Erasmus University Rotterdam

EVALUATION OF PROJECTS CO-FINANCED BY THE SUSTAINABLE WATER FUND (FDW)

Synthesis Report

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Acknowledgements

This synthesis report is based on the reports of the evaluation of five projects that were co-financed by the Sustainable Water Fund (or FDW, for its Dutch abbreviation): two projects in Ethiopia, two in Ghana and one in Colombia. These evaluations were conducted by researchers of the Erasmus University Rotterdam, the University of Bayreuth and RWI, who were supported by national counterparts and numerous data collectors and processors. Their time and energy were vital to this undertaking. The core team for the evaluation consisted of: John Cameron and Getnet Alemu (responsible for the evaluation of the Ethiopia projects), Elena Gross and Carley Pennink (responsible for the evaluation of the Ghana projects) and Niek de Jong, Jörg Peters, Ann-Kristin Reitmann and Maximiliane Sievert (responsible for the evaluation of the project in Colombia).

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List of Acronyms

APC	*Agencia Presidencial de Cooperación* (Presidential Agency for International Cooperation)
ATE	Average treatment effect on the treated
CA	conservation agriculture
Cenicafé	National Centre for Coffee Research in Colombia
CFM	Conservation Farming Methods
CDW	Clean Drinking Water
CWSA	Community Water and Sanitation Agency, Ghana
DiD	Difference-in-Difference
EUR	Erasmus University Rotterdam
EWU	Efficient Water Use
FDW	*Fonds Duurzaam Water* (Sustainable Water Fund)
FFS	Farmer Field School
FNC	*Federación Nacional de Cafeteros* (Colombian National Federation of Coffee Growers)
GHC	Ghanaian Cedi
HH	Households
HPNRS	Harari People National Regional State
HPRS	Harari People Regional State
HWSSA	Harar Water Supply and Sewerage Authority
ICM	Integrated Crop Management
ITT	Intention to Treat
IWAD	Integrated Water and Agricultural Development Ltd
IWM	Intelligent Water Management
IWMKT	Integrated Water Management and Knowledge Transfer in SisiliKulpawn
JMP	Joint Monitoring Program for Water Supply and Sanitation
LDC	Least Developed Country
LSMS	Living Standards Measurement Surveys
MADR	Ministry of Agriculture and Rural Development
NRW	Non-Revenue Water
PPP	Public Private Partnership
RVO	Rijksdienst voor Ondernemend Nederland (Netherlands Enterprise Agency)
RWSSU	Rural Water and Sanitation Support Unit
SADA	Savannah Accelerated Development Authority
SARI	Savannah Research Institute
SMTA	modular anaerobic treatment systems
SWSH	Sustainable Water Service for Harar, Ethiopia
ToC	Theory of Change
ToR	Terms of Reference
UDS	University for Development Studies
WUR	Wageningen University & Research

Executive Summary

A. The FDW Evaluation

Each Sustainable Water Fund (FDW) project should include at least one public, one private, and one 'third sector' partner, collaborating in a Public-Private-Partnership (PPP). The 'third sector' was broadly defined to include not-for-profit non-governmental organisations and research institutes. The Fund aimed to contribute to inclusive and sustainable economic growth, self-reliance and poverty reduction in developing countries through support to PPPs in the water sector, including the following sub sectors:

1 Improved and sustainable access to drinking water and sanitation;
2 Efficient and sustainable water use in agriculture; and
3 Safe deltas and improved river basin management.

It was expected that the PPP-approach creates synergies between the different partners and therefore add value in reaching the intended development objectives. Important for this evaluation was to verify if the funded interventions have reached these objectives and what the added value of the partnerships has been in reaching the results. At the start of the evaluation, five out of thirteen of the first call were selected for case studies, two in respectively Ghana and Ethiopia and one in Colombia.

Several data collection and research tools were applied to analyse the output, outcome and impact indicators based on a Theory of Change developed for each of the cases. A non-randomized difference-in-difference (DiD) approach was used to observe the impact indicators over time with baseline (2015) and follow-up (2017 or 2017/18) data in the efficient water use projects in Colombia and Ghana and in the clean drinking water project in Ethiopia. The main quantitative data collection instrument was a comprehensive farmer and household questionnaire, including standardized modules on demography, income and specific water-related questions. Secondary quantitative data were used to identify national trends and cross-check with our own survey data.

B. Impact

In **Colombia**, adoption of water-saving coffee processing devices was higher in treatment river basins than in control basins. The programme was successful regarding reforestation: more trees were planted in the treatment river basins than in the control areas. However, for the rationale behind the comprehensive approach, namely the expectation to create environmental awareness and to sustain the project dynamics over time, the results of the assessment were mixed.

The evaluation could not analyse the effects of the programme on the financial conditions of the farmers who participate, because effects and impacts did not yet materialize fully.

The level of knowledge on the effect of the coffee sector on surface water bodies increased through the IWM intervention. The relevance of the IWM intervention can, however, be questioned from the pollution point of view, since it might have been more relevant to tackle other pollution sources.

In **Ghana**, there were positive changes initiated by the project concerning improved farming practices, such as the use of chemicals and irrigation; these then also converted into higher yields of maize and rice. Especially rice output increased. This was particularly true for irrigation farmers. The results regarding income generation were however rather modest. Prices below the market prices for produce offered by IWAD, and the payments for inputs reduced the farmers' profits.

In terms of food security, farmers kept more rice for home consumption. Although there was no direct impact of the intervention on cash income, food scarcity decreased and availability of food in terms of number of meals per day increased slightly. The nutrition effect did not (yet) transform into anthropometric effects on children's development.

Women in the project area, especially in the four irrigation villages, gained strength from the project. More women work in agriculture and are more engaged in the intra-household decision making process, especially when they get the chance to work on IWAD's nucleus farm as casual workers with a family-independent income.

The SWSH project in **Ethiopia** was focused on improving supply of drinking water in an urban area. Excluding purchases from neighbours, direct access to drinking water from protected sources, increased from 48% in 2015 to 85% in 2017. There was a larger improvement in access to water from protected sources among treatment households. The econometric analysis revealed that access to safe water significantly increased among the treatment group.

Overall, the intervention reduced the number of trips to collect water. Similarly, the average in-line waiting time to get drinking water from primary sources dropped attributable to the project. This result indicates that the project saved time that could be used for educational and/or productive purpose.

During the study period, the water supply intervention appeared to significantly reduce urban incidence of diarrhoea by 14 percentage points. However, in the peri-urban sample, the over-time change in illness is not statistically different between treatment and control group. The average water treatment and medical spending for diarrhoea declined for both intervention and control households.

Experience of absence from school happened in about 9% of treated households in the urban sample in 2015 and this was significantly reduced and became less than 2% in 2017. Similarly, the incidence of absence from workplace was reduced for the treatment group. But these changes were not significant in double-difference terms and must be seen in wider contextual terms and cannot be totally attributed to the project intervention.

Overall Conclusions on impacts based on the three cases

There were indications that the projects contributed positively to the ultimate objectives of the respective projects. In Colombia, the awareness of an efficient use of water increased more in the group of farmers that participated in the programme. A similar trend can be observed for the participants in the project implemented in Ghana. Here as well, the estimates show a significant improved use of fertilizer and seeds. However, this did not have a significant effect on the financial benefits of the farmers, partly because a larger share of the produce was kept for home consumption and partly because the project paid lower prices for the products than market.

The surveys in Ethiopia indicate some positive impacts of the project interventions, but the quantitative impact on households' well-being was limited. With little gain in quality of drinking water consumed by targeted households in urban areas, a claim to positive impact depended primarily on decreased costs of purchasing drinking water. Urban households were able to reduce expenditure on drinking water, which provided some financial gains amounting to about ten percent of household cash income.

C. The PPP governance structure

The assessment of the PPP governance structure was problematic because a counterfactual did not exist. This assessment is therefore based on a comparison of the five projects studied. The

information has been collected through interviews with the main stakeholders, among them representatives of the PPP partners.

Without exception, the five PPPs had both public and private partners, but in some cases the role of the public partner was limited. In Colombia, the Ministry of Agriculture and Rural Development (MADR) was a silent partner and was replaced by another public entity halfway the implementation of the project. For the Integrated Water Management and Knowledge Transfer in SisiliKulpawn project in Ghana it was noted that the partners worked 'together but separately'.

In all projects, the partners were critical about the sharing of risks and returns. It was often mentioned that private partners took a disproportionate amount of the risk. Meeting the obligations agreed during the inception phase of the PPP sometimes created problems, in particular concerning the public sector partner. In Colombia, the financial contributions from the government were significantly less than agreed. It appeared that also in the other cases the Colombian government faced difficulties in meeting the financial commitments made at the start of the PPP. The Ghana projects are clear examples. In SisiliKulpawn, the government (SADA) did not meet all financial obligations. The scope of SMARTerWASH in Ghana increased substantially since the government managed to generate additional funds from the World Bank. But after project completion, it was not able to come up with its own funds.

The conceptualisation and design of the projects took into account that through the sharing of skills, resources and risks, the partners were able to achieve more than if they worked separately. By working together, partners were indeed able to bring complementary knowledge, skills and resources to the relationship, which contributed to positive outcomes and achieving developmental objectives. The perception of the partners was that the projects would not have been possible without the partnership, at least not at the same scale.

Some project designs were changed during the implementation phase on the basis of new information about the local needs. Some projects were planned too optimistically. In these cases, the partners were generally willing to adapt the original inputs. An example is SMARTerWASH in Ghana, which was, according to the partners, over-ambitious and the timeframe was too short to achieve what the project had intended, and therefore the project ended with certain aspects unfinished. Yet, there was (and still is) a general 'pride' amongst partners in what was achieved and that this was due to the partnership.

The PPP governance, multi-activity approach can be seen as having advantages in that it has shown both robustness and flexibility. The combination of multiple organisations carrying out multiple activities over a significant lifetime allowed shifts of focus between planned activities to carry the overall project through periods of uncertainty. All five FDW projects went through such periods and used the opportunities that the FDW PPP governance approach offered.

The three household surveys do suggest some positive value added impacts of all three FDW projects independent of the very different PPP membership structures, planned activities and goals, and differing national political economy contexts. These positive effects are, in particular, related to the scale and scope of the projects was larger, which benefited a larger group of people than intended and covered a wide range of topics. Examples are the coffee project in Colombia and the SisiliKulpawn project in Ghana. This was also possible because the range of different disciplines provided by the different partners of the PPPs.

Crucial to the positive performance of all five projects were adjustments during their implementation processes and, in some cases, the willingness of certain partners to take a disproportionate amount of risk. For example IWAD's mother company kept the venture afloat.

D. Sustainability

Regarding sustainability, a distinction has to be made between sustainability of the PPP and sustainability of the intervention/project. Although there have been some discussions about the continuation of the PPP in SMARTerWASH in Ghana, a continuation of the funding is far from certain. In the other projects, the PPPs were phased out as soon as the projects were finished. Given its character of a Special Purpose Vehicle, elimination of the PPP after project ending is a logical step. In some cases, partners have discussed the possibilities for a continuation of their working together without support from FDW.

Financial Sustainability

The two projects on water supply in ***Ethiopia*** involved a well-established drinking water supply company. The support of the project in setting up an administrative and financial department was an incentive for reducing the provision of Non-Revenue Water, which should be to the benefit of the financial soundness of the services in the future.

The agricultural project in ***Colombia*** had a landscape approach and supported individual farmers in their efforts to reduce the use of water. This was successful during the project period, but it is not clear to what extent there were clear financial incentives to continue these efforts in the future.

The training and awareness activities of the project will be included in the extension services provided by FNC, which was one of the PPP partners. FNC is mainly financed by the coffee farmers and occasionally supported by the government.

There are serious concerns about the financially sustainability of the business model of SMARTerWASH in Ghana, namely stemming from the (in)ability of the end user to pay, and to provide revenues to make the venture viable on the longer term or, in absence of this, from the budgets provided by the government.

The end users of the in SisiliKulpawn project in Ghana, these are the farmers, should be able financially to continue the activities of the project. This will most likely be the case if these activities provide them with financial benefits. However, since the farmers were not happy with the price offered by the local private company in the PPP (IWAD), the financial sustainability of the activities is under pressure.

Institutional Sustainability

The public goods of the project in Colombia will be included in the extension services of FNC, which as partner in the PPP has created the knowledge base to provide these services in the future. It is further likely that the Water & Coffee Platform established by the project will continue to exist. This depends, however, on FNC's financial strength, which is largely based on the contributions of the farmers by means of a percentage of the coffee price.

The situation for the water management project in Ghana is more problematic, because the knowledge, capacity building and training was provided in the PPP by an overseas institution (Wageningen University) and the local provider of extension services was not included in the PPP. Continuation of the project activities would therefore be the sole responsibility of the local private PPP partner (IWAD).

The institutional setting of the SMARTerWASH project is so far unclear.

As explained above, the two projects in Ethiopia are institutionally part of the local drinking water company and as such be expected to be institutionally sustainable.

Ecological Sustainability

Ecology was the core issue of the project in Colombia. As a result, much attention was given to awareness raising and training in the project. The participating farmers fully acknowledged the

importance of these issues. A tangible reflection is the effort in reforestation by the farmers. The surveys show the adoption of water-friendly equipment and behaviour.

The SMARTerWASH project was also focused on ecological issues. Here as well the sustainability depends heavily on the financial means available. Conservation of farming techniques and a strong environmental policy were key components of the IWAD project. Yet, consumption of water for irrigation, which was a major part of the project, is still a serious issue.

The drinking water projects in Ethiopia do not have a significant effect on the environment.

Technical Sustainability

In the Colombia project, the beneficiaries were trained in the maintenance of the devices. SMARTerWASH was based on the use of handheld technology for reporting breakdowns, as well as interoperable technology to monitor water use and breakdowns. The Ghanaian private sector firm (SkyFox) is still using the handheld technology to provide spare parts. The innovations and the technology in SisiliKulpawn, though relatively simple by European standards, were too complicated for the farmers to grasp and required adjustments. They are more appropriate now. In addition, the farmers in this project were trained in maintenance of their machinery and in the use of production stimulating means. The two projects in Ethiopia are part of the local water company, which has a longstanding experience in supply of water.

Social Sustainability

All projects were to the benefit of the farmers in case of the water management projects in Colombia and Ghana, or of the clients in case of the two projects in Ethiopia. All five projects evaluated included a component in particular focused on gender. In Colombia, it also included an activity to promote group membership. A statistically significant effect on women empowerment was not found in this project, considering looking at female decision power, equality of the relationship and perceptions about female stereotypes. In contrast, in Ghana women in the project area gained from the project's efforts to strengthen the role of women, considering work in agriculture and engagement in intra-household decision making processes. In Ethiopia, the women benefited most from the improved access to reliable water.

1 Introduction

1.1 The Sustainable Water Fund

The Sustainable Water Fund (hereafter FDW[1]) originated in 2012. Its governance structure was considered innovative for Dutch developmental funding. FDW focused on the water sector projects that came on-stream over a series of phases. Each project was required to include at least one public, one private, and one 'third sector' partner, collaborating in what is referred to as a Public-Private-Partnership (PPP) in FDW terminology. The 'third sector' was broadly defined to include not-for-profit non-governmental organisations and research institutes. (This definition was modified in later phases). The FDW programme was managed by RVO.[2]

This innovative form of governance justified creating an evaluation exercise to track FDW projects from inception to impact, with a focus on impact and governance performance. This document synthesizes the results of the evaluations of five case studies of FDW-projects implemented in three countries.

1.2 Context and Background of this Evaluation

"The Netherlands wants to be world leader in water – both the government and the sector commit to that goal". This statement is from a Government's Letter to Parliament and illustrates the ambition that permeates the Dutch water policy.[3] One of the ways in which this ambition has materialized is through the creation of the Sustainable Water Fund (FDW). The main principles of the fund are further detailed in the decision of the Minister of Foreign Trade and Development Cooperation of 31 August 2016.[4] The Fund aimed to contribute to inclusive and sustainable economic growth, self-reliance and poverty reduction in developing countries through support to public-private partnerships (PPPs) in the water sector, including the following sub sectors:

1 Improved and sustainable access to drinking water and sanitation;
2 Efficient and sustainable water use in agriculture; and
3 Safe deltas and improved river basin management.

The Ministry of Foreign Affairs defines a PPP as: "… a partnership between government and business, often with the involvement of NGOs, trade unions and/or research institutions within which risks, responsibilities, resources and skills are shared to achieve a common goal or to perform a specific task".[5] The choice for working with PPPs was motivated by the assumption that the PPP-approach would create synergies between the different partners and therefore add value in reaching the intended development objectives. Important for this evaluation was to verify if the funded interventions have reached the intended development results and what the added values of the partnerships have been as experimental institutional governance regimes. Although the evaluations focused on the project level, the combined findings of these evaluations give an indication of the results of the fund as a whole. Together the monitoring and evaluations will be input for an inter-departmental learning facility on PPPs that is being developed to identify lessons on PPPs from various instruments such as FDW.

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[1] In Dutch FDW: Fonds Duurzaam Water.
[2] Netherlands Enterprise Agency. RVO is the abbreviation of the name in Dutch "Rijksdienst voor Ondernemend Nederland".
[3] Source: Kamerbrief "Water voor Ontwikkeling", 2012, http://www.rijksoverheid.nl/documenten-en-publicaties/kamerstukken/2012/01/09/kamerbrief-water-voor-ontwikkeling.html.
[4] Staatscourant, Nr. 44953, 31 August 2016.
[5] IOB, 2013, "*Public-Private Partnerships in developing countries. A systematic literature review*"; IOB Study 378. The Hague: Ministry of Foreign Affairs of the Netherlands.

1.3 Organization of this report

After this introduction, this report continues with a brief explanation of the methodology applied in the evaluation. The details of the methodologies of the five case studies selected for this evaluation are presented in the Annex. In line with the Terms of Reference, the study looked into the effectiveness of a limited number of case study projects, with a view to provide an indication of the impact of the fund as a whole, including the role of the PPP approach. The case studies are presented in chapter 3. In order to conclude on the effects and impact, base- and end line surveys were executed in three cases. The results of these surveys are presented in Chapter 4. It should be noted that impacts are estimated for only three of the selected five case studies. The focus of the other two studies was, in particular, on the governance structure of the projects. Chapter 5 discusses the role of the PPP modality in the projects studied. The sustainability of the interventions applying the so-called FIETS criteria is dealt with in chapter 6. Chapter 7 presents the main conclusions of the exercise.

2 The Methodology applied in this study

2.1 Selection of Case Studies

The Terms of Reference for this study defined the aim of the impact evaluations as: ".... look into the effectiveness of the interventions, by assessing the positive and negative, intended and unintended impacts of the different projects, in order to enable aggregation of achieved development results (in terms of impact) at fund level and a conclusion about the added value of the PPP-approach".[6] This implies that– next to the assessment of the results of the projects – the working of PPP governance regimes is a key aspect of the evaluation, in particular in relation to the results of the projects. The latter has been verified by quantified surveys of impacts upon households.

Based on the information available at the start of the evaluation, five projects were selected for case studies (See Table 2.1). Out of the five selected cases, the Clean Drinking Water (CDW) projects in respectively Ghana and Ethiopia were analysed only qualitatively. In the other three cases, a quantitative analysis was conducted as well.

Table 2.1: Selection of projects for case study analysis

Applicant	Project title	Country	Total Budget	Subsidy	Theme
Colombian Coffee Growers Federation	Intelligent Water Management	Colombia	24,500,000	9,500,000	EWU
Wienco (Ghana) Limited	Integrated Water Management and knowledge transfer in SK Basin	Ghana	11,775,050	7,065,030	EWU
IRC International Water & Sanitation Centre	SMARTerWASH	Ghana	3,812,707	2,220,000	CDW
VitensEvides International	Source to tap and back	Ethiopia	7,083,417	4,250,050	CDW
VitensEvides International	Sustainable Water Services in Harar	Ethiopia	5,481,549	3,260,000	CDW
Total case studies			**52,652,723**	**26,295,080**	
Total Portfolio phase 1 (13 projects)			95,373,923	45,897,207	

CDW = Clean Drinking Water; EWU = Efficient Water Use

At the time of the selection, this sample of projects covered over half of the total subsidy provided to thirteen projects approved at that time.[7] The sample involved a spread between projects in LDCs (Ethiopia) and non-LDCs (Ghana and Colombia) and between CDW and Efficient Water Use (EWU) projects. It furthermore included two projects with VitensEvides in the lead, which allowed for some PPP comparison in different contexts (though both in Ethiopia). The inclusion of a qualitative study of the CDW project in Ghana allowed for additional PPP comparisons.

An additional criterion applied in the selection of these projects was that they should include CDW projects in Africa. This was due to the fact that Africa, in particular, could not meet the Millennium Development Goal 7c and providing clean drinking water in a sustainable manner is of high importance for improving living conditions in general and of women in particular.[8] Further, choosing an EWU project in an African and a Latin-American non-LDC made it possible to look at two different contexts. Representativeness needed to be safeguarded not only at the level of the FDW portfolio but also within the individual case studies that included survey activities. For this purpose, it was crucial to assess potential heterogeneities within the project areas, e.g. in terms of water availability

[6] See Terms of Reference: "Impact Evaluations for the Sustainable Water Fund".
[7] Refers to first round (2012) projects only.
[8] UNICEF/WHO, 2012, "Progress on Drinking Water and Sanitation: 2012 Update. Joint Monitoring Program (JMP) for Water Supply and Sanitation. Available at http://www.wssinfo.org/data-estimates/table (accessed 1/17/2014).

and living conditions. Based on that assessment, sub-areas were stratified according to observed characteristics.[9] In these cases, standard sampling procedures were applied to both project users and non-users as treatment and comparison groups. A trade-off existed between power considerations (doing fewer individual case-study surveys with higher sample sizes) and the extent to which the case studies were indicative for the fund as a whole (doing more individual case study surveys). In order to address this trade-off appropriately, the study focused survey activities on three selected projects for which also in-depth institutional/stakeholder analyses were made. These were the two EWU projects in Colombia and Ghana respectively, and the CDW project in Harar, Ethiopia.

Qualitative analysis of the other two CDW projects allowed for additional PPP comparisons. In this way, a robust set of evidence was compiled that can be considered indicative of the level of success of the fund as a whole. Considering the most important power analysis parameters, minimum sample sizes were determined for the three projects for which a full quantitative and qualitative evaluation was conducted, to be adequate to come up with a sufficiently powered study for, at least, core indicators. However, it may be unclear for other indicators whether a non-significant result means that the control group was also affected by the programme activities[10] or that the effect is in fact zero, or whether true programme impacts exist that are only too small or imprecise to be detected given the available sample size (so-called “false negative” findings).

In order to understand the performance of the PPP governance model, the team built on-going relationships with virtually all the partners in all five projects. Regular semi-structured interviews with partner organisation representatives, access to project documentation and direct observations generated qualitative data which was used to understand and analyse institutional performance.

2.2 Sources of Information

A mixed-method approach combined findings from the institutional, stakeholder and beneficiary dimensions. Several data collection and research tools were applied to analyse the output, outcome and impact indicators based on a Theory of Change developed for each of the cases. A non-randomized difference-in-difference (DiD) approach was used to observe the impact indicators over time with baseline (2015) and follow-up (2017 or 2017/18) data. Table 2.2 presents the types of data collected and used for baseline and impact assessments. The main primary quantitative data collection instrument was a comprehensive farmer and household questionnaire, including standardized modules on demography, income and specific water-related questions. Secondary quantitative data were used to identify national trends and cross-check with our own survey data.

Table 2.2: Typology of data sources

	Primary	Secondary
Qualitative	Semi-structured interviews and focus group discussions among stakeholders, independent experts and beneficiaries (households/ farmers and potentially firms)	Literature study, desk review of programme and project documents (including PPP contracts), documents from national impact monitoring mechanisms, direct observations, taking part in project meetings and internal notes
Quantitative	Baseline and follow-up household surveys resulting in a panel data set	Demographic and Health Surveys, labour force and enterprise surveys or Living Standards Measurement Surveys (LSMS)*

* In many countries, LSMS surveys are only irregularly conducted.

[9] See for the details the respective case study reports.

[10] In Colombia this happened only in a relatively small number of cases and for some project activities only. Controlling for these cases does not basically change the results of the DiD estimation.

To analyse causality between the interventions and results, a combination of data sources were used and a mixed-methods approach of quantitative and qualitative methods (Q2) applied; this mutually reinforced data collection and analysis. Exploiting multiple information sources and combining different evaluation approaches increased both the internal and external validity of results. The Q2 approach involved pre-baseline and ongoing qualitative analysis of institutions, beneficiaries and the comparison group using qualitative data collection methods such as in-depths interviews. For the quantitative analysis of survey data, state-of the-art econometric methods and probability sampling methods were applied for rigorous counterfactual analysis[11], offering the possibility to delve into impact heterogeneity. Open deliberative processes were used to ensure ownership of the institutional analysis and any disagreements on logic or evidence were acknowledged and reported without forcing consensus where it did not exist. To conclude, since data sources and the projects' monitoring data were not sufficient to answer the evaluation questions, the approach comprised the collection of a unique data set, a quantitative analysis complemented by qualitative methods, as well as an institutional analysis.

2.3 Attribution of the observed changes

Attribution of observed changes in selected indicators requires a counterfactual analysis. In the selected case studies, data were collected by means of stratified random sample surveys, both prior to the start of the intervention and some years after the start of the projects. Using the survey data collected, the aim was to attribute changes to interventions by applying a large n evaluation approach, involving a statistical/econometric analysis in which a comparison was made with a counterfactual situation in accordance to best practice academic standards. Small *n* approaches were useful to probe more deeply into contextual issues by means of an in-depth study of processes focusing on cultural values, motivations, and aspirations. Both approaches were complementary.

The analysis of the partnership relationships in governance explored the nature of the interaction between partners, and the role of the different stakeholders in the project. This involved contractual partners and more peripheral actors that took part in some way or influenced the project. Deliberative processes were examined at all levels including the quality of argumentation and use of empirical evidence. The study was expected to give prominence to evaluating PPP relationships and assessing the value added of the PPPs. Any form of PPP relationship can be seen as a governance regime and compared with the pure forms of its component parts in the wider national governance context. In practice, it did not appear to be feasible to assess the differences in the selected cases with strictly private, civil society or public sector regimes. However, the selection of case studies allowed making comparisons of forms of PPPs.

[11] For example, matching and probit models with different specifications or difference-in-differences as proposed in Gertler, P.J., S. Martínez, P. Premand, L.B. Rawlings, and C.M.J. Vermeersch (2016). *Impact Evaluation in Practice. Second Edition.* World Bank Group and IDB.

3 Case Studies

This chapter discusses the five case study projects, starting with the water management project in Colombia. It is followed by a brief description of the case studies in respectively Ghana and Ethiopia. It shows the differences between the projects, which is an indicative reflection of the content of FDW in 2014, when this evaluation study started. In three of the five cases, the focus was on the provision of clean drinking water. The other two dealt with supporting the improvement of efficiency in the use of water, both in the agricultural sector.

3.1 Intelligent Water Management Project in Colombia (IWM)

Introduction

The coffee sector is a major source of income for the rural population of Colombia, giving work to around 2.7 million people, mainly in the rural areas. Considerable amounts of water are used to process coffee after harvesting. These traditional water-use practices lead to water contamination that transgresses the Colombian standards allowed for the coffee sector by roughly a factor often. Against this background, IWM intended to contribute to improved water management among coffee farmers, through the use of information and sensitization campaigns, training, hardware investments, and an improved institutional environment.

PPP Establishment

A Public-Private Partnership (PPP) was established for the implementation of the project, with the Colombian Coffee Growers Federation (FNC) as the lead partner. The other partners were the Ministry of Agriculture and Rural Development (MADR), Wageningen University & Research (WUR), *Cenicafé*– the National Centre for Coffee Research in Colombia– and the private companies Nestlé and Nestlé Nespresso. MADR was a 'silent partner' and was replaced in 2016 by the *Agencia Presidencial de Cooperación* (APC).

The Intervention

The activities of IWM Colombia encompassed six different components:

- Component 1 prepared and planned the next phases;
- Component 2 included among others the establishment of a Water & Coffee Platform in which at least 50 institutions would participate, apart from the key partners implementing the project;
- Component 3 targeted 11,000 individual coffee farmers with interventions concerning domestic and productive water use and was, budget-wise, IWM's most important part;
- Component 4 included both river basin-level and farm-level activities concerning reforestation and bioengineering;
- Component 5 comprised activities regarding river basin management and informing decision makers at the institutional level; and
- Component 6 concerned Project Management and the cross-cutting issues of Good Governance, Risk Management, Gender and Social Responsibility.

The activities of Components 3 to 5 were implemented in 25 municipalities.

Theory of Change

For the programme, four main outputs could be identified: (i) farmers receive training and equipment; (ii) water and climate monitoring stations are installed, (iii) ecological restoration and bioengineering plans are elaborated, (iv) outputs on the institutional level. These outputs led to outcomes on the level of: (a) the coffee farmer, (b) the river basin, and (c) the institutional level. The intervention's outcomes influence the coffee farmers in the following three areas: (a) activities of

coffee farmers and their families, (b) their farming activities, and (c) the general quality of the watershed and the forest where the farm is located. The intervention produces only few tangible impacts that materialize on the individual's farmer level in the shorter run.

Actual Inputs

IWM was co-financed by the Netherlands with a €7.7 million grant of FDW. The grant represented almost 40 percent of the total project budget of €20.5 million. Including investments realized in complementary projects, €4.3 million was invested in Components 1 and 6, and €16 million for activities of Components 2-5. The total resources invested were substantially less than the originally budgeted €24.5 million (€20.5 million from PPP partners and the Netherlands and €4 million from additional partners for complementary projects). The main reason was that MADR's financial contribution amounted to only a quarter of its committed resources and a subsequent reduction of the RVO grant.[12]

Actual Output

IWM was very effective in implementing the foreseen activities. Use of resources from additional (non-PPP) partners in complementary projects and a favourable exchange rate change allowed for realizing more output than foreseen, even though the amount in Euros of the reported contributions of the PPP partners and RVO for the project was less than planned.

The core objective of Component 2, the establishment of a Water & Coffee Platform, was achieved. Additionally, methodologies were introduced that contributed to improved water management in the coffee sector. Examples of this were the application of a river basin-based planning approach, participatory knowledge management and an ICT application developed for extension work at the farm level. For Component 3, over 3,500 coffee farmers – more than twice the planned number – received direct technical assistance and financing for implementation of water solutions.

3.2 Integrated Water Management in SisiliKulpawn, Ghana

Introduction

The purpose of the project was to "foster smallholder and private sector led growth through the promotion of integrated water management practices and the development of irrigation in the Savannah agro-ecological zone in the North of Ghana, with emphasis on partnership, investment, capacity development, profitable crop value chains, and accountability."[13]The project was executed as a Public Private Partnership (PPP) with the private entity "Integrated Water and Agricultural Development (IWAD) Ghana Ltd." coordinating and operating the activities of the partnership.

PPP Establishment

Wienco (Ghana)[14] Limited (WGL), a joint venture Ghana-Dutch company involved in businesses in the agricultural sector organisation approached the Government of Ghana, represented by the Savannah Accelerated Development Authority (SADA), to take part in a PPP promoting sustainable agricultural practices in the Northern Region. SADA's mandate is to develop the local economy and the agricultural sector in Northern Ghana and to provide an environment conducive for private agricultural investment. For the purpose of the project, Wienco Ltd. established a legal entity; a branch named Integrated Water and Agricultural Development (IWAD) Ghana Ltd. IWAD Ghana Ltd. joined the PPP as a separate company for the coordination and operational aspects at field and local

[12] The devaluation of the Colombian peso also required a lower level of expenditure in terms of Euros.
[13] Appendix I: Project Plan Sustainable Water Fund (October 2012). Title: Integrated Water Management and Knowledge Transfer in SisiliKulpawn Basin (FDW/12/GH/02).
[14]Owned at that time by Africa Tiger Holding. Ltd.

level. Two of the original partners stepped out, but the partners that ultimately took part in the PPP are listed in Table 3.1.

The Project was approved in April 2013. On 31 March 2014, the partners signed a Partnership Agreement which defined the organization of the project, the roles and responsibility of the partners, communication flows, the governance structure, distribution of finance and subsidies, the rights to knowledge and project results, conditions for termination and liabilities, etc. (Partnership Agreement, 2014). In the original set-up, all partners were to have shares in the venture. The duration of the agreement was from April 2013 to December 2017 and included the flagship-phase from 2013 to 2017 and the start of the scaling-up phase from 2015 onwards.

Table 3.1: Partners in the Integrated Water Management and Knowledge Transfer in the SK Basin

Partner	Sector	Strategic role
Wienco Ghana Ltd.	Private	Coordinator
Integrated Water and Agricultural Development Ltd. (IWAD)	Private	Coordinator and Implementation
Savannah Accelerated Development Authority (SADA)	Public	Governmental representation, facilitation of processes
Wageningen University and Research Centre – Alterra	Research	Capacity building, training and research, knowledge development
RebelGroup International BV	Private	Transaction advice and scaling-up of the project

The Intervention

The intervention introduced effective water management practices and conservation agriculture (CA) into an area characterized by dry-land, rain-fed farming. Through providing a reliable source for irrigation water, introducing water conservation measures and offering knowledge transfer to smallholder farmers, the project envisaged an improvement of living conditions. The project employed two parallel interventions, an investment in technology, in the form of irrigation infrastructure, and capacity building through Farmer Field Schools (FFSs).

Theory of Change

Three main output categories were identified: (i) farmers have received training on CA, chemicals and improved market access; (ii) farmers have received access to irrigation infrastructure, (iii) outputs on the institutional level. These outputs were to lead to outcomes on the farmer or household level of farmers participating in the FFS, assuming that farmers would eventually i) adopt new farming behaviour and technologies, ii) use improved seeds and chemical inputs and iii) practice CA. The intervention's outcomes influenced farmers in three dimensions: farming, household and generally in living conditions (health and education).

Actual Inputs

The total project costs were calculated at € 11.7 million; the subsidy was to contribute 60% of the total budget (€6.9 million). The remaining 40% of the budget was to be covered by the partners. SADA was to invest funds (€800,000) and as such had an important stake in the project.

Actual Outputs

The project built irrigation infrastructure (an irrigation dam and bulk water infrastructure) and provided input supplies and market access for smallholder farmers. The irrigation block scheme involved the construction of four different systems: pivot irrigation, overhead sprinklers, furrow irrigation and drip irrigation. The irrigation systems could be used for an additional harvest in the dry season and as a supplement in case of a drought or low rainfall in the rainy season. Through the FFSs,

the project trained the farmers on the cultivation of different crops, using improved farming inputs (seeds and chemicals) and conservation farming methods. CA practices included three major, simultaneously applied principles: (i) continuous minimum mechanical soil disturbance or minimum tillage; (ii) permanent organic soil cover or mulching; and (iii) diversification of crop species grown in sequences or associations. The final progress report summarizes the following:

- IWAD has been established and is a stable company
- Flooding has been reduced
- There is secure access to irrigation water
- There is secure access to farm inputs
- There is increased participation of women in the farmer's groups
- There is increased productivity for smallholders and out-growers
- Improved land and water management technologies have been introduced
- There is now access to high quality agricultural extension services
- Up to date knowledge and research capacity is available in Northern Ghana

3.3 SMARTerWASH - Monitoring Rural Water and Sanitation, Ghana

Introduction

The malfunctioning of water facilities in Ghana relates to limited access to spare parts and lack of (funds for) maintenance on the part of communities when breakdowns occur. The project set as priority the continuous tracking of the state of facilities and actions to ensure that service levels improved. The project developed and applied the latest IT and aimed to strengthen private sector investment to do so.

The PPP Establishment

The partners of the Public-Private Partnership were as follows:

Table 3.2: SMARTerWASH - Mobile Monitoring for Rural Water and Sanitation Services that Last

Partner	Sector	Description applicant
IRC International Water and Sanitation Centre, the Netherlands and Ghana	Private	A non-profit foundation knowledge centre on water and sanitation
Community Water and Sanitation Agency (CWSA), Ghana	Public	A national government agency with the delegated responsibility to facilitate the provision of safe drinking water and sanitation services to rural communities and small towns in Ghana.
AKVO, the Netherlands	Private	A non-profit foundation that builds open source tools for the web and mobile generations emerging rapidly in every community.
SkyFox, Ghana	Private	Ghanaian private company specialised in internet and mobile phone-based payments, transaction portals and database systems. SkyFox has expertise in web-based and mobile-based systems design and development, and in translating its systems to solve WASH problems.

IRC International Water and Sanitation Centre had been working with the Community Water and Sanitation Agency (CWSA) of Ghana for some time. In 2009, IRC supported CWSA on the Triple S (Sustainable Services at Scale) project[15] in the development of monitoring tools in the form of

[15] Triple S: http://www.waterservicesthatlast.org/countries/ghana_triple_s_initiative.

sustainability and service level indicators. The project piloted these, using Akvo's FLOW technology in three pilot areas[16]. The partners (IRC, CWSA and Akvo) decided to work together again to scale up the project and to combine the skills of the different partners in the SMARTerWASH project. SkyFox came on board as a partner to introduce a handheld (USSD/SMS) technology to report breakdowns (on handheld phones) and to order spare parts. IRC had the lead in managing the SMARTerWASH programme.

Though IRC was the main applicant for funding, CWSA was in the 'driver's seat' in the project. CWSA had the overall responsibility for the in-country, day-to-day coordination, with support of IRC Ghana. This '*includes coordination, operations and progress reporting'*. CWSA was also responsible for activating local networks and key stakeholders, as well as ensuring political ownership. Internally in CWSA, there was a country coordination committee in place responsible for the '*integration and alignment*' of different work streams, implementation of work plans and reporting on/monitoring of progress[17].

In addition to the above-mentioned partners, there were several ministries and other government agencies with ties to and influence on the project (e.g. Ministry of Water Resources, Works and Housing, the Ghana Water Company Ltd., the Ministry of Local Government and Rural Development). CWSA took a primary role in coordinating the activities.

Intervention

The SMARTerWASH - Mobile Monitoring for Rural Water and Sanitation Services project sought "*to scale up and consolidate WASH sector monitoring in rural and small towns of Ghana*"[18]. The project planned to focus on "*upgrading and developing systems and tools for nationwide, long-term monitoring of services in rural communities. Using smart phones and other new technology, the programme aim(ed) to reduce down time and increase the functionality of WASH services*."[19]

Actual inputs

The project was executed in the period 1 April 2013 – 31 March 2016. In the original design, it was to be implemented in three regions (53 districts). However, additional funding from the World Bank (the matching funding for CWSA required as part of the FDW project) gave the opportunity for the project to expand its scope to 6 regions (119 districts). Additional funding from UNICEF and Conrad Hilton for baseline studies during the project implementation period implied that the project worked in 13 additional districts as well. The bundling of finance and the increase in scope was a demonstration of the ability of the project to attract attention and additional funding. At the end of the project period, the partners requested a budget-neutral extension of a year, which was granted till 31 December 2016. The end of project financial information indicates that the original proposed total project budget was €3,764,124, of which RVO provided 58.22% (€2,191,473).

Actual Outputs

The final external report lists the following outputs:

1. *4000 communities subscribed to SkyFox mobile services*– To date the number is just over 2000 communities enrolled.
2. *80 SMS alerts per region sent*– Most recent records suggest that there have been over 2000 alerts sent to the SkyFox platform.
3. *Private sector responds to breakdown and repairs system as evident in €50 / community average expenditure on WASH spare parts through SkyFox*– To date the number is approximately €20 spend on average. This combined with the number of communities using the system is

[16] Taken from SMARTerWASH Project Plan: Appendix I, 2012: 4.
[17] Final Project Plan (2012), page 11.
[18] Ibid: Appendix I, 2012:2.
[19] IRC contracts.

insufficient to ensure a viable business going forward for SkyFox without some diversification of offering to the communities, some level of guarantee from Districts or others, or some other supporting mechanism.

4. *95% of districts in 3 regions using the system*– The rollout of the system is still in process (although no longer with programme funding). 154 Area Mechanics have been registered on the system including 84 newly signed up through World Vision.
5. *260 reports generated from the system database (DiMES, FLOW)*–Detailed factsheets have been produced for each of the 6 participating regions and each of the 119 districts.
6. *Two African countries requesting for technical advice and training in monitoring using SMARTerWASH modalities*– SMARTerWASH (through Akvo or otherwise) has been working with Benin, Burkina Faso, Mali and other countries in West Africa to implement a SMARTerWASH approach.

3.4 Sustainable Water Service for Harar, Ethiopia (SWSH)

Introduction

The Harari People National Regional State (HPNRS), including Harar town is still characterized by acute water scarcity. In order to alleviate this problem, the African Development Bank financed a project that brought water from near Dire Dawa, over a distance of 71 km, to Harar city which became operational in 2012. A major problem is that Harar Water Supply and Sewerage Authority (HWSSA) did not have the financial and technical capacity to deal with the high calcium content of the water that is disrupting the water supply system. The other problem was that, in the Harar town, Non-Revenue Water (NRW) was calculated to be close to 45%. HWSSA faced technical capacity and budgetary challenges in a complex socio-political environment. The rural water supply systems in Harari Region suffered from high failure rates, forcing rural people to use less-safe sources. It was estimated that only 46% of the rural population had potential access to safe water in acceptable quantities, a majority of the 40,000 rural inhabitants could be seen as vulnerable in terms drinking water quantity and quality.

PPP Establishment

The project was implemented by the following partners who agreed to establish a Public-Private Partnership:

- VitensEvides International BV
- Heineken Brewery SC
- Royal Haskoning DHV BV
- Harar Town Water Supply and Sewerage Service Authority (HWSA)
- Ethiopian Catholic Church – Social and Development Coordinating Office of Harar
- MS Consultants
- Acacia Water
- Harari People Regional State (HPRS)

Intervention

The Public Private Partnership aimed to ensure long-term water availability for urban, rural and industrial consumers in Harar State through the development of integrated water resources allocation and conservation, and the build-up of financial and organization capacity of Harar Water Supply and Sewerage Authority (HWSA). In addition, it aimed to increase water access for at least 50,000 people.

The project plan included:

1. Developing a climate-proof, sustainable integrated water resources allocation approach.

2. Implementing innovative and sustainable water abstraction practices.
3. Improving HWSA's financial capacity by reducing its Non-Revenue Water (NRW) and increase its customer base.
4. Building capacity at the Rural Water and Sanitation Support Unit (RWSSU) of HWSA through the decrease of rural system failure and the creation of an investment plan.
5. Supporting HWSA in the field of design, construction, operation and maintenance.
6. Implementing a decalcification unit to ensure long-term system integrity of the new urban water system.
7. Constructing public water points and household connections to provide 25,000 urban dwellers with safe water.
8. Constructing rural water supply schemes to provide access to 25,000 people.'

Theory of Change

The theory of change rested on a multi-intervention approach to a complex problem in which the bottom-line emphasis was on maintaining the target populations' well-being in a situation of actual and potentially deteriorating safe drinking water availability in terms of quantity and/or quality of drinking water. The project had a mix of hardware (physical investment) and software (training, education, production of Water Safety Plans) interventions. Each activity had independent value in itself (and is allocated to specific individual or small groups of partners to implement). The overall project budget is supported by a contribution of 60% from FDW funding (see Table 2.1).

3.5 Source to Tap and Back, Ethiopia

Introduction

The water supply and water quality of the greater Addis Ababa region is under stress. The occurrence of waterborne diseases and infant mortality in Ethiopia is high. Accelerated investments have led to improvement in the water and sanitation sector. However, intermittent supplies and poorly functioning existing infrastructure is a major challenge and non-revenue water (NRW) may be up to 40%. An estimated 68% of the "improved" drinking water sources for 4.5 million people do not comply with quality standards. These problems are mainly caused by 1) deteriorating water sources resulting from pollution, and 2) poor operations and quality management in the water production and distribution chain.

PPP Establishment

The Partners of the Public-Private Partnership are:

- VitensEvides International BV
- Addis Ababa WSA
- Adama WSSE
- Oromiya Regional WSA
- MetaMeta (Ethiopia) consultants
- Waterschap Vallei en Veluwe
- Waterschap Zuiderzeeland
- Netherlands National Institute for Public Health and the Environment

Intervention

The project included the following activities:

1. Stakeholder framework for integrated water resources protection, monitoring water quality and improved control of waste-water discharges;
2. Protection of drinking water reservoirs around Addis Ababa;

3. Improve water services in Addis Ababa through Water Safety Plans, Water Quality Survey and reducing Non-Revenue Water;
4. Improve the water services of Adama through Water Safety Plans and increasing supply of water;
5. Joint Capacity Education and Information Centre.

Theory of change

The theory of change rests on a multi-intervention approach to a complex problem in which the bottom-line emphasis is on maintaining the target populations' well-being in a situation of actual and potentially deteriorating safe drinking water availability in terms of quantity and/or quality of drinking water. It includes a mix of hardware (physical investment) and software (training, education, production of Water Safety Plans) interventions. Each activity has independent value in itself (and is allocated to specific individual or small groups of partners to implement).

4 Survey results

As discussed in Chapter 2, in three of the five case studies the effects and impacts of the interventions were estimated through surveys among beneficiaries and a group of persons with comparable characteristics. This was being done at the start of the programmes (to create a baseline) and after the interventions were finished. On the basis of this information, a regression model was used for to make difference-in-difference estimations, considering the specific characteristics of the beneficiaries.

4.1 IWM Colombia

Evaluation Methodology at the farm level

The novelty of IWM was to provide the individual project activities in a comprehensive and bundled way, focussing on the community and river basin level, as compared to treating individual farmers with individual activities. Accordingly, the evaluation assessed the effects of this novel comprehensive approach against the counterfactual situation of isolated activities, using a *non-randomized difference-in-differences approach* based on survey waves among coffee farmers before and after the intervention, i.e. in 2015 and 2017. For the baseline, the control river basins resembled the IWM treatment river basins as much as possible before the project kick-off. At the follow-up, 1,351 farms were re-interviewed against the 1,399 interviewed farms during baseline. This means that attrition was 3% only. Differences-in-differences estimations were obtained by using a regression model that controls for baseline values of the result indicators and, additionally, pre-intervention characteristics of the farms.

Survey Results: Take-up of Equipment and Trainings

Table 4.1 summarizes the results of the survey among the farmers in the treatment and control river basins regarding the take-up of equipment. It shows that IWM was successful in increasing the share of farms that did not use water in the pulping process and the share of farms that did not transport the pulped coffee with water. It also successfully promoted the use of tub tanks. Adoption of water-friendly equipment and behaviour also increased in control river basins, between 2015 and 2017. This increase is partly driven by other projects or FNC's normal extension services distributing the same equipment as IWM does. Moreover, a large share of farms invested into the equipment using their own means. Most of the farmers in the control group bought the devices with own resources or with financing from other programmes.

Table 4.1: Scores on take-up of equipment (shares of farms in Control and Treatment river basins)

			Control River Basins		Treatment River basins	
	DiD	Stat. Significance	2015	2017	2015	2017
Pulping without Water	0.080	10%	0.51	0.58	0.57	0.72
Transport pulped coffee without water	0.077	5%	0.94	0.86	0.90	0.89
Tub Tank	0.097	5%	0.22	0.30	0.23	0.41
Wastewater treatment equipment	0.115	1%	0.21	0.24	0.21	0.35
Pit for pulp composting	0.076	5%	0.43	0.39	0.61	0.65

Maintenance and cleaning of the equipment is in general slightly better in treatment river basins. The table also shows that the treatment river basins perform better than control river basins with regard to waste and wastewater generated in the coffee processing process. More farms got a

coffee-processing wastewater treatment system in treatment basins. IWM supported the installation of so-called SMTAs (modular anaerobic treatment systems). The surveys show that also regarding these SMTAs, farms in the control basins bought an SMTA with own resources or credits or received finance from other programmes. When it comes to usage and maintenance of the treatment systems, farmers in treatment river basins do not perform better than control basins.
The usage of pits for pulp composting increased slightly in the treatment basins, while it even decreased in control basins. Accordingly, the measured effect is clearly positive. Also, when looking at the characteristics of the pit, treatment farms perform slightly better since their pits are better equipped (with a drainage tank) and farmers rotate the pulp more frequently.

Table 4.2: Domestic Water-Saving Devices

			Control River Basins		Treatment River basins	
	DiD	Stat. Significance	2015	2017	2015	2017
Water savers	0.178	1%	0.15	0.35	0.16	0.54
Water purification	0.034		0.91	0.92	0.91	0.96
Domestic wastewater Treatment system	0.084	5%	0.39	0.44	0.46	0.59
Separation of Waste	0.019		0.96	0.94	0.97	0.98

The use of water-saving devices for domestic use increased both in the treatment and control area, but stronger among treatment farms (Table 4.2). Water filters, which were promoted by IWM, were used by a small share of farms only. In general, farms in treatment river basins increased water purification, but also control farms did, though to a smaller degree. The double-difference is positive, but statistically not significant. Ownership of domestic waste-water treatment systems increased due to IWM by almost 10 percentage points. In treatment river basins, almost 60 percent of all farms had such a system in 2017.The share of farmers separating their domestic solid waste into organic and inorganic waste was very high both in treatment and control river basins, but no difference induced by IWM was observable.

Table 4.3: Soil protection and forestry management

			Control River Basins		Treatment River basins	
	DiD	Stat. Significance	2015	2017	2015	2017
Farms reforesting trees	0.193	1%	0.20	0.22	0.21	0.43
Av. Number of tress reforested	175	1%	160	104	77	186
Share of farms receiving incentives for planting trees	0.130	5%	0.14	0.14	0.09	0.22
Av. Number of trees reforested with incentives	786	1%	634	200	140	433
Meteorological Stations	0.184	1%	0.03	0.06	0.05	0.26
Weather forecasts	0.019		0.05	0.04	0.06	0.07
Weather warnings	0.065	5%	0.06	0.05	0.06	0.12

Soil Protection and Forestry Management. The share of farms practicing recommended conservation practices decreased among treatment farmers for all practices apart from the establishment of protection areas and coverage with noble weeds. However, also among control basins, conservation practices were performed less in 2017 than in 2015.The share of farmers that used burnings decreased slightly both among control and treatment river basins, but no significant impact of IWM was observed. The IWM intervention had a clearly positive impact on reforestation activities: the share of farms practicing reforestation activities was almost 20 percentage points higher in treatment river basins than in control basins.

Meteorological Stations. IWM substantially increased the awareness of farmers regarding meteorological stations by the project, with a double difference of almost 20 percentage points. Still, only 26 percent of the farmers in treatment basins were aware of the meteorological stations.

Training. For virtually all topics, treatment farms participated on average more in training than farmers in control river basins. IWM training on "wastewater management" and "protection of plant and animal species" showed the largest double differences: the share of farmers who participated in such training rose around 28 and 24 percentage points more in the treatment basins than in control basins. Several other trainings showed double differences of around 20 percentage points. For some training, the share of farms participating also increased in the control group, partly due to spill-over effects. Excluding the farms with spill-over effects did not alter the results substantially.

Survey Results: Outcome and Impacts

Water Conservation Attitude. Many statements regarding water usage and attitudes towards water conservation were widely accepted by households, already at baseline. Especially for domestic water conservation, farms widely agreed with water saving practices. The statements were more controversial for processing water conservation. For most statements, attitudes shifted in favour of water conservation not only in treatment basins, but also in control basins. However, double-difference estimates showed no statistically significant effects at conventional significance levels. Nonetheless, effect sizes were just on the edge to be detectable. The estimates might be biased by spill-over effects from treatment to control areas, though no substantial impacts can have happened, even if the true counterfactual situation was a zero change.

Table 4.4: Water conservation attitudes

			Control River Basins		Treatment River basins	
	DiD	Stat. Significance	2015	2017	2015	2017
Domestic water conservation			No significant differences			
Processing water conservation			No significant differences			
General water conservation			No significant differences			
Sustainability Initiative	0.099	1%	0.67	0.60	0.73	0.75
Gender			No significant changes			
Group membership			No significant changes			

Sustainability Labels. While no intended effect of IWM, the share of farms that have sustainability labels increased effectively in treatment river basins, while the proportion decreased in control river basins. The effect came partially from the fact that less farms in control river basins participated in Nespresso's and Nestlé's initiatives.

Gender. Overall, no significant effects were found on women empowerment by looking at (i) female decision power, (ii) equality of the relationship, and (iii) perceptions about female stereotypes. The only significant effect concerned women deciding over medical treatment of household members.

Group Membership. Overall, the IWM intervention had no effect on group membership. The share of farmers who participate in the IWM established *Manos al Agua* groups was not very high. This does not come as a surprise, since each group consisted only of around 25 members. Valle del Cauca stood out with a disproportionately high number of farmers being member of the *Manos al Agua* group.

Water Shortage and Water Excess. The share of farms affected by water shortage was even higher in 2016 than in 2014, both among treatment and control river basins. This can be explained by the fact that in 2015/2016 the "El Niño"-phenomenon has been particularly strong, causing severe droughts throughout the country. Of course, measures of IWM to increase water quantity such as planting

trees at water sources were unlikely to produce immediate results. Effects of these activities will only be observable in the longer run. Neither can any changes be observed with regard to landslides and erosion. Here it also remains to be seen in the longer run whether IWM activities, especially the reforestation activities, produce positive impacts. Because treatment farmers effectively planted more trees than control farmers, it could be expected that this would lead to positive impacts in the longer run.

4.2 Integrated Water Management in SisiliKulpawn, Ghana

Measuring Output

In the course of the implementation of the project, changes were made in the strategy and roll-out of the conservation agriculture (CA).The focus in the second year of the project on rice farming only eliminated conservation farming through diversification of crops and crop rotation. The project also reduced the number of villages in which it was active, but treated more farmers per village. The total number of IWAD farmers treated (810) was far from the goal of 3,000 farmers. The training was a condition for taking part in the input programme, but the FFSs were open to anyone. This implied that measuring the treatment effect by village (intention to treat =ITT) was reasonable for maize and rice, because both crops were promoted in the first years. Additionally, the analysis measured the impact on the farmers actually treated (average treatment effect on the treated =ATE). These farmers followed the training and received inputs for credit to be paid back in the form of produce.

Farm characteristics and farming practices

Farmers farming maize or rice in the project seemed not to change cultivation practices (number of crops planted or harvested). Concerning land holdings in general and land allocated to maize and rice, there was an increase in land used for maize cultivation in treatment villages, but not among treatment households specifically. There was an increase in the use of higher quality seeds and the use of fertilizer. There were no significant effects for herbicides. Farmers often used chemicals, though not the appropriate ones. In treatment villages, farmers started using pesticides recommended by the project and reduced the use of other pesticides. This held for both the treated villages and the treated farmers. The use of any other pesticides decreased in treatment villages in general. There was a positive and significant effect on the use of fertilizer for maize cultivation. For rice, farmers used higher quality seeds, and thus reduced the use of traditional seeds.

Table 4.5: Indexes on farming practices in treated villages and among treated farmers

	DID Intention to Treat (ITT)	Statistical Significance	DID Actually Treated (ATE)	Statistical Significance
# of agricultural shocks in the last year	-0.652	5%	-0.912	Not significant
Use of improved seeds for any crop	0.08	1%	0.13	5%
Use of fertilizer	0.20	1%	0.20	1%
Use of pesticide	-0.14	5%	-0.072	Not significant
Use of recommended pesticide	0.06	1%	0.17	1%
HH used fertilizer for maize	0.20	1%	0.188	5%
HH used improved seeds for rice	0.099	10%	0.137	Not significant
HH used fertilizer for rice	0.155	Not significant	0.256	5%
HH used herbicides for rice	0.176	10%	0.251	5%
HH used pesticides for rice	0.217	5%	0.418	1%

Bushfires were a huge environmental problem in the area and information on the topic was included in the FFSs. However, more than 80 percent of farmers saw `pile and burn´ as the appropriate method to clear the fields after harvest. Only 17 percent of farmers in treatment villages saw mulching as the adequate method. This proportion did not change over time.

Production

There was a positive impact of the project on the total value of the harvested crops, maize and rice. The amount of rice kept for home consumption increased for CA farmers, but sales did not increase for contracted farmers. Farmers repaid inputs to IWAD in the form of produce. As reported in the focus group discussions, farmers did not produce enough on the IWAD contracted fields to repay the credit. In this case, IWAD set up a buffer account. Farmers started with a deficit in the next season.

The price by IWAD for rice was lower than the market price. As could be expected, farmers were not happy with the price offered by IWAD, but sold to the organisation anyway because the organisation *"did something for them"* i.e. provided knowledge and input support.

Table 4.6: Indexes on farming practices in treated villages and treated farmers

	DID Intention to Treat (ITT)	Statistical Significance	DID Actually Treated (ATE)	Statistical Significance
Total harvest (GHC)	45,620.643	5%	131,274.716	5%
Total harvest sold (GHC)	6,705.968	Not significant	18,827.714	Not significant
Total home consumption (GHC)	3,777.443	Not significant	11,592.530	Not significant
Total labour paid in-kind (GHC)	440.195	Not significant	3,607.163	5%
Maize				
Maize total harvest (GHC)	20,830.797	5%	32,246.294	1%
Maize Sales (GHC)	4,058.155	5%	3,699.527	Not significant
Maize kept for home cons.	3,267.531	Not significant	2,425.716	Not significant
Rice				
Rice total harvest (GHC)	16,901.541	1%	33,216.162	1%
Rice Sales GHC)	6,939.941	Not significant	8,976.034	Not significant
Rice kept for home cons.	1,939.941	Not significant	5,512.629	Not significant

There was a drop in food scarcity in the treated villages and an increase in the number of meals a household had in the last two days. This effect is probably correlated with the increased amount of rice kept for home consumption. There were no significant impacts on the child anthropometric measures, but an improvement in all scores could be seen over time. Food expenditure in the last week stayed more or less constant over time.

Expenditure, Nutrition and Anthropometrics

There were no effects of the project on expenditure and wealth, because the project had no effects on sales of harvest. Without additional income from the harvest, households could not improve their wealth position; the main source of household income was farming.

Table 4.7: Nutrition, anthropometrics and food expenditures

	DID Intention to Treat (ITT)	Statistical Significance	DID Actually Treated (ATE)	Statistical Significance
Food supply and nutrition diversity				
Food Scarcity	-0.073	10%	-0.125	Not significant
Count of number of times household had meals in the last two days	0.059	Not significant	0.246	5%
Anthropometrics				
Children in HH wasting	-0.028	Not significant	-0.100	Not significant
Children in HH stunting	-0.027	Not significant	-0.004	Not significant
Children in HH underweight	-0.001	Not significant	-0.052	Not significant
Food expenditure				
Food expenditure in GHC for the last week	-7.241	Not significant	-18.595	Not significant
Market value of crops kept for home consumption	-256.395	Not significant	-49.753	Not significant

Intra-household decision making and female roles

From the beginning, the project supported women to become part of the contracted CA farmers. For that reason, a social worker visited treatment villages on a regular basis and supported women in forming female farmer groups and other associations. This strategy was effective, as the number of women whose major or secondary working activity was farming increased significantly. The project was effective in making social changes. However, strengthening gender roles is a long process and will most likely not change after a short period of three years.

Table 4.8: Gender roles

	DID Intention to Treat (ITT)	Statistical Significance	DID Actually Treated (ATE)	Statistical Significance
Women in HH that have farming as a main or secondary activity	0.527	1%	0.752	1%

Irrigation Villages

In general, farmers had a positive opinion about irrigation and saw it as interesting new technology and as an opportunity. Farmers working on the irrigation scheme appreciated the training and new information on farming they got from IWAD. However, the analysis was descriptive here, because the sample size was too small to make robust estimates. While almost all farmers used chemicals for production, the use of fertilizer, herbicides and pesticides was more often practiced by irrigation farmers, especially when growing rice. There were clear increases of the output of maize and rice farming. Irrigation farmers had a higher value of maize harvested, maize sales and kept more maize for home consumption. Most IWAD farmers had to give the remaining harvest to IWAD to pay for inputs. A negative effect is that a higher burden of Malaria was found among all households in irrigation villages compared to the control group of the sample. In particular, irrigation farmers reported more symptoms related to water-borne diseases, such as eye infections, vomiting or having a fever.

Table 4.9: Malaria prevalence

	DiD	No irrigation		Irrigation	
		baseline	follow-up	baseline	follow-up
Number of persons with Malaria in household in the last 2 weeks	0.232***	0.34	0.49	0.32	0.69

*** represent statistical significance at 1 percent level

Female work force survey

A small survey was collected among female casual farmers on IWAD's nucleus farm. It turned out that women, instead of men, were more reliable and willing to work for IWAD on a more permanent basis. Working for IWAD brought considerable changes to these women. All women interviewed opened a bank account and received the salary directly to the account. Women reported that they used the money to buy cloths and agricultural inputs (fertilizer, herbicides or pesticides), and to pay for school fees of their children. 75 percent of women were not able to save any of the earnings, but 25 percent of women report that they accumulated savings.

4.3 SWSH Project, Ethiopia

The study on the SWSH project evaluated the effects of one activity of a multi-dimensional project in terms of improving water access for households in urban and peri-urban areas of Harari Region. In order to do so, it used household-level panel, pipeline samples collected before and after the first phase of a targeted household intervention, distinguishing first phase treatment and control households, where the control households were due to receive similar interventions in a later phase.

The baseline study was conducted in 2015 and the follow-up survey was undertaken in 2017. The baseline study covered 340 sample households with 1,619 individuals, of which 318 households were covered in the follow-up survey. The baseline study showed that neighbour 'safe' sources in the urban area and river/pond/lake sources in the peri-urban area were the major sources of drinking water. Excluding neighbour sources, access to drinking water from protected sources, overwhelmingly in peri-urban households, increased from 2015 to 2017.

Similarly, the evaluation assessed the effect of the intervention in rural areas. The project did not identify intervention target rural areas or households for almost three years after inception. Nonetheless, in order to have sufficient time between baseline and follow-up surveys, conduct a baseline survey covering 308 sample households was conducted in 2016 (before the interventions were finally identified) and households were allocated ex post to treatment and control groups. The follow-up survey was conducted in 2019, in which 278 households were re-interviewed (implying a sample attrition rate of about 10%).

The result of the econometric analysis is presented below for a number of variables indicating the effects of a more effective supply of water in terms of quantity and quality.

Effects on access to water

The project intervention brought significant reduction in the number of trips and travel time to fetch water in the urban area. In the follow-up survey, over a two-month period of time, treatment groups made 7.1 fewer trips to fetch drinking water than during the baseline period, whereas control households travelled 2.4 trips more. The resulting DiD of -9.6 is statistically significant at a 1% level of significance. The effects in peri-urban and rural areas are also statistically significant (at respectively 5% and 10% level). Average travel time to fetch drinking water from the primary source reduced in both urban and rural areas. Similarly, the water supply intervention helped to reduce water collection waiting times in the urban area, while no significant effect was observed in the peri-urban and rural areas (Table 4.10).

Table 4.10: Difference-in-difference effects on access to water supply

	DID Urban		*DID Peri-urban*		*DID Rural*	
	Estimate	Significance	Estimate	Significance	Estimate	Significance
Average number of trips to collect drinking water in the last two months	-9.6	1%	-4.7	5%	-4.8	10%
Average travel time to fetch drinking water from the primary source (in minutes)	-8.5	5%	0.3	Not significant	-14.0	1%
Average in line waiting time for getting drinking water from the primary source (in minutes)	-29.1	1%	-12.1	Not significant	-2.1	Not significant

Effect on health indicators

During the study period, prevalence of diarrhoea caused by contaminated water reduced for both urban treatment and control households. The project reduced the incidence of diarrhoea illness by 14 percentage points. In peri-urban locations, the effect of the project in controlling incidence of diarrhoea was not found to be statistically significant. No DiD estimates were made for rural areas.

The project reduced water treatment costs in rural areas. No statistically significant effects were found in urban and peri-urban areas.

Average medical expenditure for diarrhoea treatment reduced for treatment group in the urban area by Birr 66.5, while it increased by Birr 161 for control group. Thus, overall, the improved water supply project reduced medical costs for treatment of water borne diseases by Birr 228. No significant effects were found in the other two areas (Table 4.11).

Table 4.11: Experience of diarrhoea episodes and treatment cost

	DID Urban		*DID Peri-urban*		*DID Rural*	
	Estimate	Significance	Estimate	Significance	Estimate	Significance
At least one household member suffered from diarrhoea in the last two weeks (%)	-0.14	5%	0.09	Not significant	-	-
Average water treatment cost in the last month (in Birr)	-0.5	Not significant	10.6	Not significant	-39.3	1%
Average amount spent on medical treatment for diarrhoea in the last two weeks (in Birr)	-228.2	5%	32.4	Not significant	-9.0	Not significant

Effect on education and work

The incidence and duration of absence from work and school fell significantly over time for treated households. For instance, the share of urban households in which diarrhoea affected school attendance of children reduced from 9.3% in 2015 to 1.7% in 2017. This difference in school absenteeism between the baseline and follow up surveys for the treatment group was statistically significant. But the control group showed a similar reduction, implying that the double-difference was not statistically significant. Likewise, the average duration of absenteeism from school reduced considerably for the treatment group between 2015 and 2017, but also for the control group. In the urban area, both the treated households and the households in the control group reported no cases in 2017. No statistically significant effect of diarrhoea on education and labour outcomes was found. Similar trends could be witnessed for the peri-urban area, although the differences in the outcomes between the baseline and follow-up surveys were not found to be statistically different from zero. In a similar fashion, no significant DiD effects were found for the rural area, except for an (unexpected) increase in the number of days absent from school due to diarrhoea, though this may be a result of a small number of observations in the sample.

Effect on expenditure in obtaining drinking water

The evaluation exercise examined if there was a reduction in direct spending for drinking water for those urban and peri-urban households exposed to the intervention. The baseline survey revealed that treated households (Birr 70.1) on average spent more money on access water as compared to control households (Birr 55.2) in the urban area. In 2017, households in the treatment group paid less (Birr 36) than households in the comparison group (Birr 46). The difference-in-difference estimates suggest that improved water provision due to the project significantly reduced monthly spending on drinking water in the urban area.

For the peri-urban sample, the analysis revealed that the intervention did not change spending for drinking water significantly in double-difference terms. This is because many households in peri-urban areas did not pay cash for drinking water in 2015 or 2017. However, looking at single difference changes between 2015 and 2017, mean monthly expenditure reduced by 16.2 Birr for the treatment group and by 41.2 Birr for the control group between the baseline and follow-up surveys. However, the frequency distributions of payments indicated that this difference in means is probably due to specific local circumstances rather than to the project intervention.

Table 4.12: Monthly household expenditure for drinking water (Average spending in Birr)

Category	Treatment		Control		DID	
	2015	2017	2015	2017	Estimate	p-value
Urban area	70.1	36.0	55.2	46.0	-24.9	0.024
Peri-urban area	71.8	55.6	78.3	37.1	25.1	0.106

4.4 Conclusions

In **Colombia**, several IWM interventions managed to reach more beneficiaries than originally planned by securing additional funding sources along the way and a very efficient implementation. Adoption of water-saving coffee processing devices was higher in treatment river basins than in control basins. It should however be mentioned that in the control basins, some farmers bought Dry Hoppers and Tub Tanks with own resources or financed from other programmes. The programme was rather successful regarding reforestation. More trees were planted in the treatment river basins than in the control areas. However, for the rationale behind the bundled and comprehensive approach, namely the expectation to create environmental awareness and to sustain the project dynamics over time, the results of the assessment were mixed. The evaluation could not analyse the effects of the programme on the financial conditions of the farmers who participate, because the end line survey came too early. The effects and impacts did not materialize fully.

The level of knowledge on the effect of the coffee sector on surface water bodies increased through the IWM intervention. The relevance of the IWM intervention can, however, be questioned from the pollution point of view, since it might have been more relevant to tackle other pollution sources. However, from the farmers' perspective, action was needed because the Colombian law clearly defines maximum acceptable pollution levels for dumping coffee wastewater into surface water bodies that many farmers exceeded.

In **Ghana**, IWAD and the partners of the PPP made a great effort to implement the project with its technical and social components and to find a commercial model for agriculture in the Northern Region of Ghana that could also survive economically. In general, there were positive changes initiated by the project concerning improved farming practices, such as the use of chemicals and irrigation; these then also converted into higher yields of maize and rice. Especially rice output increased by more than 50 (and up to 400) percent, maize output almost doubled. This was particularly true for irrigation farmers who achieved higher maize and rice yields. When it came to sales and profits as an income-generating activity for farming households, the results were rather modest. Irrigation farmers increased sales of maize, but not of rice. This was quite similar for farmers in the programme for conservation agriculture, who had a higher production of maize and rice, and also improved productivity in rice cultivation, but showed no increases in sales of crops. The payment for inputs and prices below the market prices for produce offered by IWAD reduced the farmers' profits.

In terms of food security, farmers had a higher production of rice and maize and also kept more rice for home consumption. Although there was no direct impact of the intervention on income and poverty, food scarcity decreased and availability of food in terms of number of meals per day increased slightly towards three meals per day. The nutrition effect did not (yet) transform into anthropometric effects on children's development.

Women in the project area, especially in the four irrigation villages, gained from the project's effort to strengthen the role of women. More women work in agriculture and are more engaged in the intra-household decision making process, especially when they get the chance to work on IWAD's nucleus farm as casual workers with a family-independent income.

The SWSH project in **Ethiopia** was focused on improving supply of drinking water. Excluding neighbour sources, access to drinking water from protected sources, overwhelmingly in peri-urban households, increased from 2015 to 2017. There was larger improvement in access to water from protected sources among treatment households as compared to control households. The econometric analysis revealed that access to safe water significantly increased in the urban area.

Travelling long distances to fetch water leads to wastage of energy and time, especially for women and girls. Overall, the intervention reduced the number of trips to collect water in urban, peri-urban

and rural households. The average travel time to fetch drinking water from the primary source reduced in both urban and rural areas. Similarly, in urban areas, the average in-line waiting time to get drinking water from primary sources dropped by about 29 minutes per trip attributable to the project. This result indicates that the project saved time that could be used for educational and/or productive purposes.

Provision of improved water, among other things, is also expected to reduce incidence and side effects of water-borne diseases. During the study period, the water supply intervention appeared to significantly reduce urban incidence of diarrhoea by 14 percentage points. However, in the peri-urban sample, the over-time change in illness between treatment and control group is not statistically different from zero. As a result of the project, the average water treatment cost dropped significantly in rural areas. Furthermore, a statistically significant reduction of medical spending for diarrhoea is found for urban households that benefited from the project.

In addition, the study investigated whether access to safe water supply brings improvement in the livelihoods of treatment groups through reducing absenteeism from school and workplace. Experience of absence from school happened in about 9% of treated households in the urban sample in 2015 and this was significantly reduced and became less than 2% in 2017. Similarly, the incidence of absence from workplace was reduced for the treatment group. But these changes were not significant in double-difference terms and must be seen in wider contextual terms. There is no econometric evidence that the observed changes for the treatment group can be attributed to the project intervention.

Sustainability

In the three cases discussed here, there were a number of indications that the projects co-financed from FDW funds contributed positively to the ultimate objectives of the respective projects. In Colombia, the awareness of an efficient use of water increased more in the group of farmers that participated in the programme. A similar trend can be observed for the participants in the project implemented in Ghana. Here as well, the estimates show a significant improved use of fertilizer and seeds. However, this did not have a significant effect on the financial benefits of the farmers, partly because a larger share of the produce was kept for home consumption and partly because the project paid lower prices for the products than market.

The surveys in Ethiopia do suggest some positive impacts of the project interventions to directly improve drinking water supply for targeted households in terms of direction of change in indicators of well-being. But as most urban and some peri-urban households were already receiving ‘improved’ water supply from neighbours with in-house piped connections, while still being subjected to discontinuities in supply from the piped water system, the quantitative impact on households’ well-being was limited. Thus, with little gain in quality of drinking water consumed by targeted households in urban areas, a claim to positive impact depended primarily on decreased costs of purchasing drinking water. Urban households were able to reduce expenditure on drinking water, which provided some financial gains amounting to about Birrs 25 a month (about ten percent of household cash income).

5 The Role of the PPPs

The literature argues that PPPs (partners working together) potentially provide greater efficiencies, better quality and improved outcomes: in effect, value for money.[20] The Netherland's Policy and Operations Evaluation Department (IOB) developed five criteria for developmental PPPs;[21] the argument being that 1) to be a partnership, the relationship has to meet these criteria and 2) if a partnership meets these criteria, it will potentially provide improved outcomes and added value, in comparison to when parties work separately. This chapter discusses the role of the governance structure of the five cases studies in the achievement of the objectives.

5.1 IWM Colombia

PPP Agreement

The Colombian Coffee Growers Federation (FNC) was the initiator of IWM Colombia and the lead partner of the PPP. In June 2014, five of the six PPP partners signed a Partnership Agreement in which they agreed to operate as partners in the implementation of the project. Although the membership of MADR in the PPP was not formalised, it had both public and private partners and, in this sense, met the first of the five criteria of developmental PPPs as defined by the Netherland's Policy and Operations Evaluation Department (IOB).

The PPP also met the second criterion of developmental PPPs, because the partners defined a common development goal in a MoU. In addition, the PPP partners agreed on how the project's resources would be shared and made a division of labour by defining which partner was primarily responsible for particular activities (third and fourth criteria). While the *Agencia Presidencial de Cooperación* (APC) made a financial contribution to the project, the government's commitment was not fully realised. It amounted to only a quarter of its committed resources. Furthermore, neither the APC, nor the Ministry of Agriculture, played other roles envisaged in the PPP. In this sense, there was no true PPP as defined by IOB. Nonetheless, the relationship with APC facilitated the establishment and strengthening of relationships with other regional and local governmental institutions.

The distribution of risks between the public and the private sector (the fifth criterion of developmental PPPs) was not fully defined. It was not always clear whether the risks concerned the public or the private sector, or whether they were borne by the PPP as a whole. Some PPP partners stressed that the major risk concerned the timely disbursement of financial resources and that delay in disbursement caused delay in the project's activities in the first years. There was not only a risk of late disbursement, but also a risk of non-disbursement.

Water & Coffee Platform

The six PPP partners are the core institutions of the Water & Coffee Platform. It was envisaged that the platform would, apart from the six PPP partners, have at least 50 members towards the end of the project implementation period. These institutions would participate with contributions in money and kind (labour hours) for implementing the so-called Complementary Projects (not outlined in the IWM project documents and not to be managed by the central level of the project). The platform was supposed to continue to function after completion of the IWM project and it appears that it is

[20] Savas, E. S. (2000). Privatization and Public-Private Partnerships (New York: Chatham House); Hodge, G. A. and C. Greve (2005). *The Challenge of Public-Private Partnerships: Learning from International Experience* (Cheltenham: Edward Elgar); Hodge, G. A., C. Greve and A. E. Boardman (2010). *International Handbook on Public Private Partnerships* (Cheltenham: Edward Elgar).

[21] IOB (2013). *Public-Private Partnerships in developing countries. A systematic literature review.* IOB Study 378. The Hague: Ministry of Foreign Affairs of the Netherlands.

continuing to function. By February 2018, in total, 58 local, regional or national organisations had joined the platform.

Value added of the partnership?

Although there was strictly speaking no developmental PPP in the perception of various stakeholders, there was cooperation between private and public partners. Some actors perceive that the partnership had value added. A somewhat different view is that the partnership in particular worked in terms of generating resources, but that it "did not support much in technical and social areas, although currently there is important support from Wageningen."

In spite of the limited role of the Colombian government partner in the PPP, the partnership generated a high degree of leverage and allowed for the inclusion of other actors and implementation of additional activities via the Water & Coffee Platform.

IWM claims that the project was different in that it promoted a more comprehensive approach of accompanying technical assistance with information and training campaigns, as well as targeting the institutional framework. It took a community and landscape perspective ("the river basin") as opposed to interventions that consider exclusively the individual farmer perspective and expect the bundled promotion to create higher environmental awareness and to produce more sustainable results. Over half of the interviewees mentioned awareness or a change in knowledge or attitude regarding water as a main result. Almost half of them indicated that establishment or strengthening of *Manos al Agua* groups or associative work was a main result of the project. Other results, including reforestation and water saving or improved quantity of water were mentioned less often. The governance structure of the PPP can in particular be held responsible for these communal group activities.

Views on the potential for scaling of the IWM project

There were no concrete plans for scaling or a second phase of the IWM project for lack of financing, but there were several requests from other organisations that wanted to use the model and receive advice and materials produced by the project. In case of a second phase with a PPP set-up, it would be important that the public sector partner in the PPP would play a more active role in the project. A genuine commitment from the public sector to contribute financially to such a project would be required.

5.2 Water Management in Transfer in SisiliKulpawn, Ghana

PPP Agreement

Looking at the structure of the partnership and the elements outlined in the Partnership Agreement and the Project Plan, this partnership appears to have met the five criteria of developmental PPPs as defined by IOB. The partnership had both public and private partners (criterion 1), there was a clear agreement on the goals of the PPP (criterion 2), the project was financed by a mix of public and private funds (criterion 3), there was a clear agreement on the sharing of resources and tasks (criterion 4), and there was a distribution of risks between the public and private partners (criterion 5).[22]

The partners from the public and private sector were present, with IWAD and SADA playing essential roles (with IWAD in the lead), and the other partners providing the inputs as set out in the project documents. Partners agreed upon the goals and objectives of the partnership and the project, as signed off in the partnership agreement. In addition, the PPP partners agreed on how the project's

[22] IOB (2013) op. cit.

resources and tasks would be shared and made a division of labour by defining which partner was primarily responsible for different activities. There were however, in the execution, some differences in the expectations amongst partners of the roles and the tasks to be taken in the project. These had to be worked out during the project and the partnership.

The finance came primarily from the Dutch Government, IWAD and SADA, though funding from the public (Ghanaian) partner was delayed over the entire length of the project. The project defined 32 risks, most of them project-related risks, as well as some political (external) risks. Perhaps less well defined were the political risks that influenced SADA's participation, as well as the financial risks, and how these would be shared. This was the subject of much discussion, as IWAD took the lion share of the risk when public funding allocations were not provided as planned and cash flow was affected. The project ran into other financial risks, such as high irrigation costs, and IWAD took the lead in mitigating these. In this respect the project did not meet criterion 5 to the extent it might have.

Role of the PPP Partners

IWAD, the private company now owned by African Tiger Holding Ltd., took a very central role in the PPP, as the body coordinating all activities of the project, and through which all communication occurred. In the long run, the project partners were bound contractually, but in contrast to the original set-up in the proposal, did not have a share ownership in the company.

Various national government agencies[23] played a distant but important and influential role in the project. SADA took a key role in facilitating relations with these bodies, project activities, supporting documents, letters, and provided infrastructure on the ground: sanitation, water, power and electricity.

The Alterra Research Institute managed the capacity development component of the project and provided capacity-building services to IWAD staff and the farmers. Alterra worked closely with University for Development Studies (UDS) and the Savannah Research Institute (SARI), two local institutions subcontracted as knowledge institutions. Over time, it started to work more closely with Damongo Agricultural Training College, that provided skill development in farming technology. RebelGroup provided advice on the set-up of the partnership, the financial structuring and analysis with a special view to the future scaling up of the project.

The traditional authorities, farmers and the farmers' associations were the beneficiaries of the project. By the end of the project, a new district authority had been established and had grown into a key actor in the project. By that time, relations had shifted: the contractual, PPP partners interacted less frequently, while the local bodies became the key focus in the interaction with IWAD.

Relations and interactions were complex; in addition to the internal PPP governance structure, the project and its outcomes were also affected by a series of players outside of the contractual relationship.

Added value of the PPP

When looking at the added value of the partnership, the team executed a short questionnaire amongst the partners; this was done to complement the qualitative methods used during the assessment. The questionnaire asked them to reflect on whether this partnership resulted in benefits that are argued to be present in PPPs; these included:

- Sharing of key expertise or resources that otherwise would not be available otherwise;
- Additional investments, beyond what was planned.
- Increased innovation (ideas or solutions);
- Improved risk allocation;

[23] Ministry of Fisheries and Agriculture, Ghana Irrigation and Development Authority, Environmental Policy Agency, Water Resources Commissions, etc.

- Improved cooperation and coordination;
- Reduced transaction costs.[24]

In the end, the results of the assessment underlined the argument that PPPs produce synergies: that by working together, partners are able to bring complementary knowledge, skills and resources to the relationship, thereby also producing positive outcomes and achieving developmental objectives. The perception of the partners was that this project would not have been possible without cooperating on making their respective inputs, in effect, without the partnership.

Of note, however, is how the partners worked in the PPP. They worked 'together but separately'. This was a private-sector driven PPP. IWAD was clearly the central figure and 'linking pin', coordinating all the partners. IWAD was result oriented and focused on the sustainability of the venture. Partners were loosely bound, working individually to fulfil their roles as defined in the contract. Communication was on a need basis through IWAD, and there were no bilateral relations. There were no 'partners meetings' as these were not deemed necessary. This implies interdependence between partners and their contributions, but without the consistent interaction between partners that one often finds in partnerships. There was recognition of this interdependence and the added value of working together to achieve the outcomes of the project. This was evident in different dimensions:

- A common understanding on the part of the partners of the importance of their involvement and the common benefit to be derived from this involvement;
- The commitment on the part of the partners to share in the risks;
- SADA's role in the implementation that altered the normal arm's length processes with which a private sector organization might normally have to deal, as well as the political risks (and one can argue the transaction costs). The project would never have been implemented at its current pace without the positive influence in all bureaucratic concerns, e.g. Land Authority.

There were some criticisms of SADA and the attention it gave to the project, as well as the delays it caused in allocating finance to the project. Still, putting things in perspective, the last bullet above on SADA is a particularly salient one: respondents described an alternative scenario (one where the public agency acted only as a traditional approval agency or neglected to facilitate as promised), and commented on the fact that, had this been the case, the project would have been extremely difficult to implement.

Though there were different perspectives on this, one argument used was that the added value of the relationship related, in this case, to SADA's role in reducing time and transaction costs, but NOT interfering in the implementation of the project, because it accepted that the expertise was with other partners. Effectively, the statutory power that lies within the public body was essential for the PPP.

Regarding added value, the sharing of risks and returns between the partners were critical. IWAD took a disproportionate amount of the risk, and the project has not yet shown returns. The contribution of the PPP to this will be more evident in the coming years, also with up-scaling.

On the other hand, it was the bundling of finance (including the additional investment generated) that made the project possible. No single partner could have taken on this initiative on its own. Partners also accepted that the project could not have been implemented without the support of the grant. The grant was seen as leverage funding – allowing the commercial parties to undertake non-profit oriented bits in the project to make it operational.

[24] Batley, R., 1996. Public-private relationships and performance in service provision. Urban Studies, 33(4-5), pp. 723-751. Available at: http://usj.sagepub.com/content/33/4-5/723.full.pdf+html [Accessed 29-10-2015]. Pennink, (2017) the Trust Cycle, trust and it influence on risk and outcomes in PPPs.

When looking at the results of the interviews and the results of a short questionnaire testing added value, the conclusion is that the benefits revolve around the bundling and sharing of expertise, the interdependence between partners, the amount of additional and unexpected investments made, as well as certain innovations (thought the perception was that there could have been more). More mixed responses related to improvements in coordination/cooperation and reduction of transaction costs as a result of the PPP.

5.3 SMARTerWASH - Monitoring Rural Water and Sanitation, Ghana

Added value

When looking at the added value of the partnership, the team executed also for this project a short questionnaire amongst the partners (n=18); this was done to complement the qualitative methods used during the assessment. The questionnaire asked them to reflect on whether this partnership resulted in benefits that are argued to be present in PPPs; these included:

- Sharing of key expertise or resources that otherwise would not be available otherwise;
- Additional investments, beyond what was planned.
- Increased innovation (ideas or solutions);
- Improved risk allocation;
- Improved cooperation and coordination;
- Reduced transaction costs.[25]

The scores according to the responses in the questionnaire were, overall, quite high (all above 4.4 out of 5).All respondents of the questionnaire agreed that the project could not have achieved the same outcomes by partners working individually. The different skills-sets of the partners helped to minimise mistakes that would have added time and costs and there was a learning effect coming from working together and the attempts partners made to look for different ways of doing things better. The results indicated further that working together resulted in more innovation: the frequent interaction and the need to deal with some of the technical challenges of interoperability meant thinking outside of the box. It should, however, be mentioned that there were some negative aspects of this innovation, namely related to the absorption capacity of some of the players and the difficulties of application in Ghana.

The results underlined the benefit of sharing the large number of risks related to the execution of the project. The practice showed that everyone went the extra mile and took on the risks they were most able to bear.

In the end, the consensus was that the added value of the PPP was that it was NOT based on purely financial interests and gain only, that partners were in it to achieve something that had never been done, to innovate, and to go beyond the status quo. There was collective will to ensure that something big could be done in the sector. There was also an interest on the part of the partners to maintain lasting working relationships after completion of the project.

It was commonly recognised (by partners) that the project was over-ambitious, the timeframe was too short to achieve what SMARTerWASH had intended, and that the project ended with certain aspects unfinished. On the other hand, there was (and still is) a general 'pride' amongst partners in what was achieved and that this was due to the partnership.

The consensus was that this was a PPP characterised by the 'normal teething problems', but a PPP that was able to deal with challenges in an effective manner. There were several factors that

[25] Batley, R., 1996. Public-private relationships and performance in service provision. Urban Studies, 33(4-5), pp. 723-751. Available at: http://usj.sagepub.com/content/33/4-5/723.full.pdf+html [Accessed 29-10-2015]. Pennink, (2017) the Trust Cycle, trust and it influence on risk and outcomes in PPPs.

contributed to the positive nature of the PPP and the belief on the part of the partners that the PPP had added value:

- Respondents agreed that, in the project design there was a clear linkage and rationale for the involvement of the partners. Given the challenges of the project, different timelines and reporting requirements, partners managed these challenges with little tension and a positive attitude. This underlines one of the lessons: that, to have a partnership that works, partners must have the willingness to make the relationship work and a common goal that binds them.
- IRC put as a priority that this should be a government-driven PPP, with CWSA at the helm. This role for CWSA was essential: the PPP could not have worked without the involvement and intervention of the public sector. This points to the fact that in a PPP there are some things that only the public sector can do, with its mandate and public powers.
- IRC, mainly IRC Ghana, took on a key role to facilitate the process (one respondent called IRC the 'midwife'; another term commonly used is 'boundary spanner'). The organisation acted as a linking pin between partners providing administrative support, capacity building when needed, and mediation between partners. An IRC staff member was seconded to CWSA to work closely with CWSA staff members. He was there to provide support when needed, but was also seen as a member of the CWSA team. IRC staff worked to facilitate communication between and decision making by partners and dealt with key issues when they arose, often related to cultural differences, differences in expectations or misunderstandings between partners. IRC recognised the importance of dealing with potential cultural differences and developed mechanisms to deal with these.

5.4 Ethiopia

It can be concluded that both Ethiopian FDW PPP projects can generally be evaluated as institutionally successful: partners showed sufficient good-will to ride out various forms of unforeseen crises in implementation. Both projects faced significant external contextual challenges and internal tensions between partners during their lifetimes, but these challenges and tensions were 'managed' and the planned project activities continued. The projects created symbiotic relationships that crossed ethno-institutional and eco-technological boundaries, which would not have happened without the complex multi-organisation multi-activity FDW PPP approach. Allowing a mix of organisations to undertake a mix of activities over a significant period of time was valuable in terms of challenging pre-existing dysfunctional institutional boundaries. Though the formal partnerships will not survive the FDW projects, they have been innovative and taught valuable lessons, not least about institutional cooperation, that have sustainable prospects.

Despite the positive attitude of the partners towards the PPP, there were some issues identified that would have required more attention already from the start. These were:

- To encourage a more collective partnership governance approach, the label 'Lead Partner' could have been changed to 'Coordinating Partner' and formal Project Managers be appointed jointly by all the partners. The Project Manager would take responsibility for financial accountability, reporting to RVO and coordination of the inputs from all project partners.
- In order to clarify its role in the PPP, it would help if each partner would write a brief individual motivation statement on its organisational aims in participating in the PPP, including a summary business plan if a financial rate of return is expected. Such a motivation statement would indicate how far the combination of partners reflects the 'ideal' PPP mix.
- The project decision-making processes should be explicitly specified in the proposal, taking account of the differential inputs of partners, the partners' locations, and processes of engaging with wider stakeholders.

- In the spirit of Mid-Term Review of the FDW Programme, it would be helpful to include either explicit sustainable development goals (possibly cultural, economic, environmental, technology development/transfer, gender, inter-generational and/or institutional) or a detailed business plan with a realistic, overall project positive financial rate of return producing no negative externalities.
- A comprehensive risk analysis could have been used in assessing the FDW proposals. In the appraisal of the project, one should take an active interest in this analysis to ensure a realistic appraisal of risks and how they could be mitigated. This is not to rule out projects on the basis of profiles with high risks, but rather to anticipate key risks and institute an early warning system in case modifications are needed.
- Given the complexities involved in multi-partner multi-activity projects, it would have been desirable that an element of flexibility allowing modifications was included in the implementation process. Heavy 'blue-printing' of FDW PPP activities is unlikely to be effective in the FDW PPP context. In practice, there was appropriate flexibility shown in accepting evidence-based requests for modifications and this recommendation may be read as supporting that practice and suggesting it be made 'standard' and not seen as exceptional.

6 Sustainability

6.1 IWM Colombia

Views on sustainability of the results

Five fundamental factors were identified as contributing to achieving sustainability: (1) multidisciplinary teams in the field; (2) good methodology of awareness raising; (3) relationship with the community; (4) collaboration between actors; and (5) knowing how to communicate. Various interviewees emphasized that for the sustainability of the results, it is important that the community groups establish and strengthen relations with other institutions. The collaboration of stakeholders also concerns the point raised in an interview that "government involvement is a prerequisite of sustainability. There is a need for contribution of the government to protection of the natural environment." Likewise, someone else emphasised that "the environmental themes have to be linked to all actors present in the territory. Regarding awareness raising and knowledge transfer, it has been mentioned that "with the training that has been provided, culture has been formed and with culture there has been a transfer of knowledge."

In terms of technical sustainability of IWM, examples given of technical improvements were the measurement of water quality, soil conservation and technical evaluation of zones to know whether it is feasible to plant certain types of trees. A lot of techniques were learned in the context of IWM, which will likely continue to be deployed in the communities.

Awareness, Multi-level Training and Accompaniment

An important activity of the IWM project was the training of coffee farmers, which was preceded by training of the trainers (i.e. IWM extension workers) at the *Fundación Manuel Mejia* and by means of e-learning courses. Training of farmers was provided by means of a mix of training methods (*i.e.* farm visits, group meetings, provision of information material) and was generally rated positively.

Factors potentially hindering the implementation of the IWM project were lack of awareness of scarcity of water, the small size of plots, the relatively low price of coffee, lack of interest or lack of a 'river basin vision', or the difficulty to change attitudes and practices of coffee growers. In comparison, examples of factors that facilitated or could facilitate the implementation of the project were a positive role of women in the community, training, awareness raising and the presence of the FNC. The drought or reduced availability of water as a result of the *El Niño* phenomenon in 2015/2016 was also several times mentioned as a facilitating factor.

Awareness raising, training and accompaniment were at the same time considered important for arriving at a more sustainable intervention. The IWM project's focus on a social component in addition to traditional extension (which focuses more on the technical-, coffee cultivation- and processing component) was also expected to foster sustainability. Related to this, the formation/strengthening of so-called *Manos al Agua* groups at the level of the communities was also seen as a way to foster sustainability of the project. By June 2018, 29 *Manos al Agua* groups had been established.

6.2 Integrated Water Management in SisiliKulpawn, Ghana

Views on sustainability of the results

It is unclear whether the *partnership* will be sustainable, as it is unclear whether partners will continue to work together after project completion and in scaling up. IWAD's interest is to work

more closely with local partners and it is unclear whether the same local partners will work in the scaling up of activities.

With regard to the sustainability of the *project*, though not financially viable during the project period, the position of IWAD and its commitment to developing and continuing with this endeavour over the longer term, to test out different models (rice production), as well as innovations (solar) in reducing input prices to the production process, have contributed to the potential, future financial sustainability of the project. The role of the project partners, in capacity building and knowledge development, as well as strategies to scale up have also contributed to creating a model that will function in the future. Ecological and technical sustainability have both been key elements of the project design and execution. This should continue to be the case. This is also true for the social sustainability: the project was strong on gender and participation and was concerned with the socio-economic wellbeing of its beneficiaries. However, interviews confirm that social change, acceptance and commitment have been a challenge to date, and still remain so. What is of interest, however, is the ability of the project to find a balance between commercial interests and the community interests (the expectation of non-commercial contributions, such as schools and clinics).

6.3 SMARTerWASH, Ghana

Sustainability of the partnership

At the time of the assessment, there was a strong likelihood that with a continuation of funding (still unsettled), the partnership would continue, most probably in its current form, with a roll-out of the project strategy and activities as planned. Partners were committed to this. Again, this is a strong indicator of the added value of the partnership; that partners were planning to commit to working together beyond the scope of the FDW funding. However, this funding was far from certain.

Institutionally, the governance structure appeared to be embedded in national and local institutions and processes (partners of the project, key ministries and local government and development partners). The end of the project evaluation commented that the partnership would have benefited from strengthening its relationship with the Ministry of Local Government, and thereby ties into the district assemblies, as a key strategy to roll out the system locally, thereby strengthening sustainability.

Sustainability of the project

As stated before, there was serious disappointment that the timeline of the project was too short to achieve all that SMARTerWASH had intended. The disappointment was in not being able to see if the business model could work. There were real concerns on the financially sustainability of the business model, namely stemming from the (in)ability of the end user to pay, and to provide revenues to make the venture viable in the longer term. In absence of this, it would require budgets provided by the government. This situation did not improve substantially by the end of the project.

Technology was an essential aspect of the design of the project and appeared acceptable in the Ghanaian context. The capacity and skills to use the technology over the longer term seemed to be present. However, this technology needed to be used at the local level, by the district assemblies and the end users, and this had yet to be worked on. This also related to social sustainability: there was still a question on the extent to which project beneficiaries, district assemblies and communities had ownership of the tools and the data, felt they were relevant and could use these in a sustainable manner.

6.4 Ethiopia

Sustainability of the partnerships

The two FDW projects in Ethiopia had complex Partnership structures with eight and nine Partners respectively. Both Partnerships had the same Lead Partner which gave useful flexibility in managing the two projects and helped sustainability during the lives of the Projects during critical periods. Most Partners had worked with one or more of the other Partners prior to the two FDW Projects and these relationships proved valuable during the lives of the Projects and will almost certainly be sustained into the indefinite future. The Netherlands Partners did use the FDW Projects to strengthen relationships, but the Ethiopian Partners tended to remain in their institutional 'silos'.

Institutional commitment to the FDW Projects among the Partners varied greatly. Several Partners were de facto sub-contractors and had no interest in Project governance. On-going ethno-political tensions made close cooperation difficult and, while both Projects made efforts to bring Partners and wider stakeholders together institutionally, in practice, it proved impossible to construct formal cross-Partner deliberative mechanisms and the de facto governance result was the Lead Partner interacting with individual Partners or pairs of Partners in implementing specific activities.

The numbers of Partners combined with the Ethiopian politico-bureaucratic historical context meant that institutional sustainability in terms of all Partners working together after the end of the FDW Project was impossible to achieve.

Sustainability of the Projects

Both Projects were also complex in the numbers and forms of activities. Each had a 'flagship' activity. In the case of the SWSH Project, it was a decalcification plant that had to be abandoned as a result of technical, financial, and political factors. The S2T&B Project planned to create a self-sufficient national training centre for water authorities, but this proved challenging in terms of institutional ownership which was still problematic at the time the FDW Project ended.

The other activities can be characterised as experimental examples aimed at improving the efficiency and effectiveness of Regional water and River Basin authorities, initially in the project areas, but with a possibility of replication on a wider scale. All these activities suffered from technical and politico-bureaucratic problems which limit the possibility of sustained replicability.

7 Overall Conclusions

This chapter follows the research questions formulated in the Terms of Reference for this study. Next to the findings presented in the chapters of this document, it draws heavily on the case study reports. The first research question on the impact of the projects is based on the case studies for which baseline and end line surveys were conducted in Colombia, Ghana and Ethiopia respectively. The projects in Colombia and Ghana focused on more efficient water management in the agricultural sector, whereas the Ethiopian project concerned the improvement of supply of drinking water.

The relevance of the PPP governance structure will be discussed in the second part of this chapter and is based on the five case studies executed in the context of this exercise.

It should be noted that these studies are not representative for the whole FDW. Yet, they can be considered indicative for the results of the Fund's projects approved in 2012, in terms of impact and governance structure, because the study included three different continents, middle- and low-income countries and different sub-sectors.

7.1 Research Question 1: The impact of the projects

a) What are the changes in poverty alleviation?

None of the five projects were explicitly focused on the reduction of poverty. Nevertheless, they included components that were aimed indirectly at poverty alleviation. Both projects in Ethiopia focused on the improvement of the access of households in poor regions to drinking water, which is reliable from a qualitative and quantitative point of view. The project in Ghana showed a significant increase in the yields of agricultural products as a result of improved irrigation and the use of fertilizer and improved seeds and pesticides recommended by the project. As a result, the production of maize and rice increased significantly, both overall and per acre. These results show that farming practices initiated by the project have improved. These positive effects were however not yet translated into increases in revenues from sales of crops. The payments for inputs and the relatively low prices offered by IWAD (the project leader) did have a negative effect on the farmers' profits.

The project in Colombia focused in particular on water treatment and water saving in the coffee sector and more in general on mitigating the effects of climate change on coffee cultivation. The focus of this project and therefore also of the evaluation was on environmental awareness and water management and not on income generation effects. The objective formulated in the Project Proposal was more ambitious and encompassed the establishment of "basic environmental, social and productive conditions to reduce poverty and increase peaceful coexistence, sustainable development and self-reliance of the rural population in Colombia." This objective was in line with the earlier-mentioned aim of FDW "to contribute to sustainable economic growth, self-reliance and poverty reduction in developing countries through public-private partnerships (PPP's) in the water sector." It should, however, be concluded that it cannot be expected that this Intelligent Water Management project would really contribute to achieving these higher-level goals, given the limited effect measured in terms of the 'earlier' impact indicators (i.e. environmental awareness, water management, etc.).

The drinking water project in Ghana (SMARTerWASH) is an example of a project which was not directly focused on reduction of poverty. Similar to the two drinking water projects in Ethiopia, it was expected that, in the long run, this Ghanaian project will also contribute to the reduction of poverty through improving the provision of regular water supply and sanitation in the rural areas in the country.

b) What are the changes in sustainable growth?

The impact of the drinking water projects in respectively Ethiopia and Ghana on the changes in sustainable growth is limited so far. If improvements in the supply of drinking water have an impact on the well-being of the members of the beneficiary households, it might in the future contribute to economic growth, because it improves (or may improve) the health situation of the household members to the benefit of higher productivity. Actually, this is part of the logic of these projects, but from an evaluation point of view it is too early to assess these impacts, since these only materialize after a couple of years.

Improved water management in the agricultural sector will certainly contribute to higher yields and therefore to long-term economic growth. This is clearly reflected in the survey done for the project in Ghana, which shows an increase in the production of maize and rice, particularly in the sub-project which includes irrigation facilities. It is expected that this will be sustainable, since the farmers recognize the benefits of the use of improved seeds, fertilizer, and recommended pesticides, and also because these farmers were actively trained in the cultivation of these crops.

Continuation of producing higher-priced high-quality coffee by small holders in Colombia with a greater awareness of the use of water is an achievement of the project in Colombia. There are not yet indications that production is growing as a result of the project, but the coffee production is more sustainable, taking account of the local environmental conditions and legislation of the government. For this project, it should be noted that the follow-up phase of the impact evaluation took place three years after the project effectively started and thus questions on sustainability cannot to be fully addressed yet. This is a short time period and results might look different in a five to ten-year period. The estimated impact of the project on farmer households is small and it is unclear whether this is a result of the project or the short time horizon during which difficult weather conditions prevailed.

c) What are the changes in self-reliance?

As a result of the drinking water projects, the beneficiaries, the households that have been provided better access to safe water, no longer depend on other sources of water. They determine themselves how much water they use on the basis of what they are willing to pay or can afford. This contributes to a change in the self-reliance at the level of the household.

Both water management projects included institutional, managerial, training (awareness raising) and physical aspects. In combination, they contributed to the creativity and independence of the group of farmers that participated in the projects. In particular, the awareness of the scarcity of clean water contributed to self-confidence of this group. In the project in Colombia this is also reflected in that farms also invested in equipment using their own means and in the activities regarding maintenance and cleaning of the equipment. The latter is in general slightly better in treatment river basins.

d) What are the changes in food security?

There is no direct link between the drinking water projects in Ghana and Ethiopia and food security. Similarly, the link between the project activities in the coffee sector in Colombia and food security is weak. There are no indications from the surveys and interviews that the project contributed to the availability of food for the participating farmers/households. This is different from the Integrated Water Management project in the SisiliKulpawn Basin in Ghana. In this project, farmers had a higher production of rice and maize and also kept more rice for home consumption. Although there is no direct impact of the intervention on income and poverty, food scarcity decreased and availability of food in terms of number of meals per day increased slightly towards three meals per day (or six meals within the last 2 days). The nutrition effect did not (yet) transform into anthropometric effects on children's development. On the child anthropometric measures, there were no significant impacts, but an improvement in all scores could be seen over time.

e) What are the changes in safety and public health?

Safe and sufficient water is a necessary condition for public health. This was the main motivation of the drinking water projects in Ghana and Ethiopia. The survey for one of the water projects in Ethiopia indeed shows that there is a significant improvement in the health situation of the households that have now access to clean water.

For the projects that were focused on efficient water use in agriculture in Ghana and Colombia respectively, the relation with safety and public health is less clear. In Colombia, the survey shows some effects on the reduction of the contamination of water. However, it is not clear whether water pollution that is caused by the coffee sector is as problematic as pollution caused by other sources. Contamination is clearly less severe than originally thought and more empirical knowledge on water quality measures in the field is required to prove that the pollution is actually problematic from an environmental and health perspective.

With regard to health, there were some findings in Ghana that give concerns related to irrigation infrastructure, namely a clear increase was found of water-borne disease symptoms and malaria in irrigation villages, which was most likely related to the decision to focus on of rice, to the exclusion of other crops. The incidence of malaria almost doubled in irrigation villages and in households where members farm on the irrigated land more symptoms describing water-borne diseases were reported.

Main Conclusions regarding impact

Safety and health were addressed effectively in the drinking water projects in Ghana and Ethiopia (see Table 7.1). Because of their focus, these projects do not score on self-reliance and food security and only indirectly on poverty alleviation and sustainable growth. The water management projects in agriculture show some small positive impacts on all indicators distinguished here. For the Ghana project, the impact on Safety and Public Health is mixed because there are some positive effects on food within households, but there are some water-borne disease symptoms and Malaria in irrigation villages.

Table 7.1: Summary of the projects' impact on various indicators

Effects on:	IWM Colombia	SisiliKulpawn, Ghana	SMARTerWASH Ghana	SWSH Ethiopia	Source to tap and back Ethiopia
Poverty alleviation?	Moderate	Satisfactory	Indirectly	Indirectly	Indirectly
Sustainable growth	Moderate	Moderate	Probably LT	Probably LT	Probably LT
Self-reliance	Moderate	Satisfactory	Not relevant	Not relevant	Not relevant
Food security	Not relevant	Satisfactory	Not relevant	Not relevant	Not relevant
Safety + public health	Moderate	Mixed	Satisfactory	Satisfactory	Satisfactory

7.2 Research Question 2: Added value of PPPs

The assessment of the PPP governance structure is problematic. A counterfactual does not exist, which would be an organisation working under similar local conditions on a similar project. The assessment of the PPP structure is therefore based on a comparison of the five projects discussed in this report. The main findings are presented below. The information has been collected through interviews with the main stakeholders, among them representatives of the PPP partners.

a) What is the added value of the PPP-approach?

Using the five criteria of developmental PPPs as defined by IOB, the five projects appear to have met these criteria to a large extent. Without exception, the five PPPs had both public and private partners (criterion 1), but in some cases the role of the public partner was limited. In Colombia the Ministry of Agriculture and Rural Development (MADR) was virtually a silent partner and was replaced by

another public entity halfway the implementation of the project. The Integrated Water Management and Knowledge Transfer in SisiliKulpawn project in Ghana did indeed meet the criteria defined by IOB, but it was noted that the partners worked 'together but separately'.

One of the criteria is that the project is financed by a mix of public and private funds. In all cases it appeared that the local government faced difficulties in meeting the financial commitments made at the start of the PPP. The Ghana projects are clear examples. In SisiliKulpawn, the government (SADA) did not meet all financial obligations. For SMARTerWASH, CWSA managed to get a huge amount of World Bank funding. This increased the scope of the project substantially. But in the long run (after project completion), CWSA was not able to come up with its own funds. This created problems in executing all the tasks formulated in the project agreement. In general, there was a clear agreement on the goals of the PPP (criterion 2), although in some cases (the SisiliKulpawn project) there were differences in expectations.

In the conceptualisation and design of the projects, these IOB-defined criteria were taken into account and from the perception of the partners, they were essential in making the project work. The argument was that through the sharing of skills and resources, as well as risks, the partners were able to achieve more than if they worked separately. In other words, the synergy between partners provided added value. By working together, partners were able to bring complementary knowledge, skills and resources to the relationship, thereby also producing positive outcomes and achieving developmental objectives. The perception of the partners was that the projects would not have been possible – at least not at the same scale – without cooperating on making their respective inputs, in effect without the partnership.

Some project designs were changed during the implementation phase on the basis of new information about the local needs. Some projects were planned too optimistically. In these cases, the partners were generally willing to adapt the original inputs. An example is the SMARTerWASH project in Ghana, which was, according to the partners, over-ambitious and the timeframe was too short to achieve what the project had intended, and therefore the project ended with certain aspects unfinished. Yet, there was (and still is) a general 'pride' amongst partners in what was achieved and that this was due to the partnership. The following factors contributed to the positive nature of the PPP and the belief on the part of the partners that the PPP had added value were mentioned:

i) All except one of the partners had worked together before and 'grew into' this PPP. The working relationship had been tested during the previous project, and there was already a level of trust built.
ii) Even though the partners knew each other, there was still a common belief amongst the partners that the success of interaction was dependent on a substantial investment in relationship building. The partnership worked because the partners had the willingness to make the relationship work and a common goal that bound them.
iii) Both IRC and CWSA played an essential role. For one, IRC acted as a key mediator, bridging water differences in interest that arose. In addition, the PPP could not have worked without the involvement and intervention of the public sector, CWSA. This points to the fact, that in a PPP, there are some things only the public sector can do, with its mandate and public powers.

In all projects, the partners were critical about the sharing of risks and returns. It was often mentioned that private partners took a disproportionate amount of the risk. Meeting the obligations agreed during the inception phase of the PPP sometimes created problems, in particular concerning the public sector partner. In Colombia, the financial contributions from the government were significantly less than agreed.

The PPP governance, multi-activity approach can be seen as having advantages in that it has shown both robustness and flexibility. The combination of multiple organisations carrying out multiple activities over a significant lifetime allowed shifts of focus between planned activities to carry the

overall project through periods of uncertainty. All five FDW projects went through such periods and used the opportunities that the FDW PPP governance approach offered.

The three household surveys do suggest some positive value added of the partnerships established for the three FDW projects, independent of the very different PPP membership structures, planned activities and goals, and differing national political economy contexts. These positive effects are, in particular, related to the scope of the projects which benefited a larger group of people and covered a wide range of topics. Examples are the coffee project in Colombia and the SisiliKulpawn project in Ghana. This was also possible because the range of different disciplines provided by the different partners of the PPPs.

Still, the sample is too small, and the results are not sufficiently distinctive to allow the three FDW Projects to be ranked and test whether any of the variants on the general FDW PPP model is superior to the others.

Crucial to the positive performances of all five projects were adjustments during their implementation processes and in some cases, the willingness of certain partners to take a disproportionate amount of risk for example IWAD's mother company kept the venture afloat. There was an inevitable complexity in the FDW PPP project proposals to incorporate multiple organisations with differing skills and experiences in positive relationships to undertake multiple, broadly symbiotic activities expressing those different skills and experiences. This complexity proved to be strength in permitting consensual shifts in focus and priorities during the lives of the projects.

b) What are the benefits weighing up compared to transaction costs?

Virtually without exception, partners in the PPPs acknowledged that the governance structure of the projects is labour intensive and time-consuming. The organisation of a PPP with the right partners from private and public sectors, but also from the third sector requires a lot of travelling, communication, meetings and legal inputs. Similarly, the communication and tuning of the interests and activities of the partners requires a lot of diplomatic skills and time during the implementation phase of the project. Yet, also without exception, the partners in the PPPs confirmed that the benefits of the PPPs by far outweighed the operational costs related to the structure (Table 7.2).

Table 7.2: Summary of value added of PPPs

Effects on:	Colombia	SisiliKulpawn, Ghana	SMARTerWASH Ghana	SWSH Ethiopia	Source to tap and back Ethiopia
Value added	Slightly Positive	Positive	Positive	Positive	Positive
Transaction costs	Limited	Limited	Limited	Limited	Limited

7.3 How sustainable is the intervention?

Regarding sustainability, a distinction has to be made between sustainability of the PPP and sustainability of the intervention/project. Although there have been some discussions about the continuation of the PPP in the SMARTerWASH project in Ghana, a continuation of the funding is far from certain. In the other projects, the PPPs were phased out as soon as the projects were finished. Given its character of a Special Purpose Vehicle, elimination of the PPP after project ending is a logical step.[26] In some cases, partners have discussed the possibilities for a continuation of their working together without support from of FDW.

[26] It should be noted that formally, the PPP partners had agreed to form a partnership for a limited period of time.

a) Financial Sustainability

The projects on the supply of water in Ethiopia are embedded in a well-established drinking water supply company, which is also active in other regions in the country. An important component of the projects was to support the company in setting up an administrative and financial department, which would be capable to reduce the provision of Non-Revenue Water, which was high at the start of the projects. This would guarantee the financial soundness of the services in the future.

The agricultural project in Colombia had a landscape approach or river-basin vision and supported individual farmers in their efforts to reduce the use of water. This was successful during the project period, but it is not clear to what extent there were clear financial incentives to continue these efforts in the future. For example, what will happen when they should replace the water-saving devices or need spare parts, though it should be noted that considering the nature of these devices, there is hardly need for replacements during several years.

Regarding the training and awareness activities of the project, these will be included in the extension services provided by FNC. This institution is mainly financed by the coffee farmers and occasionally supported by the government.

If needed, the operational costs of the activities of the SMARTerWASH project in Ghana are expected to be financed from the recurrent budget of the government. However, there are serious concerns on the financially sustainability of the business model, namely stemming from the (in)ability of the end user to pay, and to provide revenues to make the venture viable on the longer term or, in absence of this, from the budgets provided by the government. This situation did not improve substantially by the end of the project.

Also, in the SisiliKulpawn project in Ghana, the end-users of the project - i.e. the farmers– should be able financially to continue the activities of the project. This will most likely be the case if these activities provide them with financial benefits. However, since the farmers were not happy with the price offered by the local private company in the PPP (IWAD), the financial sustainability of the activities is under pressure.

b) Institutional Sustainability

As mentioned above, part of the public goods of the project in Colombia will in the future be included in the extension services of FNC, which as partner in the PPP has created the knowledge base to provide these services in the future. In addition, there is a possibility that the Water & Coffee Platform established by the project will continue to exist. This depends, however, also on the FNC's financial strength, which is largely based on the contributions of the farmers by means of a percentage of the coffee price.

The situation for the water management project in Ghana is more problematic, because the knowledge, capacity building and training was provided in the PPP by an overseas institution (Wageningen University) and the local provider of extension services was not included in the PPP. Continuation of the project activities would therefore be the sole responsibility of the local private PPP partner (IWAD).

The institutional setting of the SMARTerWASH project is so far unclear.

As explained above, the two projects in Ethiopia are institutionally part of the local drinking water company and as such be expected to be institutionally sustainable.

c) Ecological Sustainability

Use and pollution of water, reforestation and attention for the environment were the core issues of the project in Colombia. As a result of the attention for raising awareness and for training in the project, the participating farmers fully acknowledged the importance of these issues. A tangible

reflection is the effort in reforestation by the farmers. The surveys show the adoption of water-friendly equipment and behaviour.

The SMARTerWASH project was also focused on ecological issues. Here as well the sustainability depends heavily on the financial means available. Conservation of farming techniques and a strong environmental policy were key components of the IWAD project. Yet, consumption of water for irrigation, which was a major part of the project, is still a serious issue.

The drinking water projects in Ethiopia do not have a significant effect on the environment.

d) Technical Sustainability

In the IWM Colombia project, the beneficiaries are trained in the maintenance of the devices. SMARTerWASH was based on the use of handheld technology for reporting breakdowns, as well as interoperable technology to monitor water use and breakdowns. The Ghanaian private sector firm (SkyFox) is still using the handheld technology to provide spare parts. The innovations and the technology, in SisiliKulpawn, though relatively simple by European standards, were too complicated for the farmers to grasp and required adjustments. They are more appropriate now. In addition, the farmers in this project are trained in maintenance of their machinery and in the use of production stimulating means.

The two projects in Ethiopia are part of the local water company, which has a longstanding experience in supply of water.

e) Social Sustainability

All projects are to the benefit of the farmers in case of the water management projects in Colombia and Ghana, or of the clients in case of the two projects in Ethiopia. All projects evaluated included a component in particular focused on gender. In Colombia, it also included an activity to promote the group membership. A significant effect on women empowerment was not found in this project, considering looking at female decision power, equality of the relationship and perceptions about female stereotypes. In contrast, in Ghana women in the project area gained from the project's efforts to strengthen the role of women, considering work in agriculture and engagement in intra-household decision making processes. In Ethiopia the women benefited most from the improved access to reliable water.

Table 7.3: Sustainability of the projects

Type of sustainability:	IWM Colombia	SisiliKulpawn, Ghana	SMARTerWASH Ghana	SWSH Ethiopia	Source to tap and back Ethiopia
Financial	Moderate	Doubtful	Lacking	Moderate	Moderate
Institutional	Doubtful	Doubtful	Moderate	Good	Good
Ecological	Good	Doubtful	Not relevant	Good	Good
Technical	Moderate	Moderate	Moderate	Good	Good
Social	Moderate	Moderate	Moderate	Good	Good

ANNEXES: Methodologies applied in the case studies

A1 Intelligent Water Management (IWM) project in Colombia

A1.1 Identification Strategy

The performance of the treated coffee farmers over time has been compared with that of a comparable control group in order to estimate the effects of the Intelligent Water Management Project (IWM). Parts of the IWM activities have also been implemented by other agents in the past, also in the non-treatment river basins. The novelty of IWM is to provide activities in a comprehensive and bundled way, focussing on the community and river-basin level. This evaluation assessed the effect of this novel comprehensive approach against the counterfactual situation of isolated activities.

For the quantitative analysis, a survey wave among coffee farmers was conducted before and after the intervention, i.e. in 2015 and 2017.

The method applied mimics a randomized treatment assignment in a non-randomized difference-in-differences approach. For this purpose, the surveyed river basins were selected in a way that treatment and control group river basins were similar before the project kick-off. The control river basins resembled the IWM river basins as much as possible. For each of the 25 IWM river basins, a control river basin was chosen with the same socio-economic and weather conditions. The *Federación Nacional de Cafeteros* (FNC) was asked to propose river basins that exhibit the same characteristics as IWM river basins. In order to avoid spill-over effects from treatment river basins to control basins (which would bias the impact estimates), the control river basins were not located downstream of the treatment river basins. The evaluation succeeded indeed in finding very comparable control river basins (see case study report). Most farm and river basin characteristics are well balanced across the two groups. In order to account for minor differences on the farm level, all estimations were controlled for baseline characteristics of the farms.

During follow-up, it turned out that IWM occasionally extended its activities beyond the originally foreseen river basins that partly led to a treatment contamination of the control group. In areas neighbouring the treatment basins, the so called “area of influence”, IWM included additional farms into IWM training activities. The number of contaminated farms is very low though, and only in Nariño a substantial share of control farms are located in this “area of influence”. Robustness checks through excluding contaminated farms from the control group or excluding Nariño completely does not alter any of the conclusions.

For analysing changes in attitudes towards reforestation, a behavioural experiment (“dictator game”) was implemented during the follow-up survey in 2017. For this purpose, a subsample of 681 farms were provided with 20,000 Colombian Pesos (around 6 EUR) and had to decide on how to split this money between themselves and a reforestation project implemented within their community. Dictator games have been widely used to assess social preferences (Della Vigna 2009).[27] The appealing feature of these games is that it made it possible to measure revealed preferences, rather than only stated preferences. Farmers can effectively donate money they could otherwise keep for themselves. If awareness of the importance of reforestation was increased among treatment river basins, treatment farms can be expected to donate more money to reforestation projects than control farms. Although the context of the experiment is a donation for reforestation in the respective community, the donation can be interpreted as the more general attitude towards the

[27] See e.g. DellaVigna, S., Psychology and Economics: Evidence from the Field. *Journal of Economic Literature* 2009, 47:2, 315–372 http:www.aeaweb.org/articles.php?doi=10.1257/jel.47.2.315.

environment. Investing in community reforestation hence expresses valuation for environmental quality. Interviews conducted as part of the stakeholder analysis were used as a source for triangulation and contextualisation of results from farm interviews.

A1.2 Farm Survey: Sampling, Sample Size, and Power Calculations

The sample size per river basin was set according to the number of farms interviewed in the treatment basin of the same municipality. In the baseline, a total of 1,399 farms, including 699 treatment farms and 700 control farms were interviewed. At the follow-up 1,351farms were re-interviewed. This means that attrition was only three percent.

The sample size of almost 1,400 farms provides sufficiently statistical power to detect changes in water conservation behaviour of a magnitude around 6 to 12 percentage points depending on the indicator. Minimum detectable effect sizes were calculated using the baseline data for three indicators: usage of tub tank and application of four rinsing rounds, pouring of production wastewater directly into surface water, and participation of women in economic household decisions. For these selected indicators, the study's power seems sufficient (a power of 80 percent and alpha of 0.05), because effect sizes smaller than the minimum detectable ones can probably be considered as failures of the project. Given the large number of other impact indicators, though, it is not certain that there is enough power to detect each and every true project impact. This is why in the final impact analysis non-significant results were analysed on sensitivity to the study's statistical power, in order to assess whether in fact the true project impact exists, but is only too small to be detected given the available sample size (so-called "false negative" findings).

A1.3 Farm Survey: Survey Tools

The main survey tool for the quantitative analysis was a structured questionnaire that had been elaborated in cooperation with IWM staff. All modules were discussed in detail with IWM staff. The questionnaire elicits basic socio-demographic characteristics of the farms. The economic situation of the farms was portrayed based on housing and asset details. Moreover, details on coffee cultivation (area in cultivation, type and age of coffee plants, production levels, plagues, participation in sustainability initiatives and organizational details) were elicited. Water usage was elicited in detail for domestic and productive activities.

Attrition with respect to observable household and farm characteristics was tested for significant differences among the farms that were successfully re-interviewed and those that dropped out after the baseline survey. Attention was dedicated to ownership, usage, and maintenance of water-saving equipment. The same applied for equipment to reduce wastewater contamination. It turned out not to be feasible to test wastewater quality, since most farms did not have a single wastewater disposal, but rather disposed of wastewater at different places of the farm. Water quality is inferred from the adopted and installed equipment and the effective day-to-day usage behaviour. Furthermore, IWM measured water quality of the ultimate downstream water body. Moreover, the questionnaire tested attitudes to and knowledge on water saving and water contamination. In addition, the questionnaire also had a special module on forest and soil management and on whether famers receive and use data from water and weather monitoring stations. For forest and soil management, farmers' answers were validated by the enumerators performing spot checks. Moreover, the questionnaire covers gender topics, most importantly decision making in different areas. Finally, participation in trainings and associations is addressed. On the river-basin level, a semi-structured questionnaire elicited information among regional extension workers in order to scrutinize the comparability of treatment and control river basins at baseline. Additionally, the questionnaire was designed to obtain

contextual information on water pollution factors and presence of other interventions in treatment and control river basins. The analysis made use of all these survey tools and included contextual information from qualitative interviews with stakeholders gathered during the scoping, baseline and follow-up phase.

A1.4 Farm Survey: Survey Implementation

The evaluation activities consisted of three different phases: the scoping phase in 2014, the baseline phase with activities in Colombia in mid to end 2015 and the follow-up phase in mid to end 2017. During the baseline mission in May 2015 and until the end of August 2015, IWM, the local research institute and the evaluation team worked together in the compilation of a common survey questionnaire. It was foreseen to merge the data sets and to mutually exploit the collected information. Unfortunately, few days before the start of the survey fieldwork, IWM Colombia decided to withdraw their participation in the survey implementation, because it feared that there was a threat of biased interviews due to a lack of independence of its enumerators. The fieldwork for the baseline data collection started the 29th of August 2015. It appeared that in two control river basins there were not enough farms within the 100-meter-radius around the river (the sampling criterion) to conduct the intended number of interviews. In these two basins the sampling area was extended to a 200-meterradius. The follow-up data collection took place between the 10th of October 2017 and the 12th of December 2017.

A1.5 Stakeholder Analysis: Methodological and Organizational aspects

The stakeholder analysis is based on a combination of document review, semi-structured interviews and a short survey among a small group of stakeholders. Important sources of information for the analysis were the Project Plan, annual and quarterly progress reports, semi-structured interviews conducted with core PPP partners and with departmental and municipal-level officials involved in the implementation of the project and other relevant actors, as well as small surveys conducted among a selection of departmental and local stakeholders. A semi-structured interview schedule was used in interviews at the central level held with representatives of Cenicafé, the FNC central office in Bogotá and a couple of other entities. A partly-structured questionnaire was applied in 31 interviews at departmental and municipal level, where a combination of fully closed, semi-closed and open questions was used.

A second round of interviews among the PPP partners and among departmental and local-level stakeholders was held in the period August 2017 to July 2018. In Colombia, seven interviews were conducted at the central level, of which four were interviews with stakeholders who were also interviewed in 2015. At the departmental and municipal level, 45 persons were interviewed, of which approximately a third was also interviewed in 2015.

A2 Integrated Water Management and Knowledge Transfer in SisiliKulpawn Basin in the Northern Region of Ghana

A2.1 Evaluation Approach and Impact Measurement

Based on the monitoring and evaluation system of the project and the relevant literature,[28] a set of possible output, outcome and impact indicators were defined. Using this available set of evaluation indicators and complementing it with existing findings of recent research, as well as the views of local experts, it was possible to develop a Theory of Change (ToC). According to the ToC, a set of evaluation questions was defined for each level. (The case study report displays evaluation questions and proposes corresponding indicators of how to approach these questions). The structured questionnaire was derived from the ToC and evaluation questions for conducting a baseline and follow-up survey among the treatment and control group in February and March 2015 and 2018, respectively.

A mixed-method approach was used, combining findings from the institutional, stakeholder and beneficiary dimensions. Several data collection and research tools were applied to analyse the output, outcome and impact indicators based on the TOC.

The intervention implemented activities at two different levels: the irrigation scheme with four different technologies and access to irrigated land for farmers in four villages, and FFSs in villages without irrigation. Furthermore, the intervention's outcomes influenced farmers in three dimensions: farming, household and generally in living conditions.

For activities on the farmer or household level of farmers participating in the FFSs, direct outcomes were observable. The assumptions of the ToC were that farmers would eventually:

i) adopt new farming behaviour and technologies,
ii) use improved seeds and chemical inputs, and
iii) practice Conservation Farming Methods (CFM).

It was expected that farmers would understand the importance of land-clearing methods without bushfires, of the application of chemicals (timing and method) and of proper harvesting methods during the whole cultivation process. Accordingly, the outcome "adoption of good agricultural practices" in the ToC represents the set of potential changes in behaviour that are intended through the FFS, such as minimum tillage, crop rotation, mulching and precision chemical application. Exact indicators for this study were designed based on theory and reviews of agricultural studies, survey material and expert interviews.

On the irrigation scheme level, IWAD planned to supervise farmer groups closely to implement the new technologies and the application of CA. Farmers additionally were to (i) adopt new irrigation farming technologies and(ii) invest own time and money to work on the irrigation farm (in contrast, conservation farming farmers work on their own land) and pay for water.

For farmers participating in the irrigation block scheme, the impact of improved agricultural practices and technologies was expected to result in a second harvest per year. This meant not only 100 percent higher yields and income increases, but also implied more effort demanded from every farmer in terms of labour input. Farmers participating in an FFS on CA could get access to improved inputs in the form of seeds and chemicals, but only work on the land they provided themselves. Farmers were to be organized in farmer groups and had to show effort because of frequent visits by

[28] H. Waddington, B. Snilstveit, J. Hombrados, M. Vojtkova, D. Phillips, Ph. Davies and H. White. Farmer Field Schools for Improving Farming Practices and Farmer Outcomes: A Systematic Review. *Campbell Systematic Reviews*. 01 September 2014. https://doi.org/10.4073/CSR.2014.6.

field agents. Also, IWAD offered to buy the harvest and acted as a trader between the producer and markets. The common procedure of selling the harvest in the project area is via trade agents who visit the villages after harvest, or farmers sell themselves at regional markets. IWAD offered improved quality inputs and also sales opportunities.

The influences at the household level could be a direct result from the intervention or a mid- to long-term result. If the households achieve higher yields and eventually crop variety, the assumptions drawn from the ToC can be that the nutritional status of household members improves, because of a higher quantity and variety. However, the effect will occur with a time lag of one to two years. Farmers applying conservation farming practices are expected to have decent yield increases in the first years and improving over time with more experience.

The effect of water management and reduced flooding risk potentially also reduces the incidence of water-related diseases. In contrast, the presence of irrigation and water storage in the reservoir could also worsen the presence of water-borne diseases as, e.g. malaria. The outcomes will be part of the later analysis.

As a focus of the FFS lies especially in motivating women to participate, it can be assumed that this can also result in the empowerment of women concerning decision making on farming, nutrition, education and expenditure. Improved anthropometric measures of children, the intra-household decision making processes and expenditure patterns can be affected by women's engagement in income-generating activities or higher contributions to household consumption.

The influence of the intervention on schooling outcomes was unclear and there has not yet been much research done on the effect of improved farming methods on education. The assumptions can go in either direction. More intensive agricultural practices and higher yields can either result in higher or lower school enrolment and school attendance. School enrolment is usually higher than actual school attendance. Because of higher income, (more) children can enrol in school and pay for fees and books (also longer, e.g. proceed to secondary school). But as more labour effort has to be invested when CA is applied, children might also be needed to conduct other household activities, as watching their siblings when the mother is working or collecting firewood and water. Therefore, this dimension has been included in this impact evaluation.

A2.2 Identification Strategy

The *Treatment Group* is represented by a sample of farmer groups using irrigation (beneficiaries planned: 150 farmers) and farmers receiving training in FFSs and later inputs for credit (beneficiaries planned: 3,000 farmers). The *Control Group* is not part of the current programme, but might benefit in the future. However, all communities lie in an area which has been identified to have the potential of being selected for the scaling up of the programme. During the investigation and planning of the project, IWAD had identified areas where it would be possible to scale up the programme. These areas serve as a sampling unit for selecting the control group villages, because they face similar savannah agro-ecological conditions. Based on this, villages were selected in the four districts: West Mamprusi, Mamprugu Moaduri, Builsa South and North Gonja. A second condition for the sampling was the population size of communities, which was used as an indicator to match control villages to treatment villages. The treatment and control communities will firstly be similar with regard to savannah agro-ecological conditions and, secondly, be similar with regard to population size. All households examined have farming as the main source of income.

The major challenge in conducting this evaluation and measuring changes in outcomes was that neither the irrigation block, nor the FFS locations were allocated randomly. For the irrigation block, a random allocation was not feasible due to technical and natural requirements of irrigation (i.e.

having an accessible source of water (river) nearby). Also, construction works started long before the evaluation started. Therefore, households participating in the programme might differ systematically from households not participating in the programme.

For the FFS treatment, a pure random assignment was not possible because 13 treatment communities in the programme area were already chosen for the first year of training sessions in 2014. Additionally to the 13 treatment villages selected previous to the baseline survey, another nine villages were selected as potential treatment villages for 2015 and onwards. In eight of these villages, treatment with FFS sessions teaching CA took place as planned, in one village farmers were not willing to participate and cooperate. In total, there are 21 treatment villages and 28 control villages to analyse the impact of the intervention.

A2.3 Sampling and sample size power calculations

Original Sample

In the ideal evaluation, the rollout of the project, i.e. conservation farming training and access to irrigation, would be distributed randomly among all potential beneficiaries and treatment would be assigned according to the random choice, not any other selection strategy. Any other selection strategy than randomness might cause biased results, but being aware of this bias ex-ante enables one to control for several factors. Therefore, the team applied the following sampling techniques: a two-stage clustered random sampling was applied, with the first stage being a cluster on the village level and the second stage on the household level. To make the sample population more homogenous and decrease variance, the sample was stratified on agriculture as the main source of income in the second stage, i.e. excluding households which are not engaged in farming as the main source of income (e.g. traders, fishers and craftsmen).

For the first stage, all villages in the four survey districts (West Mamprusi, Mamprugu Moaduri, North Gonja and Builsa South) were listed and respective population size data was collected from the Ghana Statistical Service in Tamale and in district offices. By using information on population size of the treatment villages, the control villages were matched using propensity score matching, though only on the one indicator population size. The primary sampling units were 266 villages, out of which 192 could be matched to the 23 treatment villages based on population size. All 23 treatment villages (four irrigation and 19 FFS) were eligible for the survey and 27out of the 192 potential control villages were selected randomly as control villages. The number of control villages exceeds the number of treatment villages to increase statistical power[29].

The second-stage sampling was based on full household listings in all treatment and control communities. The full household listing in 50 villages was conducted in February 2015. During the listing, the following indicators were collected: first, the name of the household head and second, whether farming was the main source of income of the household, in order to make stratification possible. After the listing process, one village was excluded from the list of control villages, because all households' main source of income was fishing and not agriculture. Therefore, only 26 control villages remained.

The study sample, therefore, comprises 48 communities in four districts with a total population of approximately 30,000 individuals and 1,360 sampled households. Based on power calculations[30]the

[29] The power (or statistical power) of an impact evaluation is the likelihood that the study will detect a difference between the treatment and comparison groups, when in fact a difference exists. Power calculations indicate the smallest sample size necessary for an evaluation to detect a meaningful difference in outcomes between the treatment and comparison groups. By increasing the sample size, statistical power can be improved.

[30] For the power calculation effect sizes for FFS on conservation farming we used figures of studies investigating Integrated Crop Management (ICM) practices. These studies find that ICM practices increased from 18% to 31% after the FFS. We

team derived a necessary sample size of approximately 1,500 farmers interviewed in 49 communities to be able to detect an effect.

A comparison between the treatment and control group at baseline shows that both groups are equal for the majority of indicators and, therefore, the applied difference in difference approach is valid.

Additional Samples

In the impact measurement risk assessment in the baseline report, it was described that uptake of the programme is the result of the farmers self-selecting themselves into the treatment group and the selection decision of IWAD. First, farmers have to follow the FFS, second, sign up for the IWAD input package and third, IWAD needs to admit the farmers to the programme. Although the uptake rates were representative for the sample and the population at baseline, the general uptake was found to be quite low in the first year. Therefore, the research team decided to interview all farmers and their households that received IWAD treatment in 2015. A supplementary sample was collected of 180 households, so that all 252 farmers (living in 230 households) that received treatment in 2015 had a fully filled-out questionnaire. In the original sample, we had already 50 farming households (CA and irrigation).

The additional sample households is referred to as the supplementary sample. It was used to analyse in which characteristics treated and non-treated farmers differ. For the impact estimations, this sub-sample was not considered, as it was not part of the representative random sample.

As the project had a strong gender dimension from the beginning, the research team decided, during the follow-up survey, to additionally do a small survey among the 200 women working for IWAD as casual workers after the follow-up survey.

A2.4 Qualitative and Quantitative Data Collection Tools

For the PPP institutional and survey-based analysis, several quantitative and qualitative data collection tools were applied forming a mixed-methods approach. Both teams developed the guidelines for the analysis together and shared knowledge. Specific questionnaires were shared before the individual field trips.

For the institutional assessment, data was collected through a triangulation of sources: semi-structured interviews, analysis of secondary sources (project documentation, progress reports, newsletters), and personal observations. All interviews were transcribed, and the results coded. The results of the interviews were complemented by a short questionnaire administered to the partners assessing the perception of the results and the added value of the PPP. The first round of interviews was held in 2015 for the baseline study, followed by intermediate and short follow-up interviews in 2016 and 2017, and a final round in 2018. The final semi-structured interviews were held with all of the contractual partners, for a total of 7 interviews in 2018. This approach was used to probe more deeply into the contextual issues, the processes and the interaction in the PPP, and the values, motivations and aspirations of the partners in the PPP[31]. This approach is complementary to the

assumed a power of 90 percent, alpha 0.05 and intra-cluster correlation of 0.40 (assumptions based on David and Asamoah, 2011, for Ghana and Erbaugh, 2010 for Uganda and Waddington et al. 2014). For the comparison of the irrigation farmers we found no adequate study but as an increase in yields by 100 percent is expected due to a second harvest (instead of only one before) we decided to oversample the villages with access to irrigation to increase statistical power.

[31] As the objective of the assessment was to analyze the relationship between partners and its contribution to outcomes, the decision was made to focus on understanding the relationship and the partnership from the perspective of the partners, the parties with intimate knowledge of the partnership. Discussions with external parties revealed less knowledge of the nature of the partnership; this also pertains to the understanding of the governance structure and relations as detailed later in this section.

approach taken in the impact analysis. The team conducted a document review in the baseline and follow-up phases. It was the intention to attend partner meetings, but the partnership never held any, so it was not possible to observe the nature of the interaction in that manner.

In order to measure the potential evaluation outcomes quantitatively and to verify the impacts outlined, several data collection tools were applied: focus group discussion (FGD), semi-structured interviews with operational partners and experts, and structured interviews using household and village questionnaires. For the baseline survey, FGDs were conducted in four villages in January 2015. Two villages were already participating in the project in 2014 and two were potential control villages. A further round of FGDs was conducted in March 2018 in three CA treatment communities and in one irrigation community. Results of the FGDs are used to verify and support the interpretation of the results of the impact measurement.

The principal tool for measuring impact is the structured household questionnaire. This questionnaire included questions on socioeconomic household characteristics (size, education, health, nutrition and financial situation) and agricultural practices (use of chemicals, planting techniques…), land holding, harvest and sales of harvest. As the project has a special gender component to foster the role of women in agriculture, the questionnaire also included a module on intra-household decision making with regards to daily expenditure, agriculture and children's schooling. The modules of the questionnaire were mainly taken from the Ghana Living Standard and Measurement Surveys and Demographic and Health Surveys and were adjusted for the purpose of this study. This ensures that questions meet international standards. For all parts of the questionnaire, answering these questions was voluntary and households were informed that the data would be treated anonymously. Interviews were conducted by male and female enumerators.

With the village questionnaire, information about regional and village-specific characteristics was collected. The questionnaire was usually conducted with the village chief and a group of elders who represent the local authority. It included questions on infrastructure access and quality, local economic and agricultural conditions such as crops, cooperatives, aid projects, employment opportunities, migration and prices.

For the sample of the 200 female casual workers, a small survey tool including questions on intra-household decision making, earnings, savings and use of the money earned was developed.

A2.5 Survey Implementation

For the implementation of the baseline and follow-up survey, a team of Ghanaian, Dutch and German researchers collaborated. The roll out of the survey was planned by the supervisors and the other team members. IWAD supported the research team in providing information on the geographical location of villages and helped in finding accommodation for team members.

The baseline survey then took place from March 2nd until March 27th, 2015. The follow-up survey was conducted in the same period from March 5th to March 29th, 2018. The surveys were conducted in this period, because it is the time of the year when farmers are not time constrained. The last harvest (usually beans) is finished in January and February and the next farming season only starts in May or June, depending on the rains. Farmers appreciated this procedure.

The data entry was done in the field in an installed data entry centre to guarantee fast feedback to the survey team in case of inconsistencies. The accuracy of the entered data was checked and final revisions were made by the research team.

A2.6 Estimation Strategy

A common method used to support internal validity is to make observations over time using the difference-in-difference (DiD) approach, as it has two advantages: the use of two time periods, namely before and after an observed treatment took place, and the comparison of a treatment group to a (similar) control group or counterfactual. Any correlation between treatment status and observed or unobserved time-invariant village characteristics is neutralized by applying the DiD approach. The source of bias influencing the treatment outcomes thus will be reduced. We observed the impact indicators over time with the baseline (2015) and follow-up (2018) data.

The advantage of the study design is that we can measure both the intention to treat (ITT) and average treatment effect on the treated (ATE). The ITT group are all households living in treatment villages and all have the potential to be treated. The ATE group are only those households in treatment villages who signed up for inputs from IWAD. The FFS were open to anyone in the village and farmers could gain knowledge on the cultivation of the five different crops. All farming inputs, however, are not exclusively distributed by IWAD, but are available on the markets as well. Thus, farmers could obtain knowledge, but purchase the improved inputs by themselves and cultivate crops with the improved methods. Therefore, we estimate two DiD impact equation containing measures of interest:

(1) $Y_{ijt} = \alpha + \beta_1 Time_t + \beta_2 CA_j + \beta_3 Time_t CA_j + \gamma_1 X_{it_0} + \varepsilon_{ijt}$

Equation (1) contains the typical DiD components measuring the ITT: A binary variable *Time* to measure the time period of the baseline =0 and follow-up =1. The treatment of CA FFS on village level CA_j is interacted with the *Time* variable to measure the ITT effect in β_3. The ITT also shows whether there is a diffusion of knowledge on the taught farming practices outside the FFS. For estimating equation (1), we include the whole sample in treatment and control villages, while the second equation is estimated only with those households in treatment villages who participated in the FFS and went under IWAD contract to receive inputs for farming.

(2) $Y_{ijt} = \alpha + \beta_1 Time_t + \beta_2 CAP_i + \beta_3 Time_t CAP_i + \gamma_1 X_{it_0} + \varepsilon_{ijt}$

The ATE treatment is measured by the variable CAP_i. In equation (2), the interaction of CAP_i with *Time* estimates β_3, the ATE, thus the effect of receiving IWAD inputs and supervision on different outcome measures (farming practices, yields, sales). The rationale of measuring two equations is that otherwise those households in treatment villages that did not receive IWAD inputs would be considered as the control group coded with 0 in CAP_i. In equation (2), those households are excluded.

X_{it_0} in both equations includes some control variables at baseline to account for heterogeneous treatment effects. The included control variables are whether the household head has primary education completed, the age of the household head and household size.

A3 Sustainable Water and Sanitation for Harar Region, Ethiopia

A3.1 Introduction

A part of the evaluation exercise is based on a longitudinal household survey conducted in urban and peri-urban areas of Harari People National Regional State (HPNRS). The first round of data was collected before the implementation of the Sustainable Water and Sanitation for Harar Region (SWSH) Project (hereafter 'the project') in 2015 and it serves to understand the baseline socioeconomic characteristics and main sources of water in the study area. After the intervention was launched, the follow up survey was carried out in 2017. The study participants include treatment households that were expected to directly benefit from the SWSH project. A 'pipe-line sample' of control households was identified that were not initially targeted by the project and would be used to compare differences in outcomes with the intervention sample.

The SWSH water-supply project intervention targeted 25,000 (peri-)urban people with five different types of activities:

i) Rehabilitation of water tankers to deliver water to a number of points where piped water is in short supply. This is linked to the rehabilitation of ROTO storage/distribution facilities.
ii) Shared yard metered provision aimed at small group collective provision where two to five households lived in close physical proximity.
iii) Water point metered provision available to wider local populations in 'peri-urban' areas judged to have deficient piped water supplies at present.
iv) 'In-house' metered provision. These households are located between households with existing 'in-house' piped water provision and therefore not suitable for 'shared yard' provision.
v) Institutional improved water provision to three institutions.

The SWSH project also had a goal of improving water accessibility for 25,000 rural people in the Harari People's National Regional State (HPNRS). The study was conducted based on two rounds of rural household panel data. The baseline data was collected in 2016 and the follow-up survey was conducted after three years in 2019. The study covers all the three rural woredas (districts) of the HPNRS.

A3.2 Sampling

Urban areas

The Harar water authority (HWSSA) categorises the urban population into different groups based on types of intervention and areas where beneficiaries are found. The urban households for 'shared-yard point' interventions were identified by local government authorities on the general criteria of lack of direct access to piped water and local perceptions of socio-economic deprivation (i.e. being too poor to pay for in-house connection). The selected households for interventions were grouped into two phases for implementation purposes, which allowed a 'pipeline' sampling frame for the evaluation household survey.

Sample households were selected using a proportionate simple random sample (i.e. proportionate to number of households targeted for 'shared-yard points'). A sample fraction of 10% was considered sufficient to give sufficient representativeness and power in assessing impact given the probable homogeneity in key variables of the beneficiary households in the two time-separated cohorts. The claim of homogeneity was tested ex post in the data analysis

Sampling and data collection in practice: The target population was initially identified from a mixture of HWSSA records of 'shared yard point' target households in the early and later intervention woredas, mainly using 'soft' copies in English (augmented by 'hard' copies in Amharic). A random sample of households proportionate to the number of target households in each cohort was drawn. The sample was geographically divided and teams of 2 to 3 interviewers (who had been trained for one and a half days) were given manageable numbers of potential interviewees for each day's work and fully debriefed at the end of each working day. In order to ensure gender sensitivity, all interviewers were women and women were the priority interviewees.

Sampled households that were not found (due to somewhat imprecise urban households' and names being ambiguous), were substituted through a new random selection, again broadly proportional to the number of cases missing in each kebele.

Sampling frame and sampling strategy for urban individual connection: Urban households that were not suitable for shared yard-points for reasons of location or risk of social discrimination were identified as the poorest of the poor and/or with diagnosed HIV/AIDS. Lists of these households for HWSSA were collected from kebele officials. The sampling approach used for households receiving individual connections was the same, with 10% from the total listed households selected using simple random sampling.

Peri-urban areas

HWSSA divides the peri-urban population into different groups based on areas where beneficiaries are found and by two implementation phases. Some categories do not have access at all to safe water and some have limited access. The four selected 'peri-urban' categories proved different in ethnic and socio-economic characteristics. The selected locations included 'villages' with livelihoods based on agricultural activity and 'suburban dormitories', where virtually the whole working-age population went to Harar town for economic activity. We identified the proposed water points (with help of HWSSA) for each category. Starting from the site of each selected 'waterpoint', interviewees were identified through a random 'paces' method (10 to 200 paces) moving away from the 'waterpoint' site in four orthogonal directions, with an arbitrary starting direction.

Rural areas

The SWSH project was not in a position to identify intervention target areas or households before the planned baseline data collection period in 2016. Nonetheless, while there was no clear project design at that time, there were sufficient indications of interventions and locations to design a survey in the three woredas, though this required **ex post** bifurcation into treatment and control groups after the follow-up survey in 2019.[32] Household data were collected in eight rural villages – Dire Teyara, Sigicha, Sukul, Awber Kele, Sofi, Awaye, Dodota, and Erer Dodota in the three Harar Region woredas.

A3.3 Sample distribution in baseline and follow-up surveys

The sample distribution of panel data by category and survey year is reported in Tables A3.1 and A3.2. The total number of ***urban and peri-urban households*** in the baseline period (2015) was 339, while the follow-up survey (conducted in 2017) found 317 households of the 339 (Table A3.1). Thus 22 (6.5%) households were not found in the follow-up survey. The baseline study contained 121 households from the urban area and 142 households the from peri-urban area. In both urban and peri-urban areas, second phase control households were fewer than first phase treated households, with the difference more evident in peri-urban areas. In the first-phase baseline and second-phase 'impact' surveys, the sample sizes of individual household connections were 37 households and 39 households, respectively.

[32] More details about survey design, sampling frame and consideration for study population are given in the baseline survey report submitted to the Ministry of Foreign Affairs in 2016.

Table A3.1: Sampling distribution of (peri-)urban households by category and survey year

No	Category	Baseline survey (2015)			Follow up survey (2017)			Sample attrition in the follow up survey		
		Treatment	Control	Total	Treatment	Control	Total	Treatment	Control	Total
1	Urban yard-point	64	57	121	57	53	110	7	4	11
2	Peri-urban[33]	81	61	142	79	52	131	2	9	11
3	Household connection (poorest of poor)			37			37			0
4	Household connection (HIV/AIDS)			39			39			0
Total				**339**			**317**			**22**

Source: HH survey, 2015 and 2017

The initial plan was to collect two rounds of data from 300 ***rural households*** with approximately 1500 individuals (determined by budgetary and logistical constraints). The baseline study actually covered 308 sample households while the follow-up survey found 278 of these households to constitute the final panel (Table A3.2). Thus, sample attrition after three years between the surveys was about 10%. There were missing households during the follow up survey from all three districts, probably due to emigration. The sample distribution per kebele (can be seen as 'village' in rural Ethiopian context) in and survey year is reported in Table 2. Among the sample villages, broadly proportionate to population sizes, a relatively larger sample was collected from Sofi Kebele (84 households) followed by Erer Dodota Kebele (74 households). On the other hand, the sample sizes taken from Sigicha and Dodota Kebeles were relatively smaller.

Table A3.2: Sample size from Rural Harar by woreda and survey period

No	Woreda	No of sample households		Sample attrition in the follow up survey
		Baseline survey (2016)	Follow up survey (2019)	
1	Dere Teyera	56	49	7
2	Sofi	140	128	12
3	Erer	112	101	11
Total		**308**	**278**	**30**

Source: HH survey, 2016 and 2019

A3.4 Empirical approach of the impact evaluation

The impact of the SWSH project in improving the livelihood of communities was assessed by using the difference-in-difference (*DID*) approach. Beneficiaries of the water supply project were considered as treatment group (*T*) and those who were not supposed to be directly benefited from the intervention were categorized as control group (*C*).

The panel data support the impact identification strategy by measuring the outcomes before (B) and after (A) the intervention. Therefore, the *DID* estimates are obtained by considering the following specification:

$$DID = (Y_{TA} - Y_{TB}) - (Y_{CA} - Y_{CB}) \quad \text{..... (1)}$$

[33] The treatment status of one sample household from the peri-urban category is not known and excluded from Table 1. Including this household, the total sample collected during the baseline survey was 340, while in the follow-up it was 318. Due to lack of a clear implementation plan in categories 3 and 5, it was not possible to identify control and treatment households. Source: HH surveys, conducted in 2015 and 2017.

Y indicates different outcomes that are expected to be affected with the intervention. The analysis considers different outcomes such as quantity of drinking water consumed, travel time to fetch water, episode of diarrhoea, water treatment cost and medical expenditure. The evaluation also examined the effect of the intervention on absenteeism from work and school due to diarrhoea, as well as on availability and use of improved toilet facilities.

For practical matters, and in order to consistently predict *DID* estimators using regression technique, the study ran the following model.

$$Y_{ht} = \alpha + \beta_1 Treat_{ht} + \beta_2 Year + \beta_3 (Treat_{ht} * Year_{ht}) + \varepsilon_{ht} \text{ ..... (2)}$$

This model regress outcome ($Y_{ht)}$ for household *h* and in time period *t* on treatment status (*Treat*) and survey period (*Year*), as well as the interaction between the two explanatory factors. In equation (2), the α and β_i's are coefficients to be estimated and the final term is the error term. Among the coefficients to be estimated, β_3 shows the difference-in-difference estimator (that is *DID* in equation 1), which is the effect of being exposed to the intervention on the dependent variable under consideration. If the intervention strongly predicts change in the outcome, β_3 will be statistically significant.

It should be noted that in order to ensure validity of *DID* estimator, the parallel trend assumption should hold. This requires that in the absence of the intervention, the outcomes for treatment and control groups should move in the same direction or follow the same path.[34] In order to check the parallel trend assumption, it requires trended baseline data collected for more than one time which is not available for this study. The effect of omitted variables is the other concern of the specified model. Equation (2) by design cancels out the effect of time-invariant factors. However, there could be still time-variant confounders that could explain the outcome and correlates with the treatment status. In order to account for the effect of such factors and as a sensitivity analysis, the study also conducted multivariate regression analysis after controlling for different covariates, as shown below:

$$Y_{ht} = \alpha + \beta_1 Treat_{ht} + \beta_2 Year + \beta_3 (Treat_{ht} * Year_{ht}) + x_{ht} + \varepsilon_{ht} \text{ ..... (3)}$$

In equation (3), x_{ht} includes a set of household and community level characteristics that were requested during the data collection process. In this regard, demographic composition by age group and household size were controlled. The socio-economic status of the households was indicated by monthly household cash income category. Experience of diarrhoea episodes among household members was also included in equation (3). Number of difficult days in obtaining water was used as a measure of access to water. The other covariates include availability of sanitation facilities and hygiene education. Finally, a location dummy for household living in a peri-urban area is also included to account for differences in the outcomes between urban and peri-urban areas.

[34] See e.g. Ravallion, M. Evaluating Anti-Poverty Programs. *World Bank Policy Research Working Paper* 3625, June 2005 (http://documents.worldbank.org/curated/en/104761468315569641/pdf/wps3625.pdf) and Lechner, M. The Estimation of Causal Effects by Difference-in-Difference Methods. *Foundations and Trends in Econometrics* Vol. 4, No. 3 (2010) 165–224. (http://dx.doi.org/10.1561/0800000014).