014.
[102] Hommel/Calzato, 2010.
[103] Please refer to Table 1 for a table detailing the sources of the provision data used in the analysis in sub-chapter 3.5.

## Model refinement

The specification of our regression functions, or path-diagrams, could have been further refined. For example, in the state-level regression analysis of sub-chapter 3.4, some of the variables from the non-survey data were significantly correlated to each other and may have been causally related, for example, the per-student education spending and the student-teacher ratio for education service. This was not accounted for when we constructed our OLS regression models, which may have led to biased estimates for our variables of interest. Although the fact that there are only 15 observations (15 Sudanese states) in the regression model makes the statistical treatment of the data, especially the goodness-of-fit tests of the regression models therein, rather difficult in terms of accounting for standard errors in the model, we expect that a proper implementation of SEM technique would again make it possible to obtain more refined regression estimates.

# 5 Evidence-based policy for inequalities in public services

In the previous chapters of this report, we aimed to identify and analyse the main inequalities in both provision and perceptions of public services in Sudan. Our findings show that there are a number of significant horizontal inequalities across services. These could arguably be "an important source of grievance and potentially of instability, independent of the extent of vertical inequality"[104]. Thus, it makes sense for DFID Sudan to measure and address inequality through evidence-based policies with a particular focus on horizontal inequalities and perceptions, based on research on the importance of these interacting factors in the conflict-context. In this final part of the report we outline how our results can be used to inform policy. We first briefly outline DFID's current role in Sudan; then, in sub-chapter 5.1, we propose new indicators by which DFID Sudan can measure its progress; and finally, in 5.2 we use our findings to discuss policy recommendations.

It is DFID's vision to work towards "a Sudan which is at peace with itself and with its neighbours and where government has the capacity and political will to meet the needs and aspirations of all its people".[105] To achieve this, DFID Sudan focuses on five strategic priorities for 2011-2015, of which three reflect the sectors we have analysed in this report.[106] DFID aims to integrate different sectors and priorities to avoid fragmentation and vertical implementation and cooperates with international and non-governmental organisations, with most programmes being implemented through the UN.[107] However, following the secession of South Sudan in 2011, many international donors have left Khartoum and aid spending has decreased significantly, including with respect to DFID Sudan.[108]

## 5.1 Indicators on service inequality

Currently, there are two main indicators in DFID's operational plan which relate specifically to the public services analysed in this report (Table 13). These indicators focus primarily on service outputs. However, as our findings on the perceptions of service quality show, a focus on outputs in public services alone does not allow for insights into existing inequalities in both service provision and perceptions.

| | Education Programme | Health Programme | WAS Programme |
|---|---|---|---|
| **Current DFID Inputs** | DFID Sudan's education programme is currently suspended, a new programme might be planned in the near future | £5 Mio. (2012/13 – 14/15) | £22 Mio. (2012/13 – 14/15) |
| **Current DFID OP Indicator** | - | Number of people reached by health and nutrition-related programmes through - DFID support in Sudan – 2,701,857 (yearly result, 2014) | Number of people with access to clean drinking water sources with DFID support - 1,053,563 (cumulative result, 2011 - 2015) |

**Table 13 - Current DFID activities by sector.**
**Source: DFID Operational Plan, authors of this paper**

Figures 10-14 in sub-chapter 2.3 point to the possibility of creating two insightful indicators that are, in combination, able to capture inequalities across groups. First, we can measure the average perception of service quality for those groups identified as having unequal

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[104] Stewart et. al, 2005.
[105] DFID Sudan, 2013.
[106] DFID Sudan, 2013.
[107] DFID does not work with the federal government but with some of the state-level and local governments.
[108] ICAI, 2013.

access, inequality in service provision, as identified in Chapter 2. For example, we can measure the average perception of quality of public schools for women, measured in year t, which can be denoted: $PoQ_{school}(female)_t$. DFID's strategic aim surrounding this measure would be, by a particular group identified as having unequal access, to contribute to an increase in this indicator over time. In the 2013 DFID household survey data, $PoQ_{school}(female)_t$ = 34.8, on a scale from 0 – 100; here, we would aim to see an increase in this value over time.

The second possible indicator is to measure the gap between the two groups in each inequality category by taking the ratio of the perception of quality ratings for each of these two groups. For example, this could mean taking the ratio of perception of school quality for men and women to measure gender inequality in public schools. DFID could also, as another example, use the rural-urban ratio of perception of water quality measured in year t as an indicator of the gap between rural and urban areas:

$$R_{water}(rural/urban)_t = PoQ_{water}(rural)_t/PoQ_{water}(urban)_t.$$

The aim with respect to this measure of inequality should be to contribute to a decrease in this indicator over time. In the 2013 DFID household survey data, $PoQ_{water}(rural)_{2013} = 31.5$ and $PoQ_{water}(urban)_{2013} = 28.3$, hence the gap indicator for this service is computed as $R_{water}(rural/urban)_{2013} = 31.5/28.3 = 1.12$. This tells us that, on average, those living in rural areas have a 1.12 times higher perception of quality in water services than those in urban areas. If DFID aimed to decrease inequalities across groups in the inequality categories, it could use these indicators as a measure of its effectiveness in doing so.

For further clarity, the proposed indicators, PoQ and *R,* are depicted in Figure 25, using rural-urban inequalities as an example. Diagram (a) shows a scenario where the perception of quality has increased and the inequality has decreased: an example of a successful result. Conversely, in scenario (b), though the gap between rural and urban has decreased, the overall perception of quality has substantially decreased. In the prior scenarios there are not significant differences between the sectors. However, if it is the goal of DFID to balance priorities across sectors, then scenario (c) is an example of problematic resource allocation. Although the PoQ- and the *R*-indicators improved for WAS services, the PoQ-indicators for the other service sectors decreased significantly. These examples outline how both indicators together help to evaluate the perception of quality in each service sector, and that they need to be analysed interdependently.
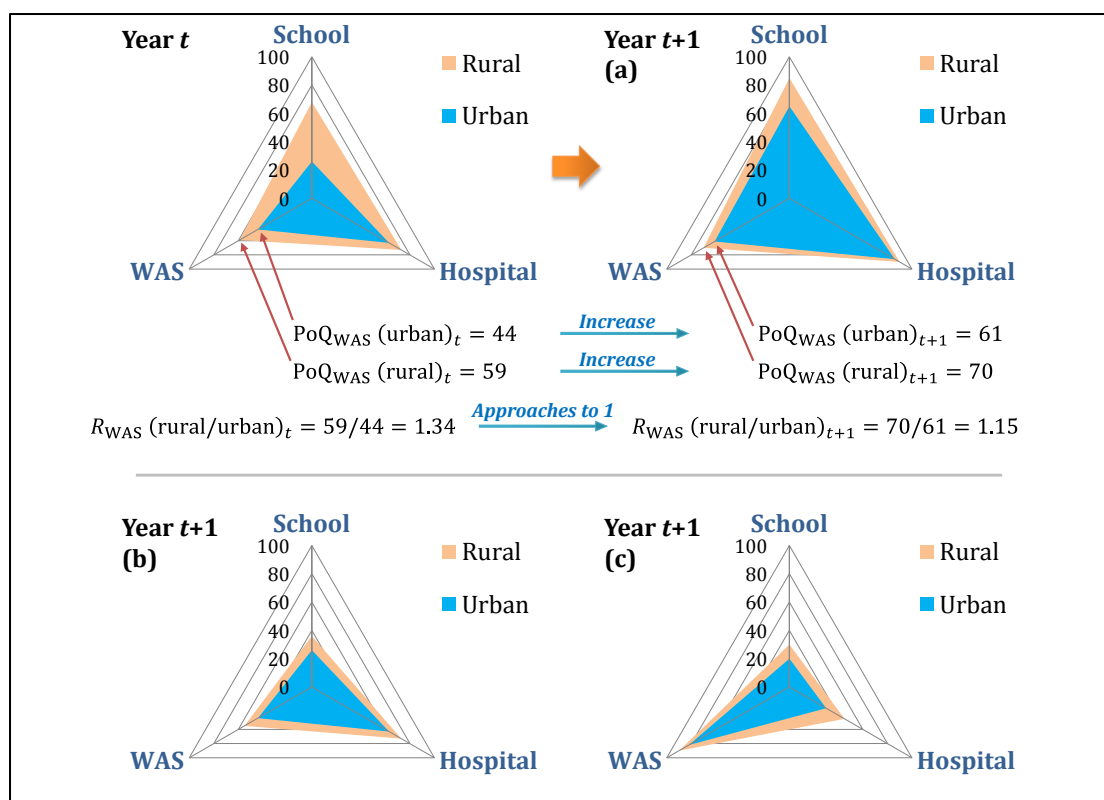
**Figure 25 – Possible indicators to capture perceptions of service quality.**

There are several advantages to using these two indicators to measure the effectiveness of public service provision policies with regards to horizontal inequalities. First, DFID Sudan would to be able to collect data needed to calculate both indicators on a regular basis, given the Sudan household survey is expected to continue over the coming years. This would allow DFID to capture the long-term trends with respect to the outlined inequalities. The indicators could also be applied beyond the three sectors outlined in this report, enhancing comparability. Furthermore, it would be possible to compare these indicators to other countries where the same or similar questions on the perceptions of service quality were asked in comparable household surveys. Finally, the indicators would allow DFID to measure outcomes, in addition to the current measurement of inputs and outputs. The combination of these three measurement categories could go a long way towards improving DFID's understanding of its value for money in Sudan, both through ex-ante and ex-post policy evaluation. Additionally, combined with rigorous regression models, as per Chapter 3, the indicators also point to possible entry points for policies aiming to improve public services while decreasing existing horizontal and vertical inequalities.

However, the indicators proposed here only provide insights into perceptions of service quality, it would furthermore be interesting to analyse them in combination with data on service provision, as analysed in Chapters 2 and 3. The limitations of data on service provision used in this report indicate that such an analysis would need to be investigated both methodologically and in terms of the technical constraints of data collection.

Having outlined how DFID could better measure its interventions with regards to public service inequality, we now move on to examine which policies could contribute to reducing public service inequality in the Sudan, based on the results of our analysis in Chapter 3.

## 5.2 Policy Recommendations

The main horizontal inequalities in public services analysed in this report are pertinent across all three sectors. In addition to tackling those through effective cross-cutting measures, for example by focusing on the periphery, DFID Sudan should consider the sector-specific measures we present below. Furthermore, we outlined several problems related to the governance and the political economy of public services in Chapter 2. While we could not investigate these issues further with the survey data at hand, qualitative interviews underlined the importance of these structures, especially with regards to the horizontal inequalities in public services. Any of the recommendations below should thus be seen in light of the underlying political economy. Of further significance in the governance of public services is the increasingly relevant privatisation of public services, particularly in parts of Sudan not directly affected by conflict.[109]

### Education

DFID Sudan initially aimed spending £6 million on its education programme until 2015, however, it recently suspended the programme. In South Sudan DFID initiated a large-scale girls education project in 2013, and in the Sudan DFID last funded a multilateral education project in 2005. The following recommendations might thus be relevant for a new programme in this area, which might be launched in the coming years.

A number of issues seem to be crucial in terms of countering the existing inequalities in education services. Firstly, though increased access to education is an important step this is only effective if accompanied by measures to improve the quality of education, as measured by indicators such as the student-teacher ratio. Our findings suggest that education policy in Sudan may have relatively unsuccessful, given that our state-level regression models suggest that the number of schools, as well as spending per-student, are negatively associated with perceptions of service quality, controlling for several variables including trust. Focusing on improvements in the quality of education is also in line with DFID's position paper on education that places learning at the core of education in development.[110] However, the positive correlation of the trust factors with the perception of school quality, both at the individual-level and in the state-level models, indicate that there is a close link between an emotional predisposition towards institutions and perception of education quality. It would be interesting for DFID to further investigate how trust in education institutions in the Sudan is formed and if the level of trust can be improved with, for example, more ownership at the local level. One possibility would be to collaborate closely with local school councils who understand local needs and might, through accountable and participative policies, drive improved education outcomes and perceptions of quality. While improving teacher quality is an essential part of this story, J-PAL recommend the employment of "young low-cost teaching assistants to help the weakest kids catch up".[111] This recommendation is based on the results of a large number of randomised experiments in remedial education.

### Health

In DFID Sudan, the current health programme resources, amounting to £5 million (see Table 13 above), are implemented via humanitarian projects, focusing on the conflict-affected states in the country. At the same time, other programmes contribute to the achievement of health-related objectives as their impact overlaps. For instance, most of the WAS interventions promote hygiene, which in turn improves health. DFID Sudan is currently developing the implementation of a new programme ("SHARP").

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[109] Aside from this, one of the main structural concerns in public services in Sudan remains the long-term financing of public services, as transfers from the centre decreased significantly over the past years. To address this, regionally-targeted and sustainable strategies are needed for all sectors.
[110] DFID 2013b.
[111] Crawfurd 2013.

Our analysis of health services produces similar results to those found in the education sector insofar as increased availability of health services, measured through outputs, is not associated with higher quality ratings in our models, whereas the actual delivery of services as measured by outcomes (ARI treatment rate for children) seems to play an important role (we see increased treatment in health services is significantly associated with better perceptions, holding all other variables constant). For DFID, this implies that a focus on the quality of health services should be prioritised over a quantitative increase in the availability of health outlets. In other words, the right balance should be struck between investments in infrastructure and management as well as health personnel capacity. Often, hospitals and PHCs only have minimum capacity, meaning people are unlikely to use them until they are seriously ill. This finding goes hand in hand with the health priorities outlined by the Ministry of Health as well as the World Bank, namely that upgrading and improving existing facilities to the Basic Health Unit level should be the main focus.[112] However, one has to note that the statistical relationship found in our model in Chapter 3 has its limitations, as the provision indicator used might not be representative for all health services, and as being treated with ARI might be correlated to other, unobserved factors.

## Water and Sanitation

The WAS sector is one of DFID Sudan's main priorities, with planned funds of £22 million for the period 2012/13 – 2015. Previously, DFID Sudan had mostly focused on the Darfur states. With its new "Water for Eastern Sudan" programme, DFID aims to move away from humanitarian to a long-term capacity building approach in this field. The new programme focuses on the states Red Sea, Kassala and Gedaref, and aims to "to strengthen local level capabilities to demand accountability but also to respond and deliver quality services and decision making processes".[113]

Much of the variation of quality perception of water services at the state-level is captured by the variable access to water on premises, whereas improved drinking water sources in the village have no significant association with perceived quality in our dataset. This indicates that people see a significant improvement in water services when their households have water directly delivered to their homes, which DFID might want to prioritise over village access to drinking sources. However, as with health, and education, we must emphasise the limitations of the provision data used for analysis in this report.

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[112] Federal Ministry of Health of the Republic of Sudan, 2007.
[113] DFID Sudan, 2013.

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# APPENDICES