

EMPOWERING COMMUNITIES THROUGH WATER SUPPLY PROJECTS

Lead Author: Gina Yukich (Eligible for Young Author Award) – Engineers Without Borders NZ, Opus Consultants

Second Author: Jen Johnstone – Engineers Without Borders NZ

ABSTRACT

Water supply projects in developing communities usually deliver physical infrastructure, but often fail to enhance the capacity of communities and their partner organisations to deliver future projects. This paper uses the Wawan Rainfall Harvesting Project (jointly led by the all-female Wawan Fonhal Development Council, Engineers Without Borders NZ and Rotary) in remote north Ambrym, Vanuatu, as a case study. It investigates how projects can be tailored to enhance the capacity of local and international community organisations to carry out future projects and/or meet their own infrastructure needs.

It concludes that lack of meaningful engagement in projects is a barrier to community capacity development. Furthermore, even technically successful projects may reduce community capacity through disillusionment and expenditure of limited resources. A different model of project management and additional resourcing are required in order to realise sustainable enhancement of community capacity.

KEYWORDS

Rural Water Supply Capacity Development Vanuatu Community

PRESENTER PROFILE

Gina Yukich is geotechnical engineer for Opus Consultants and a project manager for Engineers Without Borders NZ (EWBNZ). She has volunteered for EWBNZ on a Vanuatu water supply project for the past two years, and is currently completing her last semester of a conjoint Bachelors Degree at the University of Auckland.

1 INTRODUCTION

The United Nations Sustainable Development Goals, implemented in 2015 to replace the Millennium Development Goals, included the aim to ensure the availability and sustainable management of water and sanitation for all. In 2015 91% of the world's population had access to improved drinking water sources, up from 82% in 2000. However there remain broad variabilities in access to water globally (Secretary-General 2017). Oceania and sub-Saharan Africa were identified as the regions with improved water supply access below 90%. Rural populations are also far more likely to be disadvantaged in this regard.

Many non-governmental organisations (NGOs) and aid providers are focused on the development of water supply programmes in rural and disadvantaged communities. However, this focus does not always lead to long lasting, sustainable solutions to issues of water scarcity. It is not difficult to find examples of water supply infrastructure that, several years after construction, are damaged, unmaintained or abandoned and subsequently failing to meet their objectives. Reasons behind failed water infrastructure projects are varied, but can include:

1. Poor design or construction;
2. Lack of training in repair and maintenance;
3. Lack of funding for operation and maintenance (O&M) and spare parts; and
4. Lack of organisational capacity to carry out O&M.

Examples of poor design observed by Engineers Without Borders (EWB) volunteers include water pipelines built across flood-prone stream beds, and water tanks collecting water from houses built with cheap roofing materials that rust quickly in humid areas subject to sea spray. These water supplies failed partly due to a lack of consideration of the environmental factors, and partly for the other three reasons listed above. Lack of consideration of the whole life cycle of a project, and the O&M required to keep the system running is a common problem in the provision of development aid – the prioritisation of flashy, marketable solutions over truly sustainable ones.

These issues are not always driven solely by NGOs. Sometimes it is the recipient community who push for a more prestigious option over a practical one. When external groups offer to fund and build water supply projects for communities, there can be little incentive for the community to recommend downsizing for practicality. Rather they are incentivised to favour a more expensive, elaborate solution in order to obtain as big a piece of the funding pie as possible.

This needs-based, project-focused model of aid encourages the building of impressive capital projects without a thorough consideration of the whole life of the project. There is a growing school of thought to change the system of aid provision and move towards a more participatory, strength-based approach. This involves a greater engagement with the community and aims to have the aid recipients driving the outcome. Recipient communities are therefore more invested in, and take greater ownership of infrastructure projects.

An EWB case study in rural Vanuatu, the Wawan Rainfall Harvesting Project, utilised a participatory model of development in the construction of four rainwater harvesting structures. The Wawan Fonhal Development Council (WFDC), representing the local community, initiated the project and agreed to financially invest in its outcome, build the structures with EWB guidance and develop a user-pays system to cover maintenance and repair costs. The construction phase of the Wawan project is used in this paper as a critical case study of the difficulties in implementing good quality participatory development projects. It also suggests some lessons for improving this approach in future.

2 ENGINEERS WITHOUT BORDERS NEW ZEALAND

EWB is a member-based, non-profit organisation with the mission to connect, educate and empower people through humanitarian engineering. EWB works in partnership with organisations and communities in developing countries and New Zealand (NZ) assisting them in accessing knowledge, resources and appropriate technologies needed to achieve their objectives.

EWB focuses its programs in the South Pacific region, and follows a strengths based approach to development, which identifies and builds on the abilities and assets that communities already possess to address social issues. The approach leads to better,

more sustainable development, and allows everyone in a community to participate in building a better future (Caritas Australia, 2017).

EWB's approach includes:

- Establishing long term partnerships with organisations with an intrinsic understanding of in the communities they work in, including governments, NGOs and local community groups,
- Focussing on the importance of relationship building and contextual understanding,
- Use a strengths based approach – human asset mapping to identify unexpected strengths (not just skills, also knowledge of local context & culture, relationships and alliances, values and morals),
- Recruiting field professionals who have characteristics that allow flexibility and agility, hold attributes such as humility, and are able to build strong relationships.

3 REVIEW OF COMMUNITY DEVELOPMENT MODELS

Prior to discussing the Wawan Project case study, it is important to understand the wider context of rural water supply (RWS) in developing communities. Research into the outcomes of RWS projects indicated that the level and quality of community engagement in the initiative was one of the most significant determinants of the quality of overall outcomes. (Cunningham 2017; Moriarty & Verdemato 2010; Prokopy 2005; Isham, Kähkönen & Puttnam 2002; Isham, Narayan & Pritchett 1995; Katz & Sara 1997; Gross et al. 2006). This is generally understood amongst NGOs already, and the field of development aid is full of references to community development, empowerment, engagement and capacity building. These terms are vague and often ill-defined, but all refer to a generally accepted notion that successful development projects engage the active participation of the community that they aim to serve. Where the vagueness of the terms lie is in what that participation looks like, how it should best be fostered and what level of participation is necessary for positive outcomes.

This review covers a brief overview of some of the current models of thought in the field of RWS schemes, and extracts key learnings for the practical management of a successful RWS project.

Community capacity building (CCB) is a common term in development that places a focus on strengthening the ability of disadvantaged groups and communities to act with agency to combat self-identified social issues (Craig 2007). CCB is intended to be incorporated alongside infrastructure projects like RWS schemes, to provide the community with skills to carry out future projects without requiring external support. There have been several criticisms applied to the use of CCB by state bodies, NGOs and other groups. One of these criticisms is that the term is vague and uncritically applied to a range of activities that don't necessarily empower communities meaningfully. The primary criticism however, is that it is too easy for CCB to foster a deficit mindset in aid – emphasising that one group are the 'capacity-builders' and the other suffer from a 'capacity-deficit'.

The deficit mindset affects both those providing aid and those receiving it. It perpetuates an unequal power dynamic that encourages the disadvantaged community to believe they lack skills, talents and resources and are therefore dependent on the capacity-builders. It encourages the service providers to take on a 'white man's burden' attitude and overlook the existing assets of the community. This is called a needs-based approach to development. Needs-based initiatives start with assessing the challenges and

problems a community face, and from that assessment, develop a solution to combat those issues (Mathie & Cunningham 2003). The approach can encourage community leaders to exaggerate the problems they face and to underplay their successes and resources to the most external support. The focus on need can create internalised feelings of uselessness, deficiency and dependency in a community, especially when their leaders buy into this narrative.

An alternative approach is referred to as asset-based community development (ABCD), a subset of the strengths based approach to development that EWB follows. Strengths based approaches focus on first recognising, and then leveraging the assets of a community (Cunningham 2017). These assets may include social assets like people's skills and talents, already established community organisations and the existing capacity of those groups to bring about change (Mathie & Cunningham 2003; Mathie, Cameron & Gibson 2017). It recognises that by focusing internally on the strengths and assets that already exist, you can more successfully drive community engagement and implement successful development initiatives. Mathie, Cameron & Gibson (2017) identify the starting point of an ABCD approach is:

- collecting stories of community successes and analysing the reasons for success;
- mapping community assets;
- forming a core steering group;
- building relationships for mutually beneficial problem solving;
- convening a representative planning group;
- Leveraging activities, resources, and investments from outside the community.

At its core, ABCD and strengths based approaches push for communities to be the ones driving development. The role of external agencies therefore takes a back seat position as facilitators of the process. By changing the framing of the development work from a needs-based approach to an asset-based one, you challenge the internalised sense of powerlessness that is an all-too-common problem with aid work. Communities and groups are encouraged first to mobilise around 'low hanging fruit' – solving smaller problems – to build intangible assets like confidence and organisational strength before moving on to larger more ambitious projects (Mathie & Cunningham 2003).

Hutchings et al. (2015) carried out an analysis of three different scales of rural water supply management and assessed them over the long term, looking at what factors were most important in determining the success of different schemes. His research identified that in areas like India and Sub-Saharan Africa around a third of RWS systems are non-functional. This calls into question the workability of typical models of community management used in RWS schemes. He uses the term community management plus (CM+) to refer to the model of operation of successful mid-scale RWS schemes he witnessed. The 'plus' in the title indicates that one of the key aspects that created successful RWS projects was ongoing, post-construction support provided to the recipient community by an external organisation.

From his research Hutchings et al. (2015) identified several internal factors and external factors that correlated with a RWS project's success. The external factors were those which could be provided or influenced by the external organisation, which involved:

- External financial support,
- Building management skills and capacity,
- Building technical skills and capacity,
- Access to technical O&M advice,

- A transparent, regulatory framework managing the RWS,
- Access to management and financial advice,
- Access to loans and microfinance,
- Access to a supply chain of repair parts and services,

It was noted that failures in RWS schemes typically appear sometime after construction, when issues with ongoing O&M cause a breakdown of the system (Hutchings et al. 2015). Success rates were higher when ongoing and long term support from external parties was available to help the community in managing these processes.

The conclusion from this literature review is that an improved model of providing RWS infrastructure to disadvantaged communities is required to improve project outcomes. Organisations working on these projects in rural communities should aim to adopt a strengths based approach in preference to a needs-based one. A rethinking of the typical project implementation cycle should occur, creating space in the organisations' budgets for the provision of ongoing technical and management support to the community. A recognition that managing O&M issues over the long term is as critical as the construction process needs to be built into the provision of RWS schemes, in both the minds of the external groups and the recipient community themselves. Training and capacity building on the management and administrative processes required to maintain a RWS system is critical for a project's long term success.

4 WAWAN PROJECT CASE STUDY

The Wawan Project was initiated in 2014 when EWB was contacted by the WFDC to assist in providing a potable water supply to the people of the Wawan province, the north-east area of Ambrym Island, Vanuatu. The WFDC is a local community group run by female representatives from each of the nine villages in the area. WFDC's mandate is to look after community water and sanitation issues, and they have identified water access as one of the biggest problems their community faces. The WFDC had an existing relationship with Rotary (Port Vila and Heirisson clubs), who were keen to continue their work with the WFDC with technical support provided by EWB.

Over the past few years Vanuatu has suffered from growing water insecurity. The recent El Niño weather pattern brought droughts and unpredictable weather, while Cyclone Pam (2015) and Donna (2017) have recently battered the country and damaged critical infrastructure. Climate change is increasing the severity of extreme weather events like these (Vanuatu Meteorology and Geohazard Department 2011). Changes disproportionately affect rural communities like the Wawan province, which has a primarily subsistence economy that relies on stable growing seasons for a significant proportion of local livelihoods.

On the basis of early consultation with the WFDC and the community, EWB proposed the construction of four rainwater harvesting structures, with associated tanks and reticulation, servicing Falibeur and Barereo villages. The structures were designed by professional engineers through both voluntary engagement and corporate pro-bono hours, generally complying with Vanuatu building codes and relying heavily on NZ codes except for the use of locally sourced materials. In 2016 a EWB volunteer spent a 6 month placement in Ambrym to oversee construction, which culminated in successful completion of four operational water supply structures. In 2017 the project is ongoing, with a forward focus on water supply in another village of the Wawan province and capacity building through training and ongoing technical support.

This case study will be used to illustrate, assess and critique some of the standard methods used in the delivery of rural water supply projects, to show the difficulties in application of development theory in real environments, and to identify areas for future improvement in the supply of RWS.

4.1 THE STRENGTHS BASED APPROACH APPLIED

The strengths based approach adopted by EWB involved early discussions with the WFDC and the following community assets were identified:

- The WFDC itself, specifically possesses:
 - Previous experience of water projects,
 - Basic financial and literacy skills,
 - Regularly scheduled meetings,
 - An existing funding-based relationship with Rotary,
 - Previous water management training from the Department of Geology, Mines and Water Resources,
- The community members, who possess:
 - Basic hand and power tools,
 - Self-taught construction skills,
 - Motivation and eagerness to contribute time,
 - Access to renewable building materials, such as timber, bamboo and natangora leaves (used for flooring matts and thatched roofs),
 - Experience in fundraising events,
- The village chiefs, who possess:
 - Respect and power to enforce decisions,
 - Organisational abilities, i.e. the power to arrange working bees that all village members must attend,

This focus on the assets of the community fostered a positive outlook, where they saw their own power bring about the changes they want in their community. However, this is an ongoing process. There were still expectations amongst some community members that projects like this should be completely financed and constructed by the aid donors. It may take more than the span of one project to change those expectations.

4.2 COMMUNITY LEADERSHIP

4.2.1 WAWAN FONHAL DEVELOPMENT COUNCIL

WFDC meetings are scheduled monthly. However in practice they can occur less frequently than this and attendance (of the 18 members) is generally low. The WFDC members represent nine different villages, which range in size, population and quality of access to improved water systems. Some members of WFDC are more active than others, an issue which is exacerbated when the council projects serve only one or two villages at a time. Membership of the WFDC is voluntary so there can be a lack of incentive for members to attend meetings or workshops related to projects in a different village to theirs. The WFDC chair and her husband have been the main driving force behind water and sanitation projects in the Wawan community, and also act as the host family for EWB volunteers who have worked in the region.

4.2.2 VILLAGE CHIEFS

Each village has one chief and a hierarchy of lesser chiefs. They are always men and are important members of their community, generally listened to regarding issues and in charge of enforcement. The WFDC and chiefs interact informally, with the representatives from each village talking to their chief about WFDC projects. During the project, the chiefs of Falibeur and Barereo villages played an important role as foremen of the construction process, helping to mobilise the local men to provide labour where neither EWB nor WFDC had the authority to do so.

Some villages have chiefs who are more effective than others. For example, the chief of Falibeur village has had an education and views that aligned with the WFDC – as such, the consultation process was fairly straightforward, with the chief and WFDC working together to discuss options with the community. However, in Fonteng village, the chiefs and sub-chiefs had differing viewpoints and could not agree on the best course of action. This resulted in a last-minute withdrawal of Fonteng village from the project, after the community consultations had already been completed.

4.3 CULTURE AND COMMUNICATION BARRIERS

An unforeseen issue faced during the project occurred when the WFDC and community members would agree to terms during discussions but renege or change their minds at a later date. One previous volunteer who worked with the WFDC on the first water project they undertook, prior to EWB's engagement, reported the following:

"I informed the community the water fee would likely be 400V/h/m. I asked all households to sign a statement saying they acknowledge and accepted the proposed water fee, which was to be submitted with the grant proposal. It was not until a few weeks later I was informed by my host mother that she told the community to agree to anything I said because she thought I was depressed and did not want me to worry too much." (Cleary 2013)

A later example involved the footprint size of the rainfall harvesting structures that were presented to the WFDC. After seeing the marked out size (~200m² per structure), the designs were agreed to. However, when faced with a practical understanding of the scale of work this would require during construction, the communities decided they would prefer smaller structures. Their reasoning was legitimate and foreseeable – a smaller structure was more useable as a community house, and required a more feasible allocation of time and local resources to construct. The reason it only became apparent later in the project stage could be attributed to an over-technical focus on the design of the structures and an insufficient understanding by either party of the amount of work involved. Maximising roof size maximises possible rainfall recovery. However it overlooks the holistic value of the project where the infrastructure is a community asset with broader impact than just as a water supply.

EWB volunteers are required to learn Bislama, the local language, prior to their assignments in Vanuatu. This helps to overcome the language barrier, but it is often cultural barriers that create confusion. It's not sufficient to understand the words that are being said. In order to fully interpret the meaning behind them, our volunteers need to have an intrinsic understanding of the culture.

This highlights that community consultation can be problematic, and merely asking some members of the community what they want is rarely enough. Communities are non-homogenous, they have widely differing opinions that sometimes clash, and standpoints

that change throughout the course of the project. The strengths based and CM+ approaches suggest the solution to these problems is to give the community a greater role in determining the scope and design of the project than just consultation (Cunningham 2017; Hutchings 2007; Mathie & Cunningham 2003). It doesn't eliminate cultural barriers, but time spent engaging the correct participation early in the project could reduce significant time and resources spent on late-stage design changes.

4.4 FINANCES

The partnership agreement required the WFDC to provide 10% of the capital cost of the project, to be contributed by the households in the two villages that would benefit from the new water supply. In addition to this, a monthly household water fee was proposed to provide funds for ongoing maintenance and repair, and eventual replacement of the system at the end of its useable life. The villages would also provide the labour for the construction of the new structures.

This is a typical financial model for a RWS project delivered by an NGO. The commitment to contribute to the start-up cost signalled an existing demand for the infrastructure was present and acted as a way to ensure community buy-in to the project going forward. The funds were raised and spent internally within the Wawan region for the project, on tasks like buying trees, and transporting materials from the harbour. Management of the money became an issue, with little record keeping by the WFDC causing friction between the two villages over how much money they each had remaining.

Prior to the Wawan project, the community did not need to pay monthly water fees, as the households were responsible for maintaining their own rainwater water sources, and collecting water from springs once their household storage tanks ran dry. During consultation and options assessment, the WFDC were presented with several water supply options, including their initial contribution and the ongoing fees that would be required.

However, as the project progressed, issues emerged with the collection and management of the water fees. By the end of construction of the project, it became clear that the WFDC was unlikely to have the capacity to collect water fees from Falibeur and Barereo villages.

Water fees were not without precedent in the Wawan area, as they had been established by the WFDC in a nearby village, Willit, to cover the costs of a water supply pipeline constructed with the assistance of an Australian engineer prior to EWB involvement. The collection of water fees in Willit had been somewhat successful, with most of the households contributing, and records being kept by the Council. However, when repairs needed to be made to the Willit pipeline, the WFDC was unable to cover the costs from the monthly water fees. This was partly due to the impact of Cyclone Pam, which had resulted in a large section of above-ground pipe being damaged and requiring replacement, but a contributing factor was that not all of the fees had been collected.

There are several factors contributing to the difficulty in setting up a sustainable water fee programme. These include lack of enforcement power of the WFDC, mistrust of the WFDC's ability to manage funds, and a lack of understanding from the community about why they should pay for a previously free resource. The all-female nature of the WFDC is a bonus for fair representation, however the cultural position of females in the Vanuatu society means they often lack the stature and respect to enforce compliance.

There is also not full trust in the financial management of the WFDC. Tensions arose during the project when funds were spent without record-keeping of the expenses or of the amounts of money the individual villages had contributed to the project. The money was treated as a pooled asset by the WFDC while the villages saw their contributions individually and wanted transparency as to how much had been spent. Transparency, particularly in financial management, was one of the long-term success indicators of the RWS literature (Hutchings 2007), and is particularly important in this situation where one body is managing the different, sometimes-competing interests of 9 villages.

4.5 SUCCESSES

Despite the many challenges faced by the project, there were several real measures of success that can be made. Firstly, the completion of four rainwater harvesting structures to operational level in time for the wet season, provided the two villages with an extra 40,000L of water storage capacity to help see them through the next dry season.

Successes in the technical aspects of the project were notable. The design of the rainwater structures was initially made and reviewed through pro-bono input of Beca and AECOM, in compliance with Vanuatu and NZ building codes. Yet over the course of construction a range of changes to the shape, size and materials of the structure had to be made to ensure usability of the structures, and in response to limitations in time and resource availability. These changes were able to be reviewed and signed off by professional structural engineers through the EWB Technical support hub. The ongoing engagement of these professionals meant that we could be reactive to changes in design through construction without compromising quality. This allowed us to adapt to design change requests from the community, resulting in a solution that fits their needs.

The technical training that took place during construction with the local men from Falibeur and Barereo also proved successful. On-the-job training was undertaken with the people constructing the rainfall harvesting structures, providing guidance on improved construction methods, concrete grading, health and safety measures, and building more resilient structures. Training onsite meant the workers were already motivated by the project at hand, and so proved more successful than carrying out training in workshop format which may have suffered from low turnout and participation. Over the course of the project, the improved building methods taught onsite were seen replicated in the personal projects of some of the workers. The men from the villages generally all had self-taught experience with building, and so in many cases only minor guidance was required to improve the resilience of their structures.



Photograph 1 & 2: Examples of the Wawan project rainfall harvesting structures near the end of construction.



Photograph 3 & 4: Examples of improved construction methods being re-used on personal building Falibeur and Barereo villages.

Finally, having managed this project through to completion, the WFDC developed their capacity and experience. Being able to implement a successful project has given them additional confidence and empowered them to continue their work to improve access to water and sanitation in their community. They sought the continued support of EWB in providing more improvements to water systems in nearby villages, and the partnership will provide ongoing support to build their technical, managerial and administrative capacity.

4.6 LESSONS LEARNED

Despite their growth and empowerment during our partnership, the Council currently lack sufficient capacity to effectively manage the water systems within their community. They have struggled to regularly collect water fees and manage the maintenance sufficiently. This is something that EWB will be working with them to improve on in future. Tailored

training resources on finances, operation and maintenance and water administration will be developed based on the needs of the council and community.

One of the indicators of long term success shown by the literature was the presence of ongoing support with technical O&M and management issues. EWB is committed to extending our partnership with the WFDC from providing physical infrastructure, to providing advice and sharing knowledge on how to successfully manage projects as a voluntary organisation. In the future the WFDC will take a greater role in areas of their existing strengths of direct project management and material procurement, while we work with them to develop greater administrative and financial management capacity. We also have a clear awareness that by the end of the rainfall harvesting structure construction, the community was suffering fatigue from the scale of commitment required to complete the structures. The development was a significant detraction from the normal operating conditions of the community and the use of a local workforce pulled people away from their normal jobs and farming. Projects like these must therefore strike a balance and make concerted efforts to not exhaust the resources of the community, lest they suffer from burnout.

5 CONCLUSIONS

The Wawan project case study has been discussed in this report to critically analyse the strengths based approach to development adopted by EWB.

The project achieved its tangible goals; to produce four operational rainwater harvesting structures and increased water security to a vulnerable region. It also made significant progress on the more intangible goal of strengthening the existing social assets of the community. The WFDC has gained experience in organising a RWS project of much greater scale to their previous ventures, and can feed that experience into future projects. Members of the community have gained personal skills in building and construction methods that can be applied back into other aspects of their lives. The success of the project required extensive cooperation and teamwork amongst members of each village, strengthening community ties and the belief in their own skills and abilities.

The strengths based approach is not always simple to implement. Communities can have pre-formed ideas about the role that NGOs play, with expectations that NGOs cover the costs of RWS schemes completely. Cultural and language differences make it challenging to get a good understanding of the existing capacity of a community organisation for tasks like finances and administration. Communities may have strong assets in leadership, mobilisation and physical construction, but for long term success of RWS these assets need to be backed up by good water management that includes a focus on O&M and transparent finances.

The true success of the Wawan project will be measured over the long term. The partnership of EWB and the WFDC will continue, with a renewed focus on facilitating the growth of the organisational capacity of the WFDC. This will result in a community organisation who have the ability to independently implement, manage and maintain future projects within their community, leading to sustainable growth and change.

ACKNOWLEDGEMENTS

The authors acknowledge the input and contribution to this paper by fellow colleagues Matthew Lillis, Abbas Que Rahman and Tiago Almeida. A further acknowledgement goes to our partners, the Wawan Fonhal Development Council, Rotary Heirisson and Rotary Port Vila for their ongoing contributions to our work in Vanuatu.

REFERENCES

- Caritas Australia (2017) Strengths Based Approach. Retrieved 4th July 2017, from <http://www.caritas.org.au/learn/strengths-based-approach>
- Cleary, S. (2013) 'Community water governance, management and participation in Ambrym, Vanuatu' *International Water Center*, University of Queensland.
- Craig, G. (2007) 'Community Capacity Building: Something old, something new...?' *Critical Social Policy*, 27, SAGE PUBLICATIONS, 335-359.
- Cunningham, I. (2017) 'Strength Based Approaches and Citizen Led Rural Water Supply' Institute for Sustainable Futures.
- Gross, B., Wijk, C., van Mukherjee, N., Mundial, B. & others (2006), 'Linking sustainability with demand, gender and poverty: A study in community-managed water supply projects in 15 countries', *Knowledge management for change: a compilation of WSP publications*, WSP, 1-42.
- Hutchings, P., Chan, M.Y., Cuadrado, L., Ezbakhe, F., Mesa, B., Tamekawa, C., Franceys, R. (2015) 'A systematic review of success factors in the community management of rural water supplies over the past 30 years' *Water Policy*, 17, IWA Publishing, 963-983.
- Isham, J., Narayan, D., Pritchett, L. (1995) 'Does participation improve performance? Establishing causality with subjective data', *The World Bank Economic Review*, 175-200.
- Isham, J., Kähkönen, S., Puttnam, R. (2002) 'How do participation and social capital affect community-based water projects? Evidence from Central Java, Indonesia', *The Role of Social Capital in Development*, Cambridge University Press, 155-87.
- Katz, T., Sara, J. (1997) 'Making rural water supply sustainable: recommendations from a global study.' *Water and sanitation program*, World Bank Group.
- Mathie, A., Cunnigham, G. (2003) 'From clients to citizens: Asset-based Community Development as a strategy for community-driven development' *Development in Practice*, 13, 5, 474-486.
- Mathie, A., Cameron, J., Gibson, K., (2017) 'Asset-based and citizen-led development: Using a diffracted power lens to analyse the possibilities and challenges' *Progress in Development Studies*, 17, 1, SAGE PUBLICATIONS, 54-66.
- Moriarty, P, Verdemato, T. (2010) 'Report of the international symposium on rural water services: providing sustainable water services at scale' Thematic Group on Scaling Up Rural Water Services,
- Prokopy, L.S. (2005), 'The relationship between participation and project outcomes: Evidence from rural water supply projects in India', *World development*, 33, no 11, 1801-1819.

Secretary-General (2017) 'Progress towards the Sustainable Development Goals', 2, United Nations Economic and Social Council.

Vanuatu Meteorology and Geohazard Department (2011) 'Current and future climate of Vanuatu' Pacific Climate Change Science Programme.