# Ladders for assessing and costing water service delivery

## An excerpt from WASHCost working paper 2 as input for MUS Cost-Benefit Analysis, Netherlands, 22-26 February 2010

Moriarty et al. 2010

**This working paper introduces the concept of service levels grouped into ladders as a way of differentiating between broad and recognizable types (levels) of service. By developing this concept, we intend to provide a structure to analyse the data being collected in different countries and settings, not just in terms of the technologies being used, but in terms of the services being received.**

**It is a working document for the WASHCost team, setting out current thinking on the topic. As such, it represents work in progress and will undoubtedly evolve. The service delivery ladder as a concept and as a framework for analysis will be both *used* and *tested* by WASHCost.**

**To this end, comments and feedback are actively solicited from interested parties.**

## 1. Introduction

WASHCost is a five year action research project investigating the costs of providing water, sanitation and hygiene services to rural and peri-urban communities in Ghana, Burkina-Faso, Mozambique and India (Andhra Pradesh). The objectives of the collection and disaggregation of cost data over the full life-cycle of WASH services are to better understand the drivers to costs and then, to enable a more cost effective and equitable service delivery (see www.washcost.info).

At the heart of the approach used by WASHCost is the concept of disaggregating the costs of service provision over the different phases of the service delivery life-cycle. This is illustrated in the matrix below (Table 1), which shows the main phases of service delivery –initial capital investment, operation and minor maintenance, and major repairs and upgrades. It includes support costs to service provision both direct and indirect. The table also incorporates different aspects of service delivery: the management of the water resource base, the provision of service delivery infrastructure, and the costs associated with users and their access to the service. Within each cell of the matrix, different cost data can be collected and analysed. Typically, data within each cell will require further disaggregation as the main cost drivers become clear.

### Table 1: WASHCost Life Cycle Cost Components for Water Services (Fonseca et al, 2010)

| Life Cycle Cost Components: *Water Services* | **Resources** *Costs involved in sustainable provision of water resources of required quantity and quality* | **Infrastructure** *Costs incurred by service providers when constructing, operating and maintaining water supply infrastructure* | **Demand/Access** *Costs incurred by users who routinely access formal, informal and private water supply systems to meet normal demands. Also costs incurred when accessing alternative sources during system failures* |
|---|---|---|---|
| ***Capital Expenditure – hardware (CapEx)*** | *Capital investment in fixed assets* | | |
| ***Capital Expenditure – software (CapEx)*** | *One-off work with stakeholders prior/during to construction or implementation* | | |
| ***Cost of Capital (CoC)*** | *Costs of raising capital for investment* | | |
| ***Operating and minor maintenance Expenditure (OpEx)*** | *Expenditure on labour, fuel, chemicals, materials, regular purchases of any bulk water.* | | |
| ***Capital maintenance expenditure (CapManEx)*** | *Expenditure on asset renewal, replacement and rehabilitation costs* | | |
| ***Expenditure on Direct Support (ExpDS)*** | *Post-construction support activities for local-level stakeholders, users or user groups* | | |
| ***Expenditure on Indirect Support (ExpIDS)*** | *Macro-level support, planning and policy making* | | |

In its current 'research' phase, WASHCost is collecting data about the actual costs of providing services in rural and peri-urban settings. The matrix is the main framework for the collection and analysis of costs related data in this phase. (see Briefing Note n.1 Life Cycle Cost Approach: glossary and cost components. 2010. Fonseca et al. Available www.washcost.info).

However, one challenge faced both within WASHCost and by planners and providers of water services, who want to use cost comparisons to underpin policy decisions, is to be sure that the comparisons they are making are legitimate. When one researcher or planner says 'it costs 25US$ per person to provide a water service', it must be made clear what the service consists of; whether different 'levels' of service can be identified, from the most basic wells or taps in every house.

This working paper, introduces the concept of service levels, grouped into a ladder, as a way of differentiating between broad and recognizable levels (types) of service. Using this concept, we hope to provide a structure to analyse the data being collected in different countries and settings, not just in terms of the technologies being used, but in terms of the services being received. We also hope, by bringing the whole concept of service delivery and service levels into discussion with sector colleagues,

to contribute to a shift in sector focus: from the roll out of new hardware, to the provision of sustainable services. We feel that clearly defined, nationally agreed, service levels will be essential to a meaningful analysis of whether expectations are being met.

The paper sets out the concept of service levels as a useful way of aggregating and benchmarking critical indicators of water service in a way that aids both planning and analysis. It is a working document for the WASHCost team, setting out current thinking on the topic. As such it represents work in progress and will undoubtedly evolve. There is more agreement and more certainty on some aspects that on others. Although WASHCost, as the name implies, looks at costs related to water and sanitation services, this paper concentrates on services; on how to identify and describe them in a way that aids comparison.

The paper is divided into four main sections: section 1, this introduction; section 2, an explanation of service levels and ladders, and discussion of their usefulness; section 3, a presentation of existing water service ladders, and of a proposed WASHCost ladder ; and section 4, a brief summary and identification of next steps .

## 2. Water service levels and ladders

This section introduces and defines the terms: water service, water service level, and water service ladder; and discusses why they are useful concepts to the sector and WASHCost.

### *2.1 What is a water service?*

For WASHCost, water services focus on the delivery of water to people. A conceptual difference is made between the service itself, loosely defined as the quantity of water of a given quality provided to users, and the system (both hardware and software) used to deliver it. In practice, the two are often closely related. For example, a borehole and hand-pump operated at the village level provide one type of service; a professionally managed network of household taps another. However, the difference between system and service is critical. By focussing on systems, more specifically the capital costs of rolling out new water supply infrastructure, engineers and planners risk losing sight of what they are (or should be) trying to achieve: counting the number of systems implemented – without looking to see if they are providing the service that they should.

Failing to ask critical questions such as: do the systems provide the design amount of water? Do they do so every day? Does everyone in the community (however defined) have access to them? Do they meet national norms for quality? A water service is defined by the answers to these questions. We propose that the water service accessed by an individual can only meet a certain standard or level when the answers to all these questions are in the affirmative. Therefore, a water service isthe provision of access to water in a way that meets a set of key indicators (or norms). Taken together these key indicators define the service. In the next sections, the key indicators will be discussed.

### *2.2 What is a service level?*

Based on the above definition of a service, it follows that a service level is a term used to describe and differentiate between qualities of service. Service level as a concept can be analysed within the context

of a ladder (see next section) in which each level is a step up from the previous one. As a service level is a collection of different indicators – some dependent and some independent of each other – its definition varies across countries.

The most common indicators against which the quality of water services can be assessed include: **quantity** (typically measured in litres per-capita per day) and **quality** (which itself is typically composed of one or more separate indicators looking at chemical and biological quality). There are other indicators either as international norms or used by many countries. Two important indicators that are also widely used are the **distance** between users and access points and the **number of people** sharing the point source. These can both be seen as proxies for ease of access. A final important indicator is **security** of the service, defined by its reliability of functioning at its defined level over time.

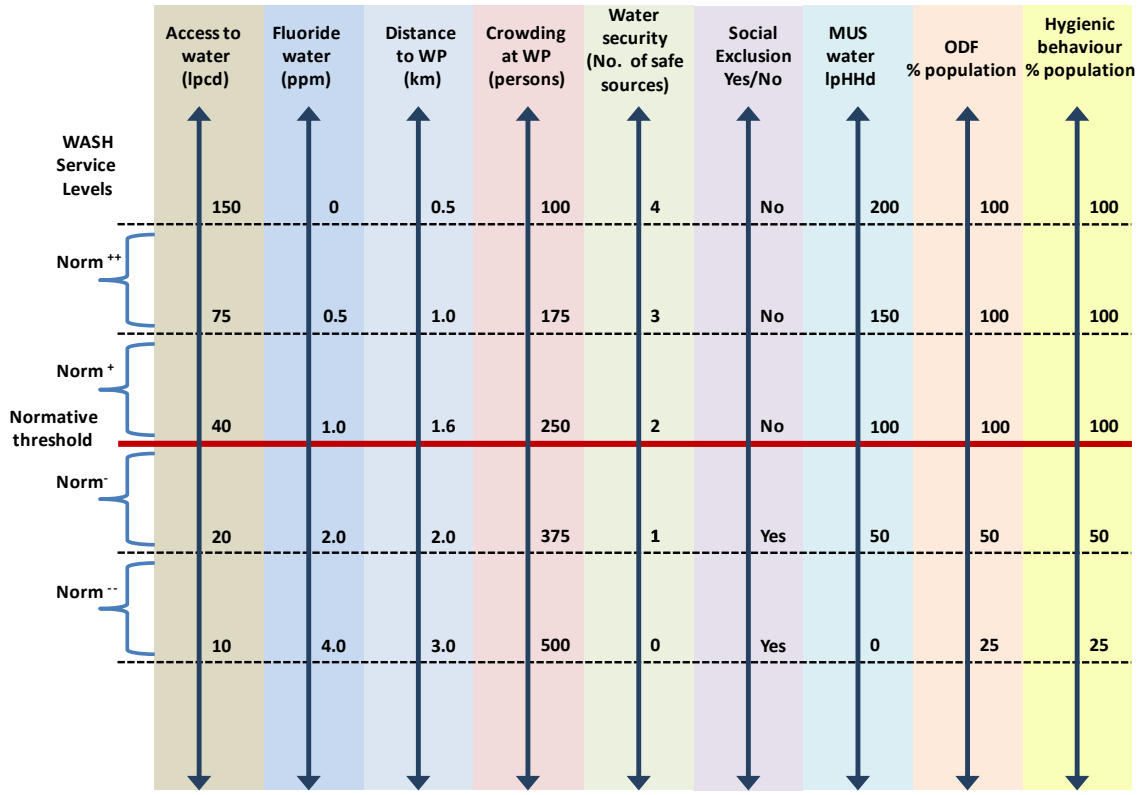
Figure 2, prepared by WASHCost India, shows some of the main indicators for assessing service quality in the Indian context. They have been grouped to show how, by setting a baseline for each key service indicator, overall service quality can be assessed as being either satisfactory or not satisfactory against an agreed norm. The logic of this approach is that failure of a received service to meet the norm on every indicator, will lead to the entire service being classified as non-satisfactory. In this example, apart from the indicators mentioned above, others have been added. One indicator deals with '**water security**' – a critical issue in India where water scarcity is a serious problem. Another indicator deals with '**social exclusion**' which is whether people are prevented from accessing water due to caste or other socially related issues. Finally the indicator of **MUS[1] water** which refers to access to water for non-domestic productive uses.

This Indian example demonstrates one of the problems facing policy makers (or WASHCost country teams) in trying to define service levels. Each indicator represents a continuum of possible values, and there are (at least in theory) an infinite number of possible combinations of indicators and values. This illustrates why differentiating between service levels is an essentially political choice, which should be negotiated between service providers and service users.

**In order to define service levels, one must decide on indicators and their values which will then be used for monitoring service quality. For many indicators, there are internationally accepted 'bottom lines' - for example WHO norms for drinking water quality, or JMP norms for improved and unimproved sources.**

[1] MUS is an acronym for Multiple Use Services. That is, services that are explicitly intended to meet the needs of people for both productive and domestic water. See Van Koppen et al 2009

**Figure 1: service levels used in WASHCost India work**




WP – Water point; MUS – Multiple Use Service (i.e. quantity of water available for non-domestic activities); ODF – Open defecation free. Source: WASHCost India team

## *2.3 Why use service level ladders?*

WASHCost looks at what it costs to provide WASH (in this case water) services to people, and eventually aims at doing so a more cost effectively. Benchmarking – the systematic comparison of the costs of providing services to different users - is a way of understanding, controlling and reducing the costs. Yet to benchmark a service – or to compare the costs of providing a service in different contexts or with different technologies - it is essential to first agree on 'what is the service'? What does the service consist of? how do we know when we have provided it? when every community member has access to an acceptable quality of service? How do we define the service, and more importantly how do we monitor it.

To be able to compare costs effectively, it is important to be sure that we are comparing like with like. To see whether one technical or management option is 'more efficient' than another we have first to agree on what it is we wish to achieve with them. Yet, as discussed before, because a 'service' as we understand it consists of a broad range of possible indicators, many of which are unrelated in practice, this becomes very difficult to do. What is more, we have strong reason to believe that improvements in service delivery are not linear with respect to costs, and that – in particular – there is a major leap between the most basic point-source type services and any form of networked service delivery.

Box 1 below illustrates the non-linear nature of services provided by different types of technology in South Africa (note that the level or quality of service provided is not defined other than in terms of quantity). While the very precise figures should, perhaps, be taken with a pinch of salt (ranges would have been more convincing), the main point to note is the order of magnitude leap between the most basic level of point source based services and all subsequent 'improved' services. It is particularly striking that the first 'step' up the ladder – from a rural hand-pump to a rural/peri-urban standpost delivers no more water for a 12 times increase in capital and 3 times increase in O&M costs.

**Box 1: Incremental costs of providing domestic water supply in South Africa**

| Service level | Rural - hand pump | Rural/ peri-urban - communal standpost | Urban - yard tank (low pressure) | Urban - roof tank (medium pressure) | Urban - piped water and house connection (full pressure) |
|---|---|---|---|---|---|
| Typical consumption (l/p/d) | 15-25 | 15-25 | 25 | 60 | 120 |
| Capital cost in (€/household) | 25 | 305 | 390 | 470 | 530 |
| O&M costs (€/household/ month) | 0.4 | 1.4 | 2 | 2.4 | 3.8 |

Source: Moriarty and Butterworth, 2003. p. 20

In South Africa, the concept of a water service delivery ladder is enshrined in national policy. *"The policy makes reference to a 'water ladder': the emphasis is on the progressive improvement of levels of service over time. The first step on this ladder involves the provision of at least a basic water supply and sanitation service to all people living in South Africa. Poor households will receive this basic service free of charge. This is highlighted as the most important policy priority. The next step up this service is an intermediate level of service such as a tap in the yard. Water service authorities are expected to assist communities to achieve an intermediate and higher level of service where this is feasible."* [2]

[2] http://www.dwaf.gov.za/dir_ws/waterpolicy/toolbox/policy_detail_print.asp?Policy=22

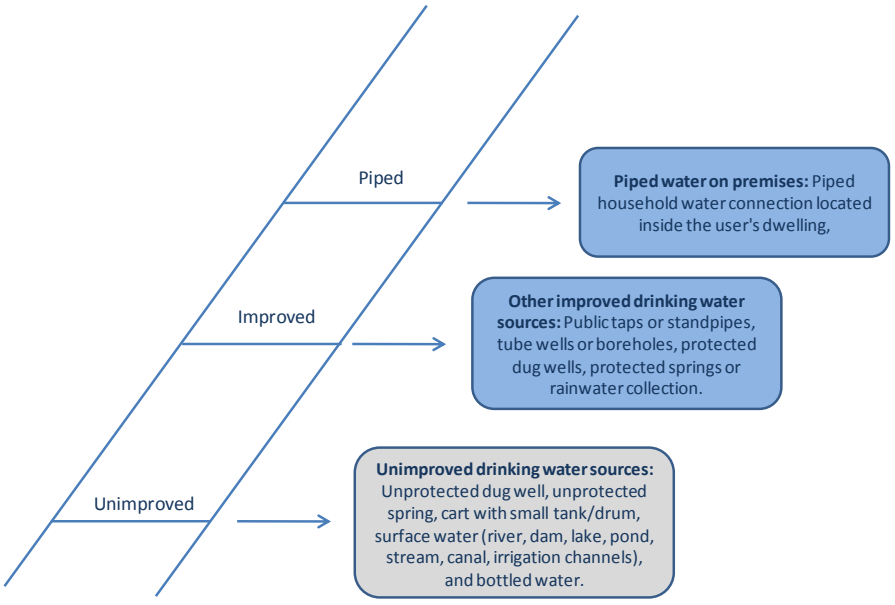
## 3. A ladder for water service delivery

In this section, we first briefly present some existing service ladders currently used or proposed for the water sector, and then present our own proposed ladder of different service levels for use in WASHCost. The WASHCost ladder is based on our own experiences of the types of service that are found in many developing countries. To define the service levels, we propose a number of core indicators and acceptable ranges for each of these. The sets of indicators and indicator ranges make up the different steps of the ladder.

### *3.1 Existing water sector ladders JMP and MUS*

Recently (JMP, 2008) the Joint Monitoring Platform of UNICEF and the WHO have adopted a simple ladder for water supply based on three categories. These are: Unimproved, Improved and Piped water on premises (Figure 2). According to the JMP unimproved drinking water sources include sources such as: unprotected dug wells, unprotected springs, carts with small tank/drum, tanker trucks, untreated surface water sources (river, dam, lake, pond, stream, canal, irrigation channels), and bottled water. Improved sources include: Public taps or standpipes, tube wells or boreholes, protected dug wells, protected springs and rainwater collection. At the top of the JMP ladder, piped water on premises involves piped household water connection located inside the user's dwelling, plot or yard.

**Figure 2: JMP's water ladder (JMP, 2008)**



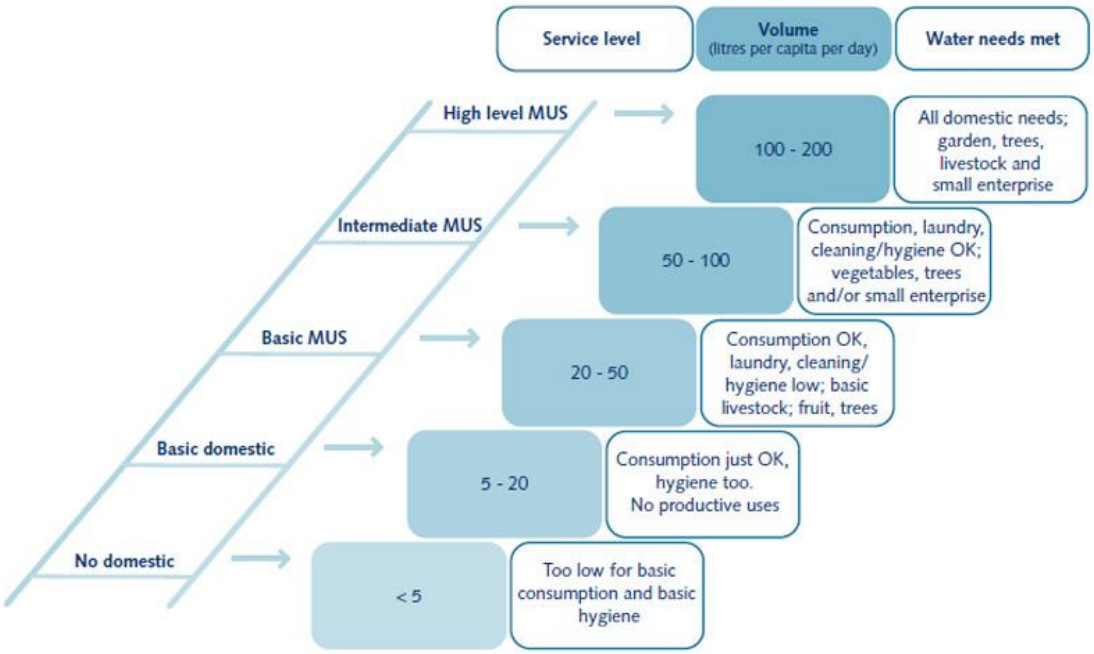

What immediately stands out in the JMP ladder is its technology focus. Service levels are explicitly linked to technology types, which are in turn linked to JMPs definitions of 'improved' and 'unimproved' water sources. This decision is probably motivated by JMP's status as a global level monitor of WASH MDGs, overseeing a geographically large data set based on a very limited number of indicators – gathered essentially by questionnaires that identify the type of source people use and its location (outside or inside their house). Interestingly on their website, JMP gives no recommendations at all for

either the quantity or quality required of water for domestic use, although for the latter they provide a link to the WHO drinking water guidelines[3].

In short then, the JMP ladder provides a good starting point, and because of the status of its co-hosts (WHO and UNICEF) within the UN system should ideally serve as the basis for other types of ladder. That said, we think it is likely that the level of detail is not really adequate: to allow for cross-comparison of costs, and certainly not for monitoring service delivery.

A second recently developed service ladder for water has been proposed by Van Koppen et al (2009) as part of their work on multiple use water services. A multiple use service is one in which water is provided for homestead based productive uses as well as for domestic consumption; activities such as livestock rearing, small businesses or horticulture. This ladder is presented in Figure 3, below. The MUS ladder has as its primary indicators the quantity and ease of access (measured through time to collect) of water. It then qualifies each level of access according to the type of domestic and productive activities that such a level of service can support. It also, like the JMP ladder, attempts to link typical service delivery options to different service levels – and also puts household tap connections as the highest level. The MUS ladder maps relatively easily onto the JMP ladder, with the bottom two tiers corresponding to 'no access' on the JMP ladder, and the top three to improved access.

**Figure 3: Multiple Use Services ladder**




[3] http://www.who.int/water_sanitation_health/dwq/gdwq2v1/en/index.html.

## *3.2 A proposed WASHCost service ladder*

Having briefly presented two existing service delivery ladders, we now set out our own ideas for a service delivery ladder to be used within WASHCost. To do this we first identify a set of core indicators of WASH service, following which we identify how to group these (together with service delivery technologies) into different service levels. For both exercises a pragmatic approach is taken, in which only those indicators that can realistically be identified and relatively easily assessed are chosen; while the groupings of service levels is informed by what we feel to be differences in service that are recognizable to most service users and service providers.

**Indicators for service delivery**

Five main indicators are proposed, quantity, quality, accessibility, reliability, and status of source.

**Quantity.** Quantity is the simplest indicator conceptually and the most commonly used for monitoring and comparing between services. It is typically measured in terms of litres per person per day of water.

**Quality:** Quality refers to both microbial and chemical quality of water provided. Quality includes a number of different sub-indicators (i.e. biological contamination and several physical parameters). It does not, typically, differ according to service level.

**Accessibility:** Accessibility refers to the ease (or lack of it) with which people can get water. We feel that if there is a single indicator for this it is time per day spent fetching water, as this would incorporate a number of traditional barriers to reducing access such as distance and waiting time. The most common indicators we see used in national norms are arguably proxies for tie (which can be difficult ot measure) including: maximum permitted distance to a water point, and maximum permitted crowding (i.e. how many people should share a given point)

**Reliability:** Reliability (or security) refers to the extent to which the service performs according to expectations. Typically this is expressed as the percentage of time that the service is not fully functional. In India, the concept of security is based on the assumption that all services will fail at some point in time, and therefore that full security can only achieved by having access to more than one source of supply.

**Status of source:** This is included to allow direct comparison with the JMP ladder, and basically refers to whether a water supply system is considered ‘improved’ or ‘unimproved’.

The justification for choosing these indicators is based on an understanding of the final outcome envisaged when providing water services. Namely a reduction in morbidity and mortality related to water borne disease and poor hygiene, coupled with a desire to reduce the burden (particularly on women and girls) of fetching water for use in the homestead. When taking a MUS perspective, an additional outcome is reduced poverty through economic activity related to access to water. Yet none of these outcomes can be achieved if there is not sufficient water of acceptable quality. Or, if it is too far away to be fetched, there are barriers to accessing supply systems, or the system is chronically unreliable.

Based on these five key indicators, and looking to the reality of services being provided in the field as well as the need to be able to relate to JMPs ladder, we propose a service ladder of five steps (Figure 4). Two 'unimproved' and three improved. We feel that the inclusion of one extra step in the improved service levels (when compared to JMP) is merited in reflecting the reality experienced in many countries where there is an identifiable 'middle-ground' between absolutely basic rural (or emergency) services, and fully fledged household tap based supply. We therefore introduce an intermediate level of 'improved' service, leaving us with: no-service, sub-standard service, basic service, intermediate service, and high service. The different service levels are illustrated diagrammatically below, against the four main indicators.

**Figure 4: WASHCost proposed service levels and indicators**

<table>
<tr><th></th><th>Quantity (l/c/d)</th><th>Quality</th><th>Accessibility (min/c/d)</th><th>Reliability</th><th>Status</th></tr>
<tr><td>High</td><td>>60</td><td>Good</td><td><10</td><td rowspan="4">Reliable/unreliable</td><td rowspan="4">Improved</td></tr>
<tr><td>Intermediate</td><td>>40</td><td rowspan="3">Acceptable<br>Acceptable<br>Acceptable</td><td>30</td></tr>
<tr><td>Basic (normative)</td><td>>20</td><td>30</td></tr>
<tr><td>Sub-standard</td><td>>5</td><td>60</td></tr>
<tr><td>No service</td><td><5</td><td>Unacceptable</td><td>>60</td><td>Unreliable/unsecure</td><td>Unimproved</td></tr>
</table>

Of these five indicators, two (quality and accessibility) are typically aggregates of what could a quite large sets of sub-indicators. For each of these, a range of three ordinal values is proposed to allow for ease of use. These are based on the idea of having one value that represents an 'unacceptable' level of the indicator, one that represents 'acceptable' and one that is 'good'. In practice, the accessibility indicator, is also often based on a number of proxies for the suggested time indicator. For example, distance to source and number of people accessing the same source (crowding).

*The 'quality' indicator*
It is proposed that an 'acceptable' score would be awarded if all the WHO (or national) indicators for drinking water quality are met. While a 'good' level could be based on that supplied (or targeted) by well run urban utility services.

*The 'reliability' indicator*
Like the 'source type' indicator has only two states – reliable or unreliable (secure or insecure). In practice this would mean that the service meets national norms for being reliable or predictable. That is, people are secure in the knowledge that they can access water that meets all the other indicators from a given source at a given time. A service that punctually provides water every three days is reliable. So to is a service that is based on using different sources for wetter and drier parts of the year.

**The service levels**

**No service:** It is a truism that people always have access to water – because if they don't then they die very quickly. However, this is not the same thing has having access to a service. The whole concept of service delivery is undermined if there is acceptance that a service not meeting the minimum agreed norms merits, nevertheless, to be described as such.

**Sub-standard service:** Because, in practice, many services fail to provide the basic minimum established by norms, yet are still 'better than nothing', an intermediate service level is included between the basic and no-service levels. This level probably corresponds most closely to services that are suffering from problems or where due to context specific issues (such as low population density) it is not possible to meet all service delivery parameters. It is typical of the sort of service accessed by people living on the fringes of serviced areas.

**Basic service:** This corresponds to the sort of service found in rural communities, and some poor peri-urban or emergency situations. It is typically provided by point sources including wells and boreholes, and also sometimes simple gravity systems. The service is also typically community managed, and is strictly focused on providing a minimum level of potable water – it is typically assumed that water for other needs will be found 'elsewhere'. Although, following our logic of setting minimum levels for the different criteria we have indicated this level as meeting 'acceptable' levels for water quality, the majority of such schemes do not include any treatment of the water provided, and hence the quality of water supplied is assured (or not) purely on the basis of the underlying water resource quality.

**Intermediate level services:** These are the type of services found in denser rural, small-town or peri-urban settings. They are typically designed to provide more water than basic services, and closer to the household – indeed they often comprise a mix of household and communal access points. They are typically provided by small networks, fed by either ground or surface sources. They involve some treatment of the water – even if it is only basic chlorination. They are less often managed at a purely village level, and often involve some level of (semi)professional management. They are more likely to involve the payment of user fees. The main reason to include them as a distinct and different service level, is partly because of the (typically) greater quantity of water provided, but also because of the very different technologies and management models involved. This type of service is known to be considerably more expensive and to demand much greater management skills than the basic level. In many ways the intermediate level service is more closely related to the high than the basic level. The initial infrastructural investment (powered pumps; storage tanks, treatment, distribution networks) are a quantum leap from simple wells and boreholes. Often the basic infrastructure can allow for incremental improvement in individuals level of services – for example by paying for a house connection to move up from collecting from a standpipe.

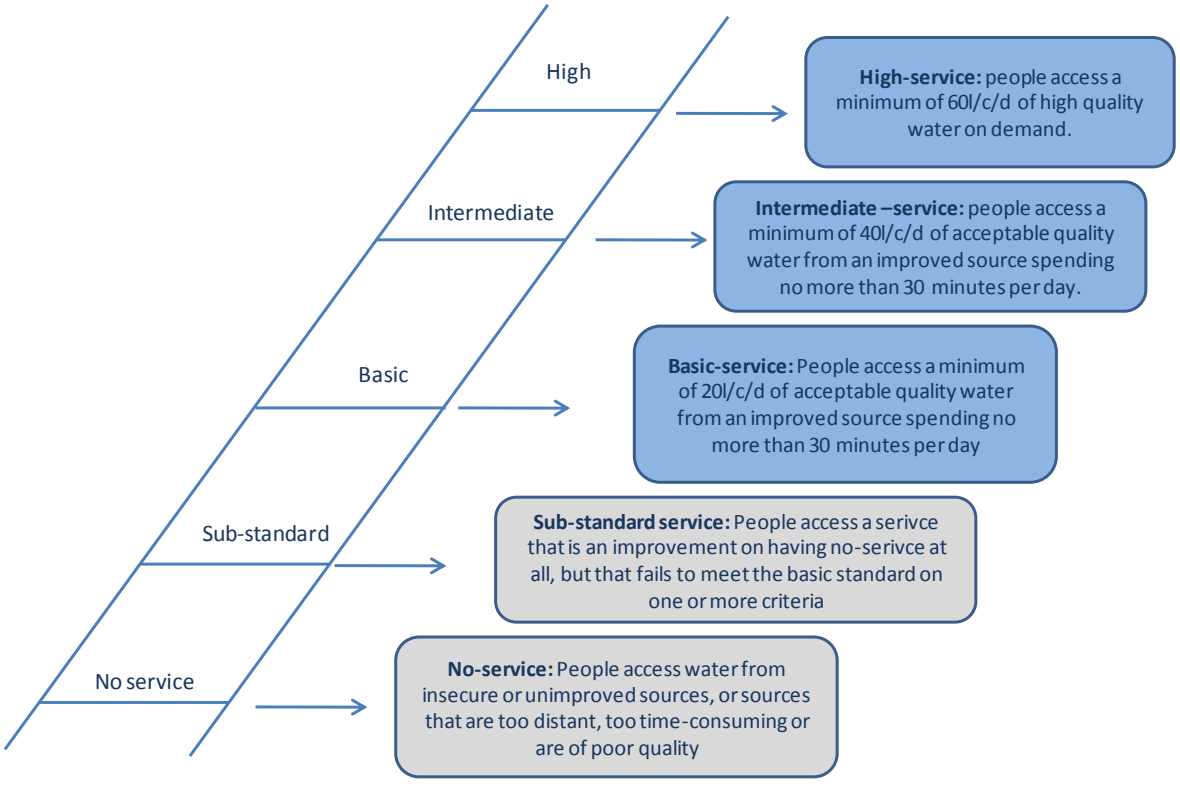
**High level services:** High level services are essentially piped services into people's houses. They are – when operating properly – typically a continuous (24/7) service, and 60l/c/d is very much a minimum. More realistic figures for actual use from such levels are from 100l/c/d upwards. These services are also typified by high levels of treatment – and nominally of water quality. Management is by utilities – public

or private, and the relationships are those of clients and service providers. The assumption is that the client is an individual household paying for their own (often metered) water use.

These then are the proposed service levels for use in WASHCost, they are shown in 'ladder format' in the diagram below. Five levels spanning situations from no-service, through basic provision of lifeline quantities of water, to the sort of 'always there' service expected in modern cities. The decision to split them, as mentioned, is essentially pragmatic, reflecting the real evolution of service provision on the ground.

An acceptable level of service is one that meets agreed norms for each of these indicators. Turning this mix of indicators into a single objectively identifiable aggregate indicator could be complex. However, one simple way to deal with the mix is to say that *the level of service accessed by a person is set by the level of the lowest individual indicator*. That is, a person spending an hour a day taking 30l/d from a reliable borehole of acceptable quality would have access to a sub-standard service due to the time required, and despite other indicators all suggesting a basic service.

**Figure 5: WASHCost water service delivery ladder**




## *3.3 Using the service delivery ladder in WASHCost*

As mentioned, the motivation for using a ladder of different service levels within WASHCost is driven by two main assumptions or hypotheses. The first of these is that the five step ladder we propose reflects operational reality in the field, namely an emerging intermediate level of service that mixes elements of basic point source services with those of modern utility services provided through household taps. And

that this operational reality is something which it is useful to enshrine in policy in the form of clearly defined and differentiated service levels underpinned by norms.

The second is that differences between different levels of service are non-linear and not directly comparable. Therefore, that it makes more sense to compare costs between similar services within a single service level; and that doing so will provide cost ranges that are usefully narrower than those created by looking at aggregated service delivery across all levels.

**While we have good anecdotal and experiential reasons to believe that both of these hypotheses reflect reality, we emphasise that they remain to be tested more formally. Therefore, the service delivery ladder as a concept and as a framework for analysis needs to be both *used* and *tested* by WASHCost.**

## 4. Outstanding issues for MUS

As mentioned earlier, this paper presents work in progress. At the moment there are a number of important issues that will require further clarification through subsequent work and discussion. For MUS, these include:

- **Including multiple uses:** one of the examples of an already existing service delivery ladder is that developed by the MUS project (Figure 3). Several of those involved in WASHCost feel strongly that multiple uses should, at the very least, be acknowledged when assessing service levels. On the other hand, as much multiple use draws on sources that are not specifically designed for domestic use (see next point) this can risk complicating both data collection and analysis. An added complication of assessing MUS service levels is that much water use for livestock and agriculture comes from surface sources where use is difficult to measure.
- **Multiple (non-domestic) sources:** in many rural communities people take only a very small proportion of their water from 'official' domestic sources, with the rest coming from other 'traditional' sources such as ponds or streams. How should this be dealt with in assessing service received? Does it matter if of a total of 20l/c/d people take 15 for use in washing clothes etc. from traditional sources as long as the cook, drink and wash themselves using 5 from an improved source?
- **Type of lifting device and physical effort:** There is at least anecdotal effort that the type of lifting device has an impact on people's perceptions of the quality of service they are accessing: it is easier to turn on a tap than work a hand-pump. Should this be taken into account in assigning norms and indicators for service levels? Or is it adequately catered to in the existing accessibility indicator?

## References

Fonseca, C., et al (2010) Life Cycle Cost Approach: glossary and cost components. Briefing Note n.1. WASHCost. Online available at: www.washcost.info

van Koppen, B., Smits, S., Moriarty, P., Penning de Vries, F., Mikhail, M., Boelee, E. (2009) *Climbing the Water Ladder - Multiple-Use Water Services for Poverty Reduction,* Technical Paper Series, no. 52, 216p, IRC, The Hague, The Netherlands
Online available at: http://www.irc.nl/page/49660

World Health Organization and United Nations Children's Fund Joint Monitoring Programme for Water Supply and Sanitation (JMP). Progress on Drinking Water and Sanitation: Special Focus on Sanitation UNICEF, New York and WHO, Geneva, 2008.
Online available at: http://www.wssinfo.org/en/40_MDG2008.html

Moriarty, P., Butterworth, J (2003) *The productive use of domestic water supplies. How water supplies can play a wider role in livelihood improvement and poverty reduction.* IRC Thematic Overview Paper (ToP), IRC, Delft, The Netherlands
Online available at: http://www.irc.nl/page/1925