Evaluation of the Sustainable Water Fund (FDW)

Intelligent Water Management Colombia

Final Evaluation Report

Stakeholder Analysis:
Niek de Jong

Quantitative Impact Study:
Jörg Peters, Ann-Kristin Reitmann, Maximiliane Sievert

Colombian Coffee Sector Experts and Data Collection:
Carlos Garcia, Gustavo Ochoa, Mónica Ramírez

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Contacts:

Maximiliane Sievert, ecol, sievert@ecol-cologne.de

Niek de Jong, ERBS, EUR, ndejong@ese.eur.nl

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List of Acronyms

APC	*Agencia Presidencial de Cooperación* – Colombian Presidential agency that coordinates the international cooperation with Colombia
BOD_5	Biological Oxygen Demand
CAR	*Corporación Autónoma Regional*
CDC	*Comité Departamental de Cafeteros*
cps	*café pergamino seco*
CSR	Corporate Social Responsibility
DiD	Difference-in-Difference
FDW	*Fonds Duurzaam Water* (Sustainable Water Fund)
FMM	*Fundación Manuel Mejia*
FNC	*Federación Nacional de Cafeteros*
GIA	Gestión Intelligente del Agua
ha	hectare
ICO	International Coffee Organization
IWM	Intelligent Water Management
MADR	Colombian Ministry of Agriculture and Rural Development
MoU	Memorandum of Understanding
OC	Operational Committee
POMCA	River Basin Management and Organization Plans
PPP	Public Private Partnership
SC	Steering Committee
SMTA	Modular Anaerobic Treatment Systems
ToC	Theory of Change
TSC	Technical-Scientific Committee
WUR	Wageningen University & Research

1. Introduction

Colombia is the third most important coffee producer in the world after Brazil and Vietnam, contributing with around 13.5 million bags of coffee per year around 10 percent of the world production in 2015/16 (ICO 2016). For the last decades, coffee prices on the world market have been low due to increasing supply especially from Brazil, Vietnam, and Indonesia. Production in these countries is dominated by highly concentrated, capital-intensive farms, whereas coffee production in Colombia is characterized by numerous small family businesses with labour-intensive cultivation. The Colombian market share has decreased over the last decades. In order to compete on the world market, Colombia has focussed on a premium customer segment since the beginning of the century, by producing high-quality coffees that stand out for their environmentally and socially sound production. The coffee sector is especially important to Colombia, since it is a major source of income for the rural population. Coffee production accounts for 33 percent of rural employment, giving work to around 2.7 million people. In terms of GDP, the coffee sector only accounts for 0.5 percent, though (FNC-Cenicafé 2013).

In Colombia, considerable amounts of water are traditionally used to process coffee after harvesting. Depending on the processing practices, the wastewater can have considerably elevated organic load, a high amount of suspended solids, and low pH levels. Environmentalists frequently suspect that these effluents contribute substantially to the contamination of surface water bodies, most importantly leading to eutrophication (see for example Adams et al. 1987, Beyene et al. 2011, Chanakya et al. 2004, Haddis and Devi 2008, Mburu et al. 1994, Zuluaga and Zambrano 1993). As of January 2016, new legislation came into force in Colombia, where maximum pollution levels for dumping wastewater into surface water bodies are defined. Traditional water-using practices lead to water contamination that transgress the Colombian standards allowed for the coffee sector by roughly a factor ten.

Furthermore, the Colombian coffee sector is affected by changing climatic conditions. In general, water is abundant in Colombia's coffee growing areas and dry and wet periods in Colombia are associated with the phenomena of "*El Niño*" and "*La Niña*" that periodically lead to rainfall deficiency or increase, respectively. But the effects of these phenomena appear to have become stronger, possibly as a result of climate change, resulting in episodes of above average drought and excessive rainfall. Periodical low water availability in recent years has sometimes resulted in substantial losses in coffee production and excess water has led to substantial soil erosion. For this reason, there is a need to mitigate the effects of these changing climatic conditions by a better management of water.

Against this background, the Intelligent Water Management (IWM) project in Colombia intends to contribute to improved water management among coffee farmers by information and sensitization campaigns, training, hardware investments, and an improved institutional environment. The intervention has formulated a very ambitious objective, which is "to establish basic environmental, social and productive conditions to reduce poverty and increase peaceful coexistence, sustainable development and self-reliance of the rural population in Colombia by means of implementing an Intelligent Water Management System" (Appendix I to application proposal, IWM Project Plan, page 2). The project covers 25 intervention municipalities that are evenly distributed across five of Colombia's nineteen coffee-growing departments. An ambition of the project is to become a benchmark for other departments of Colombia as well as other countries in the world. The objective of the IWM project is in line with the aim of the 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."[1]

IWM Colombia is implemented by the Colombian Coffee Growers Federation (Federación Nacional de Cafeteros, or FNC), in partnership with the Colombian government, the private companies Nestlé S.A. and Nestlé Nespresso S.A, as well as the research institutions Cenicafé and Wageningen University. According to the project plan, a Public-Private Partnership (PPP) was to be established for the implementation of the project, with FNC as the lead partner.

The IWM Project Plan includes a budget of €20.5 million. This is also the amount specified in the Subsidy Award Letter and concerns the eligible cost on which the planned RVO subsidy of €9.5 million is based. The project budget was topped up by an expected €4 million from complementary projects. With an overall budget of €24.5 million and an RVO grant of €9.5 million, IWM Colombia is by far the largest of the 2012 projects financed by the Sustainable Water Fund (FDW) – representing a quarter of the budget of all the 13 first FDW call projects taken together and over a fifth of the corresponding RVO grants.[2] It is the only intervention covering both the themes Efficient Water Use, and River Basin Management and Safe Deltas. IWM targets eleven thousands of the 563 thousand coffee growers in Colombia. It is designed as a pilot to be replicated in other parts of the Colombian coffee zone. The intervention aspires to be even replicable in other sectors in Colombia and the rest of the world.

In this report, we present results from the in-depth evaluation of the IWM project, which forms part of the evaluation of the overall FDW programme that looks at first-call projects co-financed by the FDW programme. The evaluation of the IWM project encompasses two components: (*i*) a quantitative and large farm-level survey-based impact evaluation and (*ii*) a qualitatively oriented stakeholder analysis which focuses on Public-Private Partnership (PPP)/institutional aspects. For the quantitative part of the impact evaluation, we conducted a survey among almost 700 treatment farms located in the 25 IWM intervention river basins. In addition, we visited 700 farms in 25 control river basins. A second survey was conducted approximately two years after the baseline. The main identification strategy to evaluate the intervention's impacts is a difference-in-differences approach. The purpose of this report is to analyse and discuss the impact of the IWM project on different outcomes on the farm-level. Furthermore, the report assesses the institutional aspects of the IWM project designed as a project with a PPP set-up.

The remainder of this report is organized as follows. Section 2 briefly describes the IWM intervention and its input, activities, and output. Section 3 introduces our methodology. Section 4 presents the results of the stakeholder analysis. Sections 5 and 6 present the results of the analysis of quantitative farm-level surveys. Section 7 provides a conclusion.

[1] Term of Reference 'Impact Evaluations for the Sustainable Water Fund (FDW)', p. 3.

[2] IWM only had to report to RVO on the activities funded by the budget of €20.5 million. In the Terms of Reference of the evaluation, the amount of €4 million related to additional resources that IWM expected to obtain in Colombia was added to the €20.5 million to give a complete picture of the project. IWM did not have to report to RVO on the use of these expected additional resources.

2. The Intervention

2.1. Original Project Planning

2.1.1. Project Components

The activities of IWM Colombia encompassed six different components (also called Results). Component 1 was implemented in Year 1 of the project and related to the preparation and planning of the next phases. Component 6 concerned Project Management and the cross-cutting issues of Good Governance, Risk Management, Gender and Social Responsibility. It related to activities such as elaboration of a Gender Strategy, Risk Management and Technical Assistance & Rural Extension Plans.

All components are presented in Table 1. Component 2 included among others the establishment of a Water & Coffee Platform in which at least 50 institutions would participate, apart from the PPP partners.[3] While Component 2 focused on establishing a conducive institutional framework, activities of Component 3 targeted the individual coffee farmer. Component 4 included both river basin-level and farm-level activities. Activities of Component 5 were concentrated on the river basin level and were supposed to inform decision makers on the institutional level. Budget-wise, Component 3 was the most important part of the intervention: in total, nearly €10 million were foreseen for this component. In addition, the foreseen investment in Component 4 was €2.8 million. Accordingly, the focus of the quantitative analysis is on the effects of Component 3 and 4 activities on coffee farmers. The institutional analysis focuses on effects and dynamics induced through Components 1, 2, 5 and 6, as well as the institutional (PPP-related) background of all project components.

The activities of Components 3 to 5 were implemented in 25 municipalities in five departments. The departments are Antioquia, Caldas, Cauca, Nariño, and Valle de Cauca (see Figure 1). The 25 intervention municipalities are evenly distributed across the five departments, so each department has five intervention municipalities. Within each of the 25 municipalities, one river basin was selected for the intervention. A river basin is defined by an area around a main river and all its tributaries. The treatment population comprises all coffee farmers in a basin who use and discharge water from/to the main river or its tributaries.

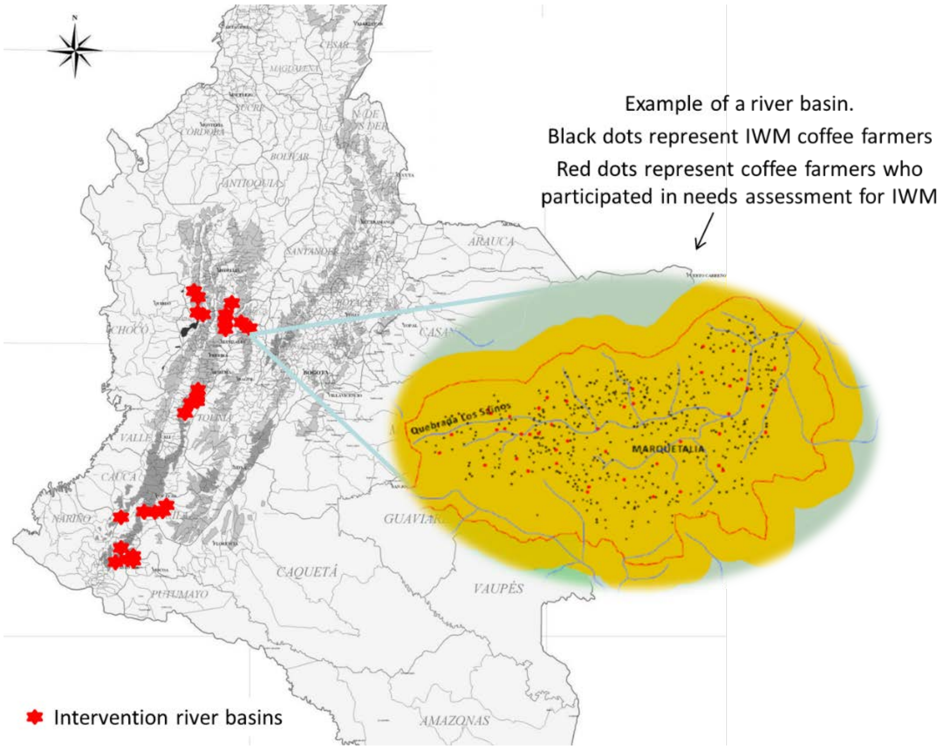
[3] The PPP partners were the first members (Annual Progress Report Results 2 to 5 – Year 2, p. 2).

Table 1: IWM Colombia Project Components

	Component	Activities related to:	Intervention targets	Planned investment[a] € million *(% of total 1-6)*
1)		• Project preparation and planning		*pro memoria*
2)	"Water is everybody's business"	• Water & Coffee Platform • Community Participation • Learning Network • Communications Strategy • Complementary Projects	Institutional framework	2.3 *(11.2)*
3)	"Water for Sustainable Coffee Farming"	• Diagnosis and Baseline • Economic Analysis at Farm Level • Transfer and Sustainability • Multilevel Training • Technical Assistance & Rural Extension • Ecological Wet Milling and Water Saving • Waste Water Treatment • Water Fund	Domestic and productive activities of coffee farmers	10.8 *(52.7)*
4)	"Strategic Water Ecosystems"	• Reforestation with Native Species • Renovation of Coffee Crops with Rust-Resistant Varieties • Bioengineering • Environmental Services	River basin management (on river basin level); activities of individual farmers (on farm level)	2.8 *(13.7)*
5)	"Responsible Water Decision Making"	• Climate Monitoring • Water Quality Monitoring in River Basins • Coffee Water Footprint Assessment	River basin management; knowledge within sector	4.0 *(19.5)*
6)		• Project management • Cross-cutting issues		*pro memoria*
	TOTAL 2-5			19.9 *(97.1)*
	TOTAL 1 + 6			0.6 (2.9)
	OVERALL TOTAL			20.5 (100.00)

[a] The amounts for Components 2-5 include budget for coordination activities. The exact investment sums for Component 1 and 6 are not specified in the project documentation. The two components together sum up to €0.6 mio EUR.
Source: Project Plan.

Figure 1: IWM Colombia Intervention areas



Source: Own illustration based on Cenicafé (1997) *Encuesta nacional cafetera* and IWM (2014) River Basin Management Plan Caldas.

2.1.2. Activities

Components 2 to 5 comprise activities on the river basin level and on the level of the coffee farmers. Component 3 intervenes on the **coffee-farmer level** and contains three activities (Table 2).

As the **first activity** of Component 3, IWM Colombia assessed the needs among the target population, informed about the intervention, and worked on a first sensitization of the population regarding water-relevant topics. This activity targeted 11,000 farms corresponding to around half of all coffee farms in the river basin. As part of Activity 1, the needs assessment was conducted among a representative sample of 1,100 farmers in all 25 treatment river basins. For this purpose, IWM Colombia implemented a detailed farmer survey on water and coffee-growing behaviour in Year 1. The activities were implemented through the existing FNC network on the ground. FNC is organised at the municipality level through a municipal committee and counts on a well-established network of so-called extension workers. These extension workers are in regular contact with the municipality's coffee farmers and provide technical assistance to the coffee farms through regular field visits. For IWM activities, extension workers received additional training and got support from additional technicians who were trained exclusively for the IWM activities. The contact between the farmers and the IWM extension workers was clearly more intense than normal FNC extension activities.

The **second activity** comprised training programmes for around 70 percent of the farmers targeted through Activity 1 (and hence around 31 percent of all coffee farmers in the targeted river basins). IWM Colombia developed several training modules that were applied according to the needs of the farmers. Table 3 shows the planned number of beneficiaries. Some trainings were designed to reach all 8,000 Activity 2 farmers, while other training modules were targeted at a small subsample of Activity 2 farmers. The modules with the largest number of participants were those on "Good agricultural practices" and "Integrated water management".

Table 2: Component 3: Activities on coffee farmer level

Activity		Planned number of farms directly treated (of coffee farmers in river basin)	Timeline
1	Assessment, information, awareness	11,000 (43%)	Implemented first half of 2015
2	Training through the IWM Learning Programme	8,000 *(31%)*	Started at end of 2015, completed by mid-2018
3	Access to technical assistance and financing for implementation of water solutions	1,650 *(6%)*	First round started at beginning of 2016, continued until Mid-2018

Source: Project documentation.

Table 3: Component 3, Activity 2: training modules

Training module	Who participates (% of farms directly treated)?
Business management	10%
Good agricultural practices	80% (all Activity 2 farms)
Generational renewal, gender, and law	10%
Integrated water management	80% (all Activity 2 farms)
Coffee processing and wastewater treatment	15%
Forest and soil management	10%
Associative practices	10%
Entrepreneurship	20%

Source: Project documentation.

The decision on who receives which training (package) was taken by the extension workers on the ground a few weeks before starting the training activities and based on the extension workers' assessment of the farms' needs. The first training activities on business management and integrated water management started in late 2015. Many of the trainings accompanied the farmers continuously over the years of the IWM intervention.

The **third activity** of Component 3 was technical assistance and financing for water-efficient and environmentally-compatible equipment. Beneficiary farmers' participation in training was a precondition for receiving support. Financing for equipment adoption was given as a grant and the equipment was distributed for free. Farmers had to make only a relatively small in-kind contribution to the investment – either by providing work or by contributing local construction materials. Coffee farmers targeted by this activity were supposed to be the most polluting farmers (which was determined based on the extension worker's assessment) and those located at key positions within the river basin. Farmers at key positions were those farmers who disposed of their wastewater directly into the river. They had to be located within a 200m radius from the main river to be eligible for the intervention. Most of them were located within a 100m radius.

The distributed equipment addressed both the domestic and the productive activities of the coffee farms. In the domestic area, flow restrictors for reducing water consumption, water filters to purify drinking water, and septic tanks and grease traps to reduce water contamination were distributed. In the productive area, the IWM Colombia intervention distributed a variety of water and contamination-reducing equipment. More details on this equipment can be found in Annex 1.

The distributed equipment and promoted techniques were not specifically designed for the IWM Colombia intervention. Rather, FNC and Cenicafé had already been working on the dissemination of the equipment and knowledge for several years. Accordingly, some farms used these water conservation devices already before the IWM project kick-off and they were also promoted outside the treatment river basins through the normal FNC extension service. There was also promotion through other projects, such as *Huellas de Paz*, a predecessor of IWM. The IWM Colombia intervention can be seen as an intensification of these ongoing interventions. In comparison to previous activities, IWM promotes a more comprehensive approach of accompanying technical assistance with information and training campaigns, as well as targeting the institutional framework. It takes a community and landscape perspective ("the river basin") as opposed to previous interventions that consider exclusively the individual farmer perspective.

As part of Component 4 "Water Strategic Ecosystems", IWM intervened at the farm level and encouraged farmers to plant trees and renovate the coffee plantations. Farms either received only trees for reforestation – called reforestation with promotion – or they received trees and additionally a monetary incentive to plant and conserve trees – called reforestation with incentive. The value of the incentive depends on the number and type of trees planted (see Table 4). For reforestation with incentive, the project planned to select farms that covered together at least 90 hectare of reforested area. These farms had to sign individual contracts with IWM Colombia in which the exact number of trees or area to be reforested is specified.

Table 4: Component 4: Monetary Incentive for reforestation

Reforestation Model	Total Incentive in COP	In €
Conservation of natural forests - without fence	150,000	42.90
Conservation of natural forests - with fence	500,000	143.00
Mini corridors - with fence (only protection)	2,150,000	614.90
Living fences / boundaries	915,750	261.90
Forestry plantations with native trees (commercial possibility) - reforestation in pasturelands	915,750	261.90
Guadua plantations - enrichment of water resources	360,000	102.96

Note: Exchange rate 01.09.2015: 1,000 COP = 0.286 EUR. *Source:* Project Documentation.

Complementary activities took place on the **river basin level** and as part of Component 5. It had been foreseen to support the *Corporaciones Autónomas Regionales (CARs)* systematically in formulating River Basin Management and Organization Plans (POMCAS), which detail all activities that were to be implemented within the river basin. Other activities included training on gender, the establishment of farmer associations to manage water resources in the river basins, a learning platform, a communication plan, as well as the installation of water and weather monitoring stations, and ecological restoration and bioengineering plans for each river basin.

2.1.3. Theory of Change

The objective of this evaluation is to examine the effectiveness of the IWM Colombia intervention by assessing the positive and negative, intended and unintended effects of IWM activities. The intervention tackles not only water and soil-related activities, but tries to enhance sustainability of the coffee production also in an economic and social sense. IWM addresses aspects like business management, quality of processed coffee, gender, and generational renewal. In order to understand impact expectations and assess impact potentials, the evaluation team dedicated substantial effort during the baseline mission to discuss these topics with the intervention's staff. Together with the intervention's director and responsible IWM staff for each impact area, key impact areas of the intervention were identified. It was decided to focus the evaluation mainly on water and soil-related activities, because these were the intervention's core activities where changes were likely to materialize and to be measurable within the time horizon of this evaluation. FNC and Cenicafé furthermore emphasized that "gender" and "strengthening farmer associations/partnerships" were cross-cutting subjects of all their activities that should be covered by the evaluation. According to the discussions with the project staff and in contrast to what had been specified during the inception phase, sizable effects on coffee quality and quantity are not likely. Therefore, we exclude this impact dimension from the evaluation.

The following Theory of Change (ToC) illustrates possible pathways on how the intervention and its activities might lead to outcomes and impact. It is based on project documentation and intensive discussions with IWM staff in Colombia. As a first requisite for any outcome and impact to materialize, IWM has to effectively use the human, technical, and financial resources to implement the different parts of the intervention. In a first step, the PPP has to be established. We furthermore identified four main output categories: (i) farmers have to receive training and equipment; (ii) water and climate monitoring stations have to be installed, (iii) ecological restoration and bioengineering plans are elaborated, (iv) output on the institutional level are produced.

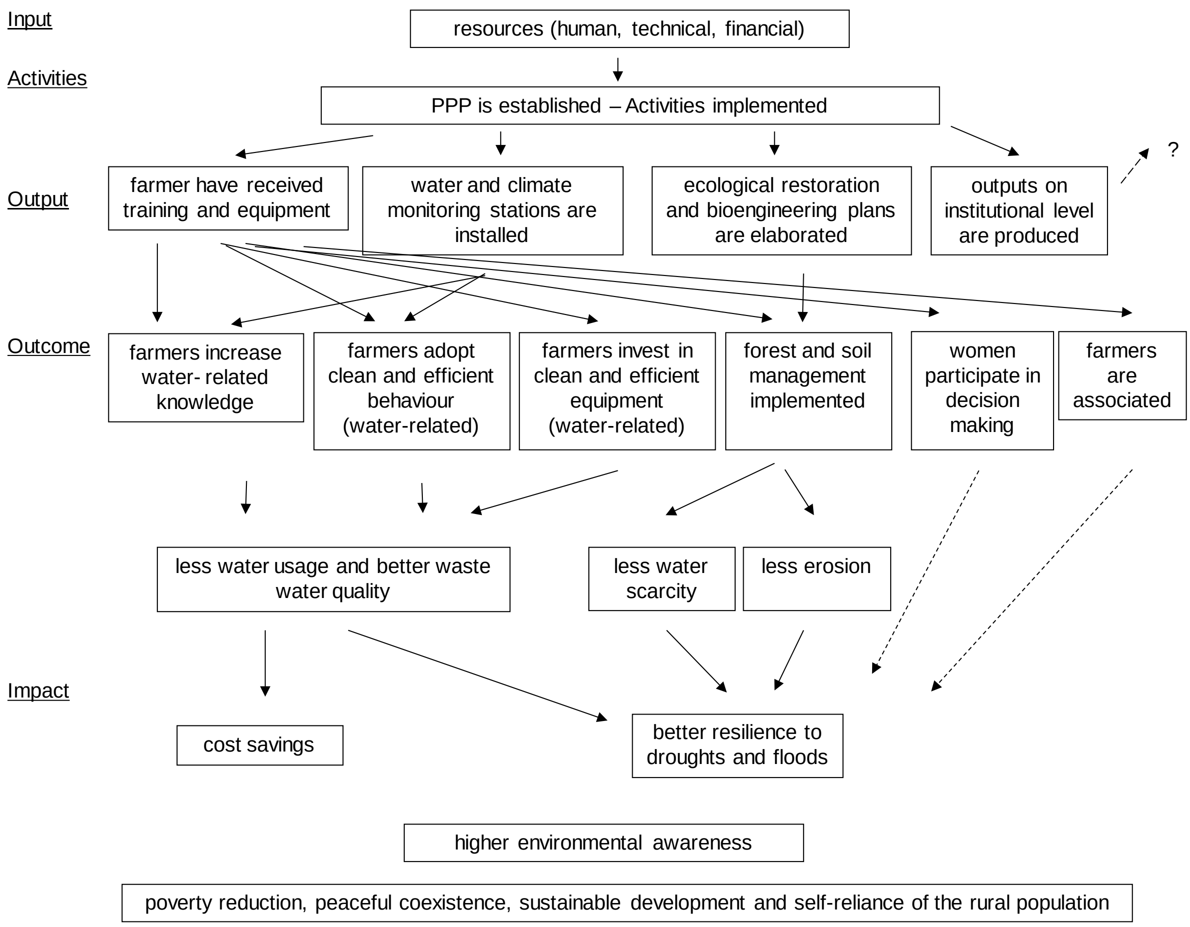
These outputs lead to outcomes on the three levels of implementation: (A) on the level of the coffee farmer, (B) on the river basin level, (C) on the institutional level.

(A) For activities on the **farmer level**, the following outcomes will be observable: Farmers will eventually i) increase their water-related knowledge, ii) adopt cleaner and more efficient water-usage behaviour, iii) invest in clean and efficient equipment related to water usage and water contamination, and iv) start to plant trees and redesign their farms in a way that increases their resilience to droughts and floods. The latter point is what we refer to as "forest and soil management" in the ToC. The trainings and interactions between extension workers and farmers are moreover expected to increase women's participation in decision making and bring farmers together in associations to discuss water-related behaviour and avoid conflicts.

(B) On the **river basin level**, IWM Colombia planned to support the formulation and implementation of River Basin Management and Organization Plans, to install water and weather monitoring stations, and to elaborate ecological restoration and bioengineering plans. As part of the latter, two pilot lots per river basin were established on which activities to improve soil resilience against excessive rainfall and to decrease the concentration of sediment in water sources were implemented. One objective of these activities on the river basin level was to generate knowledge and make it accessible. The second objective was to elaborate concrete management plans. On the farmer level, the installation of water and weather monitoring stations was to provide the farmers with information that can enhance planning of coffee cultivation. Some farms would furthermore be targeted by bioengineering activities.

(C) Most impacts on the **institutional level** will be assessed in the stakeholder analysis in Section 4. On the farmer level, the creation of local associations (*Manos al Agua* groups) might directly influence outcomes. Moreover, inclusion of different stakeholders in the Water & Coffee Platform might result in additional activities on the farmer level. For example, the Ministry of Culture, that is a member of the Water & Coffee Platform, organized farmer trainings concerning communication.

Figure 2: Theory of Change – effects on farm level



Source: Own illustration.

The intervention's outcomes influence the coffee farmers in three areas: they affect domestic activities of coffee farmers and their families, their farming activities, and the general quality of the watershed and the forest where the farm is located. For farmers receiving the Activity 3 treatment (beneficiary "equipment"), impacts on the domestic and the farming level area are less water usage and better wastewater quality. This enhances resilience of the farmers to water scarcity and might furthermore result in costs savings for directly treated farmers, since (*i*) expenditures for water will be reduced (if applicable – many farmers do not pay for water) or (*ii*) farmers avoid fines for water contamination (if these are really implemented). Both effects can be expected to be rather subtle. Moreover, these impacts might affect water availability and quality of farmers located downstream. This effect however will be negligible, as farms participating in the intervention are normally located close to the main river and no immediate downstream farmers exist whose water sources are contaminated by other farmers' activities. The water of the main river is only in some cases used by coffee farmers for domestic uses within the river basin. Water extraction downstream the river basins differs largely across the river basins and will not be assessed quantitatively in this evaluation. IWM measured water quality of the main river before and after the intervention as part of their monitoring activities. We will relate our farm-level evaluation results to these measurements.

Farms that participate in bioengineering and reforestation activities might increase their resilience to extreme weather events like droughts and floods. Since planting trees will not produce results on water availability and erosion within the timeframe of this evaluation, the focus here is on monitoring outcomes, i.e. the planting of trees and the effect of providing monetary incentives to plant trees. Ultimately, all activities are meant to reach the cross-cutting objective to improve farmers' environmental awareness.

It is important to mention that the intervention produces only few tangible impacts that materialize on the individual's farmer level in the shorter run. Therefore, we measure effects above all on the output and outcome level and make an effort to understand whether farmers adopt water and soil conservation behaviour. Moreover, we analyse whether adopted equipment is correctly used and maintained in order to examine whether adoption will lead to a long-term change in behaviour.

A particularity of the intervention is that its components and activities are not completely new. Individual components are also implemented outside the framework of the IWM project. The project promotes a comprehensive approach of accompanying technical assistance with information and training campaigns, as well as targeting the institutional framework. It takes a community and landscape perspective ("the river basin") as opposed to interventions that consider exclusively the individual farmer perspective. This is why it is of high importance to identify a credible counterfactual that illustrate what would have happened in absence of the intervention and compare results of the IWM project against this counterfactual (see Section 3.2 Identification Strategy).

2.2. Actual Inputs and PPP Establishment

According to the project plan, the following six partners had the intention to establish a Public-Private Partnership (PPP) for the implementation of the IWM project:

- *Federación Nacional de Cafeteros de Colombia* (FNC), the National Federation of Colombian coffee growers;
- Nestlé S.A;
- Nestlé Nespresso S.A (henceforth referred to as Nespresso);
- The Ministry of Agriculture and Rural Development (MADR);
- Wageningen University & Research (WUR); and
- *Cenicafé*, the National Centre for Coffee Research in Colombia

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. MADR was committed to be a partner of the PPP. However, by the end of Year 2, MADR had still not signed. Nonetheless, RVO took it for granted that the government of Colombia would participate, because it was a precondition for the FDW grant and the Dutch development cooperation is strict in this sense.

MADR was virtually a 'silent partner' in the PPP and was replaced in 2016 by the *Agencia Presidencial de Cooperación* (APC) – the Presidential agency that coordinates the international cooperation with Colombia – as the representative of the Colombian government in the PPP. At that moment, the PPP was consolidated from the point of view of membership.

As mentioned earlier, the project partners planned to invest €20.5 million. This was to be financed from both cash contributions (including the FDW grant) and in-kind contributions. The planned cash contributions were approximately €17 million or 83% of the total.

The planned investment of €20.5 million was not fully realized. The final value of the project's investments until 31 August 2018 was €15.8 million, comprising cash expenditure of the PPP partners and RVO of €12.4 million and in-kind contributions of €3.4 million (Table 5). Accordingly, the actual cash expenditure clearly fell short of the planned €17 million. The reason for this is that APC-MADR's financial contribution amounted to only a quarter of its committed resources. Because the FDW grant was conditional on the contributions of the PPP partners, it was lowered from €9.5 to €7.7 million.[4]

The operating expenses were lower than the realized cash contributions of €13.5 million, resulting in a remaining (unspent) balance of €1.1 million on 31 August 2018.[5]

Table 5: IWM Colombia Project Components

	Component	**Planned investment**[a] € million (*% of total 2-5*)	**Cash expenditure**[b] € million (*% of total 2-5*)	**Realized investment corresponding to in-kind contributions**[c] € million	**Resources invested**[d] (Incl. activities of complementary projects) € million (*% of total 2-5*)
2)	"Water is everybody's business"	2.3 (*11.6*)	0.9 (9.5)		2.2 (*13.8*)
3)	"Water for Sustainable Coffee Farming"	10.8 (*54.3*)	5.6 (59.0)		9.8 (*61.3*)
4)	"Strategic Water Ecosystems"	2.8 (*11.4*)	1.5 (15.8)		2.1 (8.6)
5)	"Responsible Water Decision Making"	4.0 (*19.5*)	1.3 (13.7)		1.9 (*9.3*)
	TOTAL 2-5	19.9 (*100.0*)	9.5 (*100.0*)		16.0 (*100.0*)
1&6)	Other	0.6	3.1		4.3
	TOTAL 1-6	20.5	12.4	3.4	20.3

Sources: Project Plan, Year 5 Report until February 2018 and Final Report of August 2018.
a) The amounts for Components 2-5 include budget for coordination activities; b) The amounts relate to operating expenses corresponding to the cash-contributions of the PPP partners and the FDW grant only; c) Breakdown by project component is not available; d) The amounts are including resources from complementary projects.

As mentioned earlier, the project budget was topped up by an expected €4 million from complementary projects. The final column of Table 5 shows that including investments realized in complementary projects, €4.3 million were invested in Components 1 and 6 and €16 million for activities of Components 2-5. The total resources invested were substantially less than €24.5 million.

[4] IWM Final report, 31 August 2018, Annex 3i, p. 7.
[5] Ibid.

2.3. Actual Output

IWM Colombia was very effective in implementing the foreseen activities. For all components, IWM Colombia reached its objectives and partly outperformed them. 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. IWM outperformed its goal to integrate at least 50 organisations. By February 2018, in total, 58 local, regional or national organisations had joined the platform.[6] This number did not increase further until the end of the project in mid-2018. In Year 2, methodologies were introduced that are contributing to improve water management in the coffee sector. Examples of this are the application of a river basin-based planning approach, participatory knowledge management and an ICT application developed for extension work at the farm level.[7]

For Component 3, over 3,500 coffee farmers received direct technical assistance and financing for implementation of water solutions.[8] This is more than twice the number that was planned initially and the additional number might be attributed to the additional resources available as a result of a favourable exchange rate change and complementary projects (see Section 2.2). Activities concerning awareness raising and training also reached at least the foreseen number of beneficiary farms (see Table 6).

Table 6: Component 3: Activities on coffee farmer level

Activity		Planned number of farms directly treated (of coffee farmers in river basin)	Realised number of farms directly treated (of coffee farmers in river basin)
1	Assessment, information, awareness	11,000 (43%)	11,600[9] *(45%)*
2	Training through the IWM Learning Programme	8,000 *(31%)*	8,600[10] *(33%)*
3	Access to technical assistance and financing for implementation of water solutions	1,650 *(6%)*	Over 3,500[11] *(at least 13%)*

Source: Project documentation.

In addition, the reforested area targeted by Component 4 exceeded the official goal of reforesting 90 hectares with incentive. In the end, an area of 161.9 hectares was reforested with incentive and 275.2 hectares were reforested with promotion on, in total, 1449 farms.[12] IWM installed meteorological

[6] IWM 2018, Year 5 Results to February 2018. The Water Coffee Platform is also called the *Manos al Agua Platform*.
[7] See Annual Progress Report Results 2 to 5 – Year 2.
[8] IWM Final report, 31 August 2018, Annex 31, p. 7.
[9] Year 5 Report until February 2018. According to page 38 of that report, 1220 coffee farmers received training in Business Management. This number was 10.5 percent of the total number of 11,600 coffee farmers that were targeted by the project.
[10] According to the IWM Final report, 31 August 2018, Annex 3i, page 7, there were 8,600 participants who received a FMM training certificate, while 520 participants received a SENA certificate. It is not clear whether there is overlap between the two categories.
[11] IWM Final report, 31 August 2018, Annex 3i, p. 7.
[12] Year 5 Report until February 2018, pp. 43-44.

stations in each department. Regarding Component 5, a systematic collaboration with the *Corporaciones Autónomas Regionales (CARs) to* formulate River Basin Management and Organization Plans (POMCAS) has not been reached. Only in some river basins, IWM was actively involved in the formulation of POMCAS.

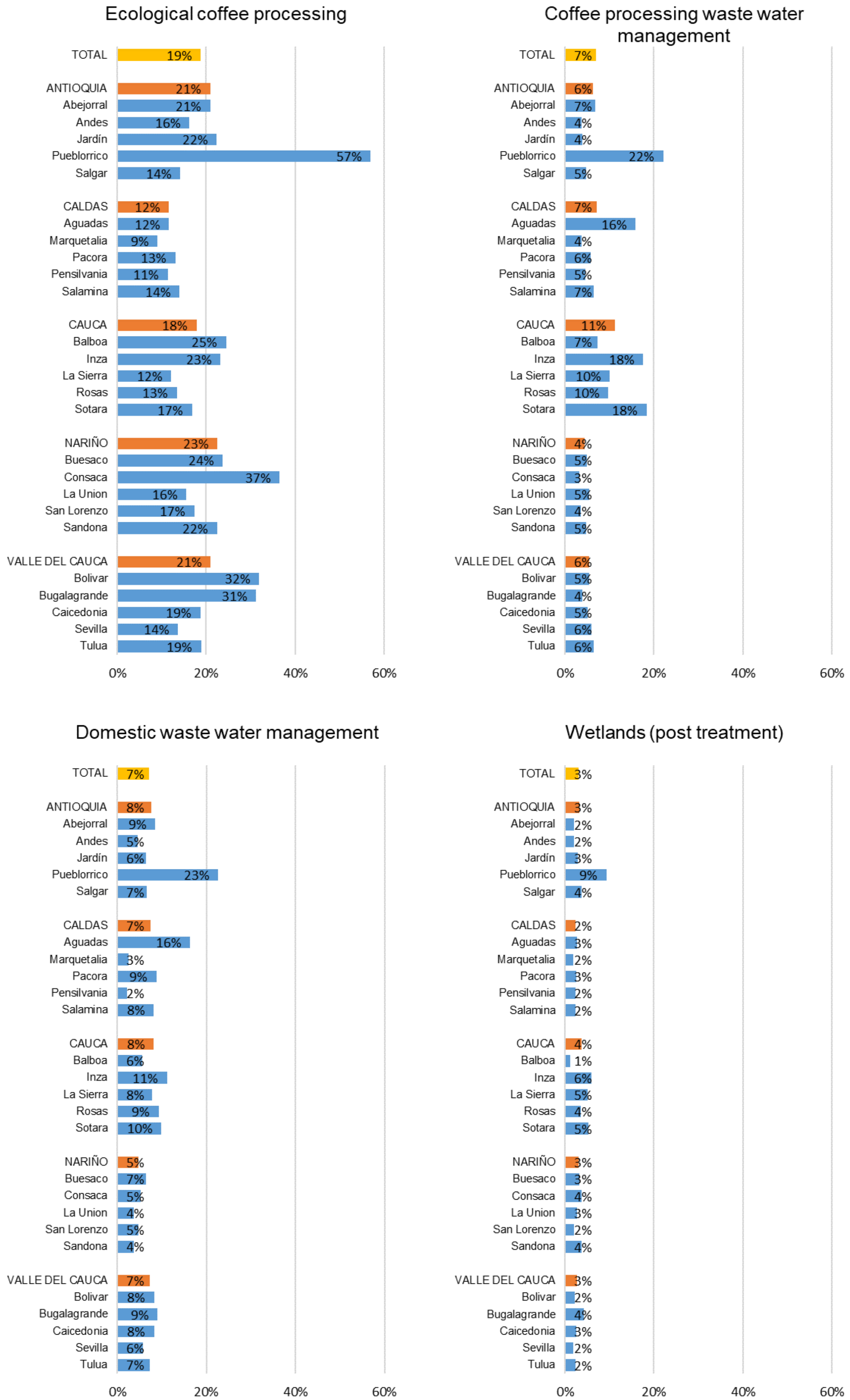
In the following, we analyse IWMs output delivery for Component 3 – Activity 3 equipment and Component 4 activities in more detail. In terms of monetary input, these are the most important IWM activities. We rely on data obtained from IWM and analyse the distribution over departments and river basins. Combining information on the number and type of IWM interventions by river basin with the information on the number of IWM coffee farmers per river basin gives an indication of the 'incidence' of the various IWM interventions.

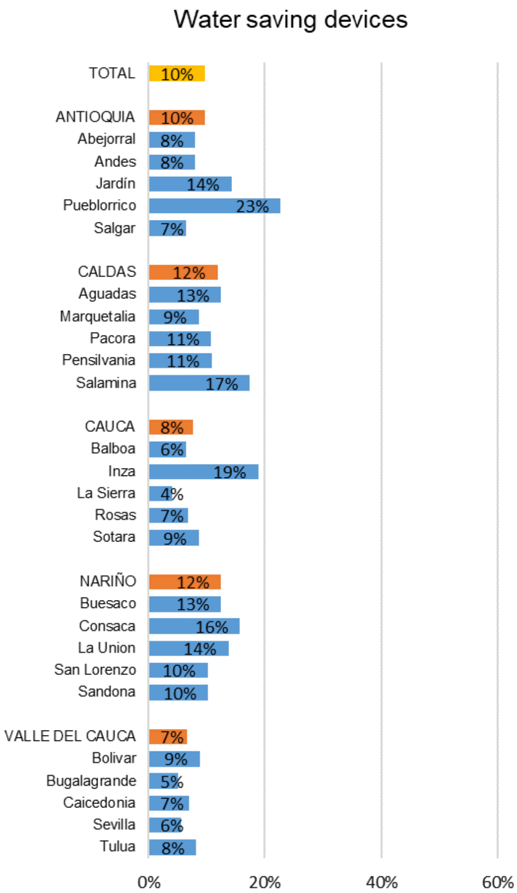
The results in Figure 3 below indicate that the types and frequency of the IWM interventions varies largely across the different river basins. Overall, "ecological coffee processing" and "renovation of coffee plantations" where the most common IWM interventions. Furthermore, the following patterns emerge:

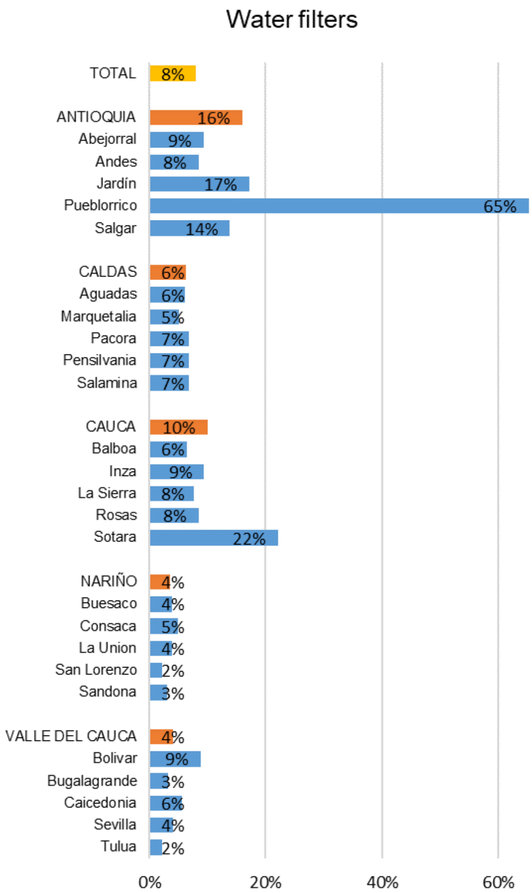
- One river basin (Pueblorrico in Antioquia) stands out in terms of the high proportion of coffee farmers with **different IWM interventions**;
- the percentage of coffee farmers involved in **reforestation** was particularly high in Andes, Jardín and Sotará;
- the incidence of **renovation of coffee trees** was highest in Valle del Cauca, and particularly in Bugalagrande and Caicedonia;[13]
- like Pueblorrico, Consacá (in Nariño), Bolívar and Bugalagrande (in Valle del Cauca) had a high incidence of investments in **ecological coffee processing**; in contrast, relatively few farms in Caldas received support from IWM to invest in ecological coffee processing;
- the proportion of IWM coffee farmers that received support for installing **coffee processing wastewater treatment systems** was highest in Aguadas, Inzá and Sotará (and of course in Pueblorrico);
- similarly, the proportion of IWM coffee farmers that received support for installing **domestic wastewater treatment systems** was highest in Pueblorrico and Aguadas;
- in general, IWM support for the construction of **artificial wetlands** was limited, but the incidence of this intervention was above-average in Cauca;
- Pueblorrico, Salamina, Inzá and Consacá had the highest proportions of IWM coffee farmers who installed **water-saving filters**;
- like Pueblorrico, Sotará in Cauca had an above-average share of coffee farmers that received **tap water filters**; in contrast, IWM provided relatively few tap water filters in Nariño and Valle del Cauca.

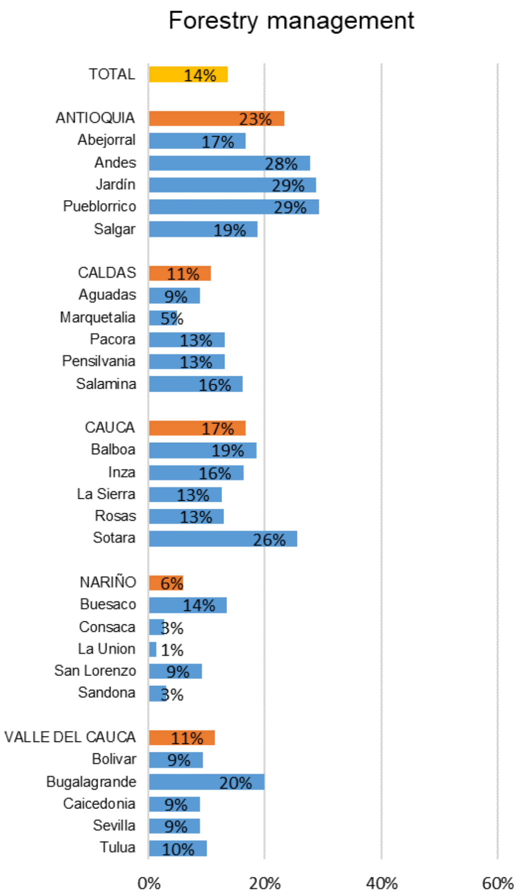
[13] An interviewed stakeholder explained that the municipal government of Bugalagrande supported the implementation of IWM and that the municipal government of Caicedonia helped with the coffee tree renovation.

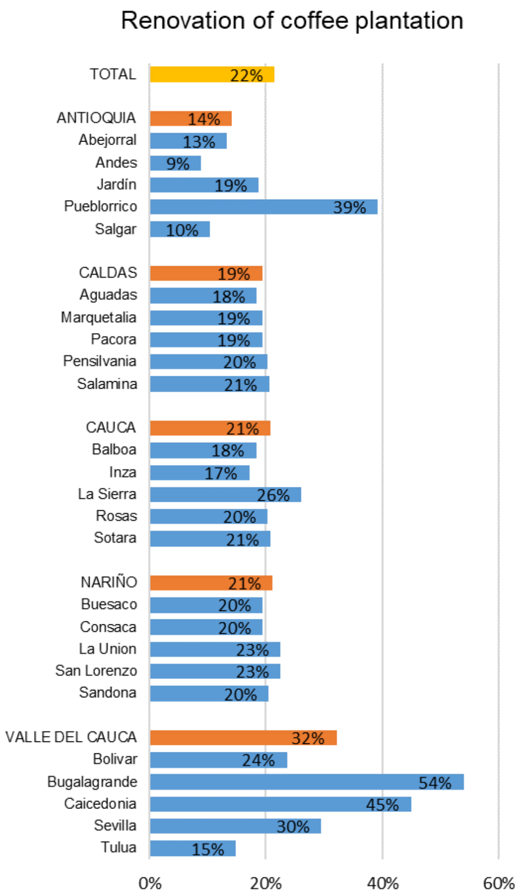
Figure 3: Share of IWM farms with at least one intervention, by department and river basin











Source: Own calculations based on data provided by FNC.

In general, the 'incidence' of interventions may vary because IWM was formulated with a flexible approach, in the sense that each Committee, i.e. each department, had the freedom to select the interventions according to its regional conditions and to the producers' preferences and technical teams' knowledge, though perhaps also according to needs. Of course, many discussions took place before getting approval. Hence, the differences in the results by number or type of interventions per river basin could be reflecting cultural or regional factors.

For instance, the reason that SMTAs were not very popular in Cauca or Nariño caused a delay in the implementation of these devices there, while in Caldas these systems were already accepted and had also been implemented by other projects prior to the IWM intervention.

In particular, the higher 'incidence' of renovation of coffee trees in Valle del Cauca can be partly explained by the presence of Nescafé Plan. In one of the interviews, it was explained that "In Valle del Cauca, there is close collaboration with Nescafé Plan – the alliance between Nestlé and FNC. Nescafé Plan is taken as the IWM crop renovation plan." But crop renovation is also a national FNC policy, so this practice is usually focused on places where the coffee trees are relatively old. In this regard, renovation of coffee trees could be higher where there is more need for such renovation. The Year 5 results to February 2018 effectively show that both the average age of coffee crops of 7.75 years in Year 1 and the decline until 6.5 years in Year 5 were indeed highest in Valle del Cauca.[14]

[14] Year 5 results to February 2018, p. 47.

3. Evaluation Methodology

3.1. Identification Strategy

The key challenge of designing a proper impact evaluation is the identification of the counterfactual situation, i.e. the question what would have happened to the treated units if the intervention had not been implemented. In the present case, the question is how treatment coffee farmers would have developed if the IWM intervention had not been present. The difference between this hypothetical development and the actual development of the farmer after the intervention could then be interpreted as the effect of the intervention. Since the hypothetical situation is obviously not observable, it has to be approximated by means of a control group. The control group serves as a reference situation and its performance over time can be compared to the performance of the effectively treated coffee farmers in order to draw conclusions about effects of the IWM intervention. The more similar the control group is to the treatment group before the intervention, the more accurate is the effect measurement.

In the IWM context, the control group is of particular importance since IWM activities are not exclusively implemented by IWM. Other actors or individual partners of the PPP had already implemented parts of the IWM activities in the past and also implemented some of the IWM activities in river basins other than the treatment river basins between 2015 and 2018. The novelty of IWM is to provide the individual 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, this evaluation has to assess the effect of this novel comprehensive approach against the counterfactual situation of isolated activities.

Methodologically, the best way to identify a proper control group would be to randomly assign the IWM treatment to river basins and subsequently to coffee farmers within the river basin. We contemplated this possibility during the inception mission, but since the selection of river basins had already been completed, it turned out not to be feasible. Also, a controlled random phasing-in of the intervention within the 25 selected river basins was not possible, because all river basins were going to be treated in parallel within the first year.

The second-best option is to mimic a randomized treatment assignment in a *non-randomized difference-in-differences approach*, which was pursued for this impact evaluation. 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, which would basically be the outcome that a successful randomization would yield. Hence, we identified control river basins that resembled the IWM river basins as much as possible. For each of the 25 IWM river basins, we chose a control river basin within the same municipality in order to make sure that treatment and control river basins were subject to the same socio-economic and weather conditions. In order to identify the control river basins, we asked the FNC to propose river basins that exhibit the same characteristics as IWM river basins. More specifically, river basins should be comparable with respect to:

- the surface area the river basin covers,
- the total number of farms within the river basin,
- the number of farms within the 100-meter-radius around the river,
- the size of the river (i.e. volume, length and width),

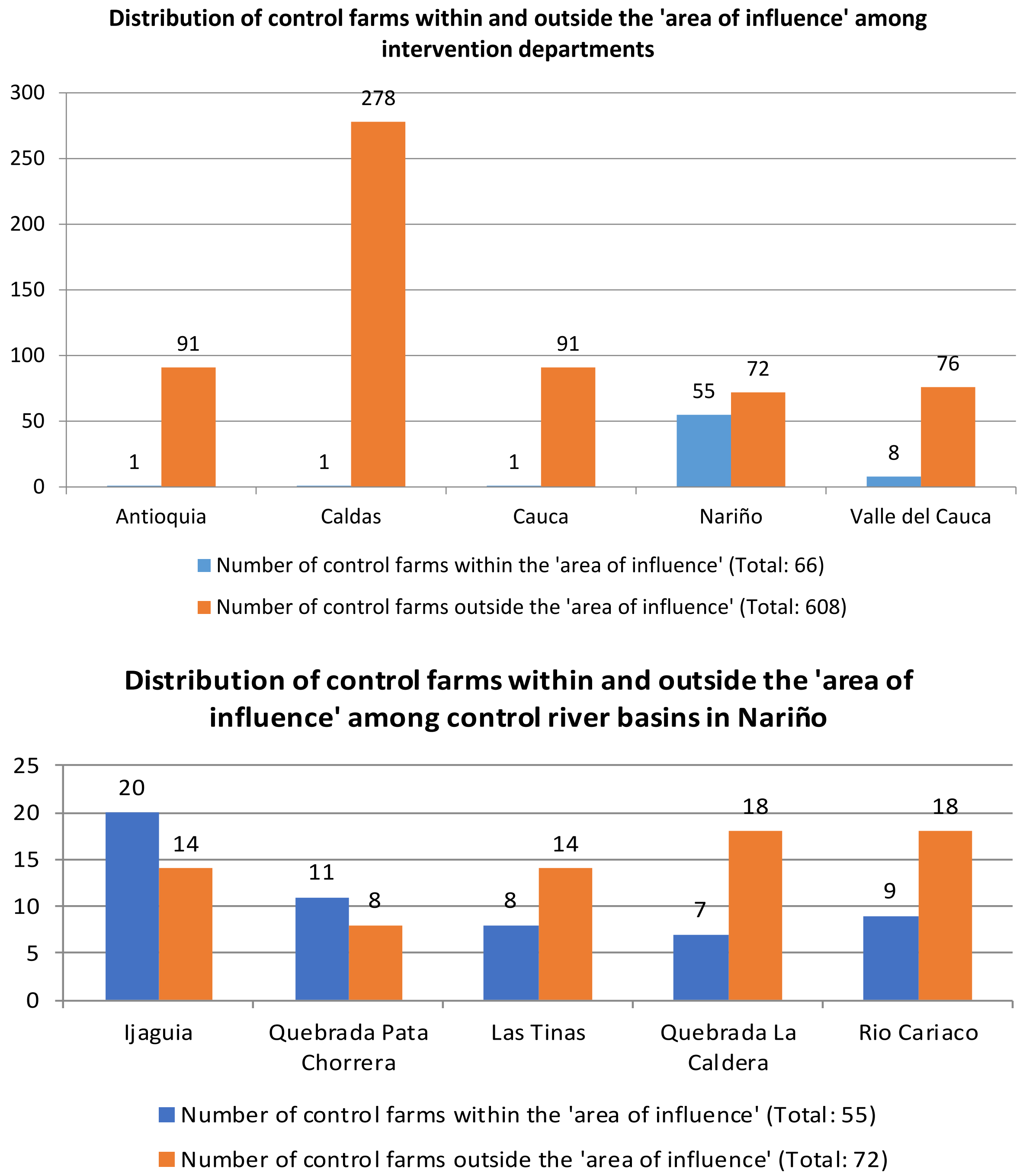
- incidences of water shortage, erosion, and other factors that potentially affect water contamination (e.g. mines),
- the existence of other on-going projects/programmes that potentially pursue similar impact goals as the IWM intervention (e.g. conservation of water),
- the presence of either Nespresso AAA or Nescafé Plan

While some of the information could be retrieved from a database (called SICA) on all coffee farmers in Colombia that is available at FNC, other more specific or more qualitative assessments were obtained from the extension workers through an Excel sheet that they filled out. Moreover, it is important to emphasize that one criterion for selecting IWM treatment river basins was the presence of either Nespresso AAA or Nescafé Plan. Priority was given to river basins with Nespresso/Nescafé presence, even though it was no mandatory criterion. Accordingly, we also chose control river basins that mostly host activities of one of these programmes. 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 treatment river basins. Using non-treated coffee farms located within treatment river basins as a control group was not an option either, since i) spill-over effects could be expected and ii) they were systematically different from treated coffee farms (non-treated farms were located in less densely populated areas). The comparability of treatment and control river basins is assessed in Annex 3. It can be seen that we succeeded in finding very comparable control river basins. Most farm and river basin characteristics are well balanced across the two groups. In order to account for minor differences on the farm level, we control in all estimations for baseline characteristics of the farms. Depending on the context of analysis, we control for the sex, age, and literacy of the head of household, household size, whether coffee is processed on the farm, the total coffee area (ha) or total farm area (ha), total coffee production, wealth quintiles constructed by an asset index, whether the farm keeps accounting records, whether they own their land, whether the household lives on the farm, whether the farm pays for coffee-processing water or water in general, whether the farm has a water source on the farm, whether the farm has a sustainability label, the water conservation attitude, and departmental dummies.[15]

During follow-up, it turned out that IWM extended their activities beyond the originally foreseen river basins that partly led to a treatment contamination of our control group. In areas neighbouring the treatment basins, the so called “area of influence”, IWM included additional farms into IWM training activities. Since some of our control groups are located just next to the treatment river basins, some of these additionally trained farms belong to our control groups. The number of contaminated farms is very low though, and only in Nariño a substantial share of control farms live in this “area of influence”. We perform robustness checks of all our results by excluding the contaminated farms from the control group or excluding Nariño completely[16]. Excluding the farms does not substantially alter any of our conclusions.

[15] For a full overview on control variables for each area of analysis, please refer to Annex 4.
[16] Results can be obtained from the authors upon request.

Figure 4: Treatment contamination in control river basins



Source: FDW Colombia farm survey 2015 and 2017.

Moreover, some control farms might have also been in contact with the IWM intervention through the radio or because their children learned about IWM initiatives at school. One dissemination channel of IWM activities was radio and TV. It is thus possible that also control farms learned about (the content of) IWM. Furthermore, activities to sensitise people on water purification and domestic water saving were held in rural schools. Since control and treatment children partly visit the same schools, also control farm children might have learned about the importance of saving and purifying water at school. Accordingly, attitudes towards water saving might have changed also in the control group as a results of the IWM intervention. This would lead us to underestimate the IWM impact through our difference-in-differences estimation. The bias is particularly important when measuring attitudes towards water saving. In addition, equipment adoption might be marginally affected if awareness rises and also control farms invest with their own means into water-saving equipment. In general, these effects can be expected to be very small, though, since it is not very likely that farms after such a light treatment invest into water-saving equipment. Only for domestic water saving are substantial effects among the control group realistic. As part of the sensitisation activities, IWM taught children at school how to save water by, for example, simply putting a bottle of water into the toilet cistern. Since these actions are very low-cost and do not imply any behavioural change, it may happen that households quickly adopt it. With regard to attitude, we will discuss in detail in how far a possible bias challenges our conclusions.

Table 7 summarizes the methodological approaches for each evaluation component. Since the most pronounced activities and effects can be expected to materialize among beneficiaries of Activity 3 in Component 3 (who receive efficient equipment) and farms that participate in bioengineering and reforestation activities of Component 4, the quantitative farm survey focusses on these beneficiary groups. To the extent that the surveyed Activity 3 farmers also participate in the Activity 2 trainings, this treatment will also be evaluated using the same treatment group.

Table 7: Methodological approaches for the different beneficiary groups

Beneficiary group	Main Identification strategy	Main survey tool
Component 3-Activity 3 farmers (beneficiary equipment)	difference-in-differences	structured questionnaire
Component 4-Reforestation farmers (beneficiary reforestation)	difference-in-differences	structured questionnaire
Component 3-Activity 2 farmers that participate at the same time in Activity 3	difference-in-differences	structured questionnaire
	Cross-sectional analysis	dictator game

We were not able to include Activity 2 training participants systematically in the survey, because they were selected by the extension workers in an ad-hoc way only after our baseline data collection. However, effectively, a large proportion of farmers in our sample also participated in IWM trainings, which enables us to assess the effect of the training on those farmers that participate both in Activity 2 and Activity 3.

For analysing changes in attitudes towards reforestation, we furthermore implemented a behavioural experiment ("dictator game") 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 (DellaVigna 2009). The appealing feature of these games is that we are able to measure revealed preferences rather than only stated preferences. Farms effectively have to donate money they could otherwise keep for themselves. Farmers' behaviour in this situation can be expected to be more realistic than simply asking about their preferences, since it involves a real-world trade-off. 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 attitude towards the environment more generally. The importance of reforestation and the implications for the environment (i.e. particularly the soil and water sources of the river basin) was emphasized throughout the whole project. Investing in community reforestation hence expresses valuation for environmental quality.

Interviews conducted as part of the stakeholder analysis presented in Section 4 were used as a source for triangulation and contextualisation of results from farm interviews.

For the quantitative analysis, we conducted a survey wave among coffee farmers before and after the intervention, i.e. in 2015 and 2017. The dictator game was implemented only once, in 2017.

3.2. Farm Survey: Sampling, Sample Size, and Power Calculations

For the baseline survey, we applied a random sampling approach among the pre-selected beneficiary equipment and reforestation farmers in treatment river basins. We received a list from IWM with all 817 farms to be treated in the first wave. All farms were located within a 100m radius of the main river. Originally, it had been foreseen to intervene in approximately 900 additional farms over the whole project duration. These had not been selected at baseline. Our sample therefore concentrates on the farmers selected for the first wave. If we compare the distribution of our sample over the five departments to the distribution of actual beneficiaries over the whole project duration, a disproportionate number of farms in our sample is located in Caldas (Table 8). The reason is that IWM activities were concentrated in Caldas in the first year. Hence, our sample is only representative for the first intervention year. This is why we always show differences between the five departments in order to assess whether results might be driven by our sample selection.

Table 8: Distribution of farm sample over departments

	Antioquia	Caldas	Cauca	Nariño	Valle del Cauca
Sample					
Total number of coffee farms interviewed (as % of whole sample)	183 (13%)	562 (42%)	184 (14%)	255 (18%)	167 (12%)
of which:					
- Farms in treatment river basins	91	283	92	128	83
- Farms in control river basins	92	279	92	127	84
IWM treatment farms					
Total number of effectively treated IWM coffee farmers per department (beneficiary equipment and reforestation)	1085 (20%)	1020 (18%)	1210 (22%)	1120 (20%)	1135 (20%)

Note: Some farms participate in both equipment and reforestation activities.
Source: Data provided by IWM (only information on the IWM implementation river basins).

For identifying comparable farms in the control river basins, we received a complete list of farms within the river basin from FNC with details on the area in coffee cultivation. From this list, we excluded farms that exceeded or fell below the minimum and maximum farm size of treatment farms. Since it was not clear from the list which farm was located within the 100m radius along the main river, the ultimate selection of farms was done in the field. 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, we interviewed a total of 1,399 farms, including 699 treatment farms and 700 control farms. At the follow-up, we succeeded to re-interview 1,351 farms. This means that attrition was very low at only three percent.[17]

We designed the questionnaires in a way that the person who is most acquainted with the coffee production at the farm was ideally the respondent. At baseline, the questions were answered in most cases by the owner of the farm (62 percent), a near family member such as the spouse or the brother of the farm owner (29 percent), or by a farm administrator (9 percent).

The sample size of almost 1,400 farms gives us statistical power to detect changes in water conservation behaviour of a magnitude around 6 to 12 percentage points depending on the indicator. We calculated minimum detectable effect sizes using the baseline data for three exemplary 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. We assume a power of 80 percent, and alpha of 0.05. For these selected indicators, the study's power seems sufficient, 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, we cannot be sure to have enough power to detect each and every true project impact. This is why in the final impact analysis we analysed non-significant results 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).

For the dictator game, we selected a sub-sample of 681 farms. In each department, we selected three out of the five treatment river basins and the corresponding control river basin (located in the same municipality). In the departments Antioquia, Caldas, and Cauca we randomly chose three treatment river basins using a random number generator. In Valle de Cauca, one control river basin was highly affected by spill-over (control farms located in the IWM "area of influence"). We therefore excluded this river basin and randomly chose out of the remaining four river basins. In Nariño all control river basins were affected by spill-over. Here, we selected those river basins with the lowest proportion of farms located in the IWM "area of influence".

Within the river basins, we included all farms covered by the structured questionnaire. Only in Caldas we randomly selected a sub-sample of 39 coffee farms within each river basin, correcting for the overrepresentation of Caldas in our original sample. The selection of these farms was done with a random draw by our team in the field.

3.3. 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 (see Annex 7). Since it had been originally foreseen to pool resources and make use of a monitoring survey conducted by the project itself, we worked together with IWM in the design of a questionnaire during the baseline mission in May 2015 and the following month. 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. Special

[17] We verified that attrition is not systematic with respect to observable household and farm characteristics by testing 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 tests attitudes to and knowledge on water saving and water contamination.

In addition, the questionnaire also has 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.

This report makes use of all these survey tools and includes contextual information from qualitative interviews with stakeholders gathered during the scoping, baseline and follow-up phase.

3.4. Farm Survey: Survey Implementation

The evaluation activities consist of three different phases: The scoping phase in 2014 with a scoping mission to Colombia in November 2014, the baseline phase with activities in Colombia in mid to end 2015 and the follow-up phase in mid to end 2017.

Initially it had been planned to jointly implement the survey with IWM Colombia. IWM had planned to collect baseline information for monitoring and evaluation purposes among their treatment farms. This information had been foreseen to be used for an external evaluation for which they contracted a Manizales-based research institute with many years of experience in the Colombian coffee sector. In order to maximize synergies, we decided to cooperate with the same institute for the implementation of the survey, too. IWM had intended to survey all of their beneficiaries and our evaluation team had planned to survey a representative sample of control river basin farms, as well as a small subsample of treatment farms. During the baseline mission in May 2015 and until the end of August 2015, IWM, the local research institute and our 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 we started our survey fieldwork, IWM Colombia had decided to withdraw their participation in the survey implementation. One of the reasons was the alleged threat of biased interviews due to a lack of independence of its enumerators. IWM Colombia had planned to use the intervention's extension workers for conducting the interviews with the coffee farmers, who might not have been impartial enough to assure unbiased answers. Since the decision was taken only few days before sending our survey team to the field, in the first instance, we adhered to the original logistics and only redistributed our sample to 375 treatment and 375 control farms. In parallel, we discussed with the Dutch Ministry of Foreign Affairs to increase our sample for reaching the originally foreseen sample size.

The fieldwork for the baseline data collection started the 29th of August 2015 and about a month later we received the Ministry's formal agreement for increasing the sample size to 1,400 farms, which meant some river basins had to be visited twice. In two control river basins there were not enough farms within the 100-meter-radius around the river (our sampling criterion) to conduct the intended number of interviews. In these two basins we therefore extended the sampling area to a 200-meter-radius. The field work ended the 9th of December 2015. Most of the data entry took place during the time of the survey. The follow-up data collection took place between the 10th of October 2017 and the 12th of December 2017.

The local research institute managed the logistical organization of our survey including the recruitment of the enumerators. All enumerators had worked with the local research institute in other projects before, and hence, were experienced in doing coffee-related fieldwork. All enumerators additionally attended a two-day training workshop. The local research institute conducted three field tests in order to guarantee the appropriateness and the feasibility of the survey questions in the field. After the field tests, some improvements were made to the questionnaire. Moreover, the local research institute was responsible for the quality assurance of the survey, i.e. that the households were sampled properly, the questionnaires were completed consistently, and the data entry was done accurately.

The local research institute submitted the entered data to the evaluation team by mid-December 2015 for the baseline data and by the beginning of February 2018 for the follow-up data. The accuracy of the data was checked and necessary revisions were reported back to the local research institute.

3.5. 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 first round of semi-structured interviews was held with representatives of most of the PPP partners, both in Colombia and the Netherlands, in 2014. The questionnaire for the interviews is included in Annex 5. Additional interviews were conducted in Colombia during the baseline mission in May 2015.

Subsequently, the local team in Colombia interviewed a total of 48 persons between September and December 2015. Occasionally, more than one person was interviewed at the same time. For this reason, the total number of interviews was 45. 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 we used a combination of fully closed, semi-closed and open questions (see Annex 6). The 31 interviews were conducted with:

- 12 IWM extension workers;
- 5 IWM regional coordinators (who each cover 5 river basins);
- 4 extension leaders of Departmental committees of coffee growers;
- 8 municipal administrators;

- 2 representatives of *Corporaciones Autónomas Regionales (CARs)*, or Regional Autonomous Committees, which are regional autonomous public entities in charge of implementing the policies of the Ministry of the Environment.

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.

4. Stakeholder Analysis

4.1. PPP partners and Other Key Actors

4.1.1. PPP Partners

As explained in Section 2, the following six partners agreed to form a PPP:

- *Federación Nacional de Cafeteros de Colombia* (FNC), the National Federation of Colombian coffee growers;
- Nestlé S.A.;
- Nestlé Nespresso S.A. (henceforth referred to as Nespresso);
- The Ministry of Agriculture and Rural Development (MADR);
- Wageningen University & Research (WUR); and
- *Cenicafé*, the National Centre for Coffee Research in Colombia

FNC was the initiator of IWM Colombia and the lead partner of the PPP.[18,19] The history of the PPP (and the project) dates back to 2010, when the director of FNC Europe and the CEO of FNC had the first discussions on the envisaged project. FNC's experience in collaborating with the Netherlands' embassy in Colombia and good contacts of the Colombian embassy in the Netherlands with the Dutch government facilitated the identification of partners. FNC had a desire to collaborate with WUR and was already collaborating with Nestlé and Nespresso. FNC, Nestlé and Nespresso had no pre-existing relationship with WUR.

The above-mentioned six PPP partners signed a Memorandum of Understanding to develop a proposal for the project. All partners had previous experience in collaborating with one or more of the other PPP partners, but had never worked together in a PPP set-up. The FDW call for proposals in 2012 came at the right moment. The opportunity to apply for a grant from the Sustainable Water Fund allowed for increasing the scale of the intervention.

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.[20] MADR was also committed to be a partner of the PPP. However, by the end of Year 2, MADR had still not signed. Nonetheless, RVO took it for granted that the government of Colombia would participate, because it was a precondition for the FDW grant and the Dutch development cooperation is strict in this sense. According to the Year 2 report: "The public cooperation framework agreement with MADR is in the process of legal review and approval."[21]

The PPP to be established for the IWM Project was meant to be a cooperation between the public sector (Colombian government) and the private sector (Nestlé and Nespresso), as well as a 'third sector' – comprising an NGO (FNC) and knowledge institutes (Cenicafé and WUR).

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[18] The Ministry of Foreign Affairs defines a PPP as follows: "A form of cooperation between government and business (in many cases also involving NGOs, trade unions and/or knowledge institutions) in which they agree to work together to reach a common goal or carry out a specific task, jointly assuming the risks and responsibility and sharing their resources and competences" (see IOB 2013, p. 17).

[19] The PPP is led by the FNC. The PPPLab's FDW portfolio scan incorrectly stated that the PPP is led by Nestlé, see http://www.ppplab.org/wordpress/wp-content/uploads/2015/06/PPPLab-Explorations01-FDW-portfolio-scan.pdf.

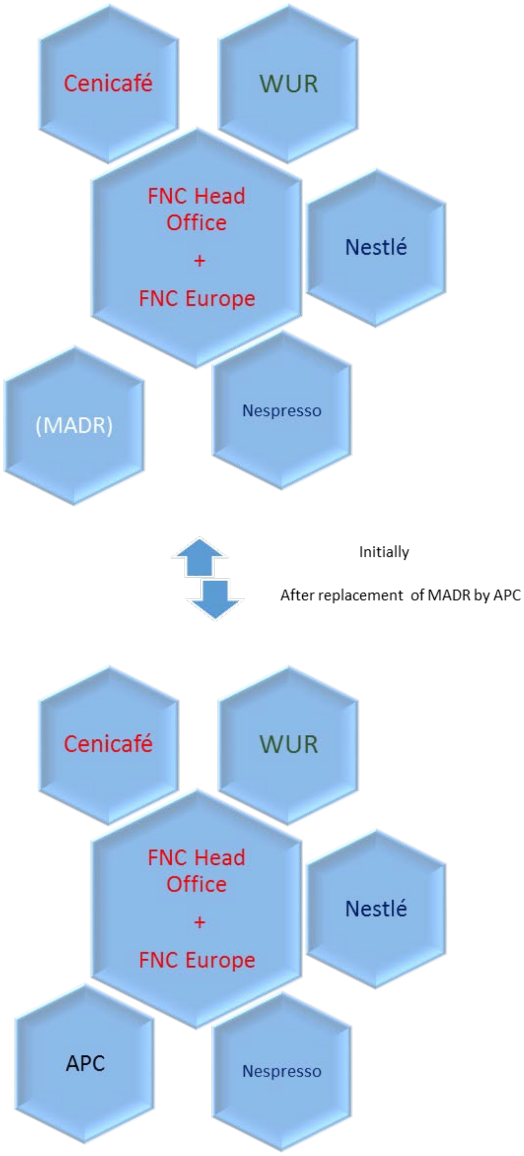
[20] In Appendix I of the Project Plan, this agreement is referred to as a Framework Memorandum of Agreement (MoA).

[21] IWM Annual Progress Report Year 2, p. 16.

Although the membership of MADR in the PPP was not formalised, the partnership had both **public and private partners** and, in this sense, met the first of the five criteria of developmental PPPs as defined by IOB (2013).

Implementation of the project was delegated to FNC Colombia. The FNC Head Office in Bogotá provided the Project Director and Project Coordinators and collaborated with departmental and municipal level staff members, CARs, as well as researchers of Cenicafé and WUR, and representatives of the other PPP partners. The PPP partners delivered as a group. Each PPP partner had specific tasks. FNC (Head Office and Europe Office) clearly played a central and coordinating role in the PPP (see Figure 5). Different partners were responsible for taking the lead in specific parts of the project. Nespresso and Nestlé operated jointly in the PPP. Although Nespresso is an autonomous company, its position in the project was fully aligned with that of Nestlé (*"Nespresso va de la mano de Nestlé"*, i.e. "Nespresso goes hand in hand with Nestlé"). As knowledge institutions, WUR and Cenicafé played a complementary role in the project.

Figure 5: PPP for IWM Colombia



Source: Own illustration.

WUR established a very good relation with all the partners. It took the initiative (during project kick-off) to start elaborating the initial documents of the Monitoring & Evaluation (M&E) plan. WUR firstly focussed on three issues: coffee waste treatment, water foot prints, and M&E. Together with FNC and Cenicafé, WUR coordinated activities related to multi-level training and the Learning Network.[22] For example, WUR held a session in the International Water Learning Network Meeting in Wageningen in 2014 to present the project and a session in 2015, in which it presented experiences of other projects from around the world.[23] A third session took place in Colombia in May 2017, which focused on wastewater management. Similarly, in April 2018, there was a fourth meeting in Wageningen on 'farm solutions in a landscape approach'.[24] WUR also contributed to the development of modules of the multi-level training project, to be delivered by WUR, Cenicafé, FNC Central Office, the FNC's *Fundación Manuel Mejía* and departmental committees of FNC.[25]

The project built on the existing Corporate Social Responsibility (CSR) activities in Colombia of the two private PPP partners – Nestlé and Nespresso. The two companies and FNC share a philosophy in the area of sustainability. For the coffee sector, Nestlé launched its *Nescafé Plan* in 2010.[26] In Colombia, the Nescafé Plan comprises among others the distribution of coffee plantlets, technical assistance and fertilization. Since October 2010, some 24 million new coffee plantlets had been provided to around eight thousand coffee farmers. The *Nespresso AAA Sustainability Quality Program* was launched in 2003 in collaboration with the Rain Forest Alliance and aims "to protect the future of the highest quality coffees and secure the livelihoods of the farmers that grow them."[27] The triple A stands for quality, sustainability and productivity. In Colombia, the AAA Programme's activities concern among others "improving farm productivity, upgrading wet milling, developing new pricing strategies and improving business management."[28] The activities in Colombia of both Nescafé Plan and Nespresso AAA are undertaken in collaboration with the FNC. The IWM Colombia project covered both coffee farmers that are participating in either Nescafé Plan or the Nespresso AAA Programme and farmers in river basins outside the Nespresso AAA/Nescafé Plan areas. Nespresso joined the project, because it wanted to try "to understand what are the most impactful interventions from a much more holistic and broader community and landscape perspective", but also because (the former chairman of) Nestlé "had a really clear view that water was *the* issue that we need to get right as society".[29]

Both Nespresso AAA and the IWM project include a component of training for coffee farmers. A difference between IWM Colombia and the AAA programme is that IWM does not focus on individual coffee growers, but on the river basin.

MADR only marginally participated in the IWM project. According to the Year 2 report, MADR was involved in:

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[22] IWM Annual Progress Report Year 2, R3 MoV 4.3 Learning Networks Plan (July 2015).
[23] IWM Annual Progress Report Year 2, R2 MoV 2 Learning Networks Plan (July 2015).
[24] IWM Final report, 31 August 2018, Annex 3i, p. 4.
[25] See also the Multi-level Training Plan included in the Year 1 report. See www.fmm.edu.co for information on the *Fundación Manuel Mejía* of the FNC.
[26] http://www.nestle.com/media/pressreleases/allpressreleases/nestle-invests-chf500-million-in-coffee-projects-doubling-direct-purchases.
[27] http://www.nestle-nespresso.com/ecolaboration/sustainability/coffee.
[28] http://www.nespresso.com/ecolaboration/nl/en/article/8/2276/empowering-small-scale-coffee-farmers-in-colombia.html.
[29] Cited from the interview.

1. The delivery of a virtual course on "Gender and Rural Development" (in February-March 2015);[30]
2. A session to develop the methodology for the "Creating the Water & Coffee Platform"-workshop.[31]

It is clear, however, that MADR was virtually a 'silent partner' in the PPP. It did not really have ownership of the project. Concerning the marginal role of MADR, one interviewed stakeholder mentioned that "during the time that we were working on this project – which is a long-term project – there was a huge focus on the peace process. I think, maybe in the era of post-peace process and in terms of community capability building to kind of build a resilient peace, I suspect actually that maybe now the government would be more interested in investing again." In the opinion of another interviewee, the role of MADR in the PPP may also have been marginal because there is a strong, hierarchical coffee growers' federation (with satellite institutions Cenicafé and FMM) that knows very well what it wants and that – apparently – did not really need the Ministry.

MADR ceased to be a (candidate) PPP core partner in 2016, when it was replaced by the *Agencia Presidencial de Cooperación* (APC) – the Presidential agency that coordinates the international cooperation with Colombia – as the representative of the Colombian government in the PPP. Numerous attempts to formalise the Ministry of Agriculture and Rural Development's membership of the PPP for the IWM project had failed and the project director decided to establish a relationship with the APC. This was the reason that the Ministry of Agriculture and Rural Development was replaced by the APC. With this change, the PPP could be formalised. Hence, from the membership point of view, the PPP was consolidated.

For the implementation of the project, the PPP partners set up a governance structure comprising a Supervisory Board, a Steering Committee (SC) that met in Europe and had representation at CEO level from PPP partners, as well as an Operational Committee (OC) based in Colombia, with representation from all the partners.[32] In addition, a Technical-Scientific Committee (TSC) with representation from Nestlé/Nespresso, FNC/Cenicafé and WUR was set up as 'a key decision-making body within the IWM's governance structure.'[33] The technical-scientific committee was to meet every two months (face-to-face or by telephone). The operational committee was also to meet regularly. The SC of the IWM Project was to meet at least every quarter. It was responsible for overall governance of the project. Several meetings were held – 25 in total.[34] In the meetings, there was discussion of issues, but always leading to consensus.

The PPP also meets the second criterion of developmental PPPs, because – as explained earlier – the PPP partners defined a **common development goal**, which was laid down 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. They provided monetary resources and/or contributions in kind to jointly undertake activities that were expected to have value added for the specific interventions at the farm and river basin level. Some parties provided a financial contribution, while others provided only an in-kind contribution (expert man hours). The project plan included a budget of €20.5 million, to which Nestlé and Nespresso were

[30] IWM Annual Progress Report Year 2, R2 MoV 2 Learning Networks Plan (July 2015).
[31] IWM Annual Progress Report Year 2, R2 MoV 1 Water & Coffee Platform Plan (July 2015).
[32] See also Year 1 Report, Intelligent Water Management Program Governance Structure Regulation.
[33] Year 1 Report, Intelligent Water Management IWM Technical & Scientific Committee Terms of Reference (ToR).
[34] IWM Final report, 31 August 2018, Annex 3i, p. 1.

to jointly contribute 22 percent, FNC and Cenicafé jointly 15 percent, WUR another 5 percent, while the Colombian government was to contribute 12 percent. The contribution of the PPP partners was to be matched by a grant of €9.5 million from RVO, comprising 46 percent of the overall budget.[35] On top of this, other, non-PPP partners associated to the project were expected to contribute an additional €4 million in kind for complementary projects that were not managed from the central level.[36] A likely incentive for the Colombian government to participate in the PPP was that partnering with the private companies (and other partners) allowed for leveraging of resources.[37] The planned financial contribution by MADR amounted to €983,101 in Year 2.[38] However, the Ministry of Agriculture and Rural Development had at the end of Year 2 still not disbursed any financial contribution. As mentioned above, in the end it was decided that the Colombian government would be represented in the PPP by the Presidential agency for international cooperation APC and not by MADR. While the APC made a financial contribution to the project, the **government's commitment** was **not fully realised**. In total, only 40 percent of the committed financial contribution for Years 2 and 3 was received, whereas no disbursement was made by APC in Year 4, and neither in Year 5 (see also Figure 6).

In the end, the APC-MADR's financial contribution amounted to only a quarter of its committed resources and the FDW grant was lowered from €9.5 to €7.7 million.[39]

Furthermore, neither the APC, nor the Ministry of Agriculture, played other envisaged roles in the PPP. In this sense, there was no true PPP as defined by the Ministry of Foreign Affairs of the Netherlands.[40] Nonetheless, the relationship with APC facilitated the establishment or strengthening of relationships with other governmental institutions. This concerned local institutions (municipal governments), regional institutions (the CARs), as well as national institutions (such as the Ministry of the Environment and the Ministry of Culture). These institutions made financial and/or non-financial contributions to the IWM project.

The participation and contribution of WUR decided upon in the Steering Committee meeting that took place on the 14th of July 2015 comprised the following:[41]

1. Added-Value Activities, or direct work of WUR staff appointed to IWM, accounting for approximately €200,000 per year, to be paid by the project;
2. Complementary Activities, or in-kind contributions representing knowledge from related projects funded by other sources, also accounting for approximately €200,000 per year.[42]

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[35] Appendix I of the Project Plan, p. 33.
[36] Year 1 Report, pp. 33-34.
[37] Cf. PPPLab (2016). *Partnering with the Public P*. Insight Series 05 https://ppplab.org/2017/06/explorations-05-working-with-the-public-p/).
[38] IWM Annual Progress Report Year 2, Sub-Annex 7 IWM SCO Meeting Minutes (July 2015).
[39] IWM Final report, 31 August 2018, Annex 3i, p. 7.
[40] See IOB (2013). *Public-Private Partnerships in Developing Countries* (https://www.government.nl/documents/reports/2013/06/13/iob-study-public-private-partnerships-in-developing-countries).
[41] IWM Annual Progress Report Year 2, Sub-Annex 7 IWM SCO Meeting Minutes (July 2015).
[42] As mentioned above, the budgeted total in-kind contribution of WUR was €1 million.

Figure 6: Budgeted and realised cash contributions for IWM Colombia (in €)[a]

Source: Own elaboration based on annual reports.
[a] The figures of the realised cash contributions in Year 5 are calculated as the residual of the contributions in Euros over the entire project period in the Year 5 report of the IWM project and the cumulative contributions in Euros in Years 1 to 4 reported in (or calculated on the basis of) Year 1 to Year 4 reports.

Concerning the fifth criterion of developmental PPPs – the **distribution of risks** between the public and the private sector – in total, 88 risks were identified and monitored.[43] They comprised very high, high, low and very low priority risks. In the Year 2 report the status of risks was classified into Active (high impact, high probability, but not yet occurred), Observation (medium/low impact and probability), Materialized (occurred in Year 2) and Mitigated (risks corrected through application of response plans). It is however **not always clear whether the risks concerned the public or the private sector** (or 'third sector'), or **whether** they were **borne by the PPP as a whole**. According to the Year 5 Report to February 2018, "8 percent of the risks materialised and appropriate measures were taken to mitigate

[43] Year 5 Report to February 2018.

impact." The Final report indicates that these seven risk were not mitigated and that one of the 88 risks was eliminated from the list, while the other 80 risks were mitigated.[44]

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. As one stakeholder interviewed in 2018 put it, "probably the biggest risk is the funding risk" and "I think, with the benefit of hindsight, … we should have considered … the risk of the Colombian government not investing".

At the start of the third year (i.e. July 2015), the IWM project was still largely in a preparatory phase. Some delay was caused by a lack of funds (because the Colombian government had not released the financial contribution and RVO's Year 2 contribution was delayed for lack of approval of the Result 1 Report and the Action Plan) and the fact that in reality in the communities things often take more time than expected at the drawing table of the project.[45] Implementation started in earnest in Year 3 of the project, when good progress was made in various result areas.[46] The expectation in Year 5 was that all the planned project activities would be completed by mid-2018. According to the final report, this goal was met.

4.1.2. Water & Coffee Platform

According to the Project Plan, it was the intention that five additional projects would arise from the Partnership Agreement, which would be carried out with the same (core-PPP) partners or with other partners, and for which separate agreements were going to be signed.[47]

Hence, the core PPP did not include all relevant partners, but allowed for an inclusive platform to involve other relevant institutions. It should be mentioned that the initial discussions on the project took place between Cenicafé and FNC Europe, focusing on technical issues. The design of the project was broadened to include also social aspects and the other core PPP partners were involved in the discussions. It was decided to limit the PPP to a few core partners with an opening to other institutions to participate in the project.

The six envisaged PPP partners are the core institutions of the Water & Coffee Platform.[48] Other institutions could join the platform but would not form part of the PPP. 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 (i.e. June 2018). 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 IWM project management signed letters of intention and made work plans with the new partners. Initial meetings were held with the new partners and every year there would be a meeting with all of them to show them figures on the investments made.

By June 2018, the Water & Coffee Platform – which is also called the *Manos al Agua* ("Hands to Water") platform or Water Platform – had 58 additional members.[49] The *Ministerio de Ambiente y Desarrollo*

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[44] IWM Final report, 31 August 2018, Annex 3i, pp. 17-19.
[45] See Year 2 Report regarding the reason for the delay of RVOs payment.
[46] See also IWM Executive Progress Report Year 4/Q13, 30 September 2016.
[47] See e.g. PowerPoint presentation prepared by the project. See also the Work Plan on formulation of complementary projects included in the Year 1 report.
[48] A Water & Coffee Platform Plan was made. This plan is one of the 23 Work Plans included in the Year 1 Report.
[49] End of project presentation in The Hague, 7 June 2018.

Sostenible (the Ministry of the Environment and Sustainable Development) is one of them.[50] At the sub-national level, the Ministry of the Environment is represented by CARs, which are responsible for the implementation of environmental legislation. CARs of departments in which IWM was executed are members of the platform. While other institutions could join, the project management was very keen on maintaining the proposed scope of the project, in order not to lose the focus. By March 2016, 13 local, departmental or national institutions had joined the platform.[51] As mentioned above, by June 2018, the number had increased to 58 institutions, including 41 departmental/local institutions and six international institutions (Table 9). Half of the institutions are public.

Table 9: Members of the Water & Coffee Platform (June 2018) [a]

	Public	Private	NGO	Total
Departmental/local	22	14	5	**41**
National	4	2	5	**11**
International	2	0	4	**6**
Total	**28**	**16**	**14**	**58**

[a] Apart from the six PPP partners that are core members of the platform.
Source: Own elaboration based on information provided by the project director.

Other examples of institutions/projects that are member of the Water & Coffee Platform and that supported the implementation of IWM are the national training service SENA (and its four departmental sub-directorates), the *Fundación Manuel Mejía*, the *Fundación Aurelio Llano Posada*, the Ministry of Culture, the national planning department DNP, several municipal governments, the International Centre for Tropical Agriculture CIAT, as well as projects such as PUR (which is supported by France) and *Campo Limpio* (implemented in Antioquia).[52]

The IWM project's website also refers to the Water & Coffee Platform. Via its website, the project wanted to communicate its results to the wider public and emphasize the importance of the strategic allies – the PPP partners and other involved institutions.[53]

FNC made a national communication plan for IWM.[54] Communication of the IWM project relates to both internal communication (between project implementers, in particular the IWM extension workers and coordinators, but also regarding strategy and reporting of the operational and technical-scientific committees) and external communication, to the founding members of the PPP, educational institutions, public administration at various levels, as well as other potentially external partners.

Until February 2018, over two billion Pesos – the equivalent of approximately €600 thousand – had been invested by new partners.[55] In comparison, the final report of August 2018 mentions a value of €1 million of, in total, over 50 complementary projects.[56] The amount of approximately €0.6 million does possibly not include all contributions in kind. The platform was supposed to continue to function after completion of the IWM project and it appears that until now it is actually continuing to function.

[50] As explained in one of the interviews, between 2013 and April 2015 there had already been various attempts to formalise the cooperation between the Ministry and the IWM project.
[51] The PPP partners were the first members (Annual Progress Report Results 2 to 5 – Year 2, p. 2).
[52] In one of the interviews it was indicated that the process of involving additional partners through the *Manos al Agua* platform started in earnest at the end of 2015, but that, on hindsight, that process should have been initiated much earlier in the project.
[53] http://www.manosalagua.com/.
[54] See also 'Integrated communications plan' included in the Year 1 Report.
[55] Year 5 Report to February 2018.
[56] IWM Final report, 31 August 2018, Annex 3i, p. 13.

There are members of the platform that (plan to) participate in new projects. Hence, the platform appears to be a crucial factor for the sustainability of the IWM initiatives.

4.1.3. Actors at Departmental and Local Level

The project worked with multidisciplinary teams in each of the 25 river basins and there was an IWM coordinator in each of the five departments in which the IWM was implemented. The task of that person was, in the first place, to coordinate the activities of the IWM extension workers based in each of the five river basins and the activities of the three 'rotating' IWM extension workers specialized in, respectively, coffee processing, reforestation and social issues. The latter each covered all the five IWM river basins within the department. The IWM coordinator also facilitated the coordination of the activities of the IWM extension workers with those of the regular FNC extension workers and, where relevant, those of the Nespresso extension workers and other stakeholders such as municipal officers. The aim was to avoid a situation in which coffee farmers are visited by several extension workers separately and, where possible, to have for example the IWM extension worker present if the Nespresso extension worker organizes a group meeting to which coffee farmers (and relatives) are invited. The introduction of the concept of multidisciplinary teams and territorial management were innovations generated by IWM.

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). In 2015, several interviewees were of the opinion that the training component of the IWM project would be essential to achieve sustainable results. At the time, all but one of the interviewed IWM extension workers had received training in the framework of the IWM project. Training of extension workers was provided at the *Fundación Manuel Mejia* and by means of e-learning courses. At the time of the interviews with IWM extension workers in 2015, they had all been trained in business management, while some of them had also received training on topics such as (*i*) good agricultural practices in coffee production, (*ii*) integrated water management, and (*iii*) gender equality relations, generational renewal and human rights. Extension workers surveyed in 2017-2018 indicated that they had been trained in all or most of the following topics: (*a*) business management; (*b*) associative work, (*c*) good agricultural practices in coffee production, (*d*) gender equality relations, generational renewal and human rights, (*e*) integrated water management, (*f*) ecological coffee processing and wastewater treatment, and (*g*) forest and soil management.

In 2015, IWM was still largely in the awareness-raising phase and the training methodology and modules were being developed. In cases where training had started, this most often concerned Business Management. In general, implementation was supposed to start at the end of 2015. By March 2016, the extension workers had provided training in Business Management and Integrated Water Management to a substantial part of the coffee growers. According to a small survey among 16 extension workers conducted in 2017-2018, towards the end of the project, training had been provided on most of the above-mentioned topics (*a*)-(*g*), often by means of a mix of training methods (*i.e.* farm visits, group meetings, involving a *Manos al Agua* group, provision of information material). Interviewed stakeholders were in general positive about the results of the multi-level training. Some pointed out that the long period of planning of the training activities was key for the success. Nonetheless, there are also some more critical voices in that the training was sometimes very intensive for the coffee farmers, with one course provided right after the other and that, consequently, for farmers it was not always clear which course they were attending. Another critique is that the training material was insufficiently adapted to the needs, partly because of an excessive use of images and other training tools.

All 12 IWM extension workers interviewed in 2015 reported that awareness raising of the IWM project had taken place. Awareness-raising was done in the targeted communities/river basins by visits of extension workers and via radio programmes, local newspapers and local 'coffee newspapers'. It should be noted that awareness raising is seen as a continuous activity, as also emphasised by various stakeholders interviewed in 2017-2018.

Departmental and local actors interviewed in 2015 were generally aware of environmental problems affecting the coffee sector in Colombia. Almost all (i.e. 25 out of 26) interviewed extension workers, municipal administrators, CAR representatives and leaders of the CDC extension workers who were asked about the main environmental problems in, respectively, the river basin, municipality, region or coffee zones of the department in which they worked considered that water pollution was the principal problem; similarly, four out of the five regional IWM coordinators reported water pollution as the principal problem in the five river basins for which they were responsible. A high level of water consumption was also frequently mentioned as an important problem.[57] All 12 extension workers surveyed in 2015 rated contamination of water as a main environmental problem; nine of them considered that high consumption of water, water scarcity, landslides and erosion were main problems. Similar results were achieved from a small survey among 16 extension workers conducted in 2017-2018, except that a smaller proportion perceived water scarcity as a main environmental problem, which is understandable, given that the climate situation in Colombia in 2017-2018 was different from that in 2015, when the country was hit by the *El Niño* phenomenon.

Factors that would potentially hinder the implementation of the IWM project that were mentioned in the interviews held in 2015 are lack of awareness of scarcity of water (for example because not all coffee farmers are charged for the use 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 (related to the fact that their average age is relatively high because of lack of generational renewal). Some of these factors were also mentioned in the later round of interviews.

In comparison, examples of factors that facilitated or could facilitate the implementation of the project mentioned by interviewed departmental and local actors are a positive role of women in the community, training, awareness raising and the presence of the FNC. Several stakeholders interviewed in 2017-2018 also mentioned these factors. Interestingly, the drought or reduced availability of water as a result of the *El Niño* phenomenon 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. These views were generally confirmed in the 2017-2018 round of interviews (see also Section 4.3).

Related to this, an initiative of the project – 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 and agreements of participation had been signed.[58] Various interviewees reported that such groups had been formed or strengthened. In

[57] Interview results 2015 and 2017-2018.
[58] End-of-project presentation in The Hague on 7 June 2018. In some departments, more than one group was established.

several occasions, this concerned strengthening of already existing community groups, such as that of a women savings group.[59]

In 2015, not every key actor at the local level knew the IWM project. Four out of the eight interviewed municipal administrators and the two interviewed CAR representatives were familiar with the IWM project. No one had participated in the design of the IWM project.[60] In the second round of interviews, all interviewed local actors were familiar with the project.

Similarly, in 2015, none of the interviewed municipal administrators was aware that a PPP was established for the IWM project; the same held for one of the four interviewed leaders of the *Comité Departamental de Cafeteros* (CDC) extension workers.[61]

Two of the leaders of the CDC extension workers who in 2015 were aware of the existence of a PPP, had used that information to argue for a change in the selection of river basins for the IWM project. In Caldas the initial selection of river basins was made by the central level. In first instance, the intention was to select five river basins in the Nespresso zone. However, the *Comité Departamental de Cafeteros de Caldas* suggested a different selection and proposed to choose two river basins in the Eastern part of Caldas. Nespresso initially did not want to select river basins in that part of the department. The CDC used the argument that not only private partners contribute resources to IWM, but also the public sector and FNC, and that for that reason other areas should be chosen as well. In the end the selection was modified. In two other departments – Antioquia and Valle de Cauca – the selection of municipalities and river basins to be covered by the project was modified later on after some pressure from the departmental coffee committee. In Antioquia, instead of choosing only river basins where Nespresso is present, some river basins were selected in parts where Nespresso is not active. The argument that was used is similar to the one mentioned for Caldas.

In 2017-2018, there was generally more awareness of the existence of a PPP, though several local actors referred to IWM as a project of FNC only.

4.2. Stakeholder Views on Value-added of the PPP, Results of the Project and Sustainability

Value added of the PPP

As emphasized above, strictly speaking there was no developmental PPP. Nonetheless, in the perception of various stakeholders there was a sort of PPP. In interviews, different actors were asked about their view on the value-added of the partnership.

Some actors perceive that the partnership had value added. One of the interviewed stakeholders expressed this as follows: “the great advantage [of a PPP] is that you bring together different stakeholders with different interests and different capabilities and, I think, everybody benefits by being part of something that is much bigger, much broader, has much wider impact. You got much more potential to learn.” Another interviewee stated that “a value-added of the PPP was the availability of resources, both financial and non-financial resources – i.e. knowledge and expertise – and a compliance requirement.” This is in line with the view that the PPP affected the mode of

[59] Interview results. Interestingly, one of the interviewed extension workers explained that the *Manos al Agua* groups originate from ‘Business Management’ groups.
[60] Interview results.
[61] Interview results.

implementation of IWM, in that there "was more involvement in the technical part than in other projects, such as *Huellas de Paz*",[62] or, in other words, that there was "also support in terms of knowledge, beyond monetary support". A different stakeholder stated that "without the PPP, there would not have been the support from the Sustainable Water Fund and the support from Nestlé, Nespresso and the University of Wageningen. Without the financial support and support in terms of knowledge related to the PPP, it would not have been possible to achieve the results that have been achieved." Without a PPP set-up, the scale of the project would have been smaller.[63]

Another stakeholder observed that IWM resulted in a cultural change within FNC, in the sense that previously the Federation was used to deliver things to coffee farmers, paying attention to some environmental and social aspects, though mainly focusing on the economic theme. In turn, in IWM there was strong focus on trying to achieve that the coffee farmers understand what they receive and why they receive it, by means of accompaniment prior to the intervention.

A somewhat different view is that the PPP 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." A complaint is that the "social component is not represented in the technical-scientific committee. This is something that could be improved, so as to strengthen the links between the technical, the environmental and the social aspects."

Finally, according to another interviewee, "the PPP set-up is more challenging than a purely public or private set-up. There are cases in which a PPP set-up is broad and not very efficient. The question is then whether a broad set-up is really required. But in the case of IWM, a broad set-up is considered adequate. Ideally, the government is always participating. Presence of the government is needed, because river basin management requires a public approach."

Perceived results of the project

In the majority of the interviews we asked the respondent to indicate what in his or her view the three main results of the IWM project are. Usually three results were mentioned. In a few cases, the respondent did not mention exactly three results. In some interviews, the question was not asked explicitly, but the information that was gathered allowed for identification of (three) main results. This yielded a total number of 152 observations of main results as perceived by, in total, 44 interviewees. We aggregated the 152 responses into different response categories of 'main results', including a category of 'other results'. The pie chart below shows the frequencies of the different categories. 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 is a main result of the project. In comparison, 15 responses concerned improved quality of water or reduced contamination of water, while landscape vision and inclusiveness were each mentioned eleven times as a main result of IWM. Other results, including reforestation and water saving or improved quantity of water were less often mentioned.

Some of the mentioned results relate to the project's effects at the farm level. These effects are assessed in Sections 5 and 6.

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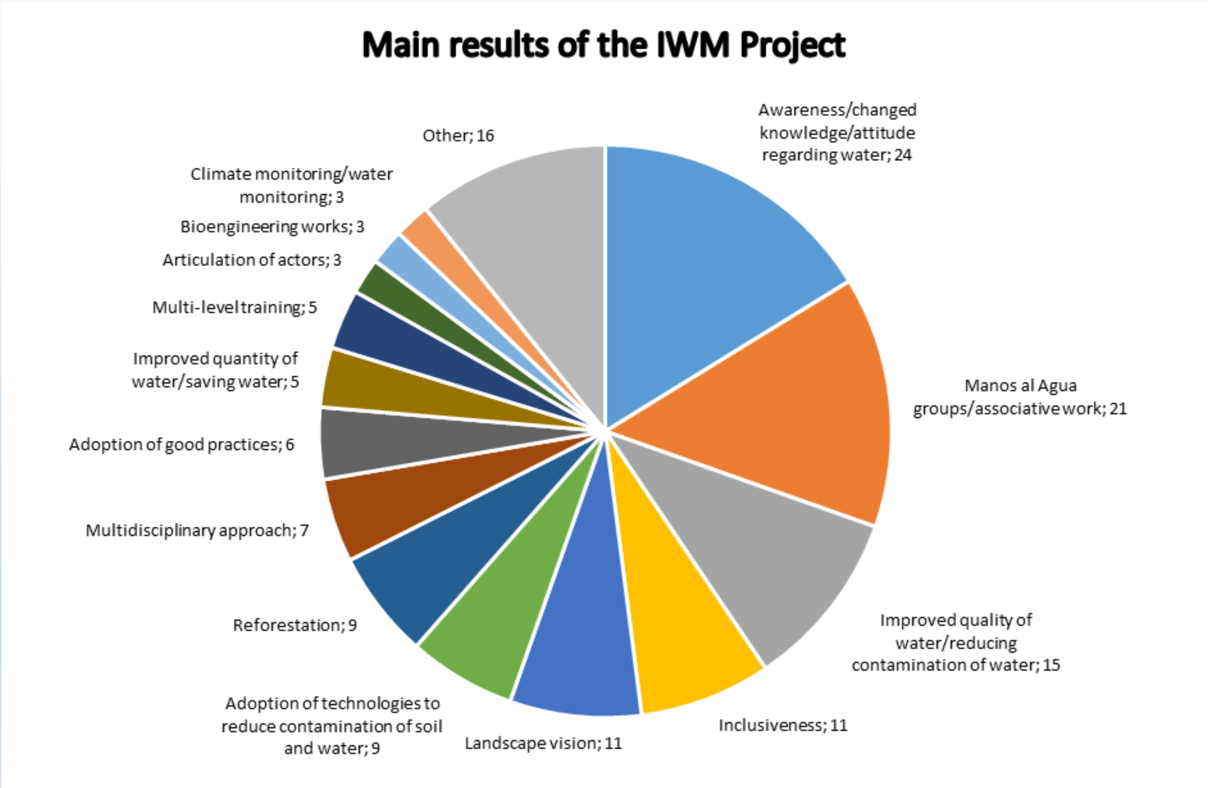
[62] http://www.hmasd.org/hmasd/siteHuellas/Huellas_main.htm.

[63] PPPLabb explains that a PPP can be an important way to reach scale, see PPPLab Food & Water (2017). *Scaling through PPPs*. Insight Series 06 (https://ppplab.org/2017/11/insight-series-06-scaling-through-ppps/)

Figure 7: Perceived main results of the IWM project



Source: Own elaboration based on interviews conducted in 2017-2018.

Views on sustainability of the results

The IWM work plan 2.3 on transfer and sustainability that was included as an annex to the Year 1 Report mentions that it is "advisable to consider the needs of the benefited communities and their active participation in the entire implementation process." A needs assessment among coffee farmers was conducted in 2013. The project also foresaw the establishment or strengthening of community groups – later on called *Manos al Agua* groups. By now, there are 29 of such community groups.

The work plan identified the following critical success factors for sustainability: sensitization and training; professional and technical coaching (multidisciplinary); associativity – social capital; communication; and articulation of stakeholders. Result indicators for sustainability cover KPIs and the so-called F.I.E.T.S. criteria.[64]

In the words of the project director, five fundamental factors that contribute to achieving sustainability are:[65]

1. Multidisciplinary teams in the field
2. Good methodology of awareness raising
3. Relationship with the community
4. Articulation with actors
5. Knowing how to communicate

[64] See also Year 1 Report, Table 9. F.I.E.T.S stands for Financial, Institutional, Ecological/Environmental, Technical and Social.
[65] See also Year 5 Results to February 2018, p. 11.

Various interviewees emphasized that for the sustainability of the results, it is important that the community groups establish and strengthen relations with other institutions. Enhanced trust in the communities helps to strengthen the groups.

Another interviewed stakeholder indicated that there are results that are sustainable. For instance, there are *Manos al Agua* groups that have a clear vision and that know with whom they can relate themselves. The existence of such group is likely to contribute to sustainability of the results. An example has been given by another respondent: "*Manos al Agua* groups can contribute to sustainability, because they are already buying plots (for conservation) with the 1 percent of the budget of municipal governments destined at investment in environmental protection."[66] While *Manos al Agua* groups can contribute to sustainability, their scope of activity is usually limited to their own neighbourhoods, as they "are not yet strong enough to have action in other neighbourhoods. More time is required for that."

Various interviewees are worried that "the process will slow down if there is no accompaniment." An opinion that is also shared by other interviewees is that "sustainability could be improved if there were a post-execution phase of IWM" and that "the regular extension service does to some extent provide a basis for the sustainability of the interventions after the completion of IWM".[67] It has been argued that "in IWM, there was emphasis on having a good articulation of the extension service with the coffee committee. In the social area, the existence of the *Manos al Agua* groups helps, because they generate confidence in the region, but still no better strategy has been found for achieving sustainability. A post-execution phase could help to achieve that and would involve only a marginal cost. It would be good if for example the social extension worker could be maintained."

In terms of technical sustainability of IWM, examples given of technical improvements are 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 related view of another stakeholder is that a lot of techniques have been learned in the context of IWM, which will likely continue to be deployed in the communities, and that interventions appear to be sustainable and "will continue to be beneficial."

The articulation of stakeholders is considered one critical success factor for sustainability. This 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." In the same interview, it was indicated that "FNC and private resources are required for sustainability at a more local level." A related point emphasised by someone else is 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." The participation of children in the education and training activities is also seen as a factor that can contribute to sustainability.

[66] According to Article 210 of Law 1450 approved in 2011 (which modified Article 111 of Law 99 of 1993), municipalities have to dedicate at least 1 percent of their revenue to the acquisition and maintenance of water providing zones or the financing of payment schemes for environmental services and defines that the priority is that the resources are spent on the acquisition and maintenance of such zones (see, e.g., http://mercadosambientalescolombia.com/wp-content/uploads/2017/05/Cartilla-Art%C3%ADculo-111.pdf)

[67] This is in line with the remark of another interviewee that "the extension service will remain and will continue to multiply what has been learned in the IWM project."

A stakeholder mentioned that "the reduction in the contamination of the water will slow down. But the change in attitude, improved practices and the *ley de vertimiento* [environment law] will continue to help reduce the contamination, although without IWM it will be more difficult to get financial support for this."

A view expressed by a stakeholder in one of the departments is that with the IWM interventions, some coffee farmers may have reached a certain level of use of sustainable practices that allows them to enter more easily into a sustainability initiative for certification.

In terms of F.I.E.T.S. criteria and financial sustainability in particular, one respondent explained that the estimated cost per cubic metre of water of improving the water quality is rather low – about 50 Colombian pesos.[68] The respondent went on to say that "coffee cultivation is sustainable in the 25 river basins, not only economically, but also socially and environmentally, but there have to be economic returns to the coffee farmers. If *Manos al Agua* groups continue to exist, they can give continuity to the programme and the conservation of water."

However, various interviewees share the view that financial sustainability may be an issue regarding the *Manos al Agua* groups, as it is "difficult that all of them will get financial resources and execute projects; it is not easy to formulate projects and get resources."

Views on the potential for scaling of the IWM project

The IWM project was designed as a model that might be replicated elsewhere. In Colombia, there may be scope for replicating or, rather, scaling of the project, either within coffee-growing departments covered by the project, or in other coffee departments.[69] A challenge for the IWM project management is then to provide the tools and lessons learned to other organisations that want to use the model. One of the lessons learned is that it is key to have a year of planning prior to actual implementation. A legacy of the project is a series of publications on the concept and a systemisation and documentation of the experience of IWM.[70]

One interviewee argued that as "interventions lead to early and good results" they will "be scaled to other farming areas." Another interviewed stakeholder emphasised that the methodologies developed in the project are well-documented, which facilitates use of the results by others.

A key stakeholder explained that there were no concrete plans for scaling or a second phase of the IWM project for lack of financing, but that there were several requests from other organisations that would like to use the model and receive advice and materials produced by the project.

For example, the National Planning Department – the *Departamento de Planeación Nacional*, DNP – is an associate partner of the IWM project via the Water & Coffee Platform and wanted to use the IWM methodology as a model for replication of the intervention in post-conflict areas. It was asked by the former president of Colombia to formulate proposals for 12 projects in post-conflict areas and approached FNC to learn about the IWM model. It formulated a project that would use the IWM

[68] See also IWM Report Year 4, Result 5 - Sub-result 3, MoVs 3.1 - 3.2. Progress of Project 4 – WP 2 - Water Quality Studies, June 2017.

[69] PPPLab (2017) explains that simplistic approaches of replication, applying 'blueprints', may be ill-adapted to different contexts and that a thorough analysis of scaling barriers should be made and effective delivery mechanisms and new rules of the game should be realized in an effective strategy of scaling of pilot projects.

[70] See also IWM Final report, 31 August 2018, Annex 3i, p. 5.

methodology with a budget of 9 billion Colombian Pesos to be implemented in the post-conflict coffee zones of the department of Caquetá.

Another example is a potential project to be financed by a Water Fund to be established in Santa Marta and to be implemented in collaboration with the FNC, with various elements of IWM Colombia.

Similarly, FNC held conversations with parties involved in infrastructure development in Antioquia to see how the resources of compensation for the loss of territory could be used to finance a project with elements of IWM to compensate affected communities.

In addition, the *Comité de Caldas* used the IWM model to present a project to be implemented with local parties, while the departmental coffee committees of Magdalena, Valle del Cauca and Huila asked the IWM project for help in training local teams in forest and soil management, because they realised that the IWM intervention model in that field had worked well.

Finally, FNC management assigned a person to initiate efforts at an international level to obtain resources for a potential second phase of IWM. Various interviewed stakeholders indicated that 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 financially contribute to such a project would be required.

5. Results from Farm-level Survey: Take-up of Equipment and Trainings

This section presents the assessment of the effect of IWM on relevant output indicators for equipment and training take-up at the farm level. Section 6 shows indicators for outcome and impact. In both sections 6 and 7, we show mean values for treatment and control river basins in 2015 and 2017 and present differences-in-differences estimations. The column "DiD" in the tables shows the coefficient of a model that compares treatment and control river basins averaging the respective variable across all farms in the respective group. A regression model is used that controls for baseline values of the result indicators and, additionally, pre-intervention characteristics of the farms (see Annex 4). For the most important indicators, we show the distribution across the departments and compare provenance and maintenance of equipment at follow-up.

5.1. Coffee Processing

5.1.1. Water-saving Coffee-Processing Devices and Techniques

With regard to water saving during coffee processing, IWM encourages the adoption of equipment and behaviour that is listed in Table 10. IWM was successful in increasing the share of farms that do not use water in the pulping process and the share of farms that do not transport the pulped coffee with water (increase of 8 percentage points each). IWM also successfully promoted the use of tub tanks (increase of 10 percentage points). Usage of Ecomill and Becolsub is generally very low since it makes only sense for big quantities of processed coffee, whereas few farmers process corresponding quantities. For this reason, IWM started to promote the association of several farmers for jointly operating community wet mills equipped with Ecomill in the last year. Around seven percent of the farmers in treatment river basins plan to participate in such community wet mills.

Table 10: Share of farms having water-saving coffee processing devices and applying water-saving behaviour

	DiD	Control river basins		Treatment river basins	
		2015	2017	2015	2017
Dry hopper	0.025	0.35	0.40	0.46	0.53
Hydraulic separator	-0.003	0.00	0.00	0.00	0.00
Pulping without water	0.080*	0.51	0.58	0.57	0.72
Pulped coffee transported without water	0.077**	0.94	0.86	0.90	0.89
Tub tank	0.097**	0.22	0.30	0.23	0.41
Ecomill	0.001	0.00	0.00	0.00	0.00
Becolsub	0.000	0.02	0.02	0.04	0.04

Note: The column "DiD" displays the coefficient from a difference-in-differences estimation, controlling for baseline characteristics of the farms (see Section 4.2 for details). Standard errors are clustered at the river basin level.
*, **, *** represent statistical significance at the 10, 5, and 1 percent level, respectively.
Source: FDW Colombia farm survey 2015 and 2017.

Table 10 shows furthermore that also in control river basins, adoption of water-friendly equipment and behaviour increased 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 (see Table 11). Moreover, a large share of farms invested into the equipment using their own means. It can be seen in Table 11 that also in treatment river basins, only a small share of farms received the dry hoppers and tub tanks from IWM. Also, among treatment river basins, many farms invested into the equipment with their own money (almost 90 and 50 percent, respectively) or got it from other development projects.

Maintenance and cleaning of the equipment is in general slightly better in treatment river basins even though no stark differences exist with respect to the control river basins (Table 11). Interestingly, a large share of farms that have a tub tank do use less than the four rinsing rounds as recommended by IWM. This share is higher among treatment river basins. A possible explanation might be that farms in treatment river basins internalized water saving too much and now use too few rinsing rounds to ensure best-quality coffee.

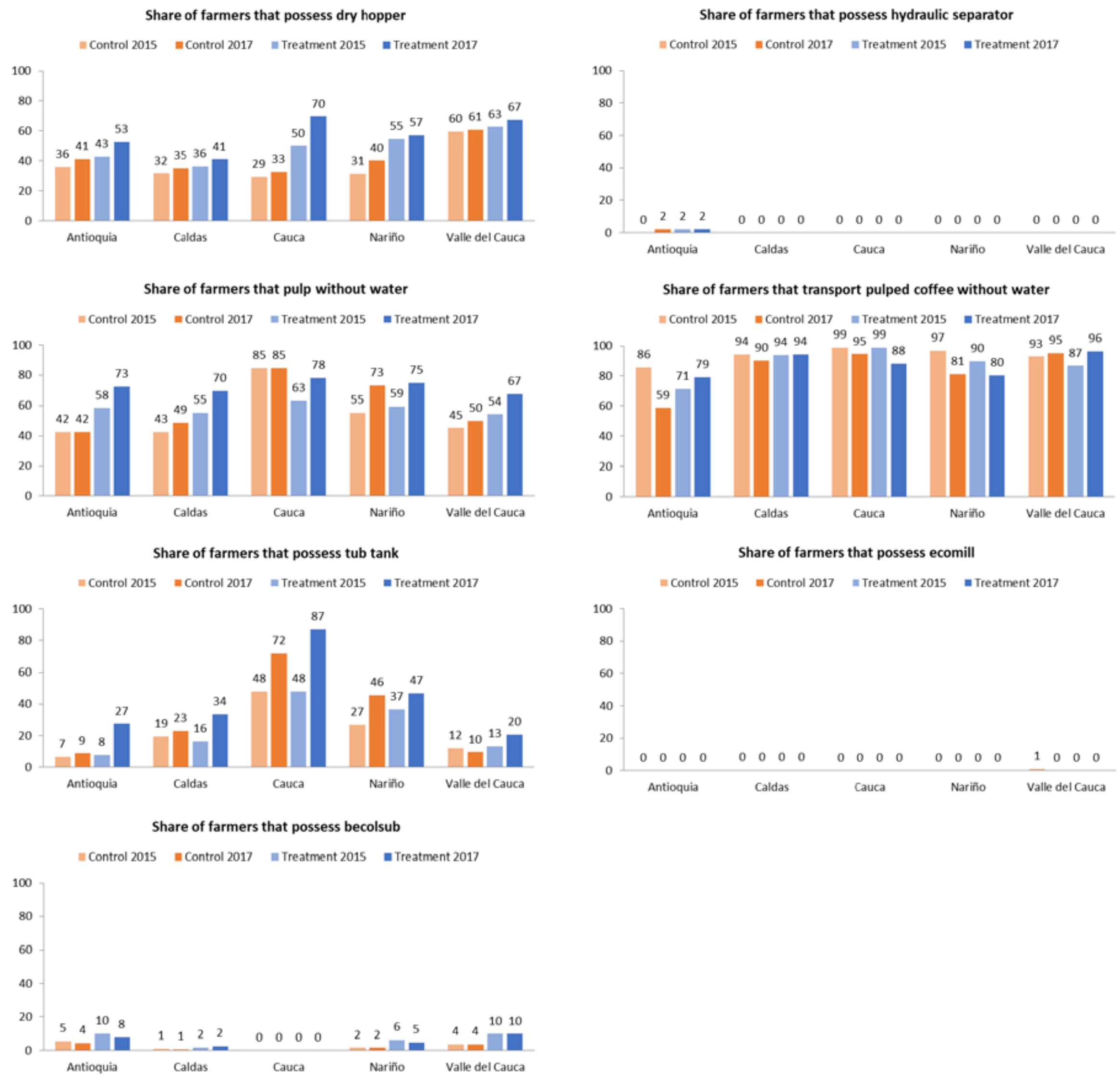
Table 11: Provenance and maintenance of dry hopper and tub tank (in 2017)

	Mean control	Mean treatment	Mean difference
Dry hopper			
Farm received dry hopper from IWM	-	0.048	-
Farm bought dry hopper with own resources or credit	0.914	0.888	-0.026
Farm received dry hopper from another programme	0.052	0.059	0.007
Farm maintains dry hopper	0.340	0.356	0.016
Farm cleans dry hopper	0.731	0.796	0.064*
Farm uses dry hopper	0.985	0.978	-0.007
Observations	*268*	*357*	
Tub Tank			
Farm received tub tank from IWM	-	0.278	-
Farm bought tub tank with own resources or credit	0.480	0.480	0.000
Farm received tub tank from another programme	0.495	0.235	-0.260***
Farm maintains tub tank	0.245	0.336	0.091**
Farm cleans tub tank	0.980	0.993	0.012
Farm uses tub tank	0.985	0.993	0.007
Farm applies four rinsing rounds	0.411	0.297	-0.114**
Farm applies less than four rinsing rounds	0.523	0.658	0.135***
Farm applies more than four rinsing rounds	0.066	0.045	-0.021
Observations	*204*	*277*	

Note: Only most common categories for provenance of devices are displayed. If devices were not received from a programme or bought with own resources/credit, the farmers listed among others the following provenances: inherited, device was already on the farm, gift or borrowed from family member/neighbour, does not remember. *, **, *** represent statistical significance at the 10, 5, and 1 percent level, respectively.
Source: FDW Colombia farm survey 2017.

Figure 8 illustrates that adoption varies substantially over departments. For example, usage of tub tanks is particularly high in Cauca, both among treatment and control farmers. Moreover, the increase in tub tanks is highest in Cauca.

Figure 8: Ownership of water reducing coffee processing devices and application of water saving behaviours, by departments



Source: FDW Colombia farm survey 2015 and 2017.

5.1.2. Coffee-processing Waste

Treatment river basins perform better than control river basins with regard to waste and wastewater generated in the coffee processing process (Table 12). More farms got a coffee-processing wastewater treatment system in treatment basins. This increase can be observed in all five departments (see Figure 9). IWM supported the installation of so-called SMTA (modular anaerobic treatment systems). These account for around 50 percent of all treatment systems in the treatment area (see Table 13). In control areas, only 34 percent have SMTAs. Looking at the provenance of the SMTAs, it can be seen that not all SMTAs in the treatment area have been received from IWM. This is in line with results from qualitative interviews that explained that IWM also tried to revive SMTAs that had been provided by the project *Huellas de Paz*, but that were not used by the farms. The approach was not always successful. In Cauca, for example, IWM revived 60 SMTAs. In Valle del Cauca, the IWM team did not succeed to revive any system. In the control group, farms mainly received SMTAs from other development projects or, to a substantially smaller degree, farms invested their private money into the SMTAs.

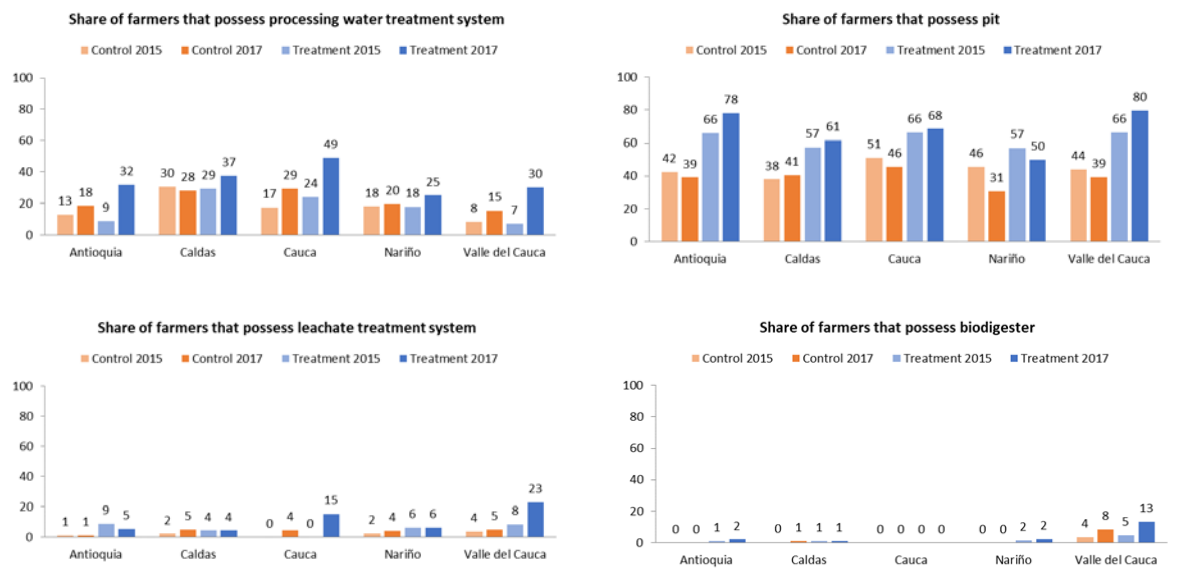
Table 12: Share of farms owning coffee processing waste treatment systems

	DiD	Control river basins		Treatment river basins	
		2015	2017	2015	2017
Coffee processing wastewater treatment system[a]	0.115***	0.21	0.24	0.21	0.35
Pit for pulp composting	0.076**	0.43	0.39	0.61	0.65
Leachate treatment	0.011	0.02	0.04	0.05	0.09
Biodigester	0.004	0.01	0.02	0.02	0.03

Note: The column "DiD" displays the coefficient from a difference-in-differences estimation, controlling for baseline characteristics of the farms (see Section 4.2 for details). Standard errors are clustered at the river basin level.
*, **, *** represent statistical significance at the 10, 5, and 1 percent level, respectively.
[a] The following systems and devices are rated as coffee processing wastewater treatment systems besides the SMTA (in order of prevalence): skimmers, biological filters, sewerage systems, infiltration fields, biodigesters, oxidation ponds, other treatment tanks, and the domestic wastewater treatment system.
Source: FDW Colombia farm survey 2015 and 2017.

When it comes to usage and maintenance of the treatment systems (Table 13), farmers in treatment river basins do not perform better than control basins. This is in contrast to what we heard in many qualitative interviews where IWM claimed that SMTAs would hardly be used in absence of the IWM intervention. Those farms that have an SMTA in control river basins even clean it more often than farms in treatment river basins. This effect might be driven by the fact that SMTAs do not have to be cleaned very frequently. Since most of the SMTAs in the treatment groups had been received from IWM they were relatively new and possibly there was no need to clean them so far.

Figure 9: Ownership of coffee processing waste treatment systems, by department



Source: FDW Colombia farm survey 2015 and 2017.

Table 13: Details on coffee processing wastewater treatment in 2017

	Mean control	Mean treatment	Mean difference
Farm actually realizes production wastewater treatment	0.831	0.840	0.008
Farm has (parts) of SMTA	0.344	0.574	0.230***
Observations	*160*	*237*	
Farm received SMTA from IWM	-	0.647	-
Farm bought SMTA with own resources or credit	0.182	0.029	-0.152***
Farm received SMTA from another programme	0.745	0.309	-0.437***
Farm maintains SMTA	0.545	0.588	0.043
Farm cleans SMTA	0.691	0.522	-0.169**
SMTA ends in artificial wetland	0.036	0.037	0.000
Observations	*55*	*136*	

Note: Only most common categories for provenance of devices are displayed. If devices were not received from a programme or bought with own resources/credit, the farmers listed among others the following provenances: inherited, device was already on the farm, gift or borrowed from family member/neighbour, does not remember. *, **, *** represent statistical significance at the 10, 5, and 1 percent level, respectively.
Source: FDW Colombia farm survey 2017.

The usage of pits for pulp composting increased slightly in the treatment basins, while it even decreased in control basins. The overall DiD-effect is accordingly clearly positive (Table 14). 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 14: Details on pit for pulp composting in 2017

	Mean control	Mean treatment	Mean difference
Pit with roof	0.924	0.950	0.026
Pit with floor	0.772	0.776	0.004
Pit with walls	0.958	0.943	-0.015
Pit with drainage tank	0.118	0.276	0.158***
Pit with sufficient size	0.593	0.573	-0.020
Farmer rotates the pulp in the pit	0.593	0.660	0.067*
Farmer adds additives to pit	0.392	0.425	0.033
Pit with worm culture pit	0.392	0.425	0.033
Farmer uses pit	0.981	0.984	0.003
Farmer ensures that pulp decomposes completely	0.814	0.833	0.020
Farmer uses composed pulp from pit as organic fertilizer	0.977	0.977	0.000
Observations	*263*	*438*	
Farms that don't have pit dispose pulp...			
At the coffee crops	0.445	0.481	0.036
At the ground or a heap	0.012	0.000	-0.012*
At the water source	0.509	0.481	-0.027
Observations	411	239	

Note: *, **, *** represent statistical significance at the 10, 5, and 1 percent level, respectively.
Source: FDW Colombia farm survey 2017.

For leachate treatment and biodigesters, no significant changes can be observed (Table 14). Biodigesters exist virtually only in Valle del Cauca (see Figure 9). This is consistent with findings from our qualitative interviews where people told us that farmers in Valle del Cauca have a preference for biodigesters and sometimes resist to adopt other wastewater treatment systems, such as SMTAs.

5.2. Domestic Water Usage and Domestic Waste

IWM promotes water-friendly devices also for domestic use. It has to be kept in mind that in the control area, a higher share of farms has a dwelling house on the farm and the difference is statistically significant (86 vs. 81 percent). This difference is important for analysing domestic water usage, since farmers who do not live on the farm do not have much domestic water consumption. We have run robustness checks for all analyses by restricting the sample to farmers that have a dwelling on their farm. All results can be confirmed.[71]

5.2.1. Domestic Water Saving Devices

IWM promotes water-saving devices also for domestic use. This includes low-water consumption toilets and flow restrictors. The use of these devices increased both in the treatment and control area, but stronger among treatment farms (Table 15). The overall DiD is clearly positive. Possibly, also a part of the increase among control farms is driven by the IWM intervention, since some IWM sensitisation campaigns took place over radio-programmes and in schools where possibly also control river basin children attend (see Section 3.2 for a more detailed discussion). IWM taught that it is very easy to implement water saving techniques (such as putting a bottle of water into the toilet cistern). If this was the case, we would underestimate the IWM impact and the true positive effect would be even bigger than the one we measure.

Table 15: Share of farms that possess water savers

	DiD	Control river basins		Treatment river basins	
		2015	2017	2015	2017
Water saver(s)[a]	0.178***	0.15	0.35	0.16	0.54

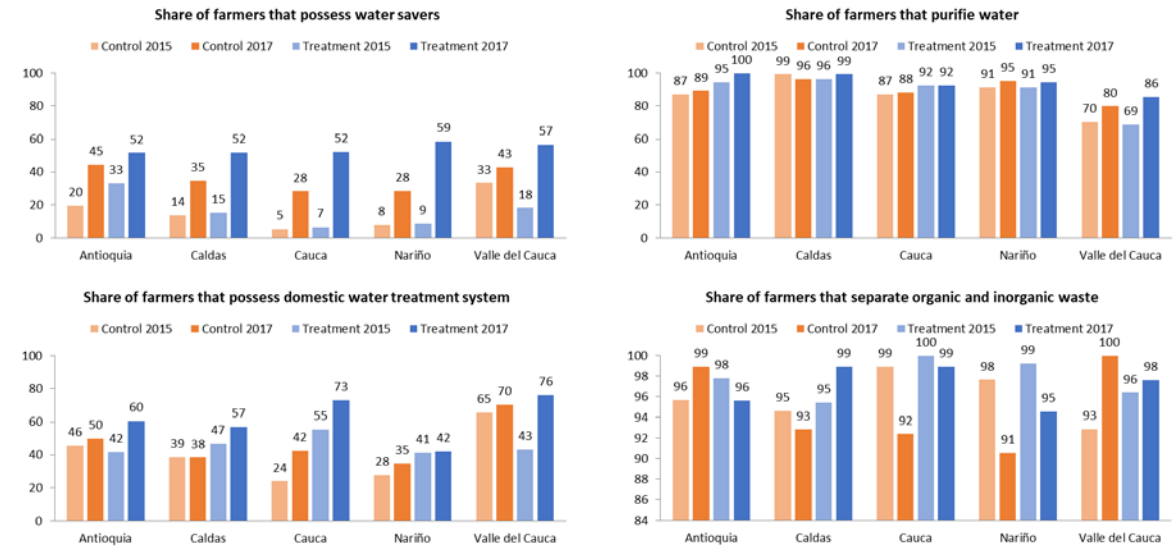
Note: The column "DiD" displays the coefficient from a difference-in-differences estimation, controlling for baseline characteristics of the farms (see Section 4.2 for details). Standard errors are clustered at the river basin level.
*, **, *** represent statistical significance at the 10, 5, and 1 percent level, respectively.
[a] Water savers include water saving installations in any of the following places: toilet, shower, sinks (laundry, kitchen, hand washing).
Source: FDW Colombia farm survey 2015 and 2017.

5.2.2. Domestic Water Treatment

More than 90 percent of all farms purify their drinking water, both among control and treatment river basins (Figure 10, Table 16). Most households boil their water for purification. Water filters, which are promoted by IWM, are used only by a small share, i.e. between six and 15 percent (Table 17). In general, farms in treatment river basins increased water purification, but also control farms did, even though to a smaller degree. The DiD is positive but statistically not significant (Table 16). Looking at regional differences, Valle del Cauca stands out with substantially less farms purifying their water. Here, on average only 80 percent of farms purify their drinking water (Figure 10).

[71] Results from robustness tests can be obtained from the authors on request.

Figure 10: Domestic water usage and waste disposal, by department



Source: FDW Colombia farm survey 2015 and 2017.

Table 16: Share of farms that purify drinking water

	DiD	Control river basins		Treatment river basins	
		2015	2017	2015	2017
Water purification	0.034	0.91	0.92	0.91	0.96

Note: The column "DiD" displays the coefficient from a difference-in-differences estimation, controlling for baseline characteristics of the farms (see Section 4.2 for details). Standard errors are clustered at the river basin level.
*, **, *** represent statistical significance at the 10, 5, and 1 percent level, respectively.
Source: FDW Colombia farm survey 2015 and 2017.

Table 17: Details on water filters

	Mean control	Mean treatment	Mean difference
HH has water filter	0.055	0.154	0.099***
Observations	*620*	*649*	
HH received water filter from IWM	-	0.560	-
Farm bought water filter with own resources or credit	0.471	0.180	-0.291***
Farm received water filter from another programme	0.471	0.260	-0.211***
Observations	*34*	*100*	

Note: Only most common categories for provenance of devices are displayed. If devices were not received from a programme or bought with own resources/credit, the farmers listed among others the following provenances: inherited, device was already on the farm, gift or borrowed from family member/neighbour, does not remember. *, **, *** represent statistical significance at the 10, 5, and 1 percent level, respectively.
Source: FDW Colombia farm survey 2017.

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 have it in 2017 (Table 18). A domestic wastewater treatment system consists of three parts that are necessary for a proper water treatment: a septic tank for water coming from the toilet, a grease trap for grey water coming from the kitchen and shower, and an anaerobic filter. Many of the systems do not have all three parts, though (see

Table 19). There is no difference between treatment and control river basins. With respect to grease traps, more treatment farms possess it. Treatment farms furthermore maintain the grease trap better than farms in control river basins.

Table 18: Share of farms having domestic wastewater treatment systems

	DiD	Control river basins		Treatment river basins	
		2015	2017	2015	2017
Domestic wastewater treatment system	0.084**	0.389	0.438	0.458	0.591

Note: The column "DiD" displays the coefficient from a difference-in-differences estimation, controlling for baseline characteristics of the farms (see Section 4.2 for details). Standard errors are clustered at the river basin level.
*, **, *** represent statistical significance at the 10, 5, and 1 percent level, respectively.
Source: FDW Colombia farm survey 2015 and 2017.

Table 19: Waste-water treatment in 2017

	Mean control	Mean treatment	Mean difference
HH actually realizes domestic wastewater treatment	0.875	0.908	0.033
HH has grease trap	0.729	0.810	0.081**
HH has septic tank	0.793	0.753	-0.041
HH has anaerobic filter	0.475	0.510	0.035
HH has complete septic system	0.451	0.495	0.044
Observations	*295*	*400*	
HH received grease trap from IWM	-	0.250	-
Farm bought grease trap with own resources or credit	0.233	0.207	-0.026
Farm received grease trap from another programme	0.702	0.500	-0.202***
HH maintains grease trap	0.786	0.852	0.066**
HH cleans grease trap	0.795	0.836	0.041
Observations	*215*	*324*	
HH received septic tank from IWM	-	0.243	-
Farm bought septic tank with own resources or credit	0.274	0.196	-0.077**
Farm received septic tank from another programme	0.628	0.495	-0.133***
HH maintains septic tank	0.581	0.635	0.053
HH cleans septic tank	0.513	0.558	0.045
Observations	*234*	*301*	
HH received anaerobic filter from IWM	-	0.270	-
Farm bought anaerobic filter with own resources or credit	0.136	0.113	-0.023
Farm received anaerobic filter from other programme	0.779	0.554	-0.225***
HH maintains anaerobic filter	0.714	0.681	-0.033
HH cleans anaerobic filter	0.643	0.613	-0.030
Observations	*140*	*204*	
Septic system ends in artificial wetland	0	0.040	0.040**
Observations	*133*	*198*	

Note: Only most common categories for provenance of devices are displayed. If devices were not received from a programme or bought with own resources/credit, the farmers listed among others the following provenances: inherited, device was already on the farm, gift or borrowed from family member/neighbour, does not remember. *, **, *** represent statistical significance at the 10, 5, and 1 percent level, respectively.
Source: FDW Colombia farm survey 2017.

5.2.3. Domestic Solid Waste

Domestic solid waste is normally separated into organic and inorganic waste. The share of farmers separating their waste is very high both in treatment and control river basins, no difference induced by IWM is observable (Table 20).

Table 20: Separation of organic and inorganic waste (mean values)

	DiD	Control river basins		Treatment river basins	
		2015	2017	2015	2017
Separation of waste	0.019	0.96	0.94	0.97	0.98

Note: The column "DiD" displays the coefficient from a difference-in-differences estimation, controlling for baseline characteristics of the farms (see Section 4.2 for details). Standard errors are clustered at the river basin level.
*, **, *** represent statistical significance at the 10, 5, and 1 percent level, respectively.
Source: FDW Colombia farm survey 2015 and 2017.

5.3. Soil Protection and Forestry Management

In order to protect the soil, the IWM intervention promotes different conservation practices that in many cases also contribute to protecting water sources. Most of the practices had already been executed by farmers at baseline (Table 21). Interestingly, 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 are performed less in 2017 than in 2015. The DiD coefficient documents a significant positive effect for establishment of protection areas and coverage with noble weeds. When looking at differences over departments, differences in the trends can be observed for several practices (Figure 11). For example, soil coverage increased both in treatment and control basins in Antioquia and Valle del Cauca between 2015 and 2017. In the remaining departments, it decreased over time.

The share of farmers that realizes burnings decreased slightly both among control and treatment river basins (which is the desirable direction of change) and no impact of IWM can be observed.

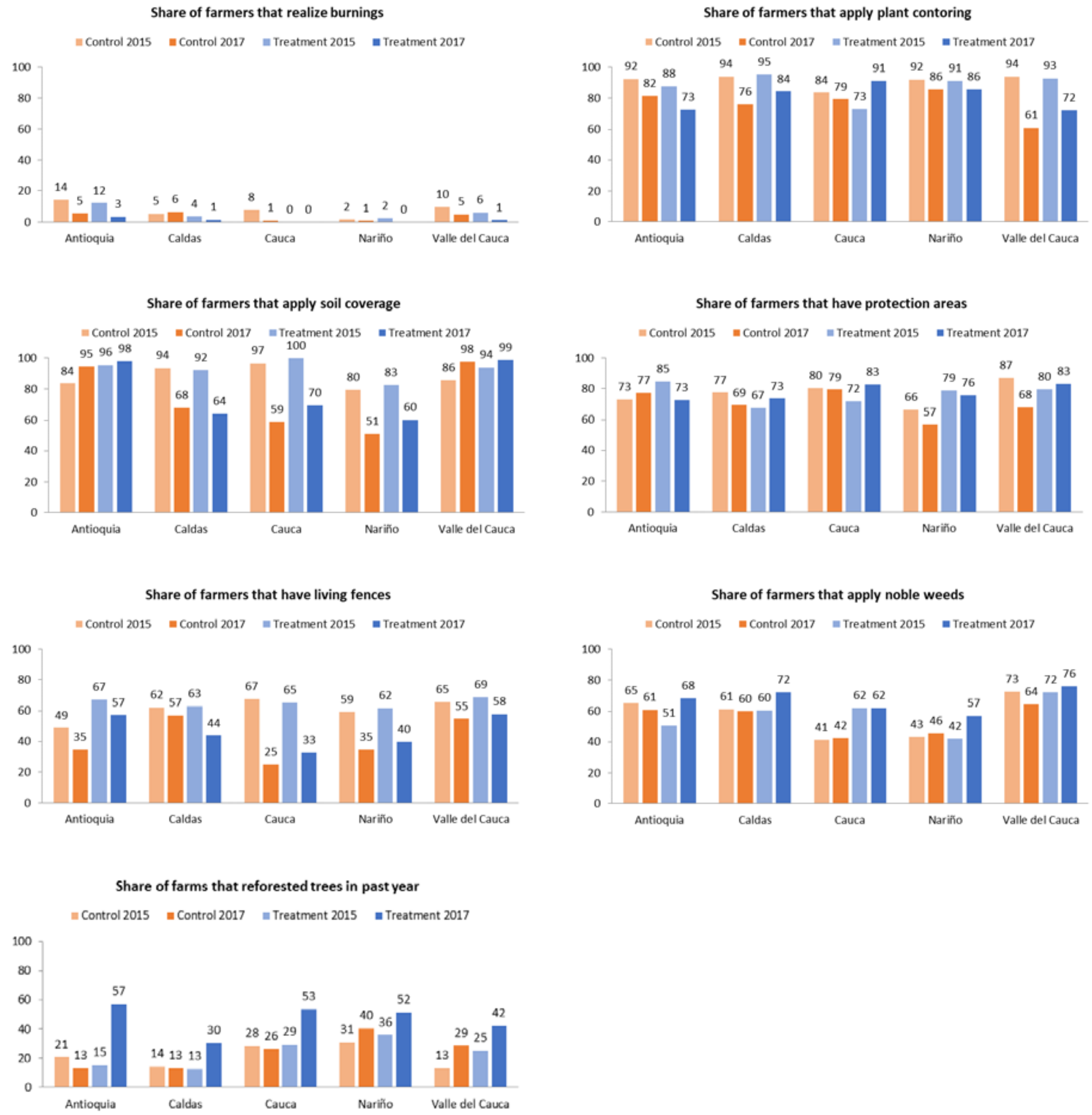
Table 21: Share of farms that performs soil protection practices and reforestation

	DiD	Control river basins		Treatment river basins	
		2015	2017	2015	2017
Share of farms that realizes burnings	-0.008	0.07	0.04	0.04	0.01
The five most applied conservation practices:					
Plant contouring	0.071	0.92	0.77	0.90	0.83
Soil coverage (plants)	-0.011	0.89	0.71	0.92	0.73
Protection areas	0.093*	0.76	0.69	0.74	0.76
Living fences	-0.035	0.61	0.45	0.64	0.45
Coverage with noble weeds[a]	0.120*	0.57	0.56	0.57	0.68

Note: The column "DiD" displays the coefficient from a difference-in-differences estimation, controlling for baseline characteristics of the farms (see Section 4.2 for details). Standard errors are clustered at the river basin level.
*, **, *** represent statistical significance at the 10, 5, and 1 percent level, respectively.
[a] Noble weeds are those weeds that do not compete with the coffee trees for nutrients, space, water or light.
Source: FDW Colombia farm survey 2015 and 2017.

The IWM intervention also had a clearly positive impact on reforestation activities. The total share of farms practicing reforestation activities is almost 20 percentage points higher in treatment river basins than in control basins. However, reforestation projects are also active in control river basins. In some departments, up to 40 percent of control farms exercise reforestation activities (see Figure 11).

Figure 11: Soil protection and reforestation, by department



Source: FDW Colombia farm survey 2015 and 2017.

Also, in treatment river basins, other programmes support reforestation activities. According to qualitative interviews, this led in some cases even to a competition between the different projects. The IWM interventions featured both reforestation activities where farmers were only provided with tree seedlings and activities where farmers received monetary incentives depending on the number and type of trees planted. In some cases, the reforestation activities without incentive were hard to implement, since farmers were used to get incentives through other programmes. The most important competing projects/programmes are reforestation activities of the German development bank KfW, “biodiversidad” and “PUR”.

The share of farmers that received an incentive for planting trees in 2017 is with 22 percent higher among treatment river basins than in control basins, where only 14 percent received an incentive

(Table 22). In 2015, the share of farmers that received incentives for planting trees is similar among treatment and control basins and around 14 percent. The number of trees planted is higher among treatment river basins with on average 186 trees compared to 104 trees among control river basins. The number of trees reforested is generally substantial higher if farmers received an incentive.

Table 22: Details on reforestation activities

	DiD	Control river basins		Treatment river basins	
		2015	2017	2015	2017
Farms that reforested trees last year	0.193***	0.20	0.22	0.21	0.43
Average number of trees reforested in last year	175***	160	104	77	186
Share of farmers that received incentive for planting trees	0.13**	0.14	0.14	0.09	0.22
Average number of trees reforested with incentive	786***	634	200	140	433
Average number of trees reforested without incentive	49	110	89	74	97

Note: The column "DiD" displays the coefficient from a difference-in-differences estimation, controlling for baseline characteristics of the farms (see Annex 3 for details). Standard errors are clustered at the river basin level.
*, **, *** represent statistical significance at the 10, 5, and 1 percent level, respectively.
Source: FDW Colombia farm survey 2015 and 2017.

5.4. Meteorological Stations

The IWM intervention installed meteorological stations in each department. In certain areas, these stations already existed at the time of the baseline data collection and a small share of farms had been aware of their existence (Table 23). IWM increased the awareness of farmers substantially, with a DiD of almost 20 percentage points. Still, only 26 percent of the farmers in treatment basins were aware of the meteorological stations.

The meteorological stations produce information on the climatic and weather conditions in the respective zone. This information is supposed to reach the coffee farms through extension workers, the radio or even the internet. The share of farms that received zonal information on weather inquiries or early weather warnings is very small in both areas. For weather warnings, the share of farmers is clearly higher among treatment basins, though.

Table 23: Awareness of meteorological stations and reception of weather forecasts and warnings

	DiD	Control river basins		Treatment river basins	
		2015	2017	2015	2017
Meteorological stations	0.184***	0.03	0.06	0.05	0.26
Weather forecasts	0.019	0.05	0.04	0.06	0.07
Weather warnings	0.065**	0.06	0.05	0.06	0.12

Note: The column "DiD" displays the coefficient from a difference-in-differences estimation, controlling for baseline characteristics of the farms (see Section 4.2 for details). Standard errors are clustered at the river basin level.
*, **, *** represent statistical significance at the 10, 5, and 1 percent level, respectively.
Source: FDW Colombia farm survey 2015 and 2017.

Figure 12: Awareness of meteorological stations and reception of weather forecasts and warnings, by department

Source: FDW Colombia farm survey 2015 and 2017.

5.5. Training

IWM provided different training modules on a variety of topics. In Table 24, we display the share of farms that participated in these trainings. We asked farms both at baseline and follow-up, whether they or another family member living on the farm had participated in any training on a particular topic. In qualitative interviews, though, it was emphasized that it was sometimes difficult for IWM farmers to tell in which training course they were exactly since one was given right after the other. Our indicator accordingly only measures those trainings that participants actively remember.

It can be seen that for virtually all topics, treatment farms have participated on average more in training than farmers in control river basins. However, also in control river basins, farms have participated in trainings on the same topics. The IWM trainings 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 (business management, associative practices, gender, generational renewal, human rights, forest management, and solid waste management). The coverage of treatment farms in 2017 is with between 70 and 80 percent highest for good agricultural practices, integrated water management and ecological coffee processing.

For some trainings, the share of farms participating also increased in the control group. Most notable increases exist for integrated water management, ecological coffee processing, soil management, and solid waste management. A small share of these additional trainings are due to spill-over effects, since some of the control farms are located in the so-called "area of influence" of IWM, i.e. they were also eligible for participating in trainings (see Section 3.2 for a detailed discussion). The number of farms in the control group that participated in IWM trainings is very low, though. To test robustness of our results, we perform sensitivity analyses for the training results by excluding the contaminated farms from the control group or excluding the department where the problem is most pronounced completely (Nariño). Excluding the farms does not alter our results substantially.

Table 24: Share of farmers that has participated in training on [...]

	DiD	Control river basins		Treatment river basins	
		2015	2017	2015	2017
Business management	0.200***	0.136	0.157	0.135	0.356
Associative practices	0.206***	0.297	0.341	0.344	0.595
Gender	0.190***	0.083	0.135	0.119	0.36
Generational renewal	0.209***	0.098	0.141	0.122	0.374
Human rights	0.222***	0.098	0.135	0.11	0.369
Good agricultural practices	0.158***	0.619	0.663	0.601	0.804
Integrated water management	0.140**	0.257	0.408	0.472	0.764
Wastewater management	0.278***	0.325	0.343	0.392	0.688
Ecological coffee processing	0.148**	0.393	0.504	0.451	0.712
Forest management	0.192***	0.288	0.329	0.372	0.607
Soil management	0.098	0.313	0.453	0.34	0.578
Establishment of seedbeds	0.055	0.352	0.329	0.343	0.375
Establishment of coffee plantations	0.082	0.346	0.421	0.32	0.479
Pest/disease management in coffee cultivation	0.089	0.66	0.585	0.645	0.659
Fertilization	0.028	0.604	0.614	0.617	0.656
Solid waste management	0.183***	0.297	0.412	0.392	0.691
Protection of plant and animal species	0.237***	0.276	0.269	0.285	0.516
Community participation	0.172***	0.175	0.159	0.188	0.344

Note: The column "DiD" displays the coefficient from a difference-in-differences estimation, controlling for baseline characteristics of the farms (see Section 4.2 for details). Standard errors are clustered at the river basin level.
*, **, *** represent statistical significance at the 10, 5, and 1 percent level, respectively.
Source: FDW Colombia farm survey 2015 and 2017.

In general, most trainings are offered by partners of the IWM project (FNC Central Office and Departmental Offices, *Fundación Manuel Mejia*, Cenicafé, Nespresso). Only a very small share of at maximum 5 percent was offered by other entities, such as NGOs and governmental organizations of different levels (e.g. local, municipal or departmental level). If we compare the intensity of training in treatment river basins versus control river basins, it turns out that in treatment river basins the trainings are on average only slightly longer than in control basins; while the average length of trainings in the treatment river basins is 3.4 hours, the respective average length in the control area is 2.8 hours.[72]

[72] We exclude control farms in the area of influence that might have participated directly in IWM activities.

6. Results from Farm-level Survey: Outcomes and Impacts

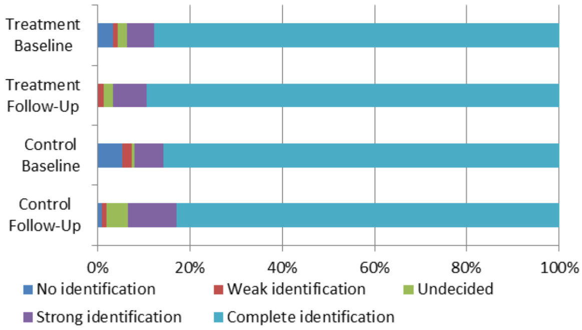
6.1. Water Conservation Attitude

For assessing attitudes concerning water conservation, we asked farms to specify their identification with several statements regarding water usage and attitudes towards water conservation. The statements were discussed intensively with the IWM team and partially stem from the IWM monitoring questionnaire. Respondents had to rate their identification on a scale from 1 to 5 (no identification, low identification, indifference, medium identification, and high identification). Figure 13 displays the rating for each statement.

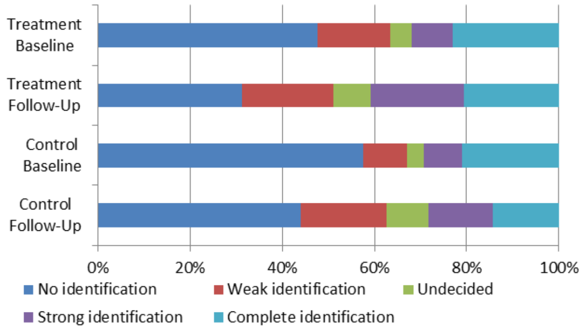
Figure 13: Attitudes towards water conservation

Domestic Water Conservation

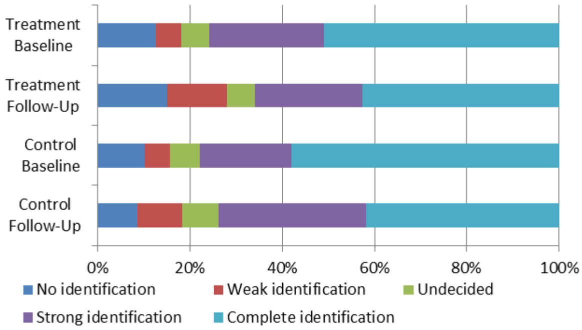
"I turn the water tap off when cleaning my teeth"



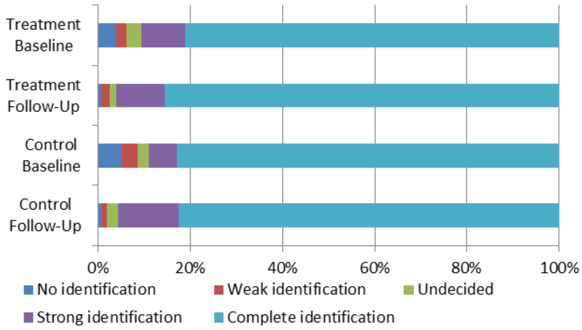
"I reuse my water for several tasks"



"I usually do not take long showers"

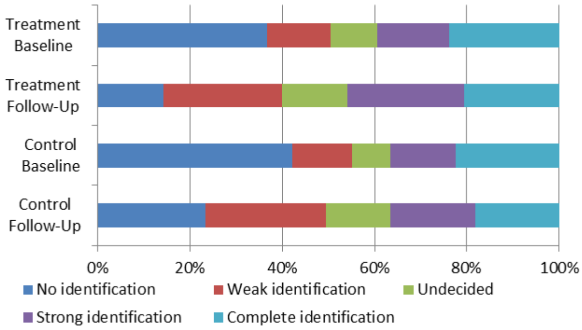


"I am frequently inspecting my taps, tubes and toilet for leaks"

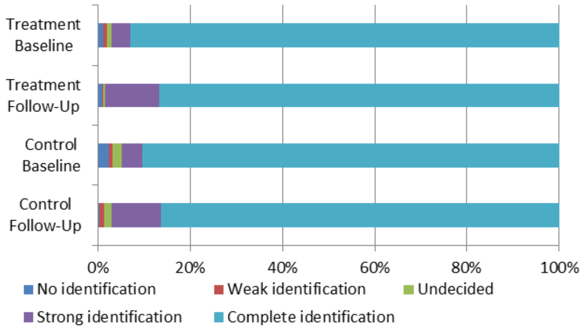


Processing Water Conservation

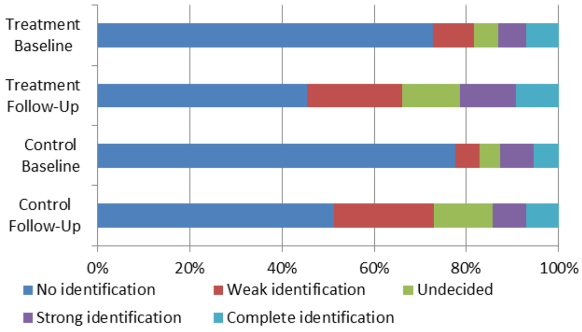
"Coffee can also be adequately washed with rational use of water"



"The disposal of production water in the river may affect the health of my family and neighbours"

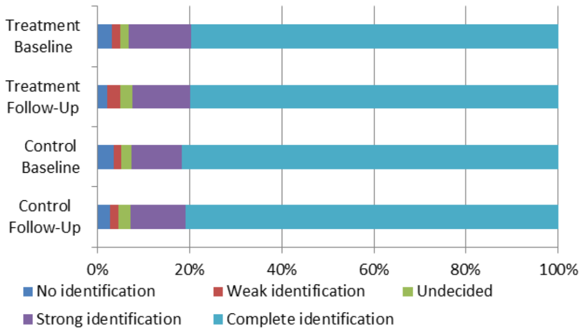


"Good practices do not only include those that guarantee a good coffee quality"

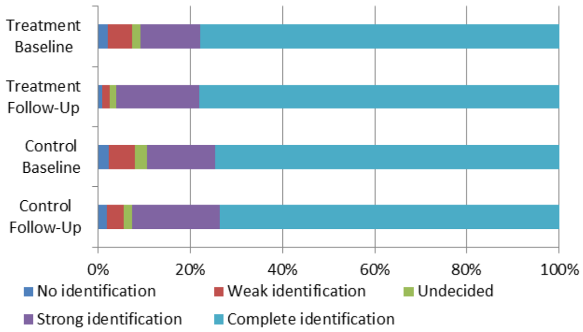


General Water Conservation

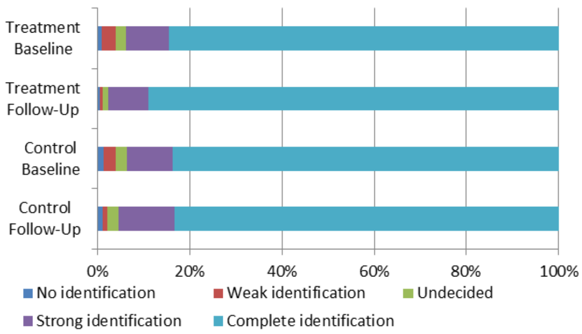
"Water is a finite resource"



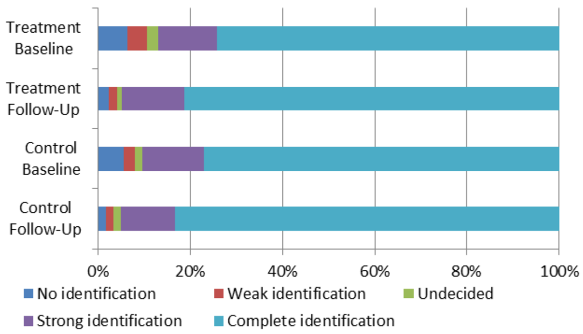
"In my household we save water"



"I save water although my neighbours don´t"



"Water conservation is not only a governmental obligation"



Source: FDW Colombia farm survey 2015 and 2017.

Figure 13 shows that many statements are widely accepted by households, already at baseline. Especially for domestic water conservation, farms widely agree with water saving practices. The statements are more controversial for processing water conservation. Especially "Coffee can also be adequately washed with rational use of water" and "Good practices do not only include those that guarantee a good coffee quality" are hardly accepted at baseline.

In order to compare attitudes over time, we constructed a binary indicator that equals unity if a respondent strongly or completely agrees with a statement (Table 25). In general, we see that for most statements, attitudes shift in favour of water conservation not only in treatment basins, but also in control basins. A substantially higher increase among treatment river basins can be observed in the domestic area for reusing water (*"I reuse my water for several tasks"*) and in the productive area for *"Coffee can also be adequately washed with rational use of water"* and *“Good practices do not only* *include those that guarantee a good coffee quality",* exactly the ones that exhibited low acceptance rates at baseline. However, DiD estimates (Table 25) show no statistically significant effects at conventional significance levels. Though, the p-values (not displayed here) are close to statistical significance (0.11, 0.28, and 0.24, respectively). Furthermore, power analyses for these indicators show that the effect sizes are just on the edge to be detectable at our sample size.[73] Accordingly, we cannot clearly rule out positive effects of at most around six to ten percentage points.

Table 25: Water conservation attitudes[a]

	DiD	Control river basins		Treatment river basins	
		2015	2017	2015	2017
Domestic water conservation					
"I turn the water tap off when cleaning my teeth"	0.016	0.92	0.94	0.94	0.97
"I reuse my water for several tasks"	0.099	0.29	0.28	0.32	0.41
"I usually do not take long showers"	-0.058	0.78	0.74	0.76	0.66
"I am frequently inspecting my taps, tubes and toilet for leaks"	-0.011	0.89	0.96	0.91	0.96
Processing water conservation		0.00	0.00	0.00	0.00
"Coffee can also be adequately washed with rational use of water"	0.065	0.37	0.37	0.39	0.46
"The disposal of production water in the river may affect the health of my family and neighbours"	-0.008	0.95	0.97	0.97	0.99
"Good practices do not only include those that guarantee a good coffee quality"	0.066	0.13	0.14	0.13	0.21
General water conservations		0.00	0.00	0.00	0.00
"Water is a finite resource"	-0.009	0.93	0.93	0.93	0.93
"In my household we save water"	0.021	0.89	0.93	0.91	0.96
"I save water although my neighbours don´t"	0.019	0.94	0.96	0.94	0.98
"Water conservation is not only a governmental obligation"	0.032	0.91	0.95	0.87	0.95

Note: The column "DiD" displays the coefficient from a difference-in-differences estimation, controlling for baseline characteristics of the farms (see Section 4.2 for details). Standard errors are clustered at the river basin level.
*, **, *** represent statistical significance at the 10, 5, and 1 percent level, respectively.
[a] Water conservation attitude in different domains (share with strong or complete identification vs. no or weak identification or undecided). Alternative indicator construction (index created with Multiple Correspondence Analysis; only share with complete identification) does not alter the results.
Source: FDW Colombia farm survey 2015 and 2017.

Furthermore, our estimates might be biased by spill-over effects from treatment to control areas. It has to be kept in mind that some IWM activities were promoted in the "area of influence", at schools or through the radio. We cannot rule out that radio spots also reached our control river basins or that control farm children attend schools where IWM intervened. This might have influenced attitudes also among control river basins. Yet, if we look at the size of changes in perceptions among treatment farmers, we see that these changes are rather small (around five percentage points). Accordingly, no substantial impacts can have happened, even if the true counterfactual situation was a zero change.

[73] Minimum Detectable Effect sizes are 0.11 percentage points for the "reuse of water" indicator, 0.11 for "Coffee can also be adequately washed with rational use of water" and 0.06 for "Good practices do not only include those that guarantee a good coffee quality".

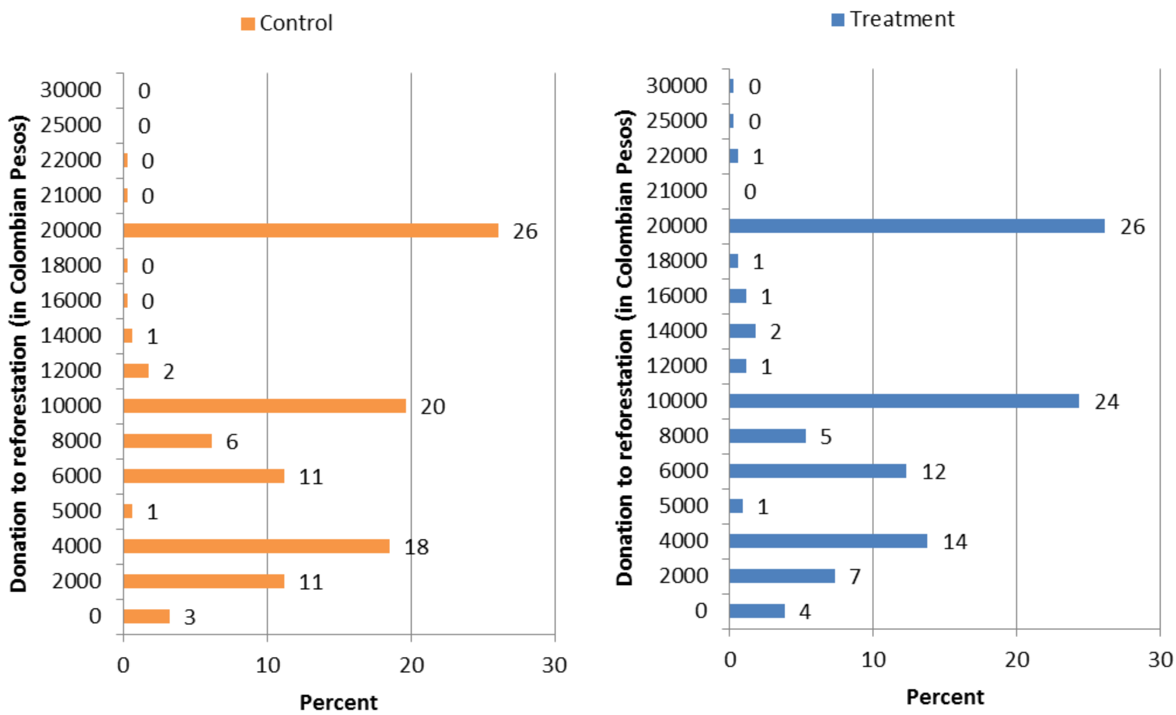
Possibly, awareness of the importance of water conservation increased generally since 2015 because of the extremely dry periods caused by the El Nino phenomenon in 2015/2016.

6.2. Attitude towards reforestation

In order to test attitudes towards reforestation, and environmental awareness in general, beyond the survey questions, we implemented a behavioural experiment among a representative sub-sample of 681 farms. In a so-called "dictator game", selected farms were provided with 20,000 COP (around 6 EUR) and had to decide how to split this money between themselves and a reforestation project. 20,000 COP is slightly below the daily minimum wage in 2017 of 24,600 COP and therefore a substantial amount of money. The decision requires farms to ponder individual, monetary short-term benefits through keeping the money against longer-term environmental benefits for the whole community through donating the money for reforestation. Although the context of the experiment is a donation for reforestation in the respective community, the donation can be interpreted as the attitude towards the environment more generally. The importance of reforestation and the implications for the environment (i.e. particularly the soil and water sources of the river basin) was emphasized throughout the whole project. Investing in community reforestation hence expresses valuation for environmental quality.

Figure 14 illustrates that around 25 percent of farmers in each group donated the whole amount (20,000 COP) to the reforestation project. Some farmers even added up to 10,000 COP from their own resources. In the treatment group, the second-biggest category of farmers donated exactly half of the money to the project and kept half of the money for them. In the control group, this category is smaller and more farms than in the treatment group donated only a fourth of the money to the project or even less.

Figure 14: Money donated to reforestation project, by group



Source: FDW Colombia farm survey 2017.

If we look at the simple mean difference between the two groups, farmers in treatment river basins donate 703 COP more than farmers in control river basins (Table 26). The difference corresponds to 4 percent of the money they were provided and hence it is rather small. Given this small effect size, we are not able to perform meaningful significance tests, since our study set-up only gives us power to detect differences of around 2,400 COP. We can accordingly only say that for sure that no statistically significant differences of the size of 2,400 COP exist. Possibly, treatment farms donated slightly more money than control farms.

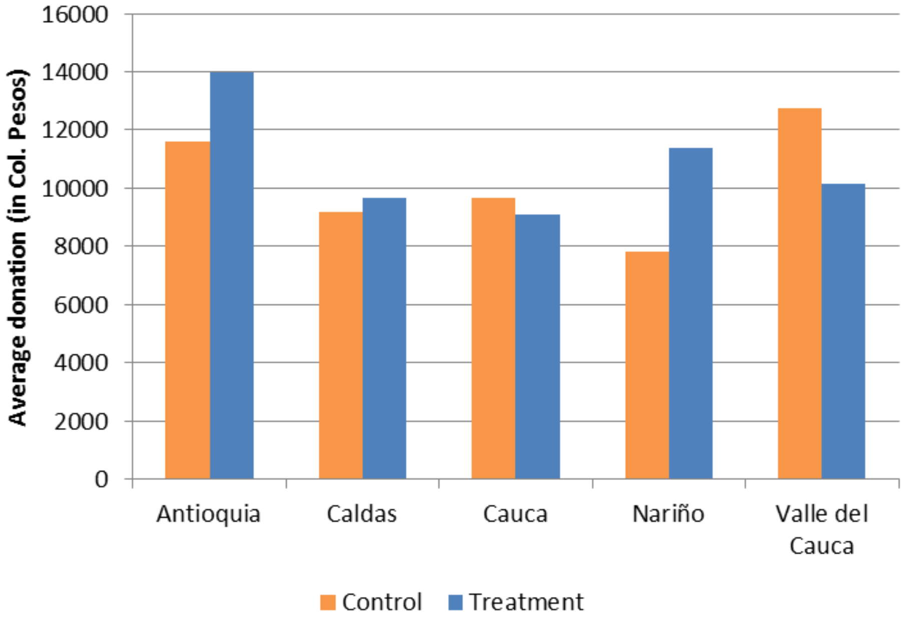
Table 26: Determinant of amount donated

Variables	(1)	(2)
Treatment	702.5 (0.562)	401.5 (0.661)
Head of HH is female		289.3 (0.670)
Age of head of HH		-30.5 (0.143)
Head of HH is literate		-493.6 (0.498)
Number of household members		-256.4 (0.190)
Wealth Index; 1. quintile		Ref.
2. quintile		2,283.6 (0.006)***
3. quintile		2,177.4 (0.001)***
4. quintile		3,204.1 (0.002)***
5. quintile		3,012.5 (0.000)***
Farm keeps records		1,599.5 (0.015)**
Secure land ownership		-167.5 (0.806)
Farm has sustainability label		975.6 (0.178)
Total area in coffee production		131.0 (0.229)
Total coffee production in 2014		0.9 (0.001)***
Water conservation attitude (index)		-534.5 (0.054)*
Department dummies		Included
Constant	9,856.3 (0.000)***	14,170.0 (0.000)***
Observations	681	681
Adjusted R-squared	0.001	0.098

Note: p-values in parentheses; all control variables are baseline values. *, **, *** represent statistical significance at the 10, 5, and 1 percent level, respectively.
Source: FDW Colombia farm survey 2015 and 2017.

If we look at difference on the department level, we see that only in Antioquia, Caldas, and Nariño, treatment farmers donate more than control farmers. In Cauca and Valle del Cauca, treatment farmers even donate less than control farmers (Figure 15). We test robustness of our results and exclude all observations from Valle del Cauca and Cauca. The difference between treatment and control farms gets only slightly higher. The difference is statistically not significant, but of course, also here our study set-up does not allow to say something about the significance of such small differences.

Figure 15: Donation for reforestation by department



Source: FDW Colombia farm survey 2017.

6.3. Sustainability Labels

Even though it was not an intended effect of IWM to increase the share of farms that have sustainability labels, effectively, more farms in treatment river basins obtained such a label, while the proportion decreased in control river basins (see Table 27).

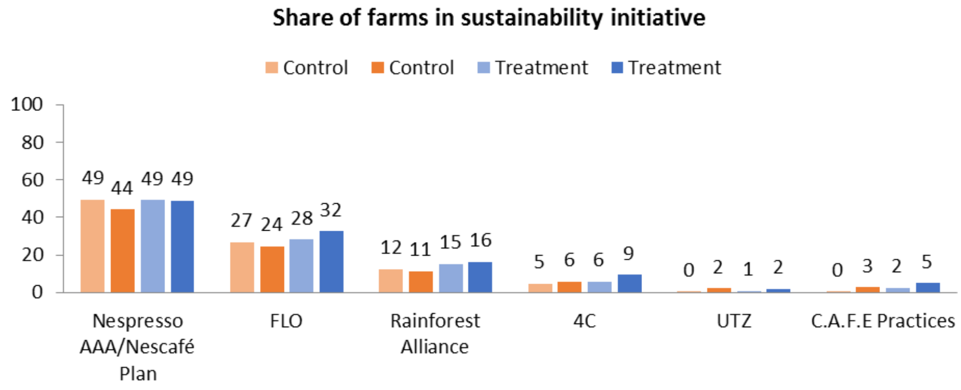
Table 27: Share of farms that participate in sustainability initiative

	DiD	Control river basins		Treatment river basins	
		2015	2017	2015	2017
Sustainability Initiative	0.099***	0.67	0.60	0.73	0.75

Note: The column "DiD" displays the coefficient from a difference-in-differences estimation, controlling for baseline characteristics of the farms (see Section 4.2 for details). Standard errors are clustered at the river basin level.
*, **, *** represent statistical significance at the 10, 5, and 1 percent level, respectively.
Source: FDW Colombia farm survey 2015 and 2017.

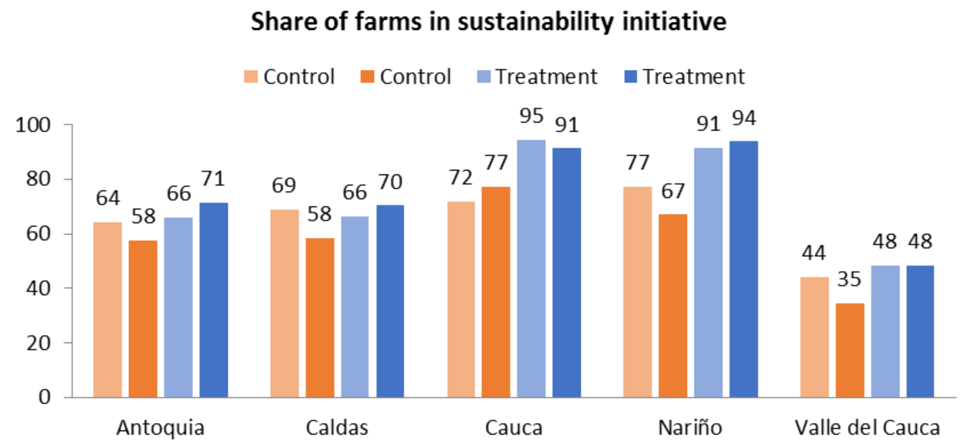
If we look more in detail in which sustainability initiative farms participate (Figure 16), it can be seen that the effects comes partially from the fact that less farms in control river basins participated in Nespresso's and Nescafé's initiative. This might actually be a negative effect of the IWM intervention because possibly Nespresso and Nescafé concentrated their activities within IWM river basins and neglected control basins. A substantial increase can be observed for the Fairtrade-FLO certification. When looking at the changes on the department-level, Cauca stands out with an opposite effect driven by more control farms and less treatment farms having a label (see Figure 17).

Figure 16: Details on sustainability initiative



Source: FDW Colombia farm survey 2015 and 2017.

Figure 17: Farms in sustainability initiative, by department



Source: FDW Colombia farm survey 2015 and 2017.

6.4. Gender

Various IWM trainings aim at creating awareness for gender topics and empowering women in the household and in the coffee business. We measure female empowerment by looking at (i) female decision power, (ii) equality of the relationship, and (iii) perceptions about female stereotypes.

Overall, we do not find significant effects on women empowerment. The only significant DiD coefficient is on women deciding over medical treatment of household members. All other indicators show no significant effects (Table 28, Table 29 and Table 30).

Table 28: Share of farms where female participates in decision process on different expenses

	DiD	Control river basins		Treatment river basins	
		2015	2017	2015	2017
(i) Female decision power					
Food expenses					
Female decides	-0.016	0.10	0.06	0.12	0.07
Men and women decide together	0.020	0.51	0.59	0.49	0.57
Expenses on other goods (personal hygiene, clothes, etc.)					
Female decides	-0.005	0.11	0.05	0.12	0.05
Men and women decide together	0.037	0.61	0.66	0.56	0.64
Household investments for (car, motorbike, household improvements)					
Female decides	0.008	0.04	0.01	0.05	0.02
Men and women decide together	0.032	0.64	0.73	0.62	0.75
Medical treatment					
Female decides	0.097**	0.24	0.12	0.19	0.17
Men and women decide together	-0.049	0.42	0.61	0.42	0.56
Female decides on coffee production	-0.013	0.11	0.10	0.15	0.12
Female decides on coffee cultivation	0.003	0.11	0.11	0.14	0.14
Female decides on coffee commercialization	-0.018	0.14	0.15	0.17	0.16
Female is in charge of housework	0.003	0.84	0.87	0.81	0.83
Men and women are in charge of housework	0.012	0.05	0.03	0.06	0.05

Note: The column "DiD" displays the coefficient from a difference-in-differences estimation, controlling for baseline characteristics of the farms (see Section 4.2 for details). Standard errors are clustered at the river basin level.
*, **, *** represent statistical significance at the 10, 5, and 1 percent level, respectively.
Source: FDW Colombia farm survey 2015 and 2017.

Table 29: Equal partnership; share of farms that agree

	DiD	Control river basins		Treatment river basins	
		2015	2017	2015	2017
(ii) Exchange of opinion between spouses					
Exchange of opinion between spouses[a]					
Almost always discuss about worries and feelings	0.003	0.81	0.75	0.79	0.74
Almost always converse about the economic situation of the HH	0.021	0.86	0.84	0.83	0.83
Almost always agree before taking economic decisions	0.011	0.86	0.86	0.83	0.85
Share of farmers that takes decision on child rearing jointly	0.003	0.81	0.75	0.79	0.74
Share of farmers that takes decision on family planning jointly	-0.005	0.84	0.81	0.83	0.79

Note: The column "DiD" displays the coefficient from a difference-in-differences estimation, controlling for baseline characteristics of the farms (see Section 4.2 for details). Standard errors are clustered at the river basin level.
*, **, *** represent statistical significance at the 10, 5, and 1 percent level, respectively.
[a] Original question gave four options: Always, almost always, sometimes, and never. The indicator represents the binary information whether the household answered always or almost always (=1) or a lower frequency (=0). Alternative specifications do not alter the results.
Source: FDW Colombia farm survey 2015 and 2017.

Table 30: Perceptions about female stereotypes; share of farms that agree with stereotype

	DiD	Control river basins		Treatment river basins	
		2015	2017	2015	2017
(ii) Perceptions about female stereotypes					
Women should concentrate on housework	-0.030	0.54	0.34	0.54	0.31
Women can manage a coffee farm	0.019	0.92	0.95	0.92	0.97
Women are good businesspersons	-0.011	0.87	0.94	0.89	0.95
Women have the same capacities to earn money as men	-0.031	0.89	0.96	0.89	0.93
Women should do what their partner tell them	-0.026	0.18	0.11	0.21	0.11
Men are better political leaders than women (for example in municipal or departmental committees)	-0.016	0.24	0.12	0.19	0.17

Note: The column "DiD" displays the coefficient from a difference-in-differences estimation, controlling for baseline characteristics of the farms (see Section 4.2 for details). Standard errors are clustered at the river basin level.
*, **, *** represent statistical significance at the 10, 5, and 1 percent level, respectively.
Source: FDW Colombia farm survey 2015 and 2017.

6.5. Group Membership

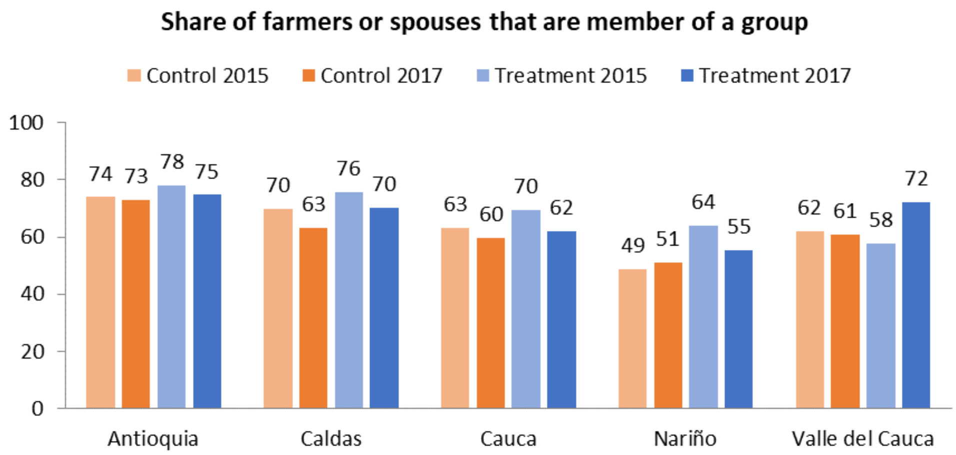
Overall, the IWM intervention had no effect on group membership. Only if we look at changes on the department level, we see a substantial increase of household members belonging to groups in Valle del Cauca (Table 31 and Figure 18).

Table 31: Share of farms where either head of HH, spouse, or both are active members in group

	DiD	Control river basins		Treatment river basins	
		2015	2017	2015	2017
Group membership	-0.006	0.65	0.61	0.71	0.67

Note: The column "DiD" displays the coefficient from a difference-in-differences estimation, controlling for baseline characteristics of the farms (see Section 4.2 for details). Standard errors are clustered at the river basin level.
*, **, *** represent statistical significance at the 10, 5, and 1 percent level, respectively.
Source: FDW Colombia farm survey 2015 and 2017.

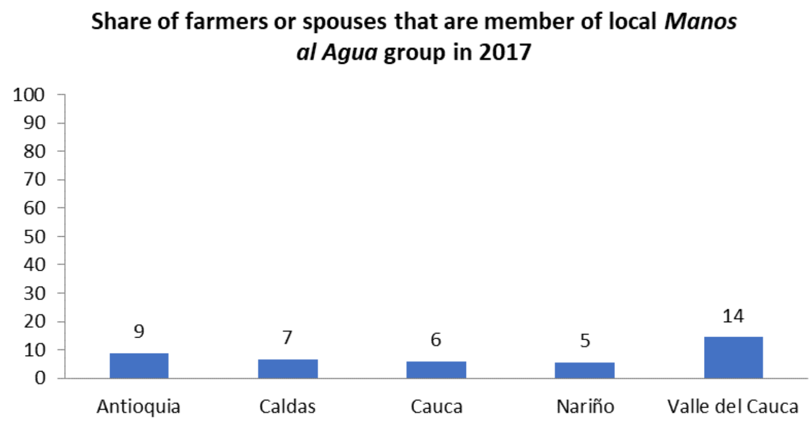
Figure 18: Group membership, by department (percentage shares)



Source: FDW Colombia farm survey 2015 and 2017.

The share of farmers who participate in the IWM established *Manos al Agua* groups is not very high. This does not come as a surprise since each groups consists only of around 25 members. Again, Valle del Cauca stands out with a disproportionately high number of farmers being member of the Manos al Agua group (Figure 19).

Figure 19: Membership in local Manos al Agua group, by department (percentage shares)



Source: FDW Colombia farm survey 2017.

6.6. Water Shortage and Water Excess

One of the ultimate goals of the IWM intervention is to counteract water shortages and detrimental effects of excess water, i.e. mudslides, landslides and avalanches. Table 32 shows that the share of farms affected by water shortage has been 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 are 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. Analyses in Section 5.3 showed that treatment farmer effectively planted more trees than control farmers. It can therefore be expected that it leads to positive impacts in the longer run.

Table 32: Share of farms with water shortage and water excess

	DiD	Control river basins		Treatment river basins	
		2015	2017	2015	2017
Farm experienced shortage of water in year prior to survey year	0.006	0.24	0.33	0.26	0.35
Farms with evidence of...					
... erosion	-0.029	0.29	0.33	0.34	0.35
... mudslides, landslides and/or avalanches affecting the residence	0.007	0.08	0.05	0.08	0.06
... mudslides, landslides and/or avalanches affecting the crops	0.036	0.28	0.25	0.33	0.33

Note: The column "DiD" displays the coefficient from a difference-in-differences estimation, controlling for baseline characteristics of the farms (see Section 4.2 for details). Standard errors are clustered at the river basin level.
*, **, *** represent statistical significance at the 10, 5, and 1 percent level, respectively.
Source: FDW Colombia farm survey 2015 and 2017.

6.7. Water Quality and Quantity

Tests of water quality and quantity have not been part of this evaluation. Hence, we have to rely on data collected by the project itself. The project measured water quality of the main river in all treatment river basins before and after the start of the implementation of the project's activities on the ground. IWM measures water quality and quantity before the river enters the intervention area (Point 1) and after the intervention area (Point 2). During its lifetime, the project also started a new approach, called 'dynamic monitoring', whereby monitoring was more intensive in a river basin, in terms of frequency and locations, which gave a better insight into the various sources of pollution in the river. Instead of monitoring at two points, the dynamic monitoring measured at eight locations along the river, in a campaign of typically one week per basin. This dynamic monitoring did not replace the regular monitoring, but was an addition to that.

IWM reports an average increase in water quantity ("flow rate") of 158% at Points 1 (before the river enters the IWM intervention area) and of 31% at Points 2 (after it leaves the IWM implementation area) in the Year 4 report. IWM claims, in its reporting in the mentioned documents, this increase is influenced, among other factors, by awareness-raising campaigns and IWM implementation processes, since water supply due to rainfall on average decreased (Report Year 4; Annex 1 – Consolidated Summary-Water Quality Report). Moreover, it reports an increase in overall water quality in 19 of the 25 river basins by comparing initial and average conditions (Report Year 4; Annex 1 – Consolidated Summary-Water Quality Report).

Regarding water quantity, we argue that the results cannot be attributed to the IWM intervention. We have four major concerns:

1) It is not plausible that an increase in quantity of water in the river before entering the intervention area (Point 1) is caused by the IWM intervention. IWM activities are concentrated on the river basin that is located downstream of Point 1.
2) The documented effect size of 158% seems unrealistically high even if this increase was measured within the river basin. The intervention's main activities to increase water quantity are reforestation activities. The implementation of these activities started in 2015. It is not plausible that in around two years substantial effects from reforestation activities materialize. Changes in water use at the farm level can neither be expected to influence water quantity substantially, since farms normally do not extract water permanently, but rather pour used water back to the system (directly to the river or via the soil). Accordingly, changes in water quantity used by farmers do not affect overall water availability. IWM's claim of an increase in water quantity stands also in contrast to our result that in 2016 more farmers experienced water shortage as compared to 2014 (see Section 9.6).
3) We discussed our impressions and conclusions with water experts from Wageningen University & Research (WUR) involved in the water measurements. The team confirmed that the measurements performed on water quantity were not able to reliably inform about the overall water quantity. The purpose of those measurements (discussed in various meetings of the TSC, Technical and Scientific Committee) was more about investigating the 'dilution' possibility of pollutants than about estimating water quantities (and the team reported it was an issue of internal debate). According to them, water measurement in only two points in the river and only for few hours are not reliable because in the Colombian climate, conditions can change quickly. Even over the measurement period, fluctuations of more than 50% have been measured. For properly measuring overall water quantity, the use of permanent monitoring

stations would have been necessary. This was discussed in TSC meetings but discarded due to cost reasons.

4) The project furthermore claims that IWM led to on-farm water savings of 305.300 m3/year. This number is estimated by comparing equipment used in the coffee processing before and after the intervention. Equipment specific water consumption values are assumed based on theoretical technical consumption values (no field measurements) (see Calderón and Rodríguez 2018). For the interpretation of these numbers, it has to be mentioned that farms do not extract water permanently from the river basin. Farms normally use water in the coffee processing and afterwards lead it back to the eco-system. By using less water in the coffee processing, the amount of water available in the eco-system is not increased. Obviously, water quality decreases during the coffee process and this is why it can be seen as a positive impact if less water is used since hereby less water is polluted during the coffee process. Moreover, the lower water consumption on the farm level is an important step to increase resilience of farmers to water shortages since they are able to process their coffee also in periods with lower water levels.

Regarding water quality, we would like to highlight the following patterns, which are partly also acknowledged in IWM publications:

1) The IWM publications show that the coffee landscape and rivers have a high natural attenuation capacity and can partially recover naturally from contamination generated by the coffee sector. First of all, contamination of the main river generated by the coffee sector is only temporal during the harvest season. In non-harvest seasons, rivers partially recover naturally (de Miguel 2018). The central IWM publication on water quality measurements (Rodriguez et al. 2018) clearly states that the contamination effect "is minimized by [the water bodies'] high self-purification capacity" (p. 51). Second, in some river basins it has been observed that water quality even improves between P1 and P2, even in harvest season (Rodriguez et al. 2018)[74]. This second point means that under certain conditions, the natural attenuation capacity of the coffee landscape and the rivers is so high that no water quality deterioration in the main river can be observed. This is in line with our observations from farm interviews showing that contamination of the main river is often indirect and contaminated water is already filtered by the soil when the water reaches the main river: Only a relatively small share of farms pours wastewater or production waste directly to a water source and even less pour it directly to the main river.
2) The KPI indicator used by the project to measure water quality shows substantial variation over time. However, the indicator does not always react to the harvest period. In some river basins, the indicator documents a better water quality during harvest than during non-harvest (e.g. in La Liborina in Rodriguez et al. 2018, p.76). Apparently, other pollution sources than coffee processing are more important here for water quality. WUR remarked that the KPI for water quality is an 'inclusive' indicator, combining physical, chemical and environmental impacts on water quality. That is partially explaining the variations in KPI. It is acknowledged in IWM publications that the impact analysis was sometimes hampered because of a substantial contamination of the water from other (non-coffee) sources: "pollution sources in

[74] Water quality improves between P1 and P2 in the following river basins: Rio Buey in M3 and Quebrada La Leona in M3 and M4 (Antioquia); Rio Pácora in M2 and Quebrada La Frisolera in M3 (Caldas); Quebrada Santo Tomas in M1 to M7, Rio Quilcacé in M1, M4, M6 and M7 (Cauca); Rio Azufral in M2 (Narino); Rio La Paila in M1, M2, and M4, Rio Barragan in M1, M3, M5, M6 and M7, Rio San Marcos in M4 (Valle del Cauca).

the river basins other than coffee production, such as urban areas and livestock or industrial activities, have an important impact on water quality, not being possible to discriminate the effects of each" (Rodriguez et al. 2018, p.51). Experts from WUR confirmed that the rivers suffered from substantial pollution from other sources and pollution levels that can be attributed to the coffee sector were smaller than originally thought. The coffee sector accounted for clearly less than 55 percent of the pollution, as it had been claimed by the World Wildlife Foundation (WWF 2012).

3) From our understanding, the central question regarding water quality is whether the level of pollution that is (temporally) caused by the coffee sector is problematic or not from an environmental and health perspective. Experts from WUR explained that the study is unable to answer this question in a definite way, because depending on contextual factors, different levels of contamination can be acceptable. First, water quality at influx (P1) influences the ability of the river to recover naturally. This water quality is highly variable due to different pollution sources upstream. Second, depending on water use downstream of the river basin, certain levels of pollution might in one case be tolerable, in other cases they are not. For example, downstream of one river basin (beyond P2), the water flows directly into a water treatment plant (River basin "La Chaparrala"). Here pollution can easily be filtered out. If the river flowed into a big, pure river, it would neither be problematic. In turn, if several rivers from coffee areas flow together and water downstream is used for example as drinking water or for example for crop irrigation, the pollution levels might be more problematic. In any way, it seems safe to conclude that, given the current level of knowledge, it is not clear that measured contamination levels always require action from an environmental and health perspective. At the same time, the experts from WUR mentioned that, in their view, the coffee sector surely affects the water quality in river basins, with an environmental and health impact, but that the situation differs per river basin.

4) In any way, from the farmers' perspective, action is needed because the Colombian law clearly defines maximum acceptable pollution levels for dumping coffee wastewater into surface water bodies (*Resolución 631 del 2015*, see *República de Colombia* 2015 in Annex 2). When coffee is processed in the conventional way, contamination thresholds for BOD_5 and suspended solids defined by the new legislation, are exceed by roughly a factor ten. However, given the insights from water quality measurements performed by IWM, it becomes clear that the thresholds defined in Resolution 631 have not been set based on empirical studies in the field (which actually is a compliment for the project's work). To our knowledge, the IWM measurements are unique in Colombia with regard to the level of detail and the realistic context in which data has been collected (actual contamination of water bodies in coffee areas during coffee harvest). The IWM results suggest that the law's threshold might be defined in a too restrictive way.

IWM documented an increase in water quality in 19 out of the 25 IWM treatment river basins in 2017 (Report Year 4; Annex 1 – Consolidated Summary-Water Quality Report). In order to see whether this difference can also be observed in terms of equipment adoption (using 2017 survey data), we analysed adoption across the "no-improvement" and the "improvement" river basins.

Table 33 shows that no substantial differences can be observed. This leads to the conclusion that whether an improvement in water quality has been achieved or not is apparently not driven by the level of activity of IWM. Possibly, other landscape-based factors are more relevant for this. Of course, we have to mention here that we only have data on Year 1 farms. So possibly later activities might be able to explain the differences.

Table 33: Share of farms using water friendly equipment and behaviour distinguished by river basins with improved water quality according to IWM Results 4 report and non-improved water quality

	DiD	Not-improved		Improved	
		2015	2017	2015	2017
Dry hopper	-0.013	0.632	0.712	0.418	0.486
Hydraulic separator	0.020	0.016	0	0	0.004
Pulping without water	0.023	0.68	0.808	0.549	0.699
Pulped coffee transported without water	-0.001	0.864	0.856	0.908	0.899
Tub tank	-0.034	0.312	0.52	0.21	0.384
Ecomill	0.000	0	0	0.002	0.002
Becolsub	0.025	0.064	0.04	0.04	0.042
Farm owns coffee processing wastewater treatment system	-0.054	0.144	0.328	0.225	0.355
Pit for pulp composting	0.010	0.664	0.696	0.594	0.636
Domestic Watersaver	-0.000	0.16	0.544	0.154	0.536
Domestic wastewater treatment system	0.084	0.504	0.568	0.447	0.596
N		125	125	552	552

Note: The column "DiD" displays the coefficient from a difference-in-differences estimation, controlling for baseline characteristics of the farms (see Section 4.2 for details). Standard errors are clustered at the river basin level.
*, **, *** represent statistical significance at the 10, 5, and 1 percent level, respectively. The group of "not-improved" riverbasins include: La Chaparalle, in Andes, Antioquia; El Marqués in Rosas, Caldas; Quilcacé River in Sotará, Caldas; Q. La Fragua in La Unión, Nariño; Q. El Molino in San Lorenzo, Nariño; and Barragán River in Caicedonia, Valle del Cauca.
Source: FDW Colombia farm survey 2015 and 2017.

7. Concluding Remarks

This report presented the results of the in-depth impact evaluation of the "Intelligent Water Management Colombia" (IWM) intervention co-financed through the Sustainable Water Fund of the Netherlands Ministry of Foreign Affairs. The intervention is designed to improve water management among coffee farmers by information and sensitization campaigns, training, hardware distribution, reforestation activities and an improved institutional environment. The intervention is motivated by the fact that traditional coffee processing in Colombia requires considerable amounts of water after harvesting. While in Colombian coffee growing areas water is generally not scarce, water availability is periodically low and water shortages sometimes result in substantial losses in coffee production. Furthermore, depending on the processing practices, the wastewater can have considerably elevated organic load, high amounts of suspended solids, and low pH levels. Environmentalists frequently suspect that these effluents contribute substantially to the contamination of surface water bodies. In the public discussion, the coffee sector is often accused to contribute substantially to overall water contamination (see for example WWF 2012). As a consequence, Colombia defined maximum pollution levels for the coffee sector for dumping wastewater into surface water bodies when updating their general wastewater legislation that came into force in 2016. Traditional water-using practices lead to water contamination that transgress the Colombian standards allowed for the coffee sector by roughly a factor 10.

The first result of this evaluation is that IWM was very effective in implementing the IWM intervention. The interventions managed to reach even more beneficiaries than originally planned by securing additional funding sources along the way. The very flexible approach that allowed them for example to also revamp water friendly equipment that had already been at the farms but had not been in use, furthermore maximized the interventions' outreach. This finding emerges both from farm-level interviews as also from the stakeholder analysis; 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. Interviewed stakeholders tend to agree that a long (one-year) planning period was key for an adequate implementation of project activities.

When it comes to outcomes and impacts of the IWM intervention, the picture is less clear. Most importantly, additionality of the IWM intervention is a priori not completely clear. Our control group, i.e. river basins that were not targeted by the IWM intervention and experienced normal FNC extension service, shows that none of the IWM-promoted equipment and few of the training activities are new and exclusively promoted by IWM. Also, in other river basins equipment has been promoted and training has been provided. In the case of reforestation activities, IWM was sometimes even confronted with direct "competition" with other reforestation activities. The IWM interventions featured both reforestation activities where farmers were only provided with tree seedlings and activities where farmers received incentives depending on the number and type of trees planted. In some cases, the reforestation activities without incentive were hard to implement since farmers were used to getting incentives through other programmes. IWM claims that the IWM project is different in that it promotes a more comprehensive approach of accompanying technical assistance with information and training campaigns, as well as targeting the institutional framework. It takes a community and landscape perspective ("the river basin") as opposed to interventions that consider exclusively the individual farmer perspective and expects the bundled promotion to create higher environmental awareness and to produce more sustainable result.

By comparing changes over time in both the IWM treatment river basin and the control river basins, we conclude that IWM can be seen as an intensification of already existing strategies and that IWM was able to reach more than previous and alternative promotion endeavours in terms of equipment promotion. Adoption of promoted equipment is higher in treatment river basins than in control basins. The same is particularly true for reforestation activities. More trees have been 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, our assessment is more mixed.

By directly comparing attitudes towards the environment in treatment and control basins, we find no clear indication for a higher awareness among treatment river basins. Our farm data also suggest that for example the information produced by IWM-financed meteorological stations does hardly reach the farmers. However, the establishment and strengthening of Manos al Agua groups seem to have the potential for social capital construction. Some of them have established links with local governments and direct contacts with coffee buyers. These groups can be an important factor for the sustainability of the project's results, even though several of these groups also need to establish stronger relationships with other local actors. In addition, the establishment of the Water & Coffee Platform that brings many stakeholders together can be seen as an asset when it comes to sustaining the dynamics of the intervention over time. Moreover, the project apparently increased awareness for water-related topics within the sector. The project generated spin-offs over the implementation phase and obtained additional (financial and in-kind) contributions from Water & Coffee Platform members.

Another very important finding emerges from our assessment of IWM measurements of impacts on water quantity and water quality. We observe that the level of knowledge on the effect of the coffee sector on surface water bodies has substantially increased through the IWM intervention. To our knowledge, the IWM measurements are unique in Colombia with regard to the level of detail and the realistic context in which data has been collected (actual contamination of water bodies in coffee areas during coffee harvest). However, we do not agree with the conclusions from the water measurements that the IWM project draws.

First, we argue that it is not plausible that effects on water availability can have materialized over the timeframe of this evaluation. The main channel through which the IWM intervention could increase water availability is via reforestation activities. While we do observe that in treatment river basins effectively more trees have been planted in comparison to control river basins, it is not plausible that any of these reforestation activities results in better water quantity within a timespan of only three years.

Second, we argue that given the current level of knowledge it is not clear whether water pollution that is caused by the coffee sector is problematic or not from an environmental and health perspective. The IWM measurements of water quality show that the coffee landscape and the main rivers have a high natural attenuation capacity and can recover naturally from contamination generated by the coffee sector. 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. The measurements also show that other pollution sources that are not related to the coffee production (e.g. urban settlements or animal production) might be more relevant to tackle if water quality is to be improved.

On the one hand, these insights question the relevance of the IWM intervention from the pollution point of view, since it might have been more relevant to tackle other pollution sources. On the other hand, 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. The IWM results suggest that the law's threshold might be defined in a too restrictive way and the results might be very valuable to draw the attention of Colombian policy makers towards other pollution sources and to reconsidering pollution thresholds for the coffee sector.

When it now comes to cost efficiency, it has to be mentioned that effect sizes at farm level are generally very small, also for equipment adoption. Hardly any indicator shows increases of more than ten percentage points. This is partly explained by the fact that IWM implemented a broad range of activities and intervened at farms in very different areas (domestic water use, productive water use, water saving and water contamination, etc.). This was a key challenge when designing this evaluation and it explains why we included a wide range of indicators to measure effects of IWM. Having this in mind, we would not expect every indicator to respond to the IWM intervention for each household and consequently do not expect substantial changes on the individual level. However, additionally we observe hardly any attributable improvement in environmental awareness at the farm level. More positive results only emerge on the institutional level with the increased knowledge on the apparently lower damage to water quality of the coffee sector and the establishment of local *Manos al Agua* groups and the Water & Coffee Platform.

It is important to emphasize that the focus of the evaluation of the IWM project was on environmental awareness and water management in a context of climate change and new environmental legislation, as well as on the role of the partnership of the key stakeholders. 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 the 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." We can conclude that it cannot be expected that IWM will 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.).

We see the following lessons learned from this evaluation:

- Apparently, upon the funding decision, it was not clear that most of the equipment and training provided by the project had already been provided prior to IWM, which raises concerns about the additionality of the IWM intervention. This could have been known already before the start of the intervention by performing a very short fact finding mission to inform the funding decision.
- Similarly, it would have been recommendable to first perform water quality measurements to establish the relevance of the coffee sector for water pollution before starting interventions on the farm level. It could have been clear before the start of the intervention at the farm level that other, possibly more polluting activities, exist in the coffee growing areas.
- The low level of attributable outcomes and impacts is due to the fact that also in absence of the IWM intervention, many actors engage in improving environmental awareness and awareness about the importance of water management, although not with at the same level of intensity and

same scale. However, this very same fact also lead to a very effective implementation process, since especially FNC could resort to its broad expertise in water management and the established relationship with the farmers.

- Sustainability seems high since the partners are generally used to work together and are likely to continue to collaborate in the future. For scaling-up or replication of a PPP project such as IWM, it is important to have a genuine commitment from the public sector partner in the PPP that will actually make its financial contribution to the project and that the public sector partner plays a more active role in the project. At the same time, given that IWM was very effective in implementing their activities also in absence of an active public sector contribution, a PPP set-up is not necessarily required for a project like this.
- Institutionalization of the knowledge via local *Manos al Agua* groups and the Water & Coffee Platform and documentation of the project's experience and generated knowledge seems well on its way.

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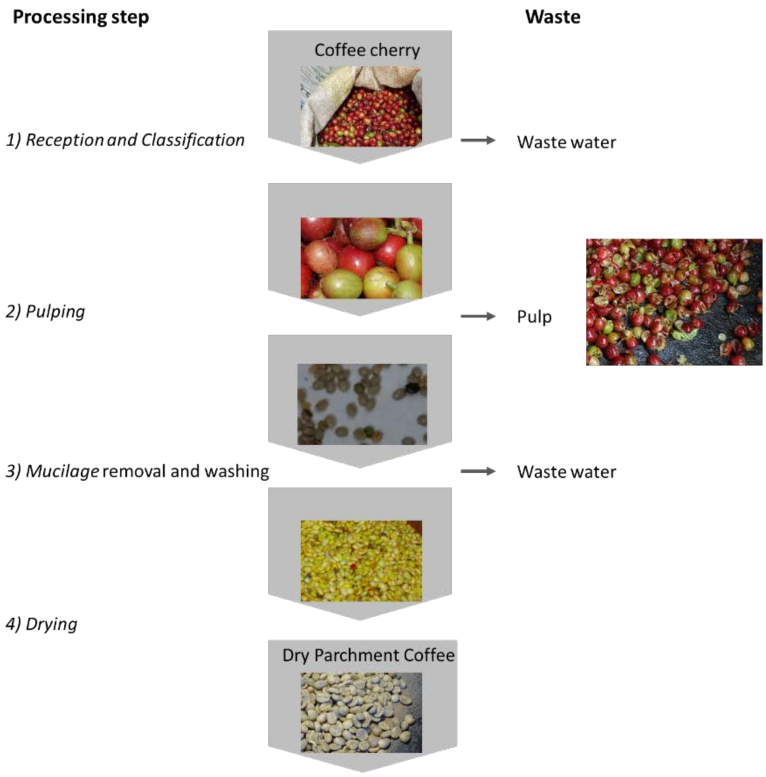
Annex 1 – Coffee Processing

Water Consumption and Contamination in Coffee Production

After harvesting the ripe coffee cherries, the majority of coffee farmers in Colombia process their coffee at the farm to produce dry parchment coffee (*café pergamino seco*, cps), which are the processed and dried coffee beans (see Figure 20). This process requires four steps. First, during reception and classification, over-ripe and dry cherries, stones and other particles are separated from good quality cherries. Second, pulping separates the pulp from the beans. This process leaves the beans with a thin slimy layer, the mucilage. To remove this mucilage in the third step, two techniques exist: natural fermentation and mechanical removal. Once the mucilage is removed, the beans are washed and then dried in a fourth step and sold.

Figure 20: Coffee processing steps



Source: Own representation, photo of washed coffee from Rodriguez et al. 2015.

About half of the water is consumed during the first two steps of reception, classification, and pulping (including transportation of pulp and pulped coffee); the other half is used during mucilage removal and washing. However, the amount of water used during coffee processing can be reduced drastically when changing to water-saving devices or applying certain water-reducing techniques.

Table 34 lists each coffee processing step and the respective devices and techniques that can be adopted. Moreover, the table shows the cumulative water savings potentials on a percentage basis with the conventional technology as the base case reference. For instance, if the coffee farmer switches from the washing technology “winding water channel” (*canal de correteo*) to washing with a Tub Tank and applying four rinsing rounds, about 40 percent of water can be saved. Pictures of all devices can be found in Annex 1. Many of the devices are designed for bigger coffee farms that process more than 1,000 kg of coffee cherries a day. Yet, the production scale of the majority of Colombian coffee farms including the IWM intervention farms is much smaller than this. The only devices that are adapted to such smaller production scales are the dry hopper, and the Tub Tank. Moreover, the classification step can be skipped completely if only good quality coffee beans are harvested and farmers pay attention to not mixing the beans with leaves or stones. This is normally also the case at smaller farms where the farm owners and their family harvest the coffee beans themselves and no external workers are contracted.

Table 34: Water saving potential in each coffee processing step

Coffee processing step		Device/Technique	Water saving potential compared to base case (in %)	Maximum value of each step
Reception of coffee and classification		Base case: Traditional Wet hopper	0	0.125
		Water tank	0.008	
		Water tank and water recirculation system	0.075	
		Submersible pump	0.075	
		Hydraulic separator with hopper and screw conveyor [a]	0.124	
		Dry hopper	0.125	
Pulping		Base case: With water	0	0.125
		Without water	0.125	
	Transportation of pulp	Base case: With water	0	0.125
		Without water	0.125	
	Transportation of pulped coffee	Base case: With water	0	0.125
		Without water	0.125	
Removal of mucilage & coffee washing	Natural fermentation	Base case: Winding water channel	0	0.490
		Submersible pump	0.306	
		Semi-submerged channel	0.319	
		Technique of four rinsing rounds (in Tub Tank)	0.375-0.400	
	Mechanic removal	Other mucilage remover	0.418-0.463	
		mucilage remover "DESLIM" [a]	0.479	
		Other coffee washing devices	0.433-0.445	
		Ecomill	0.490	
Total water saving potential				0.990

[a] The hydraulic separator with hopper and screw conveyor and the mechanic mucilage remover DESLIM together are called BECOLSUB.

Source: Adapted from Rodriguez et al. 2015.

Table 35: Organic contamination reduction potential in each coffee processing step (in BOD_5)

Coffee processing step	Device/Technique	Contamination reduction (in %)	Maximum value of each step
Pulp related contamination			
Reception	Base case: Wet hopper	0	0.020
	Water tank	0.001	
	Water tank and water recirculation system	0.012	
	Submersible pump	0.012	
	Hydraulic separator with hopper and screw conveyor [a]	0.020	
	Dry hopper	0.020	
Pulping	Base case: With water	0	0.15
	Without water	0.150	
Transportation of pulp	Base case: With water	0	0.15
	Without water	0.150	
Storage of pulp	Base case: Without roof	0	0.15
	With roof	0.150	
Decomposition of pulp	Base case: Without roof	0	0.15
	With roof	0.150	
Collection and treatment of drainage	Base case: No	0	0.12
	Yes	0.120	
Mucilage related contamination			
Washing	Untreated disposal of waste water	0	0.26
	Physical treatment system (e.g. separation and filtration of solid material).	0.05	
	Reuse of treated water. Recirculation or reuse of leachate resulting from aggregation of washing waste water to the pulp, until no leachate is left.	0.06	
	Aggregation of mucilage to the pulp, without recirculation of leachate. Or aggregation of water of the first two rinsing rounds to the pulp, without recirculation of leachate.	0.10	
	Recirculation or reuse of leachate, coming from the pulp-mucilage-mix and pulp-washing water-mix, up to their depletion. Treatment of the third and fourth rinsing rounds wastewater in treatment system and reuse of treated water.	0.16	
	Biological or physical-chemical treatment systems. Or aggregation of the wastewater resulting from washing the coffee to the pulp without recirculation of leachates.	0.20	
	Utilization of the whole mucilage for animal food. Or incorporation of all the wastewater to the pulp and reuse without discharge.	0.26	
Total contamination reduction potential			1.00

[a] The hydraulic separator with hopper and screw conveyor and the mechanic mucilage remover DESLIM together are called BECOLSUB.
Source: Adapted from Rodriguez et al. 2015.

Water contamination arises above all from the pulping and mucilage removal, producing effluent water with high organic load, a high amount of suspended solids, and low pH levels. The organic load is measured in BOD_5 (Biological Oxygen Demand) that specifies the amount of oxygen consumed in the degradation of the organic material. By processing 12.5 kg of cps in the conventional way, 3.59 kg of BOD_5 and 3.50 kg of suspended solids are generated (Rodriguez et al. 2015). Environmentalists frequently suspect that these effluents contribute substantially to the contamination of surface water bodies, most importantly leading to eutrophication (see for example Adams et al. 1987, Beyene et al. 2011, Chanakya et al. 2004, Haddis and Devi 2008, Mburu et al. 1994, Zuluaga and Zambrano 1993). Eutrophication reduces the amount of dissolved oxygen in the surface water with negative consequences for the aquatic life (see for example Chislock et al. 2013 for a general overview on consequences of eutrophication). It may even create an anaerobic atmosphere, which is an excellent condition for health threatening bacteria (Rattan et al. 2015). According to Zuluaga and Zambrano (1993), water contamination in terms of organic load from processing one kg of cps is ten times higher than contamination through faeces and urine generated by one person per day. Calculating with the average coffee production of the farms in our sample that amounts to 300 kg of cps per year, contamination from one farm's coffee processing equals the contamination of eight farm residents. This is why the Government of Colombia defined maximum pollution levels for dumping coffee waste water into surface water bodies (*Resolución 631 del 2015*, see *República de Colombia* 2015 in Annex 2). When coffee is processed in the conventional way, contamination thresholds for BOD_5 and suspended solids defined by the new legislation, are exceed by roughly a factor ten.

74 percent of the total contaminating potential measured in BOD_5 is associated with the pulp, and 26 percent with the mucilage. The reduction or even elimination of water usage in the different processing steps is an effective way to bring down the contamination of water, since the contact of the pulp and mucilage with water is reduced and less pollutants are washed into the waste water.

Table 35 presents devices and techniques to reduce water contamination in terms of BOD_5 for each processing step. Again, the contamination reduction potential is provided in percent for each device, compared to usage of the base case device or technique.

Reception of coffee and classification

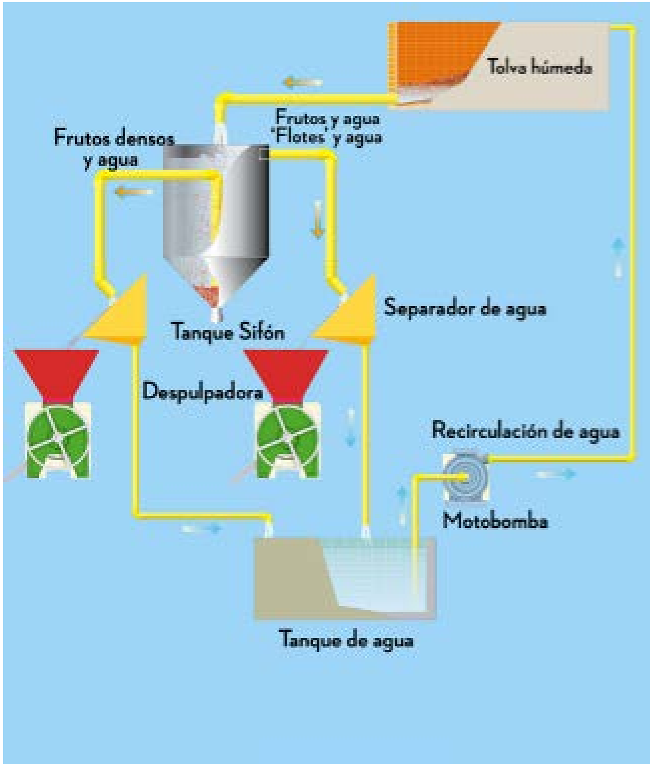
Wet hopper[1]

Dry hopper[1]

Water tank (*tanque sifón*)[1]

Submersible pump[1]

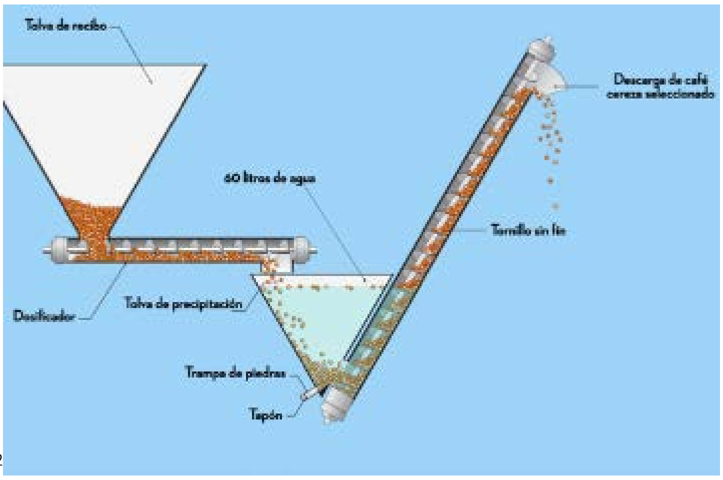
[2]



Hydraulic separator with hopper and screw conveyor:

[1]

[2]



<table>
<tr><th colspan="2">Pulping[2]</th></tr>
<tr><td>With water</td><td>Without water</td></tr>
<tr><td></td><td></td></tr>
</table>

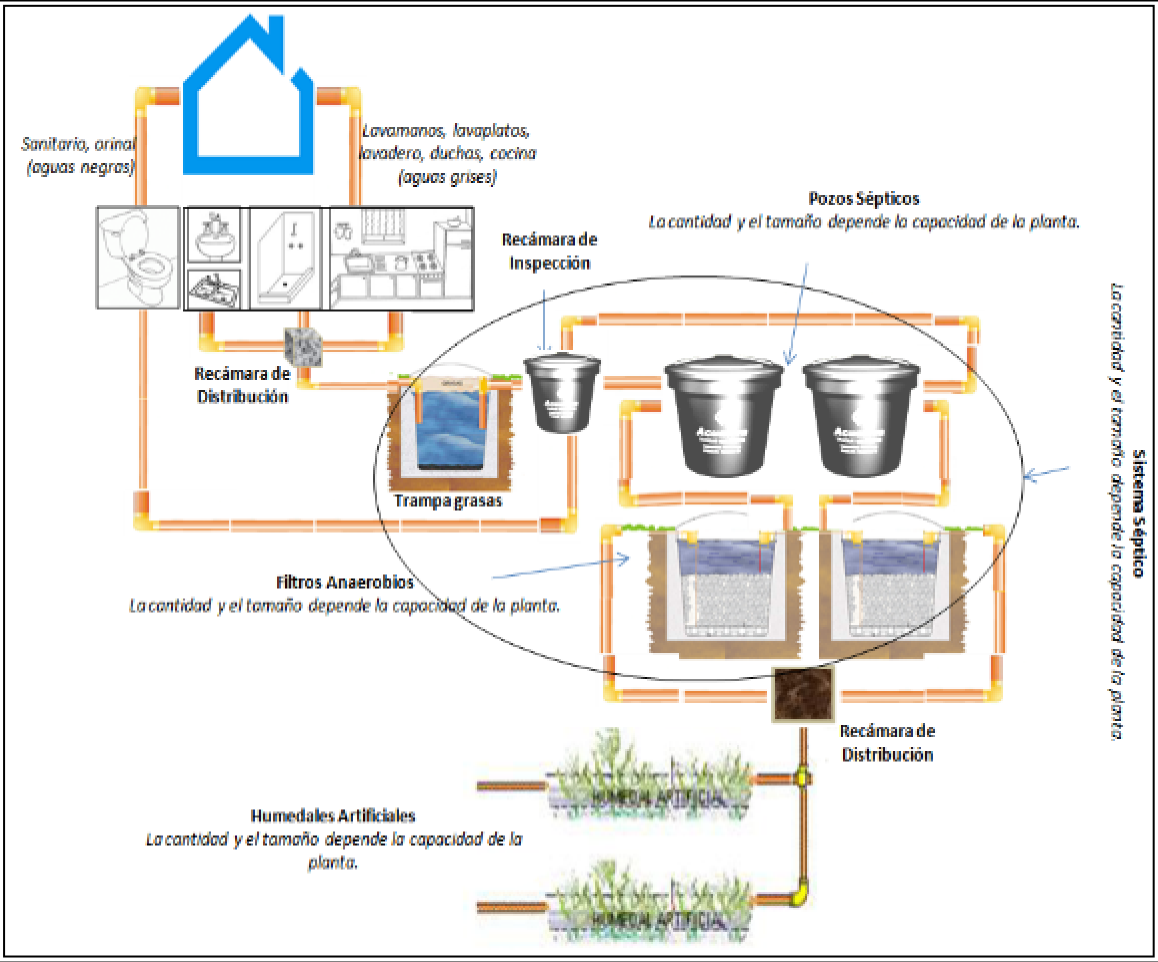
<table>
<tr><th colspan="2">Removal of mucilage & Washing</th></tr>
<tr><td colspan="2">Winding Water Channel (canal de correteo)[1]</td></tr>
<tr><td></td><td></td></tr>
<tr><td colspan="2">Semi-submerged channel (canal semisumergido)[1]</td></tr>
<tr><td colspan="2"></td></tr>
</table>

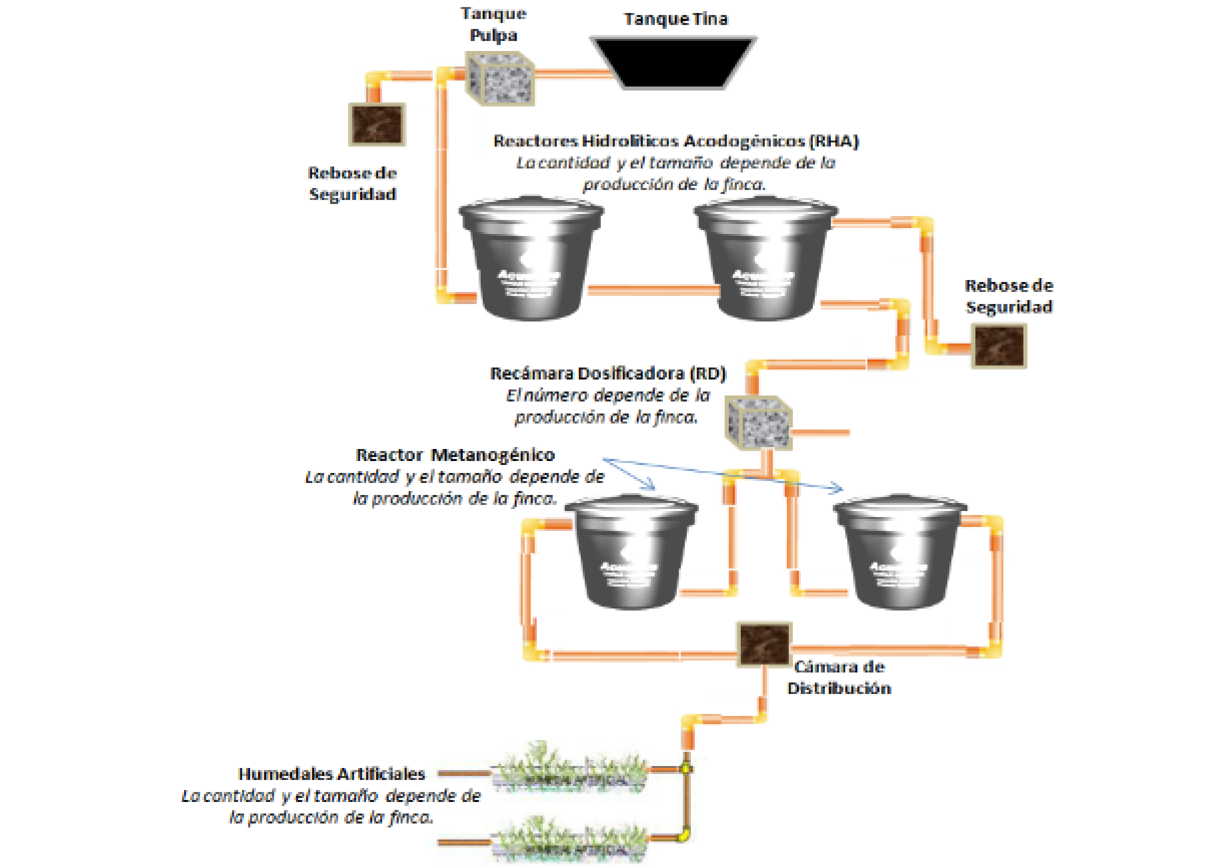
Tub Tank[1]

Mechanic mucilage remover[1]

BECOLSUB (screw conveyor & DESLIM)[2]

Ecomill[2]

Treatment systems
Septic System (domestic waste water)

Modular Anaerobic Treatment System (SMTA)



Roofed pit	
	

Sources: 1) IWM – Manual for Interviewers of Needs Assessment.

2) Rodríguez Valencia, N., J. R. Sanz Uribe, C. E. Oliveros Tascon, C. A. Ramírez Gómez et al. (2015). "Beneficio del café en Colombia. Prácticas y estrategias para el ahorro, uso eficiente del agua y el control de la contaminación hídrica en el proceso de beneficio húmedo del café." FNC – Cenicafé. Chinchiná.

Annex 2 – Permitted pollution level for coffee waste water

Resolución 631 del 2015

https://www.minambiente.gov.co/images/normativa/app/resoluciones/d1-res_631_marz_2015.pdf

PARÁMETRO	UNIDADES	PROCESAMIENTO DE HORTALIZAS, FRUTAS, LEGUMBRES, RAÍCES Y TUBÉRCULOS	BENEFICIO DE CAFÉ (CLASIFICACIÓN DE LA FEDERACIÓN NACIONAL DE CAFETEROS – FNC/ CENICAFE).	
			PROCESO O ECOLÓGICO	PROCESO TRADICIONAL
Generales				
pH	Unidades de pH	6,00 a 9,00	5,00 a 9,00	5,00 a 9,00
Demanda Química de Oxígeno (DQO)	mg/L O_2	150,00	3.000,00	650,00
Demanda Bioquímica de Oxígeno (DBO_5)	mg/L O_2	50,00		400,00
Sólidos Suspendidos Totales (SST)	mg/L	100,00	800,00	400,00
Sólidos Sedimentables (SSED)	mL/L	5,00	10,00	10,00
Grasas y Aceites	mg/L	10,00	30,00	10,00
Compuestos de Fósforo				
Fósforo Total (P)	mg/L	Análisis y Reporte	Análisis y Reporte	Análisis y Reporte
Compuestos de Nitrógeno				
Nitrógeno Total (N)	mg/L	Análisis y Reporte	Análisis y Reporte	Análisis y Reporte
Otros Parámetros para Análisis y Reporte				
Color Real (Medidas de absorbancia a las siguientes longitudes de onda: 436 nm, 525 nm y 620 nm).	m^{-1}	Análisis y Reporte	Análisis y Reporte	Análisis y Reporte

Annex 3 – Farm and River Basin Characteristics

The impact evaluation covers 50 river basins in all five intervention departments of Antioquia, Caldas, Cauca, Nariño, and Valle del Cauca. In each department, all five treatment river basins and additionally five control river basins were surveyed. This section first portraits the 50 treatment and control river basins altogether and then presents the balancing between treatment and control basins.

The five departments, and hence also the surveyed river basins, differ with respect to climatic conditions. One indicator for this is the difference in harvest seasons (see Figure 21). While in Cauca and Nariño there is only one main harvest in the whole department (from March to June), certain regions of the other three departments have two harvest periods. In Valle del Cauca, all river basins are located in a region with two harvest periods: one from September to December, and the other from April to May. In Antioquia and Caldas, all regions have a main harvest from September to December. A second harvest from April to May exists in the three treatment river basins (and their three control counterparts) located in the South of Antioquia and the three river basins (and their three control counterparts) located in the North of Caldas.

Figure 21: Harvest season in survey river basins (by department)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Antioquia				Second					Main harvest (all			
Caldas				Second					Main harvest (all			
Cauca			Main harvest									
Nariño			Main harvest									
Valle del Cauca				Second					Main harvest			

Source: Own illustration based on a harvest season map provided by Cenicafé (*Encuesta Nacional Cafetera* – 1997)

For the selection of appropriate control river basins, we solicited information on the prevalence of soil erosion and water shortage problems from the extension workers of the FNC (Table 36). According to FNC extension workers, soil erosion is more problematic in the river basins than water shortage. All but five river basins report problems with soil erosion while only 32 out of 50 river basins report problems with water shortage. No differences between treatment and control river basins can be observed. Note that this is based on the extension workers' qualitative assessments of the overall situation in the river basins. The coffee farmer data gives more detail on evidence of soil erosion and water shortage at the farm level.

Table 36: Prevalence of water shortage and soil erosion, river basin level

	Control (N=25)	Treatment (N=25)
Number of river basins with		
Water shortage	16	16
Soil Erosion	23	22

Source: Assessment of regional extension workers

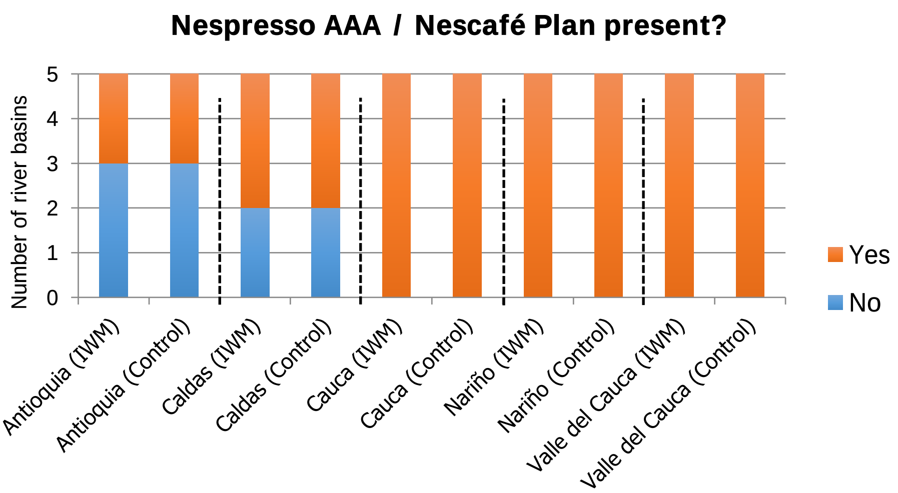
We furthermore asked the extension workers to identify particularities of the (location of the) river basin that might affect water contamination in the river basins. Most frequently mentioned contamination factors additional to those tackled by IWM are animal husbandry and water contamination from urban or larger rural settlements. In some river basins, water is also contaminated by upstream mining activities or other productive activities such as a recycling stations and large scale commercial tree plantations. In some regions of Valle del Cauca the *guerilla* movement FARC was still active in 2015. Here, farmers had been restricted in accessing their land and partly forced to abandon it completely.

As can be seen in Figure 22, in almost all river basins either the Nespresso AAA Program or Nescafé Plan is active. The latter is active in Valle del Cauca, while the former is present in Antioquia, Caldas, Cauca and Nariño. In Antioquia and Caldas, the Nespresso AAA program is not present in six and four river basins, respectively (equally distributed over treatment and control river basins).

In 38 out of our 50 river basins, other development projects are active, which (in parts) also pursue water conservation and reforestation activities (see Figure 23).

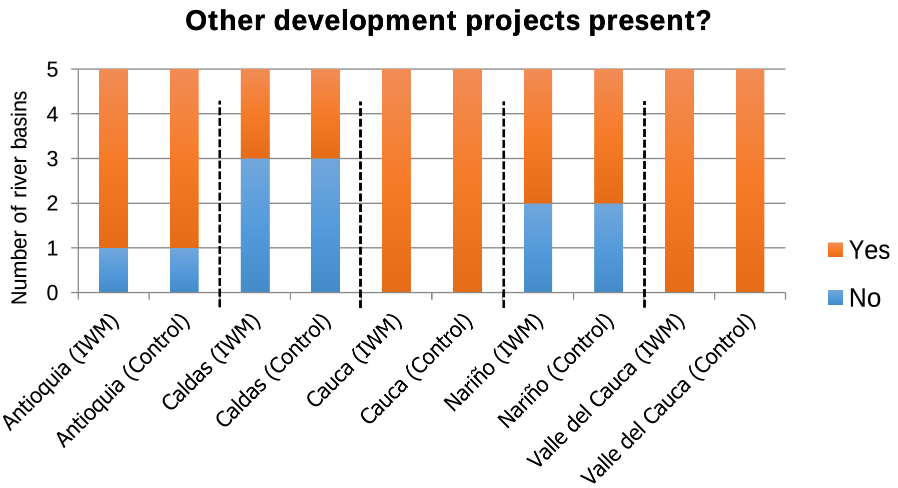
These are sustainability initiatives like the Fairtrade initiative, 4C Association, Rainforest Alliance and UTZ Certified, or activities of the coffee farmer cooperatives and the public regional autonomous corporations (CAR). The governmental activities are partly financed by royalties from natural resource extraction. In Cauca and Caldas, different reforestation programmes exist. One of them is run by the German KfW Development Bank.

Figure 22: Presence of Nespresso AAA or Nescafé Plan



Source: Assessment of regional extension workers (in 2015)

Figure 23: Presence of other development projects



Source: Assessment of regional extension workers (in 2015)

General farm characteristics

To illustrate the living conditions in the IWM project areas and the control river basins, this section presents descriptive statistics on the socio-economic structure of the surveyed farms at baseline.

In our sample, we have 1,351 households with a total of 4,823 members that were interviewed both at baseline and follow-up. The average household size is 3.6 (Table 37), with five percent of them being children younger than six years. Household size and the share of children younger than six are very similar for treatment and control farms, which indicates that the two groups are comparable along that demographic dimension. The same holds for most of the characteristics of the household head, with the exception of the share of female household heads. The latter variable exhibits a statistically significant difference between the two groups. Considering that the difference is very small in size, though, it does not give reasons for further concerns in terms of comparability of the treatment and control group. Nonetheless, we include the socio-economic variables as control variables using multivariate techniques in order to account for such differences in the analysis.

Table 37: Household's structure variables

	Control	Treatment	p-value
Household size	3.6	3.6	0.66
Share children 0-5 years, in %	4	5	0.82
Female household heads, in %	11	14	0.04**
Age of the household head	53.6	54.1	0.42
Household head received formal education, in %	91	92	0.90
Household head received secondary education, in %	15	15	0.97
Observations	674	677	1,351

Note: Asterisks represent statistical significance of the difference between control and treatment communities.
* indicates that the difference is statistically significant at the 10, ** at the 5, *** at the 1 percent level.
Source: FDW Colombia farm survey.

Among both the treatment and control farms, the majority of household heads work at the coffee farm and has on average 38 to 39 years of experience in coffee farming (Table 38). Considering the average age of the household head of 54 years, it becomes clear that most farmers have been working for their whole life in coffee farming. Although 20 percent in the control and 17 percent in the treatment group cultivate other crops than coffee, the cultivation area for other crops is relatively small compared to the area cultivated with coffee (only 0.3 ha vs. 2.5 ha for coffee cultivation). At only around 24 percent of the farms a household member works outside the farm. This illustrates that the predominant income source for the majority of farms is coffee production. Some of the variables exhibit differences that are borderline statistically significant, but again only small in size.

Table 38: Sector of main activity of the household members, in percent

	Control	Treatment	p-value
Household head...			
… works on coffee farm	81.45	79.91	0.47
… works outside of farm	7.86	5.76	0.13
Years of experience in coffee farming (not in %)	37.77	39.29	0.09*
Farm cultivates other crops than coffee	20.03	17.28	0.20
At least one HH member works outside of farm	23.29	24.08	0.74
Observations	674	677	1,351

Note: Asterisks represent statistical significance of the difference between control and treatment communities.
* indicates that the difference is statistically significant at the 10, ** at the 5, *** at the 1 percent level.
Source: FDW Colombia farm survey.

In the treatment area, only 81 percent of the farms have a dwelling (Table 39). Most farms without dwelling are managed by people living with other family members in the same river basin. Occasionally, farms are managed by people living further away in other river basins or even urban areas. In the control area, a higher share of farms has a dwelling house on the farm and the difference is statistically significant. This difference is important for analysing domestic water usage, since farmers who do not live on the farm do not have much domestic water consumption. We will check robustness of the results by restricting the sample for this analysis to farmers that live on their farm.

Table 39: Housing conditions, in percent

	Control	Treatment	p-value
Farm has dwelling	86	81	0.02**
Floor material [a]			
Cement or gravel	0.62	0.61	0.74
Higher material than cement	0.35	0.35	0.96
Wall material [a]			
Plastered brick or blocks	0.34	0.35	0.82
Lower material than plastered bricks or blocks	0.38	0.38	0.99
Number of rooms (not in %)	3.26	3.38	0.08*
Residence has a kitchen	99.55	99.41	0.71
Kitchen has chimney	67.51	66.62	0.73
Observations	674	677	1,351

Note: Asterisks represent statistical significance of the difference between control and treatment communities.
* indicates that the difference is statistically significant at the 10, ** at the 5, *** at the 1 percent level.
[a] The options of floor material and wall material are ranked according to the Colombian National Administrative Department of Statistics (DANE).
Source: FDW Colombia farm survey.

With respect to housing conditions, no substantial differences between the treatment and control households can be observed. The main flooring material is cement or gravel. Around one third of the farms have even floors made of better materials. The main wall material is plastered bricks or blocks. The average number of rooms is three. Treatment farms have slightly more rooms, but the size of the difference is rather negligible. Nearly all residences have a kitchen, whereof around 70 percent are equipped with a chimney.

Treatment and control households are also very well balanced with regard to ownership of different assets (Table 40). Most of them own a TV (more than 90 percent), a refrigerator (more than 80 percent) and a radio (88 percent). Virtually everybody has a mobile phone. About 40 percent of the households own a motorcycle, while bicycles and cars are rare. A small difference in TV ownership between the two groups is statistically significant. This difference, however, is again small in absolute numbers and does not point at a systematic difference between the control and treatment households.

Table 40: Households owning different assets, in percent

	Control	Treatment	p-value
Refrigerator	85	82	0.26
TV	94	92	0.09*
Radio	88	88	0.98
Landline phone	0	0	0.31
Mobile phone	98	99	0.24
Motorcycle	40	40	0.86
Car	8	11	0.12
Bicycle	9	10	0.66
Observations	674	677	1,351

Note: Asterisks represent statistical significance of the difference between control and treatment communities.
* indicates that the difference is statistically significant at the 10, ** at the 5, *** at the 1 percent level.
Source: FDW Colombia farm survey.

Water sources at baseline

The coffee farmers extract water from different on- and off-farm sources (Table 41). What is interesting to see is that 80 percent of farms use water to irrigate their non-coffee crops. For this purpose, most farms collect rain water in buckets and irrigate their crops with rain water. With regard to coffee farming, only 20 percent of the farms use any artificial irrigation and collected rain water is hardly used. Most farms that irrigate their coffee plantation do so manually using a water hose, a mobile water pump, or simply a watering can. Some few farmers also have proper sprinkler irrigation systems. The share of farms with these systems is substantially larger among control basin farmers. The most important reason why the majority of farmers does not irrigate their coffee plantation is that they deem their coffee plantations not to need irrigation. Some farmers exist, though, that state not to have enough water or money to irrigate the coffee. Almost 70 percent have an on-farm water source. The main on-farm sources are rivers, streams, and springs. More than 50 percent share these sources with other farms. The most common off-farm water source are aqueducts that normally provide the whole neighbourhood with water. Most of these aqueducts were installed by the coffee federation and are operated by the communities themselves.

Table 41: Water sources, in percent

	Control	Treatment	p-value	N
Farm has own water source	67	67	0.940	1,399
River or stream	31	29	0.534	1,399
Spring	47	51	0.229	1,399
Lagoon	1	1	0.783	1,399
Wetland	1	1	0.998	1,399
Farm shares own water source with other farms	53	55	0.739	934
Farm receives water from aqueduct	51	57	0.044**	1,399
Farm pays for water	49	51	0.438	1,399
Monthly payment for water, in pesos [b]	5198.85	5168.91	0.944	697
Farmer knows monthly water consumption	4	8	0.007 ***	1,399
Farm has water concession	9	8	0.401	1,399
Main water source for human consumption [a]			0.448	1,398
Aqueduct	45	48		
Water source of other farm	30	30		
Water source of own farm	21	18		
Farm does not purify water before drinking	9	9	0.785	1,399
Farm uses water for animals	56	48	0.004***	1,399
Main water source for animals [a]			0.144	731
Aqueduct	34	41		
Water source of other farm	37	30		
Water source of own farm	25	27		
Farm uses water for crop irrigation	80	84	0.064*	1,399
Main water source for crop irrigation [a]			0.140	1,142
Rain water reservoir	71	69		
Water source of other farm	14	13		
Aqueduct	6	9		
Farm uses water for coffee irrigation	20	20	0.936	1,399
Main water source for coffee irrigation [a]				
Water source of other farm	54	49	0.440	285
Water source of own farm	26	43	0.131	285
Aqueduct	20	18	0.632	285
Rain water reservoir	1	0	0.154	285
Main water source for coffee processing [a]			0.133	1,398
Aqueduct	40	43		
Water source of other farm	33	33		
Water source of own farm	23	21		

Notes: Asterisks represent statistical significance of the difference between control and treatment communities. * indicates that the difference is statistically significant at the 10, ** at the 5, *** at the 1 percent level. [a] The three most frequent options of water sources are represented in the table. [b] The coffee farmers were asked about the amount they paid last month. Exchange rate 01.09.2016: 1,000 COP = 0.286 EUR.

Source: FDW Colombia farm survey

Farms receiving water from an aqueduct have to pay for this service. Some few families are exempted from paying, for example because they administer the aqueduct's operation or helped constructing it. In both control and treatment areas, about 50 percent pay around 5,000 Colombian pesos (~1.50 EUR) per month for their water. Normally the payment is a lump-sum fee, since water meters are very rare. Accordingly, only a small share of farmers know their monthly water consumption with this share being somewhat higher among treatment farms than among control farms. Even though this and few other differences in Table 41 are statistically significant they are rather small in magnitude.

Depending on the purpose for which water is used, water sources vary (Table 41). Most farmers purify the water before drinking it. The most common form of purification is boiling the water. Only very few farms have water filter. Note that the coffee farmers potentially extract water from different sources for the same purpose; the water sources presented here only represent the main source for the respective purpose.

What is interesting to see is that 80 percent of farms use water to irrigate their non-coffee crops (Table 42). For this purpose, most farms collect rain water in buckets and irrigate their crops with rain water. With regard to coffee farming, only 20 percent of the farms use any artificial irrigation and collected rain water is hardly used. Most farms that irrigate their coffee plantation do so manually using a water hose, a mobile water pump, or simply a watering can. Some few farmers also have proper sprinkler irrigation systems. The share of farms with these systems is substantially larger among control basin farmers. The most important reason why the majority of farmers does not irrigate their coffee plantation is that they deem their coffee plantations not to need irrigation. Some farmers exist, though, that state not to have enough water or money to irrigate the coffee.

Table 42: Irrigation of coffee plantation, in percent

	Control	Treatment	p-value	N
Manual irrigation with water hose etc.	78	87	0.027**	285
Sprinkler irrigation system	22	11	0.009***	285
Other	1	2	0.317	285
Reason for not irrigating coffee cultivation			0.011	1,114
Coffee doesn't need irrigation	65	71		
Farm doesn't have water to irrigate	31	23		
Farn doesn't have the money to irrigate	3	4		

Source: FDW Colombia farm survey

Coffee cultivation

Most coffee farmers own the farm they are living on (hereafter: residential owners -Table 43), the other part of farmers does not live on the farm. Some of this latter group commute to their farm on a daily basis or contract administrator to operate the daily business. The share of these absentee owners is significantly higher among treatment farms and we have to control for this during the final analysis.

The average farm size in our sample is 4 to 5 hectare and the area cultivated with coffee trees varies between 2 and 3 hectare. The farm size and coffee production is slightly higher among treatment farms. This can also be seen in the number of coffee trees (10,659 trees in the control and 13,621 in the treatment area) and the number of trees in production (8,564 trees in the control and 11, 156 in the treatment area). It is not surprising that the coffee production in 2014 with around 354 kg is about 100 kg higher for the treatment than for the control farms. These differences are statistically significant.

Almost 90 percent of the coffee produced in 2014 was sold as dry parchment coffee (cps), which are the processed and dried coffee beans. A very small share was sold without drying or even without peeling (coffee cherry) and around eight percent both among treatment and control river basins was of low quality and sold as so-called "pasilla". These defective coffee beans surge because of plagues or because they dry out while growing. The share of coffee sold as cps is slightly higher among treatment farms, but the size of the difference is negligible.

Table 43: Coffee farming

	Control	Treatment	p-value	N
Land tenure, in % [a]			0.039 **	1,399
Residential Owner	63	54		
Absentee Owner	31	39		
Lease-to-own agreement	3	4		
Total area of farm, in ha	4	5	0.365	1,399
Area with coffee cultivation, in ha	2	3	0.013 **	1,399
Number of coffee trees	10,650	13,621	0.005 ***	1,399
Number of trees in production	8,564	11,156	0.003 ***	1,399
Average age of coffee plants, in years	4.21	4.36	0.259	1,362
Coffee production in 2014, in kg	245.96	348.51	0.024 **	1,388
Share of coffee that was sold as…, in % [b]				
Dry parchment coffee (cps)	86	88	0.026 **	1,399
"Pasilla"[c]	8	8	0.900	1,399
before drying	2	2	0.753	1,399
Coffee cherry	1	0	0.011**	1,399
Share of farms that participates in the following sustainability initiatives, in %				
Nespresso AAA	48	48	0.978	1,399
Fairtrade – FLO	26	28	0.393	1,399
Rainforest Alliance	12	15	0.084 *	1,399
4C Association	5	6	0.470	1,399

Notes: Asterisks represent statistical significance of the difference between control and treatment communities. * indicates that the difference is statistically significant at the 10, ** at the 5, *** at the 1 percent level.
[a] The three most frequent options of land tenure are represented in the table.
[b] The three most frequent selling forms are represented in the table.
[c] Defective coffee beans, affected by plagues or drought.
Source: FDW Colombia farm survey

Coffee processing

After the coffee cherries are harvested, they are transported from the plantation to the processing infrastructure. Not all coffee farmers have the processing infrastructure on the surveyed farm; some of them process the coffee beans on another farm of their possession, a family member´s farm or the neighbour´s farm. Since these places are normally also located within the same river basin, the potential impact on waste water contamination remains unaffected. In the control area, a share of 84 percent processes the coffee on the surveyed farm. In the treatment area, this share is with 81 percent slightly smaller with the difference being borderline significant.

As described in detail in the main report, the processing consists of three basic steps: reception and classification of the coffee, pulping, removal of the mucilage and washing.[75] For each of these steps,

[75] After washing, there is another step, which is the drying process. However, due to the fact that no water is used during this, we will not consider it in our analysis.

IWM Colombia distributes water saving equipment and teaches water conservation practices. As can be seen in Table 44 some of these devices and techniques are already used by the farms, both in control and treatment river basins.

Table 44: Coffee processing, in percent

	Control	Treatment	p-value	N
Coffee farmer processes coffee on surveyed farm	84	81	0.102	1,399
Farm knows their water consumption for coffee processing	2	2	0.824	1,389
Reception of coffee				
Fincas with the following type of hopper			0.000 ***	1,389
Dry hopper	35	46		
Wet hopper	14	13		
Does not have a hopper	51	41		
Classification				
Farmer classifies coffee cherries	11	8	0.051 *	1,389
Farmer reuses water from classification process	28	20	0.331	126
Farmer uses hydraulic separator	0	0.29	0.155	1,389
Pulping				
Farmer has pulping machine	99	99	0.776	1,389
Farmer pulps with water	49	44	0.042 **	1,389
Farmer transports the pulped coffee with water	6	10	0.003 ***	1,389
Removal of mucilage & Washing				
Natural fermentation				
Farmers that apply natural fermentation	99	96	0.000 ***	1,389
Share of those that…				
... use the "winding water channel"	13	16	0.061 *	1,358
... use the traditional fermentation tank	70	72	0.359	1,358
... use another device	8	5	0.058 *	1,358
... use the Tub Tank	22	23	0.572	1,358
Farmer applies technique of rinsing	98	98	0.761	1,357
Number of rinsing rounds…			0.002	1,328
Less than four rinsing rounds	68	75		
Four rinsing rounds	24	20		
More than four rinsing rounds	9	5		
Farm uses the Tub Tank and applies four rinsing rounds	6	5	0.676	1,358
Mechanic removal				
Farmer applies mechanic removal	2	4	0.005 ***	1,389
Share of those that use...				
... Ecomill	15	0	0.025 **	44
... BECOLSUB	85	100	0.025 **	44

Notes: Asterisks represent statistical significance of the difference between control and treatment communities. * indicates that the difference is statistically significant at the 10, ** at the 5, *** at the 1 percent level.

Source: FDW Colombia farm survey

For coffee reception, IWM Colombia recommends the usage of a dry hopper in order to reduce water consumption. Among the control and treatment farms, 35 percent and 46 percent already have a dry hopper, 14 percent and 13 percent have a wet hopper and 51 percent and 41 percent do not have a hopper at all. The difference in the distribution of hoppers between the control and treatment group is highly significant with more treatment farms having the IWM promoted dry hopper. Only around 9 percent of all farmers classify their coffee cherries to separate the good quality coffee from over-ripe and dry cherries as well as to remove small stones and small branches. Virtually all of them use cans or tanks with water to separate the cherries by flotation. Only a small share of farms reuses the water from the classification process as recommended by IWM. The share of farmers classifying cherries is higher among control river basins.

During the second step, only two treatment farms use a hydraulic separator that IWM Colombia promotes for saving water in the classification process. This does not come as a surprise as this equipment is designed for farms that process more than 1,000 kg of coffee cherries a day. Only few of these farms exist.

For pulping, IWM recommends not to use water in the process nor tubes with water to transport the pulped coffee from one processing step to the next. 99 percent of all coffee farms have a pulping machine. Less than half of them use water in the pulping process. The share is higher among control farms (49 percent) than among treatment farms (44 percent). Yet, the share of farms that transport their pulped coffee with water is higher in the treatment than in the control group (10 percent and 6 percent, respectively). The differences are again significant.

The last step, the mucilage removal and the washing, can be conducted in two ways: either via natural fermentation or mechanically. Some farmers have the equipment for both techniques and consequently apply both. In general, only bigger farms apply mechanical removal, since the corresponding devices require a certain amount of coffee for operating correctly and economically. The IWM intervention recommends mechanical removal for farms that process more than 1000 kg of coffee cherries a day. For smaller farms they recommend natural fermentation in a Tub Tank applying four rinsing rounds. Less rinsing rounds do not remove the mucilage sufficiently and produce lower quality coffee. More than four rinsing rounds do not have any additional effect on the coffee bean, and are thus not necessary, but consume more water. Our data shows that at baseline, only slightly more than 20 percent of the farmers have a Tub Tank and only five percent also apply four rinsing rounds using the Tub Tank. Most farmers apply less than four rinsing rounds. Only around three percent apply mechanical removal.

Domestic Water Usage

IWM distributes water saving and contamination reduction equipment also at the domestic level. The sanitary infrastructure among the control and treatment households is very similar (Table 45); nearly all houses are equipped with a bathroom and a shower. The two groups only differ slightly with regard to the possession of a kitchen sink and laundry tub; these differences are significantly different from zero, but small in absolute numbers. Furthermore, there are no significant differences with respect to water reduction devices in the sanitary infrastructure. 10 percent of both treatment and control households installed a low water consumption toilet. Few farms also installed flow restrictors in their bathroom sinks, showers and kitchen sinks (4 percent of the control and 3 percent of the treatment farms).

Table 45: Domestic water appliances and water reduction devices, in percent

Household has…	Control	Treatment	p-value	N
…bathroom	98	99	0.251	1,398
Share of those with…			0.625	1,379
… flow restrictors	1	1		
… low water consumption toilet	10	10		
… another water saving device	2	3		
….bathroom sink	40	43	0.259	1,398
Share of those with flow restrictors	8	5	0.287	580
….shower	97	97	0.890	1,398
Share of those with flow restrictors	4	3	0.442	1,351
….kitchen sink	79	84	0.029 **	1,398
Share of those with flow restrictors	4	3	0.742	1,142
….laundry tub	98	97	0.059 *	1,398
Share of those with flow restrictors	2	1	0.684	1,363

Notes: Asterisks represent statistical significance of the difference between control and treatment communities. * indicates that the difference is statistically significant at the 10, ** at the 5, *** at the 1 percent level.

Source: FDW Colombia farm survey

Waste and Waste Water Disposal

About 28 percent of the coffee farmers in both areas have a domestic wastewater treatment system and almost all of them effectively use it (Table 46). The system consists of three parts that are necessary for a proper water treatment: a septic tank for water coming from the toilet, a grease trap for grey water coming from the kitchen and shower, and an anaerobic filter. Not all of the treatment systems have all three components: Only 98 percent have a septic tank, almost 87 percent have a grease trap and about 82 percent have an anaerobic filter. Those households that do not have a water treatment system, pour their waste water somewhere on the farm (almost 50 percent) or into a specific place they use only for waste water (around 25 percent). The latter are normally holes in the ground, some equipped with a grease trap, some without. Around 13 percent pour the domestic waste water directly into a surface water body which is particularly harmful because it directly contaminates the water without being filtered by soil layers. In general, the way domestic waste water is disposed of is slightly more environment-friendly among treatment farms.

Virtually all farmers separate organic from the inorganic waste (Table 46); although there is a significant difference between control and treatment farms, the difference is very small in size.

Table 46: Domestic Solid Waste and Wastewater, in percent

	Control	Treatment	p-value	N
Domestic solid waste				
HH separates the organic and inorganic waste	96	97	0.085 *	1,399
Domestic wastewater				
Farm has a domestic wastewater treatment system	27	28	0.798	1,399
Farms effectively uses the domestic wastewater treatment system	26	27	0.749	1,399
Share of treatment systems that …				
… have a grease trap	85	87	0.708	384
… have a septic tank	98	97	0.761	384
… have an anaerobic filter	80	82	0.626	384
Disposal of domestic wastewater without treatment [a]				
Somewhere on the farm (unprotected)	52	44	0.015 **	1,034
Hole in the ground	23	26	0.295	1,034
Directly to the water source	14	11	0.180	1,034

Notes: Asterisks represent statistical significance of the difference between control and treatment communities. * indicates that the difference is statistically significant at the 10, ** at the 5, *** at the 1 percent level.
[a] The three most frequent disposal places are represented in the table.
[b] The five most frequent treatment systems are represented in the table.
[C] SMTA: Sistema Modular de Tratamiento Anaerobio; Modular Anaerobic Treatent System
Source: FDW Colombia farm survey

The coffee processing generates two types of waste that are potentially harmful to the environment. The **first type of waste is solid** and consists of the pulp that is left from the pulping process. If this pulp comes into contact with water (e.g. rainwater), toxic substances such as tannins, caffeine, chlorogenic acid, and potassium are washed out of the pulp and thereby enter the ground and surface water. These components hamper the process of degrading the organic matter even more. This is why the IWM intervention advocates for the use of roofed pits to protect the pulp from rainwater and prevent effluents to trickle away. In these pits, the pulp can be decomposed into organic fertilizer. A proper pit requires a roof and walls as well as an impermeable floor. Of those farms that have a pit (42 percent in the control and 61 percent in the treatment area), only 56 percent of control farms and 61 percent of treatment farms have a functional pit with proper walls, roofs, and flooring (see Table 47). While the overall share of coffee farms with a pit is significantly higher among treatment farms, no significant difference exists regarding the share of farms that owns a functional roofed pit.

In order to collect drainage water from the pit, IWM promotes the installation of tanks. Among the farms with a pit, 13 percent of the control farms and 16 percent of the treatment farms have a tank for drainage water – the difference is not significant. Around 88 percent of both the treatment and control farms make sure that the pulp decomposes completely. There are three methods that can be applied to accelerate the decomposition: (*i*) the rotation of the pulp, (*ii*) the addition of additives or (*iii*) a worm culture. 59 percent of the control farmers and 56 of the treatment farmers rotate the pulp in the pit on average every 29 and 32 days, respectively. These differences are not statistically significant, nor are the differences among those that add additives or have a worm culture (Table 47).

Table 47: Waste and Wastewater from Coffee Production, in percent

	Control	Treatment	p-value	N
Solid waste of the production process				
Farm has a pit to compost the pulp	42	60	0.000 ***	1,399
Pits is installed properly (i.e. with floor, roof and walls)	56	61	0.131	717
Pits has a tank for collecting drainage water	13	16	0.179	717
Farmer ensures that pulp decomposes completely	88	86	0.664	717
Farmer rotates the pulp in the pit	59	56	0.484	717
Average rotating period (days)	29	32	0.390	409
Farmer add additives	53	46	0.108	717
Farmer uses worm culture pit	11	10	0.633	717
Farm uses the decomposed pulp as organic fertilizer	95	91	0.036 **	717
Application of organic fertilizer to…				
… garden	17	15	0.468	666
… coffee plantation	82	82	0.906	666
… seedling nursery	28	27	0.983	665
… other crops	47	40	0.093 *	666
Disposal of pulp (without pit) [a]				
At the coffee crops	52	54	0.534	733
At the ground or a heap	38	33	0.193	733
At the water source	0	0	0.844	733
Production waste water				
Farm has any production wastewater treatment system	14	14	0.652	1,399
… actually realizes production wastewater treatment	14	13	0.643	1,399
Farm has… [b]				
… a skimmer	8	7	0.543	1,399
… a hydrolytic reactor	2	3	0.198	1,399
… a biological filter	3	3	0.623	1,399
… a SMTA[c]	2	3	0.202	1,399
… another treatment tank	3	0.4	0.001 ***	1,399
Disposal of production wastewater without treatment [a]				
Somewhere on the farm (unprotected)	70	67	0.253	1,212
Directly to the water source	15	12	0.090	1,212
Hole in the ground	5	8	0.019	1,212
Share that treats leachates	2	5	0.001 ***	1,399
Share that has a system to treat the water used for washing the agrochemical supplies	7	8	0.510	1,076
Farmer paid fine for contamination of a water source	0.29	0.29	0.994	1,385

Notes: Asterisks represent statistical significance of the difference between control and treatment communities. * indicates that the difference is statistically significant at the 10, ** at the 5, *** at the 1 percent level.
[a] The three most frequent disposal places are represented in the table.
[b] The five most frequent treatment systems are represented in the table.
[C] SMTA: Sistema Modular de Tratamiento Anaerobio; Modular Anaerobic Treatent System
Source: FDW Colombia farm survey

Of those farmers who have a pit, the majority (about 95 percent) uses the decomposed pulp as organic fertilizer. About 82 percent in both areas applies it to the coffee plantation. Other places of application are other crops (47 percent of the control and 40 percent of the treatment farms) or the seedling nursery (about 28 percent). Those farmers who do not decompose their pulp in a pit, dispose the pulp mainly among their coffee crops, at the ground or at a heap. Virtually nobody disposes of the pulp directly into surface water bodies.

The **second type of waste is liquid** and consists of the wastewater produced during the fermentation and washing stage. It contains the dissolved mucilage consisting of sugars that by fermentation make the waste water very acid (pH of less than 4). Moreover, the digested mucilage builds a thick crust on the surface of the waste water. Only 14 percent of farms in both areas have a sewage system of whatever sort. Among the most common sewage systems are the skimmer, the hydrolytic reactor, the biological filter, and the modular anaerobic treatment system (SMTA). The main disposal places for untreated production water are similar to those of domestic wastewater. Again, around 13 percent of the farms dispose of the waste water directly to a surface water body. This share is slightly higher among control farms. Another by-product of the coffee production process is the leachate that stems from the mechanical mucilage removal. Since the share that applies mechanical removal is small, the share of those that properly treats the leachates is small as well (2 percent of the control and 5 percent of the treatment farms) and differs significantly between the two groups.

Annex 4 – Control Variables for each area of analysis

	Coffee processing	Domestic water usage	Soil protection and forestry management	Meteoro-logical stations	Trainings	Domestic water conservation attitude	Processing water conservation attitude	General water conservation attitude	Sustain-ability labels	Gender	Group member-ship	Water shortage and water excess
Female head of HH	x	x	x	x	x	x	x	x	x	x	x	x
Age head of HH	x	x	x	x	x	x	x	x	x	x	x	x
Head of HH is literate	x	x	x	x	x	x	x	x	x	x	x	x
HH size		x	x	x	x	x	x	x	x	x	x	x
Farmer processes coffee on farm	x			x	x		x		x	x		x
Total coffee area (ha)	x			x	x		x		x	x		x
Total coffee production (cps)	x			x	x		x		x	x		x
Total farm area (ha)			x									
Wealth quintiles (asset index)	x	x	x	x	x	x	x	x	x	x	x	x
Farm keeps accounting records	x	x	x	x	x	x	x	x	x	x	x	x
Secure land ownership	x	x	x	x	x	x	x	x	x	x	x	x
HH lives on farm	x	x	x	x	x	x	x	x	x	x	x	x
Farm pays for water		x			x	x		x				
Farm pays for coffee processing water	x						x					
Water source on farm			x	x	x				x		x	
Farm has sustain-ability label	x	x	x	x	x	x	x	x		x	x	x
Water conservation attitude (index)	x	x	x	x	x				x	x	x	x
Departmental dummies	x	x	x	x	x	x	x	x	x	x	x	x

Annex 5 – Questions for semi-structured interviews of PPP Partners:

A. Is there a clear agreement on the goal of the PPP?

B. How did the Partnership come together? Who took the initiative, the current lead party or some other organization(s)?

C. Has the composition of the PPP remained unchanged so far?

D. Why was engagement in a PPP proposed?

E. Do you have other experiences of engagement in developmental PPPs? With same or different partners?

F. What do you perceive as the expected value added of being in the Partnership?

G. Which resources do you see your organisation as bringing to the Partnership?

H. What would be the alternative uses you could have undertaken with those resources?

I. How will the Partnership operate in implementing the project?

J. How are resources and tasks shared?

K. How are associated risks and rewards shared?

L. How is engagement in the PPP assessed?

M. Who monitors output?

N. Is there a mechanism in place to measure outcome?

O. What are the transaction costs (in comparison with either a fully public set-up or a fully private set-up)?

P. Does the lead party report to the RVO Project Officer on (sub-)results and use of resources, including the subsidy? What role do other partners play in this?

Q. What challenges can you see in the future for the Partnership's project? How do you see them being met in terms of the Partnership decision-making process?

R. Has the partnership been agreed upon for a definite or indefinite time period?

Annex 6 – Questionnaires for institutional analysis

See separate file

Annex 7 – Farm Questionnaire

See separate file