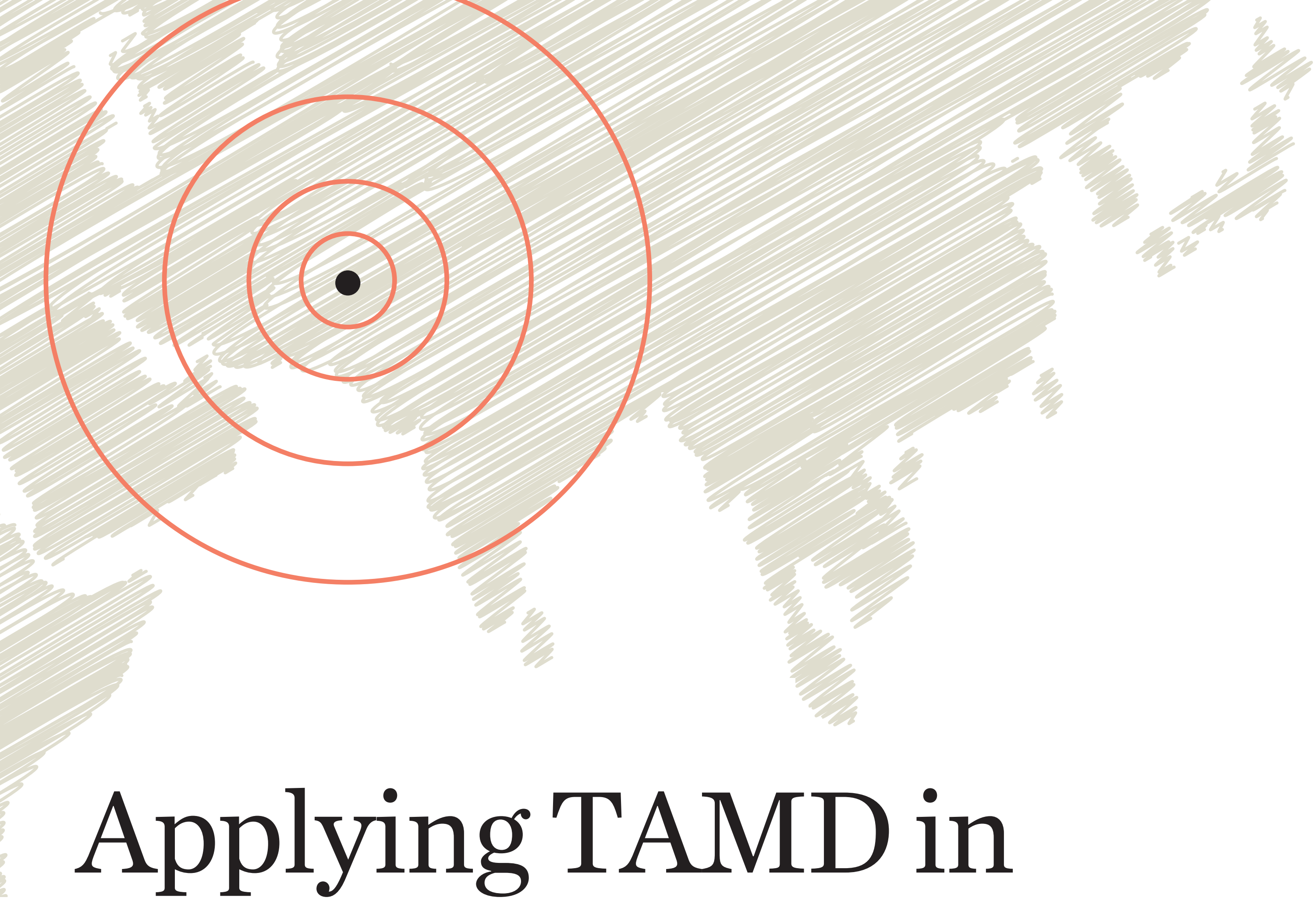

Applying TAMD in Pakistan: rainwater harvesting, resilience and gender

Fawad Khan, Atta ur Rehman and Ajaz Ahmed

Country Report
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Gender

Keywords:
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ISET-Pakistan

EARTHQUAKE RECONSTRUCTION AND REHABILITATION AUTHORITY
ERRA

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The Climate Change Group works with partners to help secure fair and equitable solutions to climate change by combining appropriate support for adaptation by the poor in low- and middle-income countries, with ambitious and practical mitigation targets.

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- Building capacity to act on the implications of changing ecology and economics for equitable and climate resilient development in the drylands.

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Partner organisations

Institute for Social and Environmental Transition-Pakistan: ISET-P is a non-profit research institute that focuses on adaptation to climate change and generates evidence and knowledge to bridge the gap between research and practice. It is a part of an ISET network of independent sister organisations and researchers that work across South and South East Asia through South-South and North-South partnerships.

Earthquake Reconstruction and Rehabilitation Agency – ERRA is an independent, autonomous, and federal institution of Government of Pakistan tasked and responsible for the operational planning, coordinating, monitoring, and regulating the reconstruction and rehabilitation operations in the earthquake affected areas of the country.

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Women and girls who used to spend a major portion of their day physically carrying water over steep slopes in inclement weather, now grow vegetables for their families and rear animals for additional income, and their daughters go to school. This case study generates evidence on adaptation and the socio-economic benefits of rooftop rainwater harvesting with a gendered perspective. It is an application of the TAMD framework to evaluate climate-resilient development in a post-disaster reconstruction programme.

Contents

Acronyms

AJK	Azad Jammu and Kashmir
ERRA	Earthquake Reconstruction and Rehabilitation Authority
IIED	International Institute for Environment and Development
KPK	Khyber Pakhtunkhwa
M&E	monitoring and evaluation
PERRA	Provincial Earthquake Reconstruction and Rehabilitation Authority
PRWH	Promotion of Rooftop Rainwater Harvesting Project
SERRA	State Earthquake Reconstruction and Rehabilitation Authority
TAMD	Tracking Adaptation and Measuring Development
WatSan	water and sanitation
WASH	Water, Sanitation and Health

Executive summary

TAMD is a twin-track framework to evaluate adaptation success. Track 1 assesses how widely and how well countries or institutions manage climate risks, while Track 2 measures the success of adaptation interventions in reducing climate vulnerability and keeping development on course. This twin-track approach means that TAMD can be used to assess whether climate change adaptation leads to effective development, and how development interventions can boost communities' capacity to adaptation to climate change. Importantly, TAMD offers the flexibility to generate bespoke frameworks for individual countries that can be tailored to specific contexts and applied at different scales.

In Pakistan, the TAMD framework was used to assess resilience benefits of a project promoting rooftop rainwater harvesting in two villages, including its impact on women and girls. The particular objectives of this evaluation were to:

- Develop and test the TAMD framework in the context of Pakistan;
- Ascertain that it can capture socio-economic development benefits of adaptation-related investments in the local context; and
- Develop socio-economic indicators for the future evaluation or assessment of similar projects.

IIED implemented the evaluation in collaboration with the government of Pakistan's Climate Change Division; the Institute for Social and Environmental Transition, a local non-profit research organisation, developed and tested the framework in the field.

The rooftop rainwater harvesting project was part of the Earthquake Reconstruction and Rehabilitation Authority's Public Sector Development Programme in earthquake-affected areas of Azad Jammu and Kashmir (AJK) and Khyber-Pakhtunkhwa (KPK). The devastating 2005 earthquake severely damaged more than 4,000 water supply schemes , and reduced the yield from natural water sources by 40 per cent. Very few houses had a piped water supply – with 90 per cent of households scattered on steep slopes, such infrastructure is too expensive. Women had to physically carry all the water for their household's use over long distances, causing hardship, fatigue and injuries. As a result of inadequate water availability, health and hygiene conditions were poor and agriculture and animal-rearing potential limited.

We selected two villages for testing the evaluation framework – Chitra Topi in Bagh district (AJK) and Nathiagali in Abbottabad (KPK) – and collected data on indicators for variables identified in the theory of change previously developed through a gender-segregated stakeholder consultation or shared learning process. Using a quasi-experimental research design, we randomly selected households with and without the intervention for data collection and made a difference-in-difference comparison to test the theory of change and develop final outcome indicators for future use.

Increased water use in households with the intervention was our indicator for measuring the programme's effectiveness in increasing water availability through storage. Our findings showed that the intervention could potentially reduce the impact of increasingly variable water availability from existing natural groundwater sources due to climate change. The few households that invested in extra storage demonstrated that water availability could be increased two- or threefold. Most houses only use a portion of their roof for collecting rainwater and could collect more by using additional roof space for this purpose.

The study found that, once freed from the arduous task of fetching water, women generated savings and income by using the additional water and time available to them in kitchen gardening and animal rearing. Having more easily accessible water also improved sanitation, hygiene and health conditions and reduced absenteeism in schools – a combination of healthier children, fewer girls involved in fetching water and the availability of girls' toilets. Improved health among the population and reduced hardship among women also led to a sharp decrease in healthcare costs in households with the intervention.

The theory of change developed with stakeholders had indicators to measure these socio-economic benefits to households, which were combined to represent the three broad sectors shown in the table below.

Summary of socio-economic impacts

SECTOR	INDICATOR	BAGH	ABBOTTABAD
Livelihood/food security	Average savings and diversification per household (Rs per month)	2,696	659
Health	Decrease in household medical expenditure (Rs per month)	2,309	2,712
Education	Decrease in children's absenteeism from school (days per month)	1.5	1.1

The average monetary benefit per household was Rs 5,005 in Bagh and Rs 3,371 in Abbottabad. These outcome indicators were statistically tested and found to be robust. This case study shows that the TAMD evaluative framework is suitable for measuring adaptation and the socio-economic benefits of development interventions with a gendered approach in local conditions in Pakistan.

Background

1

1.1 Project scope and objectives

International Institute for Environment and Development (IIED) is an international non-profit research institution, dedicated to the cause of sustainable development in developing countries, particularly addressing the challenges posed by climate change in terms of adaptation. IIED's tracking adaptation and measuring development (TAMD) initiative, funded by DFID, was piloted in five developing countries, including Pakistan. TAMD aims to develop a customised evaluative framework to facilitate the tracking of climate adaptation-related investments, thus enabling us to measure, report on and verify levels of investments in climate adaptation from public, private and international sources. Other objectives include developing instruments and methods to enable governments to independently formulate, implement, and evaluate policies and interventions related to climate adaptation. IIED developed the TAMD framework to be applied and tested in pilot countries, which could tailor it to their specific needs. In Pakistan, the project objectives included:

- developing and testing the TAMD framework and customising it to the context of Pakistan.
- ascertaining that the framework can capture socio-economic development benefits of adaptation-related investments in local context
- developing socio-economic indicators for future evaluation/assessment of similar projects.

IIED led the project and implemented it in collaboration with the government of Pakistan's Climate Change Division. The Institute for Social and Environmental Transition, a non-profit research organisation, was the local implementing partner.

To support implementation, a the Climate Change Division set up a consultative committee comprising key stakeholders from relevant government departments, the United Nations and international non-governmental organisations. The committee met periodically to monitor progress, endorse the outcomes and provide necessary guidance.

During the design and appraisal phase, we analysed more than 200 national and provincial projects that contribute directly or indirectly towards climate adaptation, selecting the Promotion of Rooftop Rainwater Harvesting (PRWH) Project for testing the TAMD framework. The Earthquake Reconstruction and Rehabilitation Authority (ERRA) worked with the research team, making data and documents available, and coordinating field visits and the consultation processes.

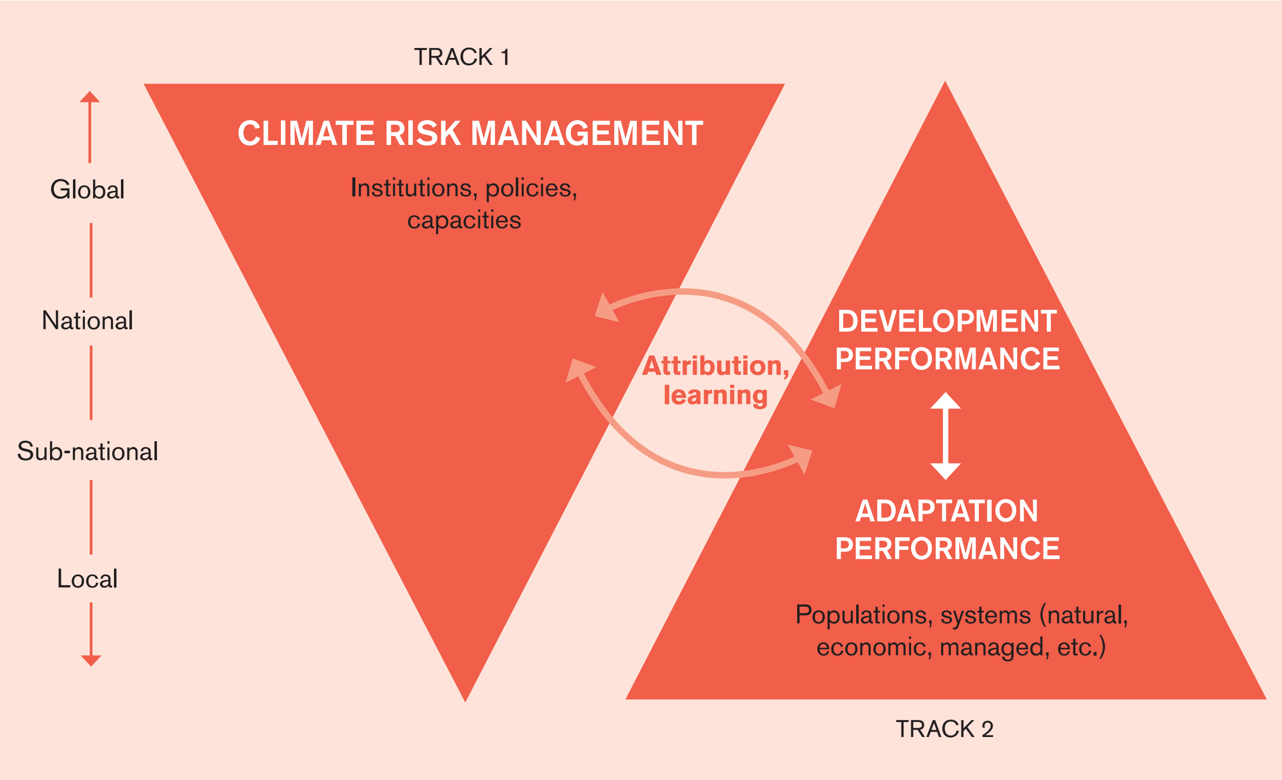
1.2 The TAMD framework

TAMD is a twin-track framework to evaluate adaptation success. Track 1 assesses how widely and how well countries or institutions manage climate risks, while Track 2 measures the success of adaptation interventions in reducing climate vulnerability and keeping development on course. This twin-track approach means that TAMD can be used to assess whether climate change adaptation leads to effective development, and how development interventions can boost communities' capacity to adaptation to climate change.

Importantly, TAMD offers the flexibility to generate bespoke frameworks for individual countries that can be tailored to specific contexts and applied at different scales. TAMD can evaluate an intervention's outputs, its short-term outcomes and its longer-term impacts, within and across the two tracks, and at scales ranging from multiple countries to individual villages. Thus, it can explore how adaptation and/or adaptation-relevant interventions contribute to better climate risk management while also helping keep development outcomes on course in the face of climate change.

In Pakistan, we applied the framework as a retrospective evaluation of the PRWH project to understand how the framework can explore the resilience benefits of a particular development intervention. This application of TAMD focused on the theory of change and changes in Track 2 (resilience and development performance).

Figure 1. Overview of the TAMD framework



1.3 Promoting Rooftop Rainwater Harvesting Project (PRWH)

The Promoting Rooftop Rainwater Harvesting Project was part of the Earthquake Reconstruction and Rehabilitation Authority's (ERRA) Public Sector Development Programme. It was planned and designed to address the issue of severe water shortage in the earthquake-affected areas of Azad Jammu and Kashmir (AJK) and Khyber-Pakhtunkhwa (KPK) following the devastating earthquake in 2005. More than 4,000 water supply schemes has been severely affected in the quake, while the yield of natural water sources fell by some 40 per cent. At the same time, demand for water increased for reconstruction.

Before the earthquake, water availability in the steep, hilly terrain was limited to natural springs. Women and school-age girls would walk many kilometres over difficult terrain to fetch water to their households. Not only did this occupy a lot of their productive time, it also led to fatigue and caused health issues related to carrying heavy loads. The hardship was particularly severe in winter, when the shorter days, cold and snow made walking very difficult. Households reported injuries, and even miscarriages, as a result of fetching water. Despite these tremendous efforts, they fetched barely enough water for drinking, cooking and other basic needs. Poor sanitary conditions impacted on health – particularly for women and girls, who could only relieve themselves in the open at daybreak or twilight hours. Climate change further threatened (and continues to threaten) the availability of water: it has been predicted that variability in precipitation may lead to periods of heavier rains with longer dry periods when the springs will stop yielding water perennially.

Rainwater harvesting was introduced as a strategy to combat water shortage among all households in the affected area. Rehabilitating the damaged water supply schemes would take years to complete, would not meet increased water needs and would further deplete water sources. Nearly 90 per cent of the population lives in scattered hamlets in this mountainous region; transporting water from main water bodies or other sources, often located kilometres away from communities, was neither viable nor cost effective.

Annual rainfall in the target areas ranges from 1,300 to 1,500mm – sufficient for rainwater harvesting – and most private houses and public buildings have corrugated galvanised iron sheet roofs, one of the best catchment materials for rainwater harvesting. The ERRA's WatSan (water and sanitation) section designed a project to provide rainwater harvesting systems to 40,000 households and 400 public buildings. Additional activities included developing technical guidelines, training of trainers, and awareness seminars and workshops for the households and schools.

1.4 Project execution and institutional support

The project was initiated by ERRA, with support from the Provincial Earthquake Reconstruction and Rehabilitation Authority (PERRA) and the State Earthquake Reconstruction and Rehabilitation Authority (SERRA). A technical advisory group was set up for strategic guidance and effective implementation, comprising representatives from all relevant technical government departments. NESPAK, a semi-autonomous engineering company, provided technical services and local NGOs were involved in implementing the project. Local masons were trained to install and subsequently maintain the systems.

A communication strategy aimed to raise mass awareness about PRWH at local level, with local rainwater harvesting committees disseminating necessary information about the system's maintenance, use and benefits. After successfully implementing the system in a pilot in two, water-scarce, remote and poor villages (one each in KPK and AJK), the project was rolled out in 20 Union Councils in AJK and KPK.

1.5 Research objectives

The overall objective of the research was to use the TAMD framework to determine the adaptation and socio-economic benefits of the PRWH project in earthquake-affected areas. The analysis was therefore broken down into following tasks:

- identifying the potential adaptation and socio-economic benefits of rooftop rainwater harvesting technology;
- developing and testing of the theory of change on how these benefits have been realised;
- quantifying their contribution in overall wellbeing of the beneficiaries;
- measuring and monetising the economic value of socio-economic benefits; and
- developing key indicators to evaluate similar projects.

Methodology

2

2.1 Site selection

Considering vulnerability to water scarcity and adequate time lapse post-completion to measure impacts, we selected two villages for the study: Chitra Topi in AJK's Bagh district and Nathiagali in KPK's Abbottabad district. Many household incomes in these villages depend on daily labouring in the local market and small businesses; some local men are government and private sector employees; and others depend on remittances from abroad. Most households also practice small-scale farming and livestock-rearing – for subsistence and sale – which is mainly the domain of female family members. Households in Bagh are more reliant on agriculture and livestock, while in Abbottabad a large portion of men work in off-farm settings, due to better road connectivity and proximity to markets.

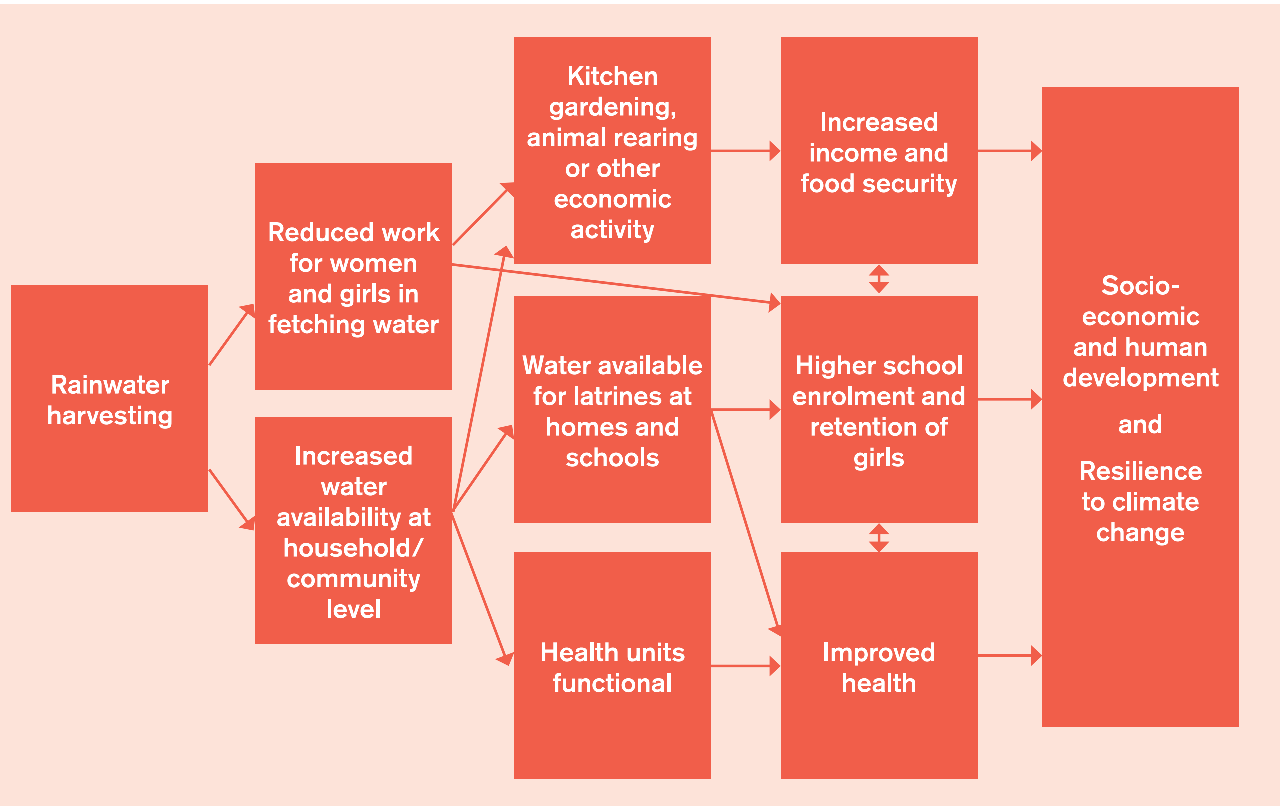
2.2 Theory of change

The theory of change refers to the sequence of causation that leads from the intervention – in this case, rooftop rainwater harvesting – to the adaptation outcomes and socio-economic benefits. To construct a theory of change in a retrospective evaluation, we made a set of hypotheses from existing studies and relevant documents. We then held a special consultation workshop with the technical advisory group to discuss and refine the theory of change and develop indicators to test it. The advisory group included representatives from organisations involved in implementing the PRWH project, and so had knowledge of its intended and unintended impacts. We discussed the theory of change with the communities, holding separate group discussions with women, men and school children. Finally, we consulted local schoolteachers and basic health unit staff to refine the theory.

This well-articulated shared learning process to shape and refine the theory of change helped us narrow down the long list of outcomes and impact indicators to a more focused list of suitable socioeconomic impact indicators that were both available and measureable. Spending time and resources with stakeholders – particularly gender-segregated community groups – made data collection more efficient by focusing the theory of change on fewer and more precise indicators. Figure 2 shows the theory of change flow chart, which we developed, evolved and tested.

The project had two immediate impacts: it increased the amount of water available per household by providing storage, and greatly reduced the workload of women and girls. This freed up a significant amount of time and provided water for other activities, allowing women to focus on kitchen gardening and animal rearing. By increasing water storage and availability at home, the project also addressed climate resilience, reducing the impact of rainfall variability and springs drying up.

Figure 2. Theory of change



The availability of more water enabled households and public buildings to use indoor flush latrines. This had a positive effect on household health and hygiene and profound implications for women and school-age girls. They were no longer restricted to relieving themselves at dawn and dusk in the open; girls were able to go to school, freed from their water-fetching duties and knowing there were working toilets at school – the lack of toilets is one of the primary reasons girls avoid school. Access to water also made government-provided basic health units functional.

2.3 Qualitative research process

The shared learning dialogue processes developed the theory of change, which formed the basis of our evaluation and identified indicators. This participatory knowledge creation process included:

- one-to-one interviews with relevant officials from the Planning Commission, the Climate Change Division, ERRA, PERRA and SERRA
- gender-segregated community-level dialogues and focus group discussions
- transect walks
- interviews with community members
- periodic consultations with the Consultative Group and WatSan Technical Advisory.

We tested the predicted theory of change using primary data and indicators that reflect the relationship between rainwater harvesting and the socio-economic resilience and wellbeing of beneficiary communities.

We also used the shared learning methods to triangulate results through quantitative techniques and to disseminate and validate findings.

2.4 Quantitative analysis

We used a quasi-experimental survey design that randomly selected and compared data from two types of household in the same location – those with rooftop rainwater harvesting (treatment group) and those without the intervention (control group) – with the control group acting as a counterfactual. We measured both groups for a change in indicators before and after the intervention, through recall.

We used this sampling strategy because there were a number of interventions in the area and we needed to isolate the impact to this specific rainwater harvesting intervention. Using a difference-in-difference approach allowed more accurate attribution to the intervention, by subtracting the change in the control population from the change in the treatment group. The difference in indicators over time in the control group is assumed to be a result of other external factors in the area and is therefore subtracted from the difference in indicators over time for the treatment group. This rationale is that the change observed in the control population would have also occurred in the treatment group over time, as a result of external influences such as other programmes.

We randomly selected 35 households from the treatment and control groups in each site, as shown Table 1. The sample size was smaller than the total treated population, but large enough to conduct non-parametric statistical testing. Keeping the sample small but sufficient builds cost efficiency in subsequent indicator use in other locations without compromising the evaluation's effectiveness in terms of accuracy and robustness.

We developed and pre-tested a detailed draft questionnaire based on indicators for the theory of change, and used it to gather data from both study sites. After collecting the data, these were entered, cleaned and analysed using SPSS software. We used Chi-Square and Mann-Whitney tests on some of the study's main variables –livelihood, medical costs, girls' school attendance, water-fetching time and total water usage. The results were statistically significant, showing that the study design and sampling strategy are both adequate for replication in other sites.

Table 1. Population and sample size

		TREATMENT	CONTROL
Chitra Topi, Bagh (AJK)	Population	50	180
	Sample	35	35
Nathiagali, Abbottabad (KPK)	Population	50	130
	Sample	35	35

Results and findings

3

This section presents the findings of our research, starting with a summary of key variables. We use the sequence in the theory of change to elaborate on each of the components that lead to predicted benefits or impacts. We also monetise socio-economic benefits and test key variables for statistical significance, using our findings from the qualitative research process to explain quantitative results.

Table 2 presents the summary of the findings based on an analysis of the data and information we collected through the primary survey, showing expected trends for each indicator. We present detailed findings in the following sections, with a difference-in-difference analysis which reveals how the changes manifest themselves and who they impact.

Table 2. Summary of results

VARIABLES	INDICATORS	BAGH	ABBOTTABAD
		(AVERAGE PER TREATMENT HOUSEHOLD)	
Increased water availability	Water usage (litres/day)	92	15
Reduced workload fetching water	Reduction in number of minutes spent fetching water each day	162	60
School-age girls fetching water	Reduction in number of school-age girls fetching water	1.6	0.7
Kitchen gardening	Households with kitchen gardens (%)	27	0
Livestock holding	Increase in number of cattle owned	1.2	0.6
Sanitation	Reduction in open defecation (%)	53	41
Sanitation	Increase in use of functional toilet (%)	20	14
Hygiene	Increase in frequency of showers per week	1	0.7
Health improvement	Decrease in frequency of injury or illness among women from fetching water each month	3	3

3.1 Water availability and security

With the use of rooftop rainwater harvesting, daily water usage has increased by 92 litres in Bagh and 15 litres in Abbottabad. The lower difference in Abbottabad is due to a water pipeline near the village, which some people in the control group can access. So, although this population qualified on the targeting criteria of distance from the nearest natural water source, they did not fetch all their water from these springs.

An increase of 92 litres per day, compared to pre-project total consumption of 115 litres, is significant and would go a long way towards assuring water availability through periods when the springs start to run dry. Discussions with the project's technical staff revealed that water usage is not limited by rainfall but rather by the amount of storage installed. People can store two or three times this amount if they invest in extra storage tanks, which only a few households have done. Also, most houses collect rainwater from one portion of the roof only; extending the system to the entire roof would increase water yield in proportion with the additional area. During the first three years of the project, most households had yet to realise the full potential of increased water availability – with extra storage and extending the systems to their full capacity, it would be possible to cope with foreseeable climate variability in terms of precipitation. Also, households can collect far more water than they can fetch from natural sources, which is as susceptible to variation in rainfall patterns in terms of availability.

Table 3. Increased water availability

	AVERAGE HOUSEHOLD WATER USAGE (LITRES PER DAY)			
	GROUPS	BEFORE PRWH	AFTER PRWH	DIFFERENCE
Bagh	Treatment	115	175	60
	Control	192	160	–32
	Difference-in-difference	–77	15	92
Abbottabad	Treatment	142	177	35
	Control	98	118	20
	Difference-in-difference	44	59	15

3.2 Time spent fetching water

We expected the workload on women and girls to decrease significantly, as they were previously fetching all the water for use in the home from the nearest water source. While this is the case in treatment households, the increased demand for water has actually increased the workload in control households.

Despite the availability of rainwater, women still chose to go at least once a day to fetch drinking water from the springs, because they said it was better. Rainwater is the purest form of water, but it does not remain fit for drinking for long if not treated. Although the project did initiate filter design and use, demand was low. One of the reasons women like to go to the spring is to spend time socialising as a group. Due to workload and cultural norms, they remain confined to their houses for the rest of the day.

Health

Carrying water over long distances on steep inclines is backbreaking work. The women carry heavy water containers on their heads, in their hands and over their backs. Reducing this workload has significantly reduced the incidence of load carrying-related injuries, such as muscular spasm, backache and headache. However, such injuries increased slightly among the control group, due to the increased demand of water over time.

Table 4. Reduced workload of fetching water

	AVERAGE TIME SPEND FETCHING WATER (MINUTES PER DAY)			
	GROUPS	BEFORE PRWH	AFTER PRWH	DIFFERENCE
Bagh	Treatment	180	60	–120
	Control	120	162	42
	Difference-in-difference			–162
Abbottabad	Treatment	102	60	–42
	Control	120	138	18
	Difference-in-difference			–60

Table 5. Frequency of injuries among women

	MONTHLY FREQUENCY OF LOAD-CARRYING INJURIES AMONG WOMEN			
	GROUPS	BEFORE PRWH	AFTER PRWH	DIFFERENCE
Bagh	Treatment	3	1	–2
	Control	4	5	1
	Difference-in-difference			–3
Abbottabad	Treatment	5	3	–2
	Control	6	7	1
	Difference-in-difference			–3

3.3 Sanitation and hygiene

We had predicted that increased water would improve sanitation and hygiene practices. The selected sites had undergone extensive WASH campaigns as part of the earthquake reconstruction package, which had influenced behaviour already. Our difference-in-difference approach allowed us to attribute changes in sanitation and hygiene practices to the increase in water available.

In Bagh, there was an 85 per cent increase in houses with functional toilets in the treatment group, and a 51 per cent increase among control households. So we can say that only 35 per cent can be attributed to the increased water; the rest was due to general changes among the whole population for other reasons – for example, the WASH campaign. In Abbottabad, only 27 of the 80 per cent improvement in toilet use can be attributed to the PRWH project.

The increased availability of water has also led to better hygiene practices. In treatment households, the frequency of showers per week has increased, while in control households it has remained similar, due to the availability of, and difficulty in fetching, extra water.

Like the reduction in injuries, improvements in hygiene should also result in improved health. We calculate the monetary value of these combined benefits in Section 3.6.

Table 6. Household toilet usage

	HOUSEHOLDS WITHOUT A FUNCTIONAL TOILET (%)			
	GROUPS	BEFORE PRWH	AFTER PRWH	DIFFERENCE (% CHANGE)
Bagh	Treatment	74	11	–85
	Control	85	42	–51
	Difference-in-difference			–35
Abbottabad	Treatment	15	3	–80
	Control	49	23	–53
	Difference-in-difference			–27

Table 7. Hygiene

	AVERAGE FREQUENCY OF SHOWERS PER PERSON, PER WEEK			
	GROUPS	BEFORE PRWH	AFTER PRWH	DIFFERENCE
Bagh	Treatment	2	3	1
	Control	2	2	0
	Difference-in-difference	0	1	1
Abbottabad	Treatment	2	3	1
	Control	1.7	2	0.3
	Difference-in-difference	0.3	1	0.7

3.4 Impact on education

As expected, improved health, reduced time spent fetching water and functional toilets led to better school attendance in both villages.

The number of school-age girls fetching water has also reduced (boys are less likely than girls to be given the job of fetching water).

Table 8. School attendance

	NUMBER OF DAYS CHILDREN MISSED SCHOOL PER MONTH			
	GROUPS	BEFORE PRWH	AFTER PRWH	DIFFERENCE
Bagh	Treatment	1.5	0.2	–1.3
	Control	1.4	1.6	0.2
	Difference-in-difference			–1.5
Abbottabad	Treatment	1.4	0.4	–1
	Control	1.1	1.2	0.1
	Difference-in-difference			–1.1

Table 9. Girls fetching water

	AVERAGE NUMBER OF SCHOOL-AGE GIRLS INVOLVED IN FETCHING WATER, PER HOUSEHOLD			
	GROUPS	BEFORE PRWH	AFTER PRWH	DIFFERENCE
Bagh	Treatment	1.8	0.8	–1
	Control	1.2	1.8	0.6
	Difference-in-difference			–1.6
Abbottabad	Treatment	1.5	1	–0.5
	Control	1.2	1.4	0.2
	Difference-in-difference			–0.7

3.5 Agriculture and livestock

By making additional water available to households, the PRWH project has contributed to an increase in agriculture and livestock output. More importantly, women have more free time and can use it productively to rear animals and increase kitchen gardening.

In Bagh, there was a 27 per cent increase in households practicing kitchen gardening. Although no change was observed in Abbottabad, when we calculated production from the same number of households, we observed that those with rainwater harvesting systems reported significantly higher yields from their gardens.

Livestock holdings increased on both project sites, but was more pronounced in Bagh, with an average increase of 1.2 cattle per household, compared to an average increase of 0.6 in Abbottabad. This can be attributed to the existence of alternative income-generating opportunities such as tourism in the latter, and the easy and timely availability of dairy products and meat in local markets.

Savings from growing and producing food for the household contributes significantly to the family income. Women were the prime contributors to these activities, with some assistance from men and children. With the double advantage of saved time and increased water availability, the role of women in supporting household livelihoods has changed to incorporate productive functions with a market value that can be monetised. Their previous main occupation – the arduous task of fetching water – was invariably inadequate in quantity and had no perceivable direct monetary benefit.

Table 10. Kitchen gardening

	HOUSEHOLDS DOING KITCHEN GARDENING (%)			
	GROUPS	BEFORE PRWH	AFTER PRWH	DIFFERENCE
Baghv	Treatment	12	35	23
	Control	45	41	−4
	Difference-in-difference			27
Abbottabad	Treatment	21	21	0
	Control	30	30	0
	Difference-in-difference			0

Table 11. Livestock holding

	AVERAGE NUMBER OF CATTLE PER HOUSEHOLD			
	GROUPS	BEFORE PRWH	AFTER PRWH	DIFFERENCE
Bagh	Treatment	2	3	1
	Control	1	0.8	−0.2
	Difference-in-difference	1	2.2	1.2
Abbottabad	Treatment	0.4	0.6	0.2
	Control	1.1	0.7	−0.4
	Difference-in-difference	−0.7	−0.1	0.6

3.6 Socio-economic benefits

We expected to find that households reduced their spending and increased their income: better sanitation, improved hygiene and fewer injuries would translate into lower spending on healthcare, while the extra vegetables and animal products could result in saving and earnings. We monetised the income effect of the project, and statistically tested the outcomes to determine the validity of combined indicators for future evaluation of similar interventions. These indicators cover health, livelihoods and food security, but not education, which cannot be easily monetised. We decided that school attendance (Table 8) would be a good proxy for this social benefit.

Table 12 shows the outcome indicators our field testing established. We believe these can be used to evaluate similar projects or sites without having to test all the parameters again.

Having more water available has led to increased production for the treatment group, while for the control groups production levels remained stagnant or decreased. The control group in Abbottabad experienced a significant decrease in livestock productivity, accounting for the majority of the difference in income value.

Similarly, the decrease in health (curative) expenditure shows clear trends of improved health among the treatment group. Health expenditure increased in the control group, which can be partly attributed to the rising cost of medicine and treatment in recent years.

Socio-economic indicators can be further combined with livelihood and food security indicators to monetise savings from food production and diversification, using the health and education indicators defined above. Table 14 provides a summary of socio-economic indicators, with monetised values. They show significant increases in average food production and savings in medical costs per household between the treatment and control groups.

Table 12. Monetary value of livestock and kitchen gardening

	MONTHLY LIVELIHOOD VALUE, IN RUPEES			
	GROUPS	BEFORE PRWH	AFTER PRWH	DIFFERENCE
Bagh	Treatment	1,241	3,323	2,082
	Control	3,573	2,959	–614
	Difference-in-difference			2,696
Abbottabad	Treatment	1,766	2,425	659
	Control	4,184	2,866	–1318
	Difference-in-difference			1,977

Table 13. Health improvements

	MONTHLY HOUSEHOLD MEDICAL EXPENDITURE (RUPEES)			
	GROUPS	BEFORE PRWH	AFTER PRWH	DIFFERENCE
Bagh	Treatment	2,158	1,316	–842
	Control	1,860	3,327	1,467
	Difference-in-difference			–2,309
Abbottabad	Treatment	3,191	1,865	–1326
	Control	3,414	4,800	1,386
	Difference-in-difference			–2,712

Table 14. Cumulative socio-economic impact between treatment and control groups

SECTOR	INDICATOR	BAGH	ABBOTTABAD
Livelihood/food security	Savings and diversification (Rs per month)	2,696	659
Health	Decrease in household medical expenditure (Rs per month)	2,309	2,712
Education	Decrease in children's absenteeism from school (days per month)	1.5	1.1

3.7 Statistical testing

To examine the robustness of the findings of the difference-in-difference analysis based on primary data about the benefits of the PRWH project, we tested the results for statistical significance, using Chi-Square and Mann-Whitney tests on some of the study's main variables. The results confirmed that the indicators are robust and the difference between the treatment and control groups is statistically significant to a high degree of confidence. Table 15 presents statistical testing results for selected indicators from the theory of change presented in Figure 2 in both Bagh and Abbottabad.

The tests yielded similar results for the three cumulative socio-economic indicators, implying that they would be appropriate for evaluating socio-economic benefits in all project locations. For areas with different geography and socio-economic conditions, the theory of change would need to be revisited and indicators added or eliminated to reflect livelihood and bio-physical conditions.

3.8 Qualitative findings

We also carried out qualitative analysis to triangulate the quantitative findings of the research. Shared learning dialogues and focus group discussions in both communities also brought to the fore a number of benefits which were difficult to assess quantitatively but may be attributed to the PRWH intervention. These include:

- Increased awareness of the importance of conserving natural resources: households reported that the corrugated galvanised iron roofs used to create high flows in certain places, causing scouring and wasting of land mass. Rainwater harvesting has stopped that by channelling the water and reducing its flow.
- Women's empowerment: the change in women's roles into productive activities has empowered them within their communities.
- Increased awareness of the value of water as a commodity: by putting additional water to productive use in kitchen gardening and animal rearing, communities have become more aware of the commercial value of water as a source of income or savings.

Table 15. Statistical testing of indicator values for treatment and control groups

	VARIABLE	CHI-SQUARE TEST	2-TAILED VALUE	MANN-WHITNEY TEST	2-TAILED VALUE	SIGNIFICANCE (%)
Bagh	Livelihood	214.514	0.000	287.500	0.000	99.9
	Medical expenditure	58.143	0.000	43.500	0.000	99.9
	Girls' school attendance	79.800	0.000	248.000	0.000	99.9
	Time spent fetching water	133.657	0.000	371.500	0.002	95
Abbottabad	Livelihood	295.143	0.000	336.000	0.000	99.9
	Medical expenditure	75.200	0.000	38.500	0.000	99.9
	Girls' school attendance	106.400	0.000	511.500	0.015	95
	Time spent fetching water	128.629	0.000	245.500	0.000	99.9

Conclusions

4

Testing the TAMD framework on the PRWH project has shown that it can effectively evaluate the adaptation and socio-economic outcomes of climate-resilient development investments. We were able to highlight a number of different aspects of the project's impact that conventional M&E systems do not capture, such as adaptation benefits, gender implications, impact on income, and outcomes in socio-economic sectors such as health, education and food security.

Statistical testing of theory of change variables showed that the indicators are robust and can be replicated in an expansion of the same programme or modified for other geographic and socio-economic conditions with minimal expert input. Local agencies and staff can use these indicators without any special technical skills other than the basic M&E skills they already have. Since this evaluation generated gender-segregated data, it can also be used to conduct specialised gender evaluation to explore, for example, the impact of the changing roles of women on gender relations within the household and wider community.

The PRWH programme has brought socio-economic and environmental benefits for individuals and communities, and for women in particular. It has proven to increase water availability and, with more erratic rainfall patterns predicted, it should reduce the impact of climate change. At the same time, the project increased productivity in agriculture and livestock, significantly improving food security and nutritional status. It also had positive impacts on women's wellbeing in terms of improved health, reduced workload and empowerment, enabling them to supplement their incomes and improve their food security. Finally, the availability of water increased the effectiveness of WASH campaigns at community level, with significant results in terms of health, functional school latrines and increased school attendance, especially among girls.

We will test the TAMD framework in one more sector in a different socio-economic and geographic location in Pakistan to ensure its validity under different conditions. If it succeeds in measuring the development and adaptation benefits, we will propose a second phase of TAMD, to mainstream it at national and provincial levels through capacity building and application in various adaptation-related projects and programmes.

Related reading

Anderson, S., et al, 2014, Forwards and backwards evidence-based learning on climate adaptation, IIED Briefing, http://pubs.iied.org/17257IIED.html

Karani, I., et al., 2014, Institutionalising monitoring and evaluation frameworks in Kenya, IIED Briefing, http://pubs.iied.org/17251IIED.html

Brooks et al., 2013, An operational framework for Tracking Adaptation Measuring Development, IIED Working Paper, http://pubs.iied.org/10038IIED.html

Fisher, 2014, Tracking Adaptation Measuring Development with a gender lens, IIED briefing (link forthcoming)

Women and girls who used to spend a major portion of their day physically carrying water over steep slopes in inclement weather, now grow vegetables for their families and rear animals for additional income, and their daughters go to school. This case study generates evidence on adaptation and the socio-economic benefits of rooftop rainwater harvesting with a gendered perspective. It is an application of the TAMD framework to evaluate climate-resilient development in a post-disaster reconstruction programme.

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