2.1 Using the life-cycle costs approach: an introduction

Module 2 of the Costing Sustainable Services Training package gives ideas and tools on how life-cycle costing can be integrated in your own work and organisation. It discusses:

- **How to develop a plan to introduce and integrate life-cycle costing into your own work or organisation to improve sustainability of WASH services.**
- **How to prepare for the collection of life-cycle costs and service level data**; selecting life-cycle cost indicators useful to your programme, creating your own life-cycle costs approach questionnaires, and developing a life-cycle cost data collection plan.
- **How to get more out of the life-cycle costs approach**; increasing the level of detail for more complex analysis; using a life-cycle costs approach for poverty and affordability analysis; and using geographical information systems (GIS) in a life-cycle costs approach.

Module 2 consists of eleven handouts, each explaining the different uses of the life-cycle costs approach. Each handout can be used independently and is linked to publications with in-depth explanation and research results derived from the WASHCost project on life-cycle costing in Burkina Faso, Ghana, Andhra Pradesh (India) and Mozambique. Module 2 concludes with a quiz that puts your knowledge of using the life-cycle costs approach to a test.

Contents

2.11 Modelling expenditure on direct support at the district level: case of Akatsi district in Ghana

This handout[1] provides a sample budget for expenditure on direct support[2] required by the District Water and Sanitation Team (DWST) to support water service delivery in the Akatsi District in the Volta region of Ghana.

The sample budget for expenditure on direct support is based on a budgeting exercise carried out with the DWST as part of a life-cycle costs approach training activity conducted by IRC's WASHCost and Triple-S projects, together with the technical committee of the Community Water and Sanitation Agency (CWSA) of Ghana in 2012.

Water service infrastructure in the Akatsi district includes 179 boreholes, one hand dug well, five small community pipe schemes, one small town pipe scheme, and one limited mechanised scheme. Together, these systems serve 73,096 people–representing 62% of the district's total population.

District level activities constituting direct support

Districts governments play an important role in ensuring sustainability of WASH services. As part of their legal mandate, the District Water and Sanitation's Team (DWST) role in water service delivery in Ghana includes monitoring and supporting the Water and Sanitation Management Teams (WSMT)[3] in the operation and maintenance of WASH facilities. According to a DWST member (Triple-S, 2011):

> *"We would not know which communities have problems with maintaining the facilities, if we don't go there and monitor. Sometimes the problems are beyond the community, so we need to make sure they are supported*."

District level activities related to water service delivery need to be budgeted as part of the expenditure on direct support. These are classified into three categories:

- Field activities
- Office/desk activities
- Equipment and supplies

Each of these categories is explained in detail in the succeeding pages.

[1] This handout was prepared by Kwabena Nyarko, Country Director of WASHCost Ghana.

[2] More information on what expenditure on direct support (ExpDs) entails can be found in **Handout 1.3 Life-cycle cost components**.

[3] Water and Sanitation Management Teams (WSMT) are formerly known as Water and Sanitation Committees (WATSANs) and Water and Sanitation Development Boards (WSDBs)

Field activities

The field activities of the DWST comprise monitoring visits, participation in community activities, and auditing visits[4]. The private sector is solely responsible for the supply of spare parts.

Monitoring visits

Monitoring visits are made by the DWST to all WASH facilities in the district every quarter. The cost of monitoring is GHC 21,080 (Ghana Cedi) per year. A detailed breakdown is shown below:

- Two persons from the DWST–using a motorbike–visit five water facilities and sleep over night.
- The Daily Subsistence Allowance (DSA) rate per person is GHC 60, giving a total DSA of GHC 120 for two DWST officers.
- The cost of fuel and oil is GHC 35 per monitoring visit.
- The total of monitoring visits within a quarter = 187/ 5 = 38.
- Therefore, the cost of a monitoring visit = GHC 120 (DSA) + 35 (fuel and oil) = GHC 155
- Cost of monitoring visits per **quarter** is GHC 155 x 38 = GHC 5,890

*Cost of monitoring visits per **year** per **District** is GHC 5,270 x 4 = **GHC 23,560 (US$ 12,400)**.*

Participation in community activities

DWSTs participate in five community meetings every quarter. Each community meeting is attended by two DWST members, who need to make a return trip.

- A DSA of GHC 10 per person for a day return trip amount to GHC 20 to cover the DSA of two DWST officers.
- The cost of fuel and oil is GHC 35.
- The cost of participating in a community meeting is GHC 20 (DSA) + 35 = GHC 55 (fuel and oil).
- Cost of participating in five community meetings per **quarter** is GHC 55 x 5 = GHC 275.

*Cost of participating in 20 community meetings per **year** is GHC275 x 4 = **GHC 1,100 (US$ 580).***

Audit visit to piped schemes

A financial audit visit by the District Authority is carried out per water system once in a year. An average of one week (six nights) is spent auditing one water system. There are seven piped water systems in a District.

- Two persons staying out-of-station for one week receive a DSA of GHC 100 per person per night (a two person-DSA amounts to GHC 200). Thus, the DSA for one week (six nights) is GHC 200 x 6 = GHC 1,200.
- Fuel + oil = GHC 165 per visit.
- Cost of Audit visit is GHC 1200 (DSA) + 165 (fuel and oil) = GHC 1,365.

Cost of Audit visit per **year** per **District** is GHC 1,365 x 7 water systems visit = **GHC 9,555 (US$ 5,030).**

[4] In Ghana auditing of the Water and Sanitation Management Team (WSMT) is a district-level activity, although inputs may be made by CWSA.

Cost of field activities for the District per year is GHC 23,560 (monitoring visits) + 1,100 (participation in community activities) + 9555 (audited visits to piped schemes) = GHC 34,215 ***(US$ 18,000, or US$ 0.25 cents per person served per year).***

Office work/ activities

The main activities of the DWSTs in the district consist of preparing and updating the District Water and Sanitation Plans (DWSP), operating and maintaining office equipment and utilities, as well as database management. Budgets for these activities are shown below:

Table 1 Budget for office work/ activities

	Office Activities/ Work	Amount (GHC)
1	DWSP update	3,000
2	Operation and maintenance of office equipment	4,000
3	Utilities	2,000
4	Database management	1,000
	Total	**10,000**

The ***cost of conducting office activities*** *per district per year = GHC 10,000* ***(US$ 5,500).***

Equipment/ logistics for the DWSTs

The ***cost of equipment/ logistics*** *from the DWST in Akatsi for direct support (estimated during LCCA training)* ***per year is US$ 30,123 per year.***

Table 2 Budget for the equipment and logistics for Akatsi district

Item	Quantity	Unit cost (GHC)	Frequency/ factor	Amount GHC	Useful life (years)	Annual cost (GHC)	Annual cost - US $
Vehicle	1	55,000	1	55,000	6	9167	6501
Motorbike	6	8,000	1	48,000	5	9600	6809
Desktop personal computer	2	1,550	1	3,100	3	1033	733
Laptop personal computer	6	1,900	1	11,400	3	3800	2695
Digital camera	2	500	1	1,000	3	333	236
Projector	1	3,000	1	3,000	5	600	426
Flip-chart board	2	150	1	300	10	30	21
Air Conditioner	3	750	1	2,250	3	750	532
Printer	2	980	1	1,960	3	653	463

2.11 Modelling expenditure on direct support at the district level: case of Akatsi district in Ghana

Item	Quantity	Unit cost (GHC)	Frequency/ factor	Amount GHC	Useful life (years)	Annual cost (GHC)	Annual cost - US $
Photocopier	1	6,000	1	6,000	3	2000	1418
Binding machines	1	150	1	150	5	30	21
Furniture and fittings	1	7,000	1	7,000	4	1,750	1,241
Stationary (A4 paper, stapler, toner cartridges, flip charts, etc.)	1	2,000	1	2,000	1	2,000	1,418
Maintenance of vehicles	1	1,500	1	1,500	1	1,500	1,064
Maintenance of motorbikes	1	2,000	1	2,000	1	2,000	1,418
Servicing of office equipment	1	1,000	1	1,000	1	1,000	709
Cabinet (steel)	1	300	1	300	5	60	43
Public address systems	1	3,500	1	3,500	3	1,167	827
DWST monthly allowance	3	150	4	1,800	3	600	426
Consumables (e.g., paper, pens etc.)	1	200	4	800	1	800	567
Utilities (water, electricity, telephone, etc.)	1	300	12	3,600	1	3,600	2,553
Total							**30,123**

Source: LCCA training workshop in Akatsi district, Ghana.

Total cost of district level activities for direct support

The total cost of direct support for Akatsi district is US$ 53,623 (or US$ 0.73 cents per person served) as shown in Table 3.

Table 3 Summary of direct support cost for Akatsi district

No	Description	Amount in USD
1	Field visit	18,000
2	Office work activities	5,500
3	Equipment and supplies	30,123
	Total	**53,623**

2.2 Generic model for starting to implement the life-cycle costs approach

This handout illustrates the uses of the life-cycle costs approach and describes the phases of implementation. The life-cycle costs approach can be customised to fit the needs of different organisations. Life-cycle costing as developed by the WASHCost project can be used for many purposes:

- to determine the relative magnitude of different costs over time;
- to examine the range of costs for different types of infrastructure (e.g., handpumps and shallow bore holes versus gravity-fed spring systems);
- to see the relative weights of different cost components (e.g., capital investment versus operations and maintenance costs for different systems and services over time);
- to estimate maximum, minimum and most likely future costs;
- to identify what level of service can be delivered and how many people can be served;
- to compare the levels of water, sanitation or hygiene services received by users;
- to compare the costs of different service levels;
- to conduct poverty, affordability and effectiveness analyses for planning improved services (e.g., to investigate the unit costs of serving a poor population in a district, or to illustrate the differences between 'designed for' and 'received' quality of service);
- to determine the effect of cost drivers (e.g., how costs change with population density or hydrogeology); and
- to conduct cost-effectiveness analyses and compare cost components across projects, districts, regions or countries.

The life-cycle costs approach is used around the world to improve the return on investments and deliver sustainable WASH services. In 2011, asked by WASHCost researchers to explain their reasons for adopting the approach, representatives of 25 organisations and governments gave the following answers:

Non-functionality is very high. How can I better understand the mechanisms and life-cycle costs for increasing sustainability?

We have invested in capital expenditure but the resulting service levels are very low. Can we get more value for money if we invest differently?

A donor keeps saying, 'This is too expensive'. How can I show that my programme actually provides good value for money?

My organisation uses a variety of approaches and strategies for implementing WASH. How can I determine which ones are cost-efficient and effective?

I want to monitor the sustainability of services delivered over time. What are the best indicators?

A donor has come into my district to construct water schemes. How can I demonstrate the additional financial burden (and long-term responsibility) this puts on our staff?

In my work for the government, I need to maintain existing infrastructure. How can I calculate the costs required to keep the system running? Who pays to keep this running?

My government ministry needs to benchmark the costs of providing WASH services.

In local government, I need to plan, budget and monitor WASH service delivery for equity and sustainability.

Are the very poor receiving a lower level of service than the non-poor in my service area?

Are the life-cycle costs of accessing WASH services affordable for the very poor?

Can service providers afford the life-cycle costs of providing WASH services?

Which factors drive the costs of delivering water and sanitation services?

Collecting data

Certain factors make it easier (or more complicated) to find, collect, validate and analyse life-cycle costs and service level data. These are:

Size of area[1]

For the data to be valid, the research area should never be smaller than one district or one small town. The area should be large enough to yield at least 30 data points at the household level for each subcategory of analysis (service level, poverty, technology, etc.). Some recurrent expenditure information, particularly direct and indirect support costs, will be found at the regional and national levels, so data collection will always extend outside the research area.

Available capacity

People within the organisation must be able to undertake data collection, validation and analysis.

Network capacity

Networking is important: it is easier to collect data with the help of other stakeholders. Because there are many sources of cost information, collecting data depends on having good relationships with government institutions and other organisations.

Monitoring processes and standards

Life-cycle costs and service level data are more likely to be available if a country already has a good monitoring system in place.

Implementation

A generic model for implementing the life-cycle costs approach consists of seven general steps. Each step is explained in detail. The duration of each step can be adjusted to the needs and capacity of different organisations.

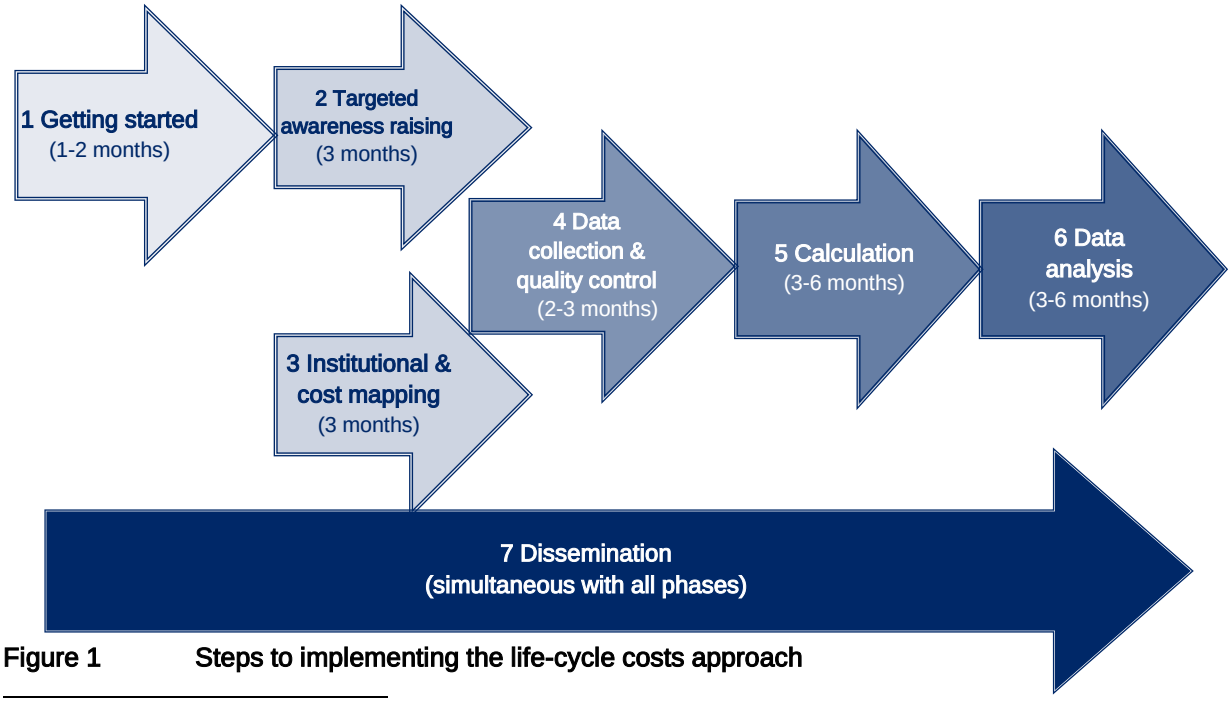

Figure 1 **Steps to implementing the life-cycle costs approach**

[1] More information on selection of the research area is provided in **2.4: Getting started with collecting life-cycle costs and service levels** of the Costing Sustainable Services Training Package.

2.2 Generic model for starting to implement the life-cycle costs approach

¨ Phase 1: Getting started (1–2 months)

Specify the domain

Specify initial spatial and temporal boundaries for information collection. The spatial boundaries can be technical or institutional–for example, the area served by a multi-village supply system or an unserved peri-urban area or village. The temporal boundaries are time limits (past and future) for data and trends; for example avoid collecting expenditure data earlier than 1990. Although the focus may be primarily at one particular level (e.g., district), it is important to collect information at both higher and lower institutional levels to give contextualise data, evaluate the quality of the information gathered, and allow for comparisons (e.g., service delivery to poor and non-poor groups). It is also possible to focus the analysis on just one component, such as direct support costs or capital maintenance expenditure.

Wider stakeholder process[2]

Decide whether the life-cycle costs approach should be carried out as a stand-alone exercise, or should be made part of a wider stakeholder process aimed at, for example, benchmarking services and expenditures or tracking indicators over time.

Specify the information needed

Specify what information is required, including the degree of disaggregation (e.g., total costs versus itemised costs), scale and granularity (e.g., level of detail), and the levels of precision (e.g., estimates versus actual data, or rounded numbers versus exact figures).

Identify sources of information

Identify easily accessible secondary sources of information (e.g., information collected by government departments or information from earlier projects or programmes) and decide what primary (new) information is needed to fill gaps, validate and/ or update existing information.

Form a multidisciplinary team

In most cases, individuals with a range of skills and experience are needed to collect, evaluate and analyse information on WASH life-cycle costs and service levels. Also desirable is experience in information management (e.g., working with Excel spreadsheets and geographic information systems). Decide whether any specialists and analytical tools are needed. Allow sufficient time for training staff and searching for experienced individuals.

¨ Phase 2: Targeted awareness raising (3 months)

Many national, state and intermediate-level stakeholders are already using unit cost information for new projects, but the concept of costing for sustainable services may be new. At the local level, ensure that the poor and other marginalised groups are involved, are able to participate, and are appropriately represented in meetings.

¨ Phase 3: Institutional and cost mapping (3 months, simultaneous with phase 2)

The life-cycle costs approach takes account of the roles and responsibilities of all WASH stakeholders, so the costs of their activities must be included. Build a complete understanding of all life-cycle costs components of WASH services in the research area.

[2] For information on how to achieve the benefits of collaboration, see **2.3: Involving stakeholders** of the Costing Sustainable Services Training Package.

Phase 4: Data collection and quality control (2–3 months)

Collect existing information from secondary sources, conduct quality control and enter the data into an information base. Fill in any gaps with primary data. Cross-check data from different sources and levels to ensure internal consistency.

The major effort in data collection[3][4] lies in reaching the research area and mobilising teams to collect information. Plan for travel, arrange lodging, and allow at least 10% extra time for contingencies.

- Do not underestimate the time it takes to meet with local authorities, and obtain authorisation to collect costs data. Typically, information is not available on the first visit; two or three visits will be needed. Allocate time to identify the right people at regional and district levels.
- Local authorities must agree on the locations where the household surveys will be conducted, and must advise communities and their representatives of the coming activities.
- Household surveys are time-consuming; field researchers should plan to spend at least one hour per household.
- Begin calculations and verification as early as possible to avoid bottlenecks in finalising the study. An outline analysis should be completed before researchers leave the area or district. Returning to the study area to gather missing data is expensive and time-consuming.

Phase 5: Calculation, current costs and WASH service levels (3-6 months)

Determine the current levels of life-cycle costs components and important cost drivers[5]. Many users may have more than one service delivery system and still not have sustainable services. Pay particular attention to trends and see whether service levels are slipping.

Per person life-cycle costs are often affected by governance systems and technology, which in turn are likely to be influenced more by hydrogeological constraints than by budgets.

The data will likely have gaps. For example, the data may not cover all service level criteria and cost categories. Recognition of such shortcomings can guide subsequent efforts. However, even with incomplete data, it is possible to start applying the life-cycle costs approach, and gaps can be filled by making certain assumptions and estimations.

Phase 6: Data analysis, future costs and WASH service levels (3-6 months)

Investigate how life-cycle cost expenditure patterns might be modified to improve WASH services and deliver improved value for money. Identify gaps in expenditure patterns (e.g., lack of allocations for capital maintenance). Investigate the relationships between expenditure and service level. Outputs from this phase will form the basis for estimating future expenditure levels and financing mechanisms[6].

Phase 7: Dissemination (simultaneous with all phases)

Share the analysis and documentation with stakeholders for discussion in formats that are most likely to inform decision making at any given institutional level.

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[3] See **2.7: Checklist on arranging logistics for data collection** of the Costing Sustainable Services Training Package.to access a step-by-step guide on how to develop a data collection plan.

[4] More information on how to collect life-cycle costs and service levels data is found in **2.6: Data collection tools** of the Costing Sustainable Services Training Package.

[5] More information on which variables need to be collected is available in **2.5: Data variables** of the Costing Sustainable Services Training Package.

[6] See materials in Module 3 of the Costing Sustainable Services Training package for more information on how to analyse life-cycle costs and service levels for water and sanitation.

2.3 Involving stakeholders

This handout explains how to involve other stakeholders in the water, sanitation and hygiene sector when using the life-cycle costs approach.

Stakeholders are individuals, groups or organisations that are involved in, have influence over, or are affected by water, sanitation and hygiene service delivery. Since service delivery starts with planning and design, continues with construction and extends from operations and maintenance to eventual replacement, stakeholders have various roles and responsibilities and may be active throughout or only at certain points during the service life-cycle. Stakeholders include local, regional and national governments, donors, community-based organisations, the private sector and households.

When collecting life-cycle costs data, it is appropriate to involve other stakeholders, for two reasons. First, costs are incurred by different stakeholders at various points in time, and thus they have data that can help validate analysis. Planners, engineers, civil society groups, decision makers and agencies involved in water and sanitation service delivery can provide access to information and help researchers see problems in context. Second, the analysis can be used by the stakeholders to plan and budget for their own roles and responsibilities during the life-cycle of a service.

Identifying other stakeholders

An institutional and costing report presents a comprehensive overview of the stakeholders in planning, decision making, implementation and management of WASH service delivery in a specific geographic area[1]. The mapping report also indicates stakeholder platforms, their members and their knowledge, resources and skills. It helps locate the sources of the life-cycle costs data, potential users and beneficiaries and determines opportunities to link up with existing sector platforms.

Examples of institutional costing mapping done by the WASHCost project in Andhra Pradesh (India) and Ghana are available on the WASHCost project website (www.washcost.info)[2].

Generally, the most efficient way to motivate stakeholders to discuss life-cycle costs and service level issues is by linking up with existing sector platforms where issues of sustainability are regularly discussed.

Starting a stakeholder dialogue

After the institutional and costing map has been drawn, contact service providers, government ministries, donors and other stakeholders to discuss existing life-cycle costs data. Collecting their data often means arranging one-on-one meetings to gather documents. Once existing data has been reviewed, organise a meeting to present and validate the information. All stakeholders who were

[1] A template and terms of reference to create an institutional and costing map is available on request. Please contact *washcost@irc.nl* for more information.

[2] See *http://www.washcost.info/page/1642* for an example in India, and *http://www.washcost.info/page/775* for Ghana

contacted can be invited to this meeting. This first meeting is an opportunity to gather additional information that fills and explains gaps. Participants can also provide leads to other stakeholders.

Table 1 Sample Agenda

Format	Description of activities
In plenary	Introductions
In plenary	Present the purpose of the meeting and the research project.
In plenary	Present an overview of the data collected thus far.
Group discussions	Divide participants into small groups to discuss the following types of topics: ▸ Use of data: *How could the information be used and by whom?* ▸ Validity of data: *Does the information reflect the reality?* ▸ Availability of data: *Is more information available, and where is it? What is missing?*
In plenary	Invite feedback from group discussions.
In plenary	Discuss how to go forward. Ask who wants to be kept updated on the progress of the research, and how, and ask whether others want to be actively involved.

Working with stakeholders through learning alliances

To stimulate the use of the life-cycle costs and service level data, it is good practice to involve all the stakeholders in the entire process–from data collection to analysis–and to continually share and discuss findings. People are more receptive to new ideas that they have helped develop and find useful. The stakeholder platform within a project is called a learning alliance[3].

Learning alliances provide a mechanism for involving stakeholder groups that are most interested in developing and using the research outputs–the tools, approaches, models and evidence. As with any group activity, momentum for new ideas is often provided by one or two individuals, with backing from their superiors or organisation.

A learning alliance needs a coordinator–a champion–and support from its members. In addition, at least one other organisation (preferably but not necessarily that of the coordinator) is required to host the 'learning platform'–the initial support, physical space and resources the coordinator needs to initiate and monitor the progress of a learning alliance.

 *Read how WASHCost applied a learning alliance approach in its action research in* ***India*** *at http://www.washcost.info/page/557 and* ***Mozambique*** *at http://www.washcost.info/page/565*

[3] More information on learning alliances and how to start and sustain a learning alliance is available from the IRC International Water and Sanitation Centre website at: *http://www.irc.nl/page/14957*

2.4 Getting started with collecting life-cycle costs and service levels

This handout gives an overview of the process of collecting life-cycle costs and service levels data, and identifying resource-availability in the research area[1].

Collecting life-cycle costs and service levels data is organised in seven phases, and can be implemented in ten steps:

Table 1 Ten steps to collecting life-cycle costs and service levels data

Phases 1 to 3	Phase 4	Phases 5 and 6
Step 1 Determine the purpose of life-cycle costing **Step 2** Collect secondary data and identify gaps **Step 3** Meet with stakeholders **Step 4** Select data collection tools **Step 5** Prepare a data collection plan **Step 6** Create templates **Step 7** Train researchers	**Step 8** Roll out data collection	**Step 9** Enter and store data **Step 10** Prepare data for analysis

N.B. The seventh phase, Dissemination, occurs simultaneous to all Phases as described in **2.2: Generic model for starting to implement the life-cycle costs approach** of the Costing Sustainable Services Training Package.

Step 1 Determine the purpose of life-cycle costing

The purpose for analysing life-cycle costs and service levels will determine what data to collect. For example, if planners will want to know of the most cost-effective technology there is in a particular

[1] Based on the generic model provided in **2.2: Generic model for starting to implement the life-cycle costs approach** of the Costing Sustainable Services Training Package.

area, information on the life-cycle costs and service levels provided by different technologies will be needed[2].

Step 2 Collect secondary data and identify gaps

Collect data from documents that have unit cost information for services provided. To start, list the service providers and other institutions that are likely to have the information needed.

The collection of secondary information can be difficult and time-consuming. It often means arranging one-on-one meetings with service providers, government, donors, NGOs and the private sector. Data on unit costs may be incomplete or aggregated (lump-sum instead of per person or per unit figures), and sources of information are often scattered. As part of decentralisation processes in many countries, government departments have changed responsibilities, and as a result of this shift, records have become difficult to recover. Some NGOs that installed water points no longer exist, and their cost information may have also disappeared along with them.

Step 3 Meet with stakeholders

Once existing data have been reviewed, go over the findings with relevant stakeholders. Such meetings often lead to additional information that fills gaps and explains discrepancies. Moreover, since the life-cycle costs approach is intended to ensure that analyses are used by those who make decisions, it is good practice to involve all stakeholders from the beginning and continually share and discuss findings. Linking up with the many existing platforms in the WASH sector is called a learning alliance approach. A learning alliance is a group of stakeholders that can facilitate change at various levels (national, state, district, local) and create opportunities for information exchange, research and learning from experience[3].

Step 4 Select data collection tools

Data collection tools[4] vary according to what is needed for implementing the life-cycle costs approach.These tools can be adapted to suit the context and resource-availability.

All WASHCost templates for collecting cost and service level data are available in Word 2003 and require a basic knowledge of the software.

- The district- and province-level tools most widely used are semistructured interviews with key informants to obtain such information as quantities specified in contracts, project completion reports, annual financial budgets, salaries, and recurrent operations costs.
- Technical surveys, in conjunction with contracts for completed projects, provide information on costs and technologies.
- Household questionnaires are the main source of information for service level indicators and sanitation cost components at the household level.

[2] The types of data to collect and the sources of information, both primary (new) and secondary (existing), are described in **2.5: Data variables** of the Costing Sustainable Services Training Package.

[3] Visit the IRC website to learn more about learning alliances, *http://www.irc.nl/page/14957*

[4] The various tools are explained in more detail in **2.6: Data collection tools** of the Costing Sustainable Services Training Package.

Information can also be obtained through focus group discussions, audits of village records, village start-up, validation meetings, and official government data[5]. Table 2 lists the types of information needed for implementing the life-cycle costs approach, and their corresponding research tools.

Table 2 Types of information and research tools

Information	Research tool					
	Household survey	Technical survey	Official data	Key informant	Focus group	Special research
Context and poverty	▯	▯	▯			▯
Technology and infrastructure	▯	▯	▯	▯		▯
Water costs	▯	▯	▯	▯	▯	▯
Sanitation costs	▯			▯		▯
Water service levels	▯					
Sanitation service levels	▯					
Cost drivers						▯
Currency, financial variables						▯

Step 5 Prepare a data collection plan

Develop a practical plan that specifies when, where and how data will be collected. The plan should contain a sampling strategy, and list the required resources (time, skills and money) for data collection[6].

When determining the sampling strategy, consider who else is involved in water and sanitation service delivery. Information on life-cycle costs can be found at different levels, from the household to the national level. The sampling strategy for collecting cost data will vary depending on the institutional level. It may be possible to save money by collaborating with other ongoing surveys.

Considerations for regional studies

- When selecting a large research area, such as a province, collect costs for different technologies and different service levels in a variety of hydrogeological and hydroclimatic conditions.
- The presence of development partners or donors indicates that water supply and sanitation services have been implemented; this means there will be sufficient data for a valid analysis, as well as there will be interest in the outcomes of the research study.

Considerations for rural community or town studies

- Select a diversity of dispersed and more densely populated areas, to capture diversity in intensity/ levels of use of water sources and sanitation facilities.
- Look for a mix of socioeconomic groups, including both the very poor and the non-poor.
- Work with a variety of infrastructure to facilitate a comparison on cost-effectivess between different technologies.
- Communities with an existing point source of more than ten years old are preferred for the study. However, if most of the infrastructure is relatively new, collect data on systems that are at least three to five years old.

[5] Fonseca et al. (2010) present a useful table that lists down the costs and service level information available from various sources.

[6] Read **2.7: Checklist on arranging logistics for data collection** of the Costing Sustainable Services Training Package.

Considerations for household studies

- If possible, conduct a quick survey of service levels through sampling, facilitating a focus group discussion, observing a water point, and engaging in discussion with water users. Based on initial information gathered, select communities with different service levels to participate in more detailed household interviews.
- Use the main economic activity of a household as a proxy to achieve a mix of poor and non-poor respondents.
- Randomly choose 30 to 40 households per community at different distances from water points. Random sampling involves taking every third household (or every fourth or fifth household in large villages) along a pathway from the centre of the village or from a randomly chosen water point. Choose the pathway by spinning a bottle in the village centre or at the water point and following the path it points to. On reaching the edge of the village, researchers can randomly select another starting water point or turn left and continue surveying every third (fourth, fifth) house, turning left again at the next pathway junction, and so on. Researchers may not choose the households they survey.

In the experience of WASHCost, most cost information has been collected at national and regional levels by senior staff members with good knowledge of sector stakeholders. But the information needed to compare costs with the services actually delivered is mostly found at village, system and household levels.

Step 6 Create templates

Create templates for the research, such as the household survey questionnaire, for the use of data collectors[7].

Step 7 Train researchers

Researchers conducting household surveys may need training in using some research tools. Special training may be required for collecting information on the costs of water and sanitation technologies.

Training reports and manuals are available for different skill levels and needs[8].

Step 8 Roll out data collection

After the researchers have been trained, and practice runs have been organised, the teams can start data collection, following the plan created in Step 5. Where resources are available, consider testing the research tools: collect, store and analyse information from one or two small locations. With the lessons learned from this process, the research tools can be refined before the full data gathering begins.

[7] A copy of the research templates used by the WASHCost project in Andhra Pradesh (India), Burkina Faso, Ghana and Mozambique is available on request. For more information, contact *washcost@irc.nl*

[8] For example, a five-day training module on fieldwork methods for assessing the unit costs of WASH service delivery in rural and peri-urban areas of Andhra Pradesh (India) is available at www.washcost.info. Tailor-made training and targeted support are also available. Contact *washcost@irc.nl* for more information.

Step 9 Enter and store data

Information needs to be stored to make it accessible for analysis by, and information sharing with third parties.

 *WASHCost templates are available in Excel 2007. A basic knowledge of Microsoft Excel (or an equivalent spreadsheet) is needed to store (and later analyse) data. A data protocol has also been developed with recommendations on how to store, clean and validate data in preparation for data analysis; this can be downloaded from www.washcost.info.*

Step 10 Prepare data for analysis

How to clean and validate life-cycle costs data is explained in **3.2: Preparing data for analysis; data entry and validation** of the Costing Sustainable Services Training Package. A step-by-step guide on how to analyse life-cycle costs and service levels are found in Module 3 handouts.

Further reading

Naafs, A., 2010. Collecting WASH services cost data: Experiences from Mozambique, In: IRC International Water and Sanitation Centre, *IRC Symposium 2010: Pumps, Pipes and Promises,* The Hague, The Netherlands 16-18 November 2010. The Hague: IRC International Water and Sanitation Centre.

WASHCost India, 2010. *Training module on fieldwork methods for assessing unit costs of WASH service delivery in rural and peri urban areas*. [online] Andhra Pradesh: WASHCost India. Available at: <http://www.washcost.info/page/1026> [Accessed 30 April 2011].

2.5 Data variables

This handout introduces the kinds of information needed to apply the life-cycle costs approach. It can be used in combination with the following handouts found in the Costing Sustainable Services Training Package:

- 1.3: Life-cycle cost components
- 2.6: Data collection tools
- 3.2: Preparing data for analysis; data entry and validation
- 3.3: Preparing data for analysis; cost conversion

WASHCost has developed an indicator list with 105 variables for the life-cycle costs components of water and sanitation service delivery, service levels, infrastructure, technology and context, each with sample questions helpful for retrieving information[1]. Each category in the list can be filtered based on data collection tool used, type of information to be gathered, and institutional level of data collection (e.g., household, district etc.). For example, select variables that relate to the level of household, or select variables that relate to expenditure on capital maintenance. Suggested units for the data and possible answer categories are provided.

With as little as 30 variables, useful analysis can be made on costs against service levels.

It is not necessary to collect information on all variables. Select what is appropriate based on the types of technology employed in the research area, the purpose of applying the life-cycle costs approach, and resource-availability. Table 1 summarises the basic information required for each type of analysis.

Table 1 Core information required to determine cost of service

Main purpose	Main category	Indicator	Sample variables
Poverty analysis; cost drivers; cost per person	Contextual and poverty information	Sampling data; geography, geology and climate; demographics and socioeconomics; coverage	Average depth to groundwater; rainfall per year; employment of head of household
Cost per technology and its components	Technology, infrastructure	Water and sanitation infrastructure	Type of technology; functionality; users (intended and actual)
	Water costs	Capital expenditure (hardware and software), including costs and time spending by households; capital maintenance expenditure; operations and minor maintenance expenditure; cost of capital; direct and indirect support	Replacement cost of pipes, platform and drains; cost of minor repairs; training of pump caretakers; interest on loans

[1] WASHCost's indicator list is available on Excel. See 2.10: Life-cycle costs approach indicator list of the Costing Sustainable Services Training Package.

2.5 Data variables

Main purpose	Main category	Indicator	Sample variables
	Sanitation costs	Capital expenditure (hardware and software), including costs and time spending by households; capital maintenance expenditure; operations and minor maintenance expenditure; cost of capital; direct and indirect support	Cost of hygiene promotion; district and regional budget for sanitation; household cost of toilet construction; microfinance cost
Service levels provided and cost per service level	Water service level	Quantity; quality; accessibility; reliability	Litres per person per day; water quality
	Sanitation service level	Accessibility; use; reliability; environmental protection	Site of defecation; use of toilet by household members
Comparison across countries	Currency and financial information	Market exchange rates; purchasing power parity (PPP) exchange rates; inflation rates; gross domestic product (GDP) deflator	Market exchange rate per year; inflation rate

The indicator list used by the life-cycle costs approach is classified according to six headings.

Category of indicator

The variables in the indicator list are arranged according to type of information; e.g., contextual information, poverty, technologies and infrastructure, life-cycle costs, service level of sanitation, service level of water, currency and financial information, and cost drivers.

Indicator name and unit (if applicable)

Each variable has been given a clear name and, if applicable, the unit in which information is collected (e.g., metres or litres). All variables other than those related to service levels can be applied to both water and sanitation. Collect cost information in the local currency, together with the year of the expenditure and the number of data points, water systems or sanitation facilities. For example, ‘20.000 cedi was spent in 1999 in Ghana to rehabilitate five boreholes with handpumps’.

Data collection tool

For each variable, the data collection tool to be used to retrieve the information is indicated. The main data collection tools used includes household survey, technical survey, GIS mapping, special research (including key informant interviews) and official government data.

Source of information

For each variable the institutional level at which the information is most likely to be found is listed; e.g., household, community, water system and/ or sanitation facility, district, region or country. ‘Various’ indicates that more than one source may have the data.

Questions to ask

The indicator list includes suggested questions that may be used. The questions also clarify what information is intended to be collected.

Possible answer categories

In some cases suggestions are made for how answers can be recorded. For example, if the household survey asks how much water each person receives, the proposed unit to measure quantity is litres per person per day. If the survey asks whether there is a sanitation facility for each family, the suggested answer is yes or no.

The list is available in Excel 2007 and will require users to have a basic knowledge of the software[2]. For more information or assistance on how to use the indicator list, contact the WASHCost team at washcost@irc.nl

Further reading

Naafs, A., 2010. Collecting WASH services cost data: experiences from Mozambique. In: IRC International Water and Sanitation Centre, *IRC Symposium 2010: Pumps, Pipes and Promises,* The Hague, The Netherlands 16-18 November 2010. The Hague: IRC International Water and Sanitation Centre.

WASHCost India, 2010. *Training module on fieldwork methods for assessing unit costs of WASH service delivery in rural and peril-urban areas*. [online] Andhra Pradesh: WASHCost India. Available at: <http://www.washcost.info/page/1026> [Accessed 30 April 2011].

[2] Available to download on *http://www.washcost.info/page/1426*

2.6 Data collection tools

This handout explains where and how to obtain information for life-cycle costing. It can be used in combination with the following handouts found in the Costing Sustainable Services Training Package:

- 1.2: The life-cycle costs approach
- 1.3: Life-cycle cost components
- 2.5: Data variables
- 3.2: Preparing data for analysis; data entry and validation
- 3.3: Preparing data for analysis; cost conversion

Tools to assess life-cycle costs and compare them against levels of service provided can be adapted to different country contexts, needs and resources[1].

There are five main data collection tools.

Household survey

Household surveys are used primarily to determine service levels and household expenditure on water and sanitation. They can also indicate the socioeconomic status of users. The survey links users to particular water and sanitation schemes. If required, the surveys can reveal how much time members of the household spend on WASH service delivery, and differences in WASH services received by socioeconomic groups within the research area.

Technical survey

A technical survey of a water system or a sanitation facility involves investigating the entire chain of delivering and accessing water and sanitation, from source to user. A technical survey also assesses household activities, such as water storage and treatment. Finally, a technical survey can provide clarity on specific cost information across the entire chain of water and sanitation delivery and access, particularly on capital expenditure and capital maintenance expenditure.

GIS mapping

Geographic information system (GIS) mapping is mainly used to measure the distance from a household to the formal water system or sanitation facility. A straight line is drawn from the global positioning system (GPS) coordinates of the household to the coordinates of the water system or sanitation facility. The distance is calculated in metres between the two points.

[1] Examples of the data collection tools that were used by the WASHCost project in Burkina Faso, Ghana, Andhra Pradesh (India) and Mozambique are available on request. Write to *washcost@irc.nl*

The straight-line distance, of course, may not represent the actual route travelled by household members. Nevertheless, this measurement helps researchers visualise and understand differences in levels of access to water and sanitation service received by different socioeconomic groups. Topographic maps also show the location of infrastructure or safe water sources, and the patterns of demand for and access to WASH services. This can help improve the design of future schemes.

If needed, GIS mapping[2] can also give insight into possible cost drivers of service delivery, such as distance to the nearest road or market.

Special research

Some data on life-cycle costs are gathered through special research involving the combination of several research methods, such as conducting key informant interviews with government officials, district water engineers or local mechanics. During interviews, researchers may collect documents with cost information (e.g., contracts, project completion reports, etc.) and request for support in identifying other sources of cost data.

Official government data

Official government data is collected by contacting the district, regional and national governmental agencies involved in water, sanitation and hygiene service delivery. Government units provide information on direct and indirect support expenditures, such as salaries and administrative costs for planning, policy, and decision making that support service delivery. Results from water quality testing and information on country-specific norms, such as distance to a water source, are also part of official government data.

Further reading

Naafs, A., 2010. Collecting WASH services cost data: Experiences from Mozambique. In: IRC International Water and Sanitation Centre, *IRC Symposium 2010: Pumps, Pipes and Promises,* The Hague, The Netherlands 16-18 November 2010. The Hague: IRC International Water and Sanitation Centre.

WASHCost India, 2010. *Training module on fieldwork methods for assessing unit costs of WASH service delivery in rural and peril-urban areas*. [online] Andhra Pradesh: WASHCost India. Available at: <http://www.washcost.info/page/1026> [Accessed 30 April 2011].

[2] The use of GIS in the life-cycle costs approach and variables that will need to be collected is further outlined in **2.9: Life-cycle costing and GIS** of the Costing Sustainable Services Training Package.

2.7 Checklist for arranging logistics for data collection

 This check list provides a series of questions to ask before collecting information on life-cycle costs and service levels. It is meant to trigger further discussion on how to organise information, and thus support development of a data collection plan within a specified budget.

Developing the data collection plan

- Select the study sites
- Organise a team to collect the data and define the support structure
- Decide how researchers will travel to the sites
- Decide whether a subsistence allowance and petty cash are needed
- Choose and arrange the equipment necessary for data collection
- Ensure safety and security
- Establish the budget

Select the study sites

Number
How many study areas are targeted; where and how large are they? How many data collection sites will there be per study area? Can they be mapped?

Sequence
Will data collection in the study sites take place in parallel (all at once) or in a sequence?

Local environment
Are the selected study sites familiar to the researchers in terms of culture, religion, language, general logistics, infrastructure and accessibility? Will the climate (e.g., rainy season) affect the timing of data collection?

External factors
Will any other external factors (e.g., elections, holidays, seasonal migration) affect the study sites or the timing?

Organise a team to collect the data and define the support structure

Coordination
Will a central office coordinate the data collection? Where will that be? Is there a project 'organigram' that includes the data collection team? Who reports to whom and how often?

2.7 Checklist for arranging logistics for data collection

Support structure
During the data collection phase, the need for logistics and administrative support will increase. How will that be organised? Will the team have sufficient capacity?

Composition
Who is going to actually collect the data? How many teams will there be, and what is their composition?

Selection
Have the team members been selected? If not, how and when will that be done? Have they worked together before? Will the researchers work with local teams?

Recruitment
Will the same team members cover all sites and surveys, or will there be turnover? This can influence the contract form (see next item).

Contract form
What are the contractual arrangements for the team and its members? Will the contracted parties be considered as personnel (individuals seen as employees), consultants (individuals but non-employees) or contracted services (institutional agreement, for a fixed service and price)?

Contract
Will national labour laws affect the contracts? For instance, can one individual work on three subsequent projects without having to become an employee? What effect do the policies and regulations of the project host have on the work?

¨ Decide how researchers will travel to the sites

Access to study area
Air or road?

Transportation within study area
By car or motorbike or on foot? Will the team have vehicles or hire local drivers? What is the difference in cost between own resources and rentals?

¨ Decide whether a subsistence allowance and petty cash are needed

Subsistence allowance
Will team members receive a daily subsistence allowance, a per diem or will they be reimbursed based on actual expenses? If an allowance or a per diem how will the appropriate amount be determined? If actual expenses, how will the researchers account for costs without receipts (e.g., from remote districts)?

Accommodation
Will the project arrange lodging for the team, will a local government or NGO do that, or will this be the responsibility of the team itself? Assuming that a team stays for a few weeks in one place, is it feasible to rent a house? At what cost?

Advances
Will the team have cash advances? What is the research organisation's policy?

Petty cash
Will the team have its own financial resources? If so, who will be responsible for the management thereof? Is the provision of petty cash allowed by the research organisation and under what conditions? What large payments might the team need to make?

¨ Choose and arrange the equipment necessary for data collection

Field equipment
What information and communications equipment are essential for the data collection team? How much of this equipment is already available?

Communication tools
Which communication tools are available at the study sites (e.g., telephone, Internet) and what needs to be purchased in advance (e.g., telephone cards, voice recorders, global positioning and geographic information systems)?

Data security
What kind of back-up system exists? Can the researchers use an on-site back-up if necessary? What about hard copies?

¨ Ensure safety and security

The most common problem is team tensions, the biggest risk is road accidents, and the largest nuisance is mosquitoes (malaria); often not considered is local conflict. In the event of an emergency, who needs to be contacted? Are the researchers covered by health and travel insurance? Is there insurance for third-party accidents? In an emergency, clear communication channels are essential.

¨ Establish the budget

Answers to the above questions will inform the research project budget. Considerable savings can be achieved by collecting life-cycle costs information as part of other (ongoing) surveys. What are the possibilities for resource sharing, particularly ‘in kind’ contributions? Can transportation be borrowed? Can staff from other projects or organisations be seconded for this research?

2.8 Life-cycle costs approach used for poverty and affordability analysis

This handout explains how using the life-cycle costs approach can assist in targeting investments.

Life-cycle costing can help answer the following questions about the equitable and sustainable access to water, sanitation and hygiene services:

- Are the poor receiving a lower level of service than the non-poor?
- Are the life-cycle costs of accessing services affordable for the very poor?
- Are the life-cycle costs of providing universal services affordable for service providers?

Life-cycle costing allows an affordability and sustainability check on all recurrent expenditures. Are the necessary funds available to keep the service working? How do recurrent expenditures compare with existing sources of revenues? Measuring the affordability of WASH services to households also provides a proxy indicator of exclusion to services by parts of the population. If households have to spend more than 5% of their household income for water and sanitation services, how affordable is the service for the poor?

Measuring poverty

Poverty is multifaceted and context-specific. The WASHCost project uses proxy indicators to measure relative poverty for within-country comparisons, and absolute poverty for international comparisons with poverty norms (Box 1).

Box 1 Definitions of poverty

A June 1998 United Nations statement signed by the heads of all UN agencies defined poverty as follows:

> *Fundamentally, poverty is a denial of choices and opportunities, a violation of human dignity. It means lack of basic capacity to participate effectively in society. It means not having enough to feed and clothe a family, not having a school or clinic to go to, not having the land on which to grow one's food or a job to earn one's living, not having access to credit. It means insecurity, powerlessness and exclusion of individuals, households and communities. It means susceptibility to violence, and it often implies living on marginal or fragile environments, without access to clean water or sanitation.*

At the international level, two basic indicators are used as a broad measure of a nation's poverty:

- percentage of the population living on less than US$ 1.25 a day; and
- inequality of wealth, as measured by the Gini coefficient.

Both indicators measure *absolute* poverty based on international standards. From a country perspective, there are however several problems with indicators used to measure absolute poverty. Both measurements are based on the premise that income is a good proxy for poverty. Poverty is a denial of a range of needs, such as, nutritious food, safe drinking water, shelter, health care, and education. Basing poverty solely on income ignores other deprivations. Measuring income works to some extent for urban areas and for rural areas with cashless economies. The Gini coefficient

indicates that there are disparities but does not say where the poor people are. Neither indicator is linked with access to water and sanitation services.

Countries have their own measurements of *relative* poverty, a term that refers to the poverty specific to a country and its circumstances. To measure relative poverty, many developing countries use a combination of income, asset ownership and one specific indicator per country, with usually three categories: very poor, poor and non-poor.

Source: UN Statement, June 1998 - signed by the heads of all UN agencies

In the WASHCost project more than 10,000 household surveys were conducted in Burkina Faso, Ghana, Andhra Pradesh (India) and Mozambique to assess where the poor live and what level of water, sanitation and hygiene service they receive.

The WASHCost project measured poverty using the following poverty indicators (Table 1).

Table 1 WASHCost indicators of poverty

Absolute poverty	
	National norm
	Statistics for community, neighbourhood, village, sub-district
	Household annual income
Relative poverty	
	Professional activity, main economic activity of head of household
	Type of dwelling, housing, roof
	Self-assessment or community assessment of poverty (in rural areas)
	Commodities availability of household[1]
	Household expenditure overall and as percentage of expenditure on WASH
	Land-ownership
	Caste or other officially defined population group that may be excluded based on social or economic status, faith, origin, etc.

To measure relative poverty, the best approach is to determine within each context (district, region, country) what indicators are used to define the very poor, poor and non-poor. If no indicators are available, asset ownership can be used in line with demographic and health surveys, and multiple indicator cluster surveys. For each socioeconomic category, each indicator is compared with the service level criteria of access, reliability, quantity, quality, etc.[2].

For example, in Andhra Pradesh, caste designation was used as a variable to analyse sanitation services for the poor (Figure 1). Caste data was obtained from official sources and the household data (for sanitation service level[3]) through a household survey. The castes include: other community (OC), backward community (BC), scheduled caste (SC) and scheduled tribe (ST). Based on analysis in Andhra Pradesh, scheduled tribes were found to have the lowest access to and use of latrines.

[1] View Demographic and Health Surveys and Multiple Indicator Cluster Surveys at *http://www.unicef.org/statistics/index_24302.html*

[2] Water and sanitation service levels are explained respectively in **1.4: Water service levels** and **1.5: Sanitation service levels** of the Costing Sustainable Services Training Package.

[3] Steps in calculating and analysing sanitation service levels are explained in **3.5.1-3.5.5** and **3.6** of the Costing Sustainable Services Training Package.

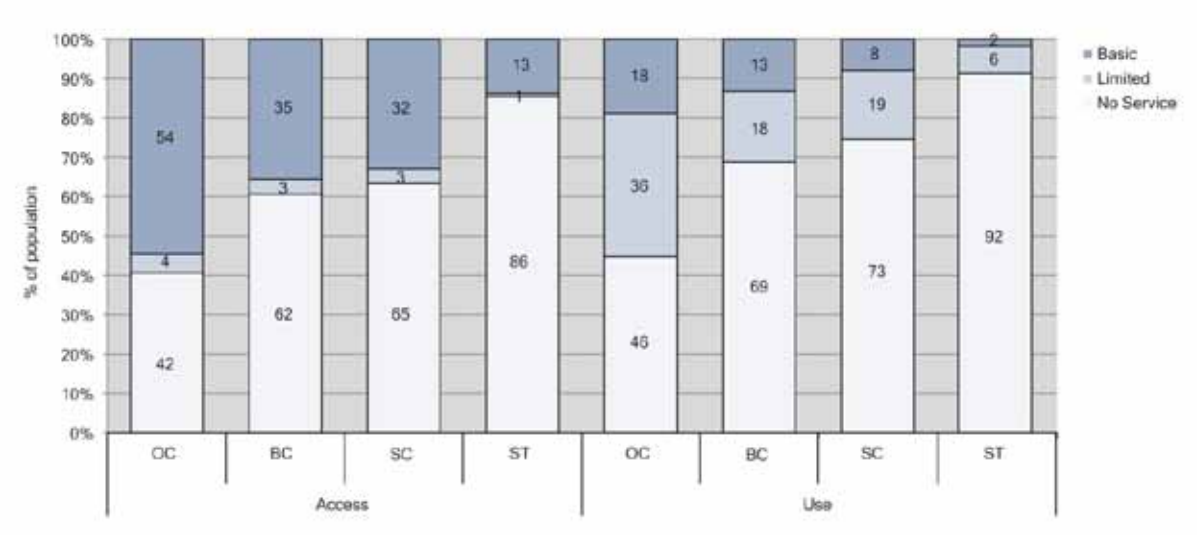

Figure 1 **Access and use of latrines by caste in Andhra Pradesh**
Source: adapted from Snehalatha, Ratna Reddy and Jayakumar, N., 2010.

Mapping poverty and services

In the life-cycle costs approach, geographic information systems (GIS) software is used to help target investments[4]. GIS maps create a visual overview of service levels received by users in a village, district or region. When the poverty status of these users is mapped out, it becomes possible to see where the poor live and what type of services they receive.

The GIS maps used by the WASHCost project for life-cycle costing are prepared using Google maps for initial identification of roads and buildings. These maps are then printed and taken to the field for cross-verification and mapping of household names, water and sanitation infrastructure (public standposts, drainage lines, pipes, etc.) and the functionality of those assets. With a unique GIS identification code, each household and all assets are linked on the GIS map, which then depicts where water and sanitation facilities and the very poorest households are located. This exercise thus identifies the poor areas of villages and the areas where water and sanitation services are inadequate.

In Figure 2 (shown on next page), the availability and use of toilets in the Tulekalan Village of Andhra Pradesh India are mapped. Based on Snehalatha, Ratna Reddy and Jayakumar (2010, p. 8):

> *The toilet usage in Tulekalan where the predominant colour (red), shows that many households do not have toilets, while the blue boxes show households with toilets that they do not use. Reasons cited by many households for not constructing toilets are the fact that the subsidy does not cover the real costs, poor economic conditions, caste status, lack of space, etc. These reasons are well correlated in regression analysis with the markers for poverty, such as lack of literacy, caste, and lack of land.*

[4] How to use GIS in the life-cycle costs approach is explained in **2.9: Life-cycle costing and GIS** of the Costing Sustainable Services Training Package.

2.8 Life-cycle costs approach used for poverty and affordability analysis

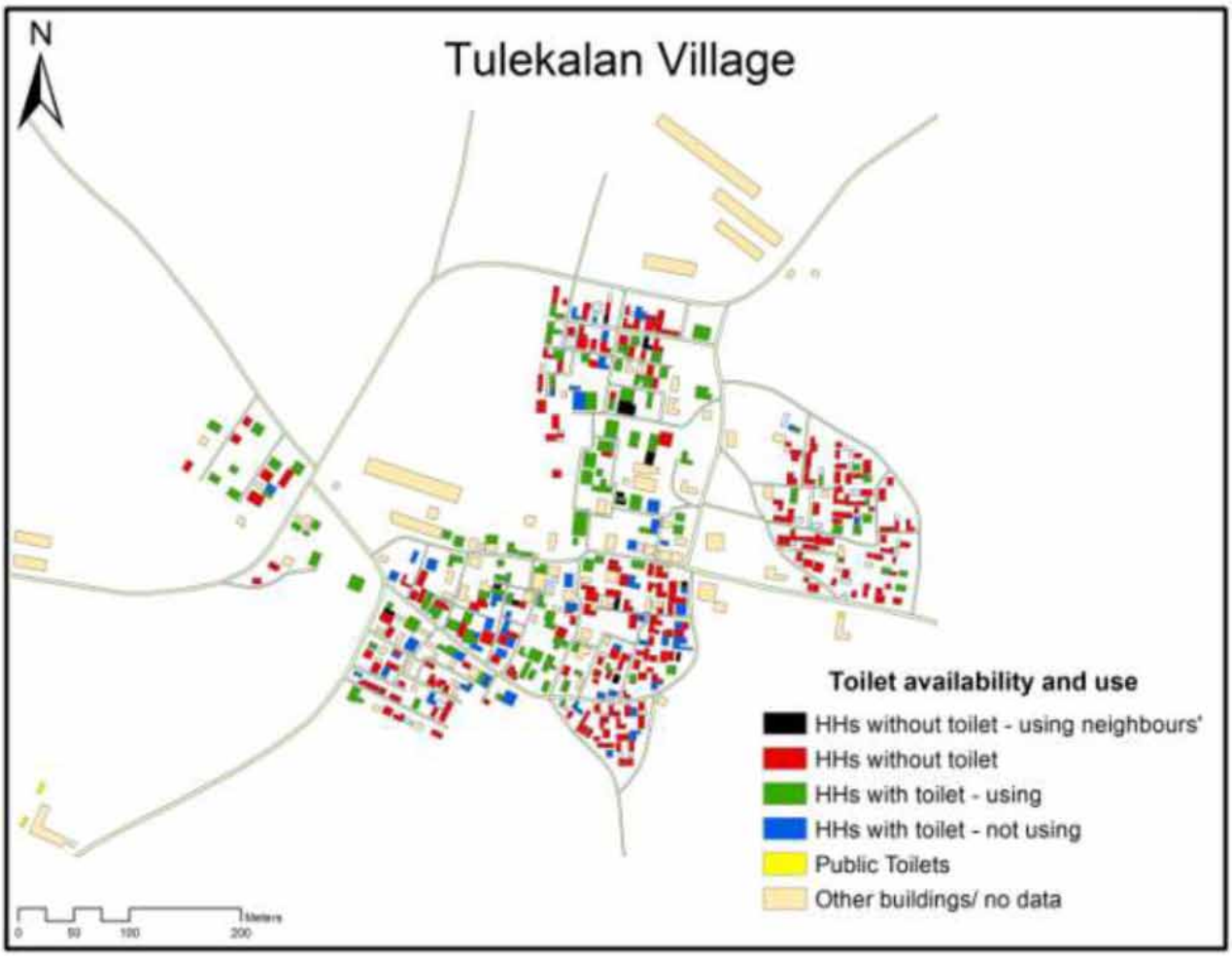

Figure 2 **Availability and use of toilets in Tulekalan Village, Andhra Pradesh, India**
Source: Snehalatha, Ratna Reddy and Jayakumar, N. (2010).

Overall lessons

The following lessons on poverty analysis emerged from the WASHCost project:

1. Poverty status and sanitation service level are clearly correlated. The very poor have a lower level of sanitation services than the non-poor.

2. In line with the national statistics institutes of Burkina Faso, Ghana, India and Mozambique, income and asset ownership did not correlate with relative poverty in rural areas.

3. The best indicator of relative poverty in each country was as follows:

   - Burkina Faso: ownership of water and sanitation assets
   - Ghana: profession of the head of household
   - India: caste and land-ownership
   - Mozambique: type of roof of the house and household expenditure

4. Household expenditure was found to be a better indicator of poverty than household income.

5. To determine the percentage of income spent on water and sanitation (to ascertain affordability), many questions on income and expenditure are needed. Oftentimes, this comprises the largest part of a household questionnaire, even when the questionnaire is supposed to focus on water and sanitation services.

6. Asking about household income is very sensitive because people fear loss of government subsidies or support. Annual household income can also be assessed based on house type, livestock, household members, land and other assets (e.g., having a household tap, individual sanitary latrine, overhead tank, etc.). However, in rural areas with non-cash economies, these proxy indicators are difficult to use. Occupation can be a better proxy indicator for relative poverty in these situations.

7. In rural areas, it was difficult to find enough non-poor families for the sample. For instance, in the sample areas of rural Mozambique, more than 90% of the population is considered poor. Similarly, in India, where the poor carry pink cards that entitle them to subsidised goods, 90% of rural households fall within this category.

8. Even the very poor receive some form of water service, since without it they would not survive. For water services, the location and cost of a water service are therefore very important. In cases where there were no alternative water sources (and tariffs had to be paid), monthly water tariffs were more than 5% of a household's income. When households have to spend more than 5% of their income for water, the service cannot be considered affordable, according to the WASHCost project.

Further reading

Snehalatha, S., Ratna Reddy, V. and Jayakumar, N., 2010. Assessing sanitation costs and services in Andhra Pradesh, India. In: IRC International Water and Sanitation Centre, *IRC Symposium 2010: Pumps, Pipes and Promises,* The Hague, The Netherlands 16-18 November 2010. [online] The Hague: IRC International Water and Sanitation Centre. Available at: <http://www.irc.nl/page/55873> [Accessed 21 September 2012].

2.9 Life-cycle costing and GIS

This handout explains how the life-cycle costs approach can be combined with geographic information systems (GIS) to enhance the targeting of interventions and investment. It draws on examples from the WASHCost India project, which applied life-cycle costing and GIS techniques between 2008 and 2012[1].

The primary use of GIS in the WASHCost India project was to find patterns and relationships between life-cycle costs data and water, sanitation and hygiene services, and identify variations in service levels by household socioeconomic status. Using GIS enabled the identification of individual households and areas of the village that were poor and received poor services. It is these areas and households that will benefit the most from investment in improved water and sanitation. GIS can also be used to visualise different infrastructure options before construction, increasing the chance of selecting the best option.

GIS has many uses in the WASH sector:

- to identify patterns in water and sanitation service levels;
- to establish spatial relationships between socioeconomic indicators and service levels;
- to store information about infrastructure and track its condition over time;
- to track the level of services being received by the target population;
- to facilitate communication with stakeholders and the public;
- to link with other technologies–such as cloud computing and mobile devices–creating a system that collects, stores and organises monitoring data, and allowing information to be quickly accessed and analysed; and
- to assess the benefits of options before the construction of WASH infrastructure.

For the WASHCost India project's GIS analysis, information was collected from more than 100 villages. Primary data was collected through a household survey on socioeconomic and service indicators from every household in each village. For 20 villages, spatial information was also collected. This involved mapping every building–using a combination of total stations and high-resolution satellite images–to create accurate maps. The buildings that were households were subsequently identified, and the data from the household survey attached to them. This allowed researchers to map household socioeconomic status, water and sanitation variables, and identify significant spatial patterns.

Additional features mapped included water schemes, water supply lines, roads and contour lines. Data was collected for water schemes, such as handpumps and public standposts, to determine the quality, quantity and reliability of service provision. Focus group discussions were also undertaken at certain points in the village. Even before analysis began, using GIS presented an excellent opportunity to organise all data collected, checking it for errors and omissions.

[1] More information on the WASHCost India project can be found at *www.washcost.info*

WASHCost India's experience with GIS

For the WASHCost India project, simple maps were produced for each village showing indicators such as household income, land-ownership, investments in water and sanitation, toilet availability and use, and per person water use. The maps were studied for spatial patterns. For example, if one area of a village had generally lower per person water use than the rest of the village, other areas of the same village were examined to see whether they displayed a similar pattern.

Figures 1 and 2 demonstrate how the simple mapping of socioeconomic status and service delivery variables can reveal important patterns and may explain differences.

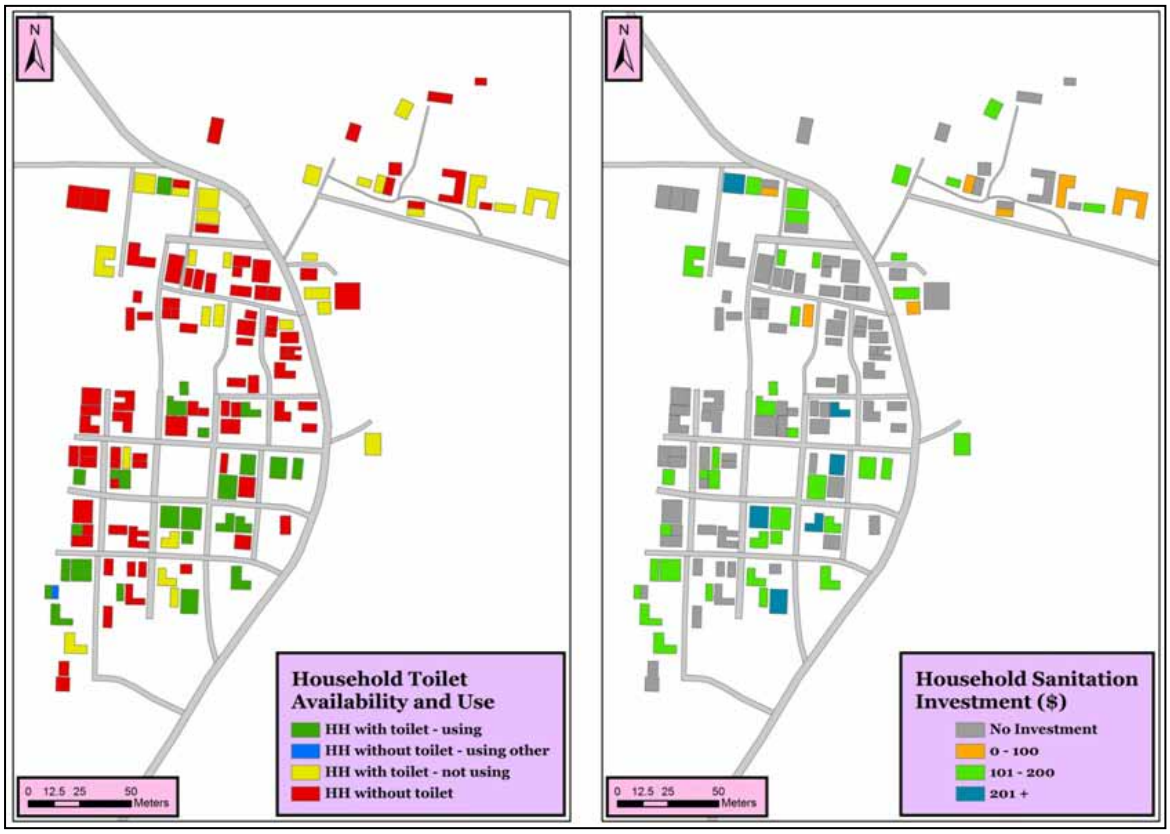

Figure 1 **Household toilet availability and use in Enkapally village**

Figure 2 **Household sanitation investment in Enkapally village**

Figure 1 shows that even though roughly half of the households have toilets, most of the toilets are not used. Almost all the households that are using toilets are in the southern half of the village. Figure 2 shows how much each household has invested in sanitation infrastructure; those households that invested in sanitation infrastructure have toilets. Households in the southern half of the village have invested more, which may explain why they are using their toilets, whereas households in the north, which generally invested less, are not using theirs.

This type of visual analysis of maps is relatively inaccurate, however: it can be very subjective, since different people may see different patterns and relationships. It is also risky to infer causality in the relationship between the variables from these maps, even if they clearly show similar spatial patterns. To confirm possible relationships and patterns in data in a more quantifiable way, spatial

analysis techniques will need to be used, including zoning, buffering and hotspot analysis. More information on these techniques can be found in IRC's GIS toolbox (forthcoming)[2].

Box 1 gives more detail on the patterns revealed in the 20 villages mapped by WASHCost India.

Box 1 Results from the WASHCost India GIS

All 20 villages mapped by the WASHCost India project showed observable spatial patterns in socioeconomic indicators or water and sanitation services, although these varied greatly in strength and clearness. In some villages one or two indicators showed a weak pattern, such as more high-income households in one area of a village. For many of the villages, however, observable patterns for multiple indicators allowed the identification of areas that were poorer and received lower levels of service. The clearest indicator–land-ownership–which showed observable patterns in 16 villages. Household income, per person water use and toilet availability and use all had observable spatial patterns in 12 villages. Household water supply investment and household sanitation investment showed observable spatial patterns in 10 and 13 villages, respectively.

The general relationship between the indicators was that areas of low income and/ or low land-ownership had low water supply and/ or sanitation investment, and low per person water use and/or toilet use. However, in the majority of cases, only two or three variables would show similar patterns. For example, an area of a village with low land-ownership and low toilet use would have low income, low water supply investment, and low per person water use.

Experience from the WASHCost India project highlights the role of the classification of variables on mapped patterns. For example, a map of a village showing household incomes above and below US$ 1,000 a year is likely to have a very different pattern than a map of the same village showing household incomes above and below US$ 500 a year. It is there important to consider carefully the categories for variables such as income, land-ownership and infrastructure investment. Ideally, the categories would have meaning and not just be arbitrarily defined. For example, the categories of household per person water use set for the WASHCost India maps were 40, 60 and 100 litres, corresponding to the levels used to create the water service level ladder for the life-cycle costs approach. The categories for all the variables were kept identical for all the villages, allowing for comparison between them.

[2] Available on the WASHCost website from December 2012.

GIS data to be collected as part of the life-cycle costs approach

Socio-economic

- Administrative areas
- Location and attributes of settlements
- Location of individual households
- Attributes of households (income, education, social group, etc.)
- Location of other buildings (e.g., schools, shops, places of worship, etc.) and infrastructure (e.g., roads, canals, etc.)
- Administrative information (budgets, etc.)

Water, sanitation and hygiene (WASH)

- Location of water points and other water infrastructure (e.g., supply lines, RO plants, overhead tanks, etc.)
- Location of sanitation infrastructure (e.g., toilets, areas of open defecation, etc.)
- Attribute data of water and sanitation infrastructure (type, status yield, cost, etc.)
- WASH service levels of individual households (water use, toilet availability, etc.)

Biophysical

- Topography
- Land use
- Location of water sources (e.g., rivers, lakes, aquifiers, etc.)
- Hydrological information (e.g., rainfall, runoff, sediment yield, etc.)
- Hydrogeological information (e.g., groundwater levels, groundwater potential, etc.)
- Other climactic information (e.g., temperature)