40th WEDC International Conference, Loughborough, UK, 2017

LOCAL ACTION WITH INTERNATIONAL COOPERATION TO IMPROVE AND SUSTAIN WATER, SANITATION AND HYGIENE SERVICES

Financial Flow Diagrams to promote policy-making, based on 20 community management case studies from India

R. Franceys, T. Guinaldo, C. Leitner, O. J. Nyangoka, V. Thomas, J. Zeilinger & P. Hutchings (UK)

PAPER 2710

This paper reports the development of 'Financial Flow Diagrams' as a means of better communicating complex financial information, directly inspired by the development of 'Shit Flow Diagrams', in this case highlighting, for policy-makers, donors and service providers financial challenges. We describe the design considerations investigated during the preparation of visual oriented financial communications. This includes arguments about the merits and limitations of visuals and associated tools/software that best display flows of resources (in our case financial). We then present visuals that were submitted for testing across a panel of informants, some closely related to the Community Water Plus project, a 20 case study, 17 States research project of 'successful' community managed water schemes in India, which provided the source financial information. Finally, we provide a critical analysis and feedback on the limitations of using Financial Flow Diagrams as a mean to convey messages on funding distribution in the context rural water supply.

Introduction

Between 2013 and 2016, research has been undertaken in 17 States in India through the Community Wash plus project (CW+), funded by DFAT, Australia, with the objective of gaining insights into the modalities and costs of service provision in so-called 'successful' community-managed rural water programmes.

The costs of sustainable water and sanitation are usually not only difficult to obtain but are also often unreliable, capturing only an element of that support. Yet such knowledge is critical to improve planning, budgeting for WASH projects and policies. It helps informing economic analysis of technologies and business models; and, in turn, improve the efficiency, effectiveness, and sustainability of WASH services. Overall the CW+ research indicated that 'successful' community managed (predominantly piped) water supply required not only 95% contribution to capital expenditure from government but also an ongoing 50% support to operations and capital maintenance expenditure. But this simple averaging hides significant variations between communities and states.

There are, therefore, important lessons for policy-makers in India as to what is working, and working longer-term, and at what cost as the programme expands. There are also important pointers to policy development in lower-income countries, particularly in Africa, who might be a decade or so behind India in terms of economic development and rural water supply development. The challenge is therefore to communicate effectively the complex picture of capital expenditure, both for hardware and software, and the recurrent expenditure, similarly hardware and software, as well as the critical for sustainability capital maintenance expenditure. This expenditure needing to be understood relative to what communities are willing to provide and that which the enabling support environment, usually government agencies of various types, are required to deliver.

This paper reports on the development of 'Financial Flow Diagrams' as a means of better communicating such complex financial information. This approach was directly inspired by the development of 'Shit Flow Diagrams' (SFD, 2015), which similarly are trying to highlight, for policy-makers, donors and service providers, complex waste flows in cities.

Methodology

Following final analysis of the 20 case study costs, the initial nine subgroups of costs was simplified with the annual recurrent expenditure data collated in five subgroups: OpEx labour & materials, OpEx power, OpEx bulk water, OpEx enabling support and CapManEx and displayed as in the example Table 1 below.

Medians of recurrent and capital expenditure across all 20 case studies were also included to add a tool for comparison. The median was chosen as a statistical component, which is more robust against outliers than the mean, which seems essential as the sample contains very disparate values (and to avoid distortion due to the differences between technologies like hand-pumps or pipe network infrastructure). The final change was to convert every cost to 2014 rupees (INR) and in 2014 US Dollars PPP. The example table contains the averaged data of the three best practice villages of each case study (which also included a fourth 'control' village where community management had not been seen to be successful).

Table 1. Final summary cost table for case study 4 Chhatthisgarh in 2014 USD in PPP

Source of funds	Use of funds - implementation			Use of funds - annual recurrent					
	CapEx hardware	CapEx software	CAPEX TOTAL	OpEx labour & materials	OpEx power	OpEx bulk water	OpEx enabling support	CapManEx	RECURRENT EXPENDITURE TOTAL
Community/consumers	-	-	-	$ 0,57	$ 1,87	-	-	$ 0,15	$ 2,59
Local self-government	-	-	-	$ 0,12	$ 0,36	-	-	$ 0,04	$ 0,52
	-	-	-	-	-	-	-	-	-
State government entity	-	-	-	$ 0,17	$ 0,60	-	-	$ 0,13	$ 0,91
State water supply agency	$ 110,19	$ 2,04	$ 112,24	$ 0,11	$ 0,25	-	$ 0,25	$ 0,04	$ 0,64
Government of India	-	-	-	$ 0,17	$ 0,60	-	-	$ 0,13	$ 0,91
NGO national & international	-	-	-	-	-	-	-	-	-
International donor	-	-	-	-	-	-	-	-	-
TOTALS	$ 110,19	$ 2,04	$ 112,24	$ 1,14	$ 3,68	-	$ 0,25	$ 0,50	$ 5,57
Median of 20 case studies			$ 184,16						$ 11,78
'Plus' %age	100%	100%	100%	50%	49%	-	100%	70%	53%
Median of 20 case studies			95%						57%

Notes: Assuming a 50/50 split of the funding for OpEx support to the community by the State water supply agency between the Government of India and the State

Initial visualisation ideas

Based on this completed summary financial information table, the Financial Flow Diagram aims to visualise, perhaps emphasise, the 'Plus' range of external support to communities necessary for sustainable community-managed rural water supply services. The conceptual foundation of the Financial Flow Diagram, via the Shit Flow Diagram development, is derived from early 'infographics', such as Minard's view of Napoleon's invasion of Russia (Tufte, E. 1983). Flow diagrams were then used throughout the early twentieth century. They were sometimes referred to as 'Cosmographs, the trade name for a type of flow chart presenting numerical information or percentages by means of black and white stripes of paper, showing source contrasted with destination.' (Brinton, p.73,1939)

Particularly from the 1960s onwards, the concept of arrows with changing widths representing changes in flow of a variable was developed further and became the popular visual interface of what is now called material flow analysis (Fischer-Kowalski, 1998). WU Vienna (2016) provides a global overview of material flow data and visualisation tools.

Initial Financial Flow Diagram and general considerations

Building on material flow analysis, and more specifically on SFDs, the initial draft Financial Flow Diagram shown in Figure 1 was created. While still in an early design stage, this diagram sparked considerable interest when first presented in India. It combined the visual code of material flow diagrams with symbolic messages such as a water reservoir being 'topped up' by capital maintenance expenditure. Operating expenditure, seen as ongoing for the lifetime of the service, was split into several components including labour, power and minor spares.

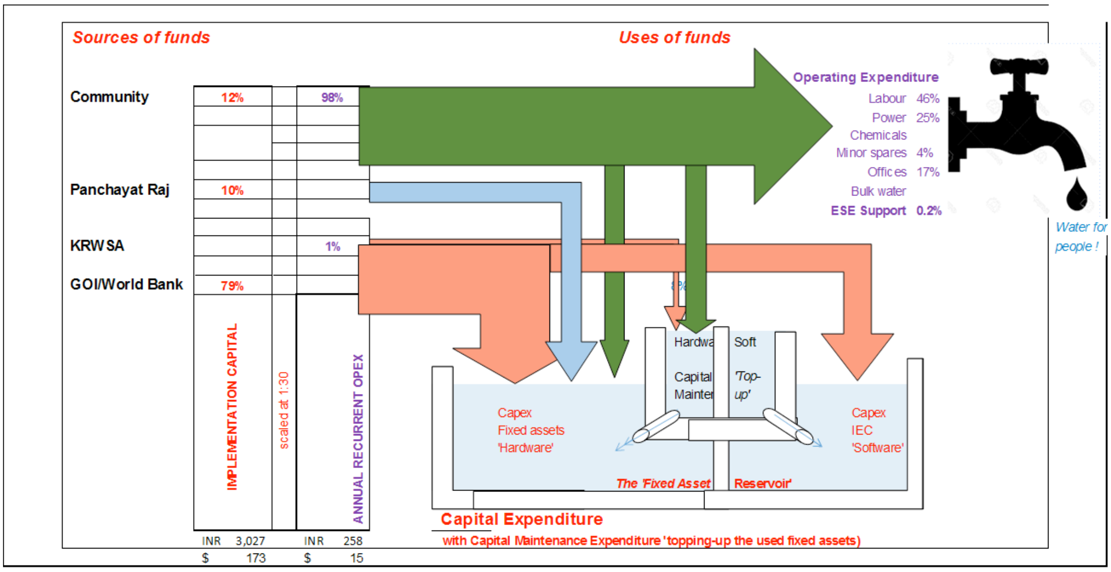

Figure 1. Initial Financial Flow Diagram

Source: Authors

From this initial version other flow diagrams were investigated with a particular focus on 'Sankey diagrams', as well as literature on data visualisation in general. The study extracted the following key principles for the visualisation of quantitative data from (Tufte, 1983) and (Yau, 2011): *Graphical excellence, Graphical integrity* and the danger of *Deceptive graphics* (Tufte, 1983) (p.53) which "is the assumption that data graphics are mainly devices for showing the obvious to the ignorant." Tufte also explains that "comparison must be enforced within the scope of the eyespan, a fundamental point occasionally forgotten in practice."

The researchers revised the initial Financial Flow Diagram, using the approach of Sankey diagrams. Initially created by MHPR Sankey in 1898 to depict energy efficiencies of steam engines, the approach of using the width of the arrow as proportional to the quantity of flow of the resource being measured can therefore also be used to represent financial flows. Sankey diagrams allow comprehensible display of interlinkages of flows in terms of where they come from and where they go. Due to ease of use, absence of need for programming capabilities and the possibility to customise the diagram, as well as free availability, SankeyMATIC (Bogart, 2016) was chosen to create the Sankey diagrams for the project.

Results

Figure 2 shows the present final development step of the Financial Flow Diagram, incorporating feedback received from a number of partners and respondents to a survey.

The test run with the external partners was conducted in the form of a simple online survey with open questions. As the core element, we juxtaposed Figure 2 with its more complex predecessor, not shown here, which provided additional information on the split of recurrent costs between different items such as labour, power and capital maintenance expenditure. It also compared capital expenditure of the respective case study with the median of all 20 case studies.

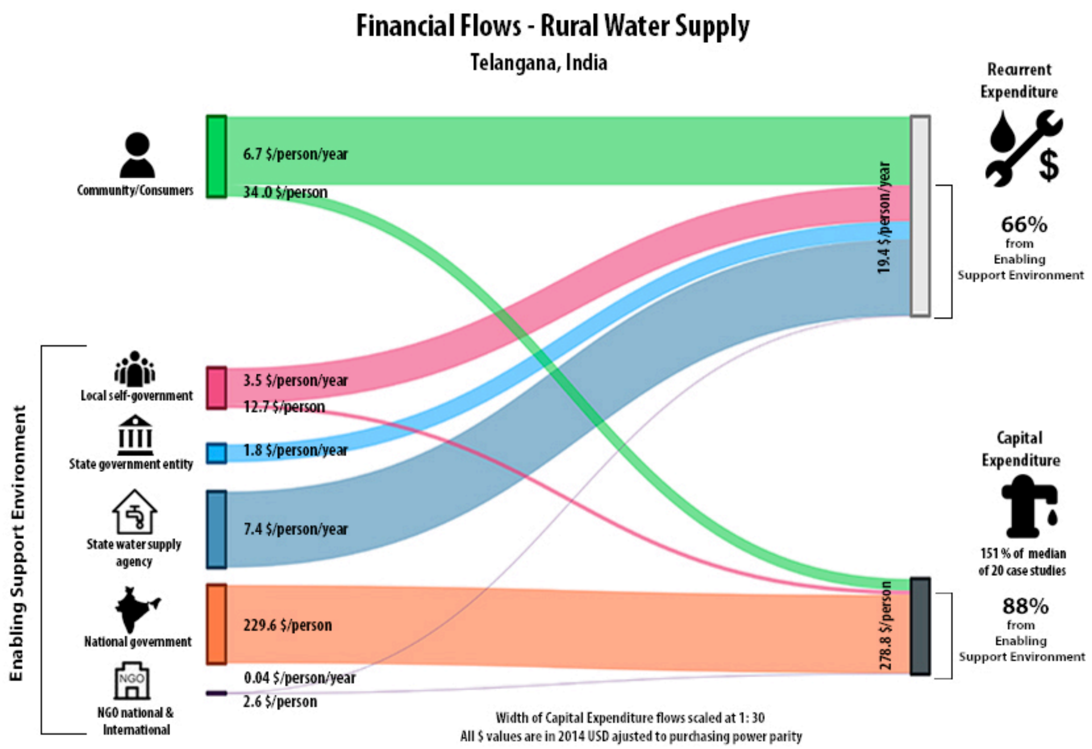

Figure 2. Final Financial Flow Diagram

Source: Authors

The test persons from whom we received responses were from both inside and outside of the WASH sector. Several common points of criticism emerged from the provided feedback. They can be split in two groups: the concept of the diagram, trying to communicate too many messages (e.g. comparison of CapEx to other cases, split of recurrent expenditure into different items), whereby the key message was lost; and secondly showing CapEx and recurrent expenditure in one graph can mislead readers, as they might not notice and/or understand that different time scales and, hence, different units are used and a split of CapEx into software and hardware might be interesting (as was possible in the summary table).

Based on this feedback the amount of information shown was reduced to the minimum required in order to convey the key messages, smoothing the layout and design details. The full set of diagrams can be found at http://www.ircwash.org/news/case-studies-community-water-plus-project.

Discussion

The researchers' understanding of the strengths and limitations of the Financial Flow Diagram approach are that readers find that it is easy to understand the '*plus'* percentage of external support to community managed water schemes. The Financial Flow Diagram tries to provide a visual clue of how contributions by different entities to both capital expenditure and recurrent expenditure compare to each other. Within each of these two categories, this is highly interesting and in line with current thinking in the WASH sector.

The diagram provides a good overview of which entities are involved in installing and operating rural water supply systems. The diagram shows that in many cases a number of entities are involved, and helps readers to identify these entities, their contributions in absolute terms, and the size of contributions relative to each other.

The diagram allows relative comparison of capital expenditure between all 20 cases by presenting it as a percentage of median CapEx. This helps readers in putting the cases in context, without encouraging direct comparison of absolute values. The diagram combines icons with text to help the reader identify and recognise the entities contributing to rural water supply systems. Similarly, it uses icons and text to differentiate between capital and recurrent expenditure.

Entities of the enabling support environment are grouped together, framed with a bracket, and separated from the community by a gap. This clearly sets them apart from the community. In combination with the brackets showing the 'plus' percentage in recurrent and capital expenditure, it helps readers understand the diagram's key message.

Limitations

By displaying capital expenditure and recurrent expenditure in one diagram and using one visual language, the diagram invites comparison between the two. This is problematic as the two types of expenditure accrue over different periods. Capital expenditure is a one-off cost, but might be paid over a longer period depending on the type of funds used. Recurrent expenditure accrues periodically, with intervals varying between types of expenditure. The diagram tries to combine statements about one-off expenditures (in $/person) with periodically incurred expenditures (in $/person/year) using the same visual code.

Our testing has shown that readers of the Financial Flow Diagram have severe difficulties to recognise that CapEx and recurrent expenditure are not displayed in the same scale.

Scaling by a factor equal to estimated average lifetime of the fixed assets can only be indicative, as opposed to methodologically rigorous. The estimated lifetime of 30 years for most cases and of 15 years for handpumps is somewhat arbitrary, as lifetime between and within water supply systems varies considerably. For example, dams in multi-village schemes will have a longer lifetime, while household connection pipes might have a much shorter one. It might therefore be hard to justify the use of 30 and 15 years. Moreover, using these numerical values of the estimated average lifetime as a scaling factor for flow arrow width might suggest that CapEx was annualised, which is not the case. However, such a lifetime approximates accounting conventions on asset lives which, for reasons of materiality, simplify categories rather than aiming for unreasonable accuracy.

In its current form, the Financial Flow Diagram does not link capital and recurrent expenditure and their 'plus' percentages to achieved service levels. This information deliberately has not been included, so as to minimise information overload.

Conclusion

A Financial Flow Diagram is one means of conveying messages on financing in the WASH sector. Some survey respondents find that it may not be the most suitable way but were unable to describe alternatives.

The visual proposed takes the form of Sankey diagram. In order to better highlight the essential messages of the Community Water *Plus*, the number of actors, the type of expenditures to be displayed and the amount of information to be communicated had to be trimmed down (as compared to the summary cost tables – and omitting achieved service levels), through several iterations and testing.

The key flaw is in trying to display flows for both recurrent expenditures and capital expenditures, which leads to comparing elements that are essentially different in units and scale. Our informal testing with experts indicate that there is a high risk for readers to be misled in their reading of the key messages emerging from the visual.

Thus, while the display of financial flows through a flow diagram (such as a Sankey) seems to be a valuable idea at first sight, it may not be the most suitable type of visual display to be considered to highlight financial flows. Less original, yet perhaps less confusing, displays such as stacked histograms, separating capital and recurrent expenditures will continue to be used whilst the researchers work on different approaches.

These initial diagrams have been used to examine existing financial flows. It has been pointed out that a simpler variation might be useful in planning new schemes with communities, making apparent the future costs, capital maintenance most importantly as well as ongoing operations and minor maintenance expenditure, along with required tariffs. Such simpler financial diagrams might indicate likely service levels alongside the financial flows, with the message that community payments could be lower overall if preventive and/or timely capital maintenance is budgeted for and included in the ongoing community and consumer tariff.

Such ideas have yet to be tested. However, the correct emphasis of sustainability in the 'SDGs' demands financial sustainability and the sector has to become more adept at communicating the challenges of financing this, predominantly, capital intensive sector if we are to achieve our goals of public health for all.

Acknowledgements

This paper is an output from the Community Water Plus project, a three-year research investigation funded by the Department of Foreign Affairs and Trade (DFAT) of the Australian government as part of the Australian Development Research Awards Scheme (Grant: 66470).

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Contact details

Dr Richard Franceys led the Community Water Plus research project at Cranfield. Richard now works as an independent consultant. Dr Paul Hutchings is a Lecturer in WASH Impact Evaluation at Cranfield University. Our fellow researchers, then Masters students, T. Guinaldo, C. Leitner, O.J. Nyangoka, V. Thomas, J. Zeilinger can be contacted through Dr Hutchings.

Dr Richard Franceys
Water and Sanitation Management (Consultant)
Tel: +44 (0) 7443617842
Email: richard@franceys.co.uk
http://www.franceys.co.uk/about-us

Dr Paul Hutchings
Cranfield University
Tel: +44 (0) 1234 750111 x8352
Email: p.t.hutchings@cranfield.ac.uk
https://www.cranfield.ac.uk/people/paul-hutchings-805215