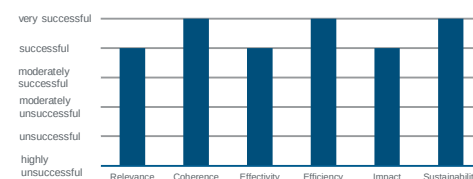


Ex-post evaluation

Sustainable management of the Tungurahua water catchment areas, Ecuador

Title	Sustainable management of the Tungurahua water catchment areas		
Sector and CRS code	3114000 Agricultural water resources		
Project number	2002 66 015		
Commissioned by	Federal Ministry for Economic Cooperation and Development (BMZ)		
Recipient/Executing agency	Honorable Gobierno Provincial de Tungurahua (HGPT), the State of Ecuador is the guarantor for the loan part		
Project volume/ Financing instrument	EUR 10,000,000 / development credit		
Project duration	2010 – 2017		
Year of report	2023	Year of random sample	2021

Overall rating:
very successful



Objectives and project outline

At outcome level, the aim was to make water management in the Tungurahua project area more environmentally friendly and to increase agricultural production on local smallholder farms. The objective at impact level was to make a qualitatively measurable contribution to improving the economic living conditions of the population in the Tungurahua project area and to protecting the adjacent water catchment area. The project focused on the development and implementation of technification programmes for collectively managed, modern irrigation systems in Tungurahua Province.

Key findings

Due to the programme's extremely high degree of coherence, effectiveness and impact as well as its highly relevant and sustainable nature, the project is rated as "very successful":

- The strong relevance of the selected measures is primarily due to the core problem and the needs of the target group being effectively addressed. Modern irrigation systems continue to represent a contemporary instrument for climate change adaptation and offer great potential for conflict mitigation.
- The project has helped to harness synergies with German TC projects and to provide targeted support for Ecuador's own efforts to technify its agricultural irrigation to this day.
- In addition to significantly increasing irrigation efficiency and intensity of land use, the project was able to make a direct contribution to ensuring that women and indigenous sections of the population continue to benefit from the project results today.
- Despite the additional costs, the resources were used efficiently, which led to a very high return on the investment in irrigation.
- The target group's operating income was significantly increased and adequate access to water was secured. At the same time, water distribution conflicts within the villages were significantly reduced.
- The project's high level of sustainability is primarily due to the capacities created by the user communities and the operators (Operadores).

Conclusions

- The project's strengths are the precise selection of the project regions, close cooperation with the user communities and the German TC, and the successful involvement of a competent implementation consultant.
- One weakness of the project was the overly ambitious timetable due to the innovative nature of the project.
- The introduction of modern irrigation systems in a region with traditional water usage rights has been very successful thanks to the target group-oriented, participatory implementation. It continues to be supported by the remarkable intrinsic motivation of the partners, executing agencies and target groups themselves.

Ex-post evaluation – rating according to OECD DAC criteria

General conditions and classification of the project

Export-oriented agriculture is a central pillar of the Ecuadorian economy, with around a third of Ecuador's land being used for agriculture. About 32% (2021) of the working population is active in agriculture¹. Overall, however, the contribution of agriculture to the gross domestic product (GDP) is declining (1960: 33.7%; 2021: 9.4%)². Water is an essential resource for Ecuadorian agriculture. However, 80% of farms in the sector do not have sufficient access to irrigation water or the associated systems. In particular, the precipitation volumes show strong variation regionally and seasonally, which limits continuous water availability. These very difficult framework conditions for farmers are further complicated by the effects of climate change (availability of water is potentially reduced further or even less reliable).

The Tungurahua region is more dependent on agriculture than the national average. In total, 34% of the working population is employed in agriculture.³ Most farms (90%) are smallholdings with an average of less than 1 ha of land and intensive land use. Overall, the soil in the region is well suited for agricultural use and, with appropriate irrigation, high yields can be generated. In total, 90% of the agricultural area, which accounts for around a third of the region's total area, is already cultivated, while around half of this is irrigated. The region's drier zones that are relevant for the project see an annual average rainfall of 800 to 1,500 mm, which makes additional irrigation indispensable for increasing the yield at an evaporation rate of 600 to 700 mm.⁴ However, at the time the project was designed, the water supplied by the páramos and the ground water was lower than the demand from the areas to be irrigated and from households and industry. The water was supplied almost exclusively in the traditional way via underground channels, with the corresponding water losses and using gravitational force. Modern water-saving techniques were not used. Furthermore, the distribution of water was not well aligned with the needs of agricultural management, as the intervals between water allocations were very long due to the scarce water supply, while the duration of water allocations was very short and intermittent. In this context, the duration refers to the watering time quotas allocated to users. In addition, the distribution of water itself was not very transparent – there was a lack of statutes from water user committees, written distribution plans and monitoring of the allocated quantities. The fragmented nature of land ownership makes water distribution and the management of irrigation systems even more difficult. Overall, the various losses mean that less than a fifth of the water is available for the crops. Due to population growth and the low intensity of land use (due to water scarcity), the area used for agriculture also extends to locations at higher altitudes (> 3,600 m).⁵ However, the increasing use of these grass-covered plateaus and high-altitude moorlands ("páramos") is problematic, as it impairs their ability to retain rain fall and helps to exacerbate water scarcity. The increasing use of páramos can be counteracted by increasing productivity in the lower-lying areas.

The provincial government and the population are aware of the deficits in water management.⁶ Public and private organisations have established initiatives to improve incomes and living conditions through modern technologies (e.g. sprinkler irrigation). Irrigated agriculture accounts for the majority of water consumption. Consequently, water shortages can be mitigated most effectively through more efficient use of water in farming. In addition, the regulation and stability of the water supply are of crucial importance. To this end, the prefecture of Tungurahua financed activities to protect the páramos in order to preserve or restore their natural water retention capacity. Through additional investments, the prefecture has pushed ahead with the construction of more large-scale water reservoirs. Finally, the prefecture also promoted the construction of sewage treatment plants in the rural communities in the province to reduce the pollution of water used in farming.

¹ The World Bank (2021): World Development Indicators (WDI): Employment in agriculture (% of total employment) (modelled ILO estimate) – Ecuador, available online at: [Employment in agriculture \(% of total employment\) \(modelled ILO estimate\) – Ecuador | Data \(worldbank.org\)](https://data.worldbank.org/indicator/NV.AGR.TOTL.ZS?locations=EC) (last accessed March 2023).

² The World Bank (2022): World Development Indicators (WDI): Agriculture, forestry, and fishing, value added (% of GDP) – Ecuador, available online at: <https://data.worldbank.org/indicator/NV.AGR.TOTL.ZS?locations=EC> (last accessed March 2023).

³ KfW Development Bank (2007): Ecuador. Environmentally friendly management of the Tungurahua water catchment areas. Project appraisal report, Frankfurt, p. 3

⁴ Ibid, p. 4.

⁵ Ibid, p. 3.

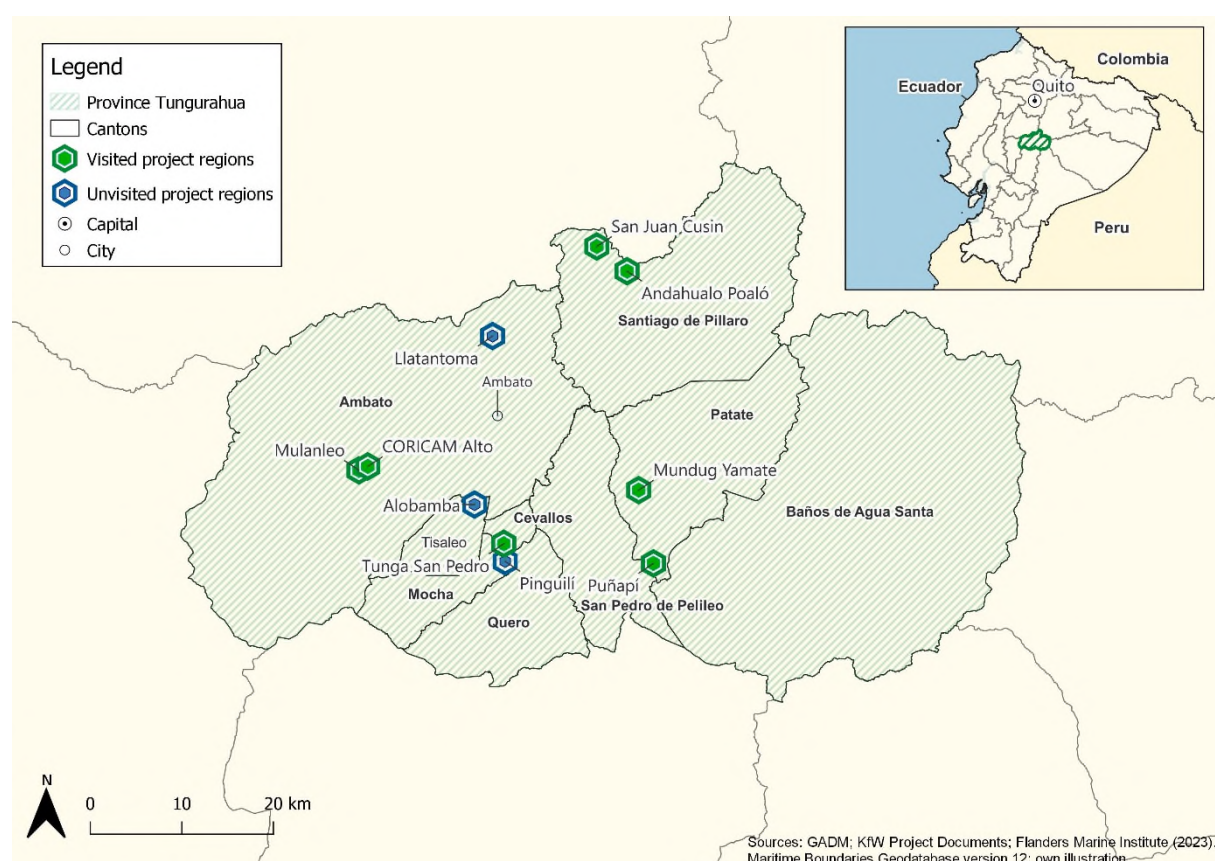
⁶ Ibid, p. 4.

Brief description of the project

The FC project, “Environmentally friendly management of the Tungurahua water catchment areas”, was implemented as an open programme from 2010 to 2017 and financed the development and roll-out of programmes to technify collectively managed irrigation systems in Tungurahua Province in Ecuador. To this end, various measures were implemented across a total of five components. The first two components focused on technically upgrading the irrigation systems, the third component on hydrometeorological monitoring, the fourth on the protection of water catchment areas, and the fifth on the sharing of lessons learned. The provincial government of Tungurahua was the project executing agency.

The target group comprised around 2,300 small-scale, traditionally irrigated farms (families and users) in the project area, especially those living and working in locations at higher altitudes. Decreasing water resources prevented them from intensifying their agricultural production. With the aim of ensuring efficient and sustainable water and resource management, 10 individual programmes were implemented as part of the project. These introduced highly innovative irrigation systems and established hydrometeorological monitoring. The individual programmes were implemented in 10 different project areas⁷, 7 of which were visited as part of the evaluation⁸.

Map of Ecuador incl. intervention area



⁷ Mulanleo, CORICAM Alto, Llatantoma, San Juan Cusin, Alobamba, Pingüilí, Tunga, Andahualo Poaló, Mundug Yamate, and Punapi.

⁸ Mulanleo, CORICAM Alto, San Juan Cusin, Tunga, Andahualo Poaló, Mundug Yamate, and Punapi.

Breakdown of total costs

Table 1: Breakdown of total costs

		Projects (planned)	Projects (actual)
Investment costs (total)	EUR million	13,035,146	16,197,315
Counterpart contribution	EUR million	3,035,146	6,197,315
Debt financing (KfW)	EUR million	10,000,000	10,000,000
<i>Of which BMZ fun</i>	<i>EUR million</i>	10,000,000	10,000,000

Source: Figures based on KfW's final audit report (2017) and project appraisal report (2007).

Rating according to OECD DAC criteria

Relevance

Policy and priority focus

In the context of the German and international development cooperation (DC), the project titled "Environmentally friendly management of the Tungurahua water catchment areas" is highly relevant, as the concept and objective of the project are in line with relevant development strategies from the vantage point of both the past and present. For example, at the UN Conference on Environment and Development in Rio de Janeiro in 1992, sustainable water management, combating poverty, the promotion of sustainable production methods and more efficient resource management were firmly anchored as international development policy goals. Furthermore, the project aligns with the UN Agenda 2030, in that it addresses several Sustainable Development Goals (SDGs).⁹ Two goals that should be mentioned here in particular are SDG 6, which aims to improve water management and facilitate the integrated management of water resources, among other things, and SDG 13, "Climate Action", both of which are taken into account by the project programmes to technify the irrigation systems and protect the water catchment areas. The measures also demonstrate a clear focus on SDG 1, "No Poverty", SDG 2, "Zero Hunger", and SDG 12, "Responsible Consumption and Production" (for more information, see the overall assessment).

The objectives of the project are in line with the Rio Convention on Biological Diversity and, within the context of Germany, with the political priorities of the Federal Ministry for Economic Cooperation and Development (BMZ). In terms of content, the focus of the project is reflected in the core aspects of the action area, namely "resource management, environmental protection and irrigated agriculture"; this was defined as one of six action areas of the bilateral cooperation in the BMZ "Promotion of sustainable agriculture" development policy concept from 2013.¹⁰ The project is also in line with the 2017 BMZ Water Strategy with its programmes for the promotion of integrated water resource management.¹¹ From today's perspective, the project's concept also addresses important core aspects of the current "BMZ 2030" reform plan. This plan sets out the protection of living resources – the environment and natural resources with the action areas of biodiversity, forest protection and water – as one of six core topics of the German development cooperation. The theme of the BMZ core strategy: "Life without hunger – transformation of agricultural and food systems" also states that securing fair access to irrigation is a decisive factor for agricultural productivity and thus a prerequisite for efficient, resilient and sustainable agricultural and food systems. In addition, the list of countries for bilateral development cooperation defines Ecuador as a bilateral partner country for the long-term monitoring and follow-up of common development objectives¹².

The objectives of the project and its measures were and remain aligned with the political and institutional framework conditions and strategies of Ecuador. In this context, for example, it is worth mentioning the national

⁹ BMZ (2023): 2030 Agenda. The global goals for sustainable development, available online at: <https://www.bmz.de/de/agenda-2030>

¹⁰ BMZ (2013): Promotion of sustainable agriculture. Development policy concept. Available online at: <https://www.bmz.de/resource/blob/23494/31388efe792d4953aa2fe31d9f7a456d/strategiepapier327-03-2013-data.pdf>

¹¹ BMZ (2017): BMZ Water Strategy. Source: <https://www.bmz.de/resource/blob/23546/strategiepapier404-06-2017.pdf>

¹² "BMZ 2030" reform concept. Source: <https://www.bmz.de/resource/blob/24906/smateriale510-bmz2030-reformkonzept.pdf>

strategy on climate change in Ecuador (2012–2025) (Estrategia Nacional de Cambio Climático del Ecuador, 2012–2025), which refers to the problem of low water availability in agriculture and describes the adaptation of irrigation techniques as an essential measure for adapting agriculture to climate change. With this in mind, the national irrigation plan (Plan Nacional de Riego, 2011–2026) emphasises the implementation of irrigation projects to ensure more efficient and technified irrigation for agriculture. With a focus on more efficient and sustainable resource and water management along with the overarching objective of improving the population's quality of life, the project is also in line with the national development plan (Plan Nacional para el Buen Vivir 2013–2017), the preceding national rural development strategy of 2013 (Estrategia Nacional para el Buen Vivir Rural) and the development strategy for Tungurahua Province (Agenda Tungurahua, 2014–2029), which identify the technification of agricultural irrigation and the overall guarantee of equal access to resources, opportunities and living conditions as an essential step for development in line with the concept of a good life ("buen vivir").

Focus on needs and capacities of participants and stakeholders

The project was geared to the needs and capacities of the target group and correctly identified the core problem – the low water supply and deficits in water management in the project region – during the design phase. The target group includes the rural population of Tungurahua Province, primarily small (family-run) farms, subsistence farming families and water users' associations. The vast majority of people living in the province belong to the rural population; in 2003, the proportion of poor people¹³ within this rural population was 78%. The proportion of the largely marginalised indigenous population (Kichwa, Salasaca and Chibuleo) in Tungurahua is also high at around 40% compared to other regions in Ecuador. A large proportion of the population and an above-average number of women and indigenous groups depend on agriculture. The productivity of these small and microenterprises was relatively low due to the fact they are split into small and microenterprise (especially those at high altitudes), farmers' poor level of training, the lack of financing opportunities, and the resulting technological lag, among other reasons. In addition, dilapidated irrigation plants and systems cause large amounts of unaccounted for water, while the region's traditional approach of intermittent surface irrigation leads to high levels of inefficiency in water use.¹⁴ Water is an extremely important and scarce resource in the project regions, which are predominantly characterised by higher-lying slopes. Due to increasing water scarcity caused by climate change and the above-mentioned challenges, improving the irrigation infrastructure and the approach to irrigation as well as increasing agricultural production continue to be highly relevant for the target group today. The consideration of targeted training programmes for the target group in the form of specialist advice, skills development and knowledge management, which was ensured by the project approach, was and continues to be assessed as appropriate, as the operation of technically advanced, modern irrigation systems requires in-depth knowledge in the area of sustainable water resource management.

Appropriateness of design¹⁵

The design of the project was considered to be and remains essential and highly appropriate in its ability to tackle the core problem of the target group. A participatory approach based on collaboratively organised user groups is the primary contributor to success. This approach aimed to facilitate the modernisation of the traditional irrigation system, including the water usage rights, for specific target groups.¹⁶ At the same time, this approach was intended to ensure the inclusive participation of marginalised groups (indigenous people, women) in terms of the focus of the project in the region. Finally, the strategy also envisaged the introduction of *Operadores*, individuals who are financed by the user communities and who ensure the operation, maintenance and servicing of the reservoirs. This strategic focus of the project can be regarded as highly innovative. The associated innovation risks were mitigated effectively through close-knit cooperation with the user groups.

Under the open programme approach, individual programmes were selected according to predefined criteria and case-specific feasibility studies. The criteria included the availability of sufficient sources of water in the páramos for the sustainable irrigation of the plots of land tended by the beneficiary users, the user groups' dependence on

¹³ According to the definition of the OECD Development Committee (DAC), poverty is the inability to satisfy basic human needs, such as food consumption and food security, health care, education, the exercise of rights, co-determination, safety and dignity, and decent work. Source: BMZ (2023): Development glossary: Poverty, available online at: <https://www.bmz.de/de/service/lexikon/armut-14038#:~:text=Armut%20mes-sen&text=Bei%20der%20Messung%20von%20Armut,pro%20Tag%20zur%20Verf%C3%BCgung%20haben>.

¹⁴ Intermittent surface irrigation in agriculture refers to an irrigation method where water is distributed over the surface of a field in short, intermittent bursts.

¹⁶ In the Andean regions of Ecuador, the historically developed water usage rights for village residents are often based on traditional community practices and collective resource management. Today, these water usage rights are institutionalised in existing statutes and governed by formal regulations that provide each user of water in the villages with clear time limits regarding their use of water from the main channel.

the agricultural production, and the willingness of the users to make financial contributions (purchasing water dispensers for their plots) and contribute labour force (laying lines and installing the irrigation system on their plots). This approach was intended to ensure that only those programmes offering a high impact, significantly increased irrigation efficiency and sustainability were specifically selected. The chosen approach of implementing the project as an open programme should therefore offer flexibility in the selection of the project regions and allow the local authorities an independent assessment. In the opinion of the interview partners, this approach was – in contrast to a preliminary determination of the participating local authorities – also expedient, as this ensures the very high relevance of the individual measures and the participation of the beneficiaries from the outset. Overall, the open programme approach for the design of the project and the resulting components is rated as targeted and critical to success.

The technical and organisational design was also suitable for helping to solve the core problem. The project aimed to finance a total of 10 sub-projects to technically improve the jointly managed irrigation systems. On a technical level, the inefficient traditional method of surface irrigation (distribution via gravity) was to be replaced by efficient modern methods (spray irrigation and drip irrigation), with the aim of counteracting water scarcity in Tungurahua Province.

The project programmes were to be implemented across five components. Component 1, "Integral irrigation projects", and component 2, "Technifying modular irrigation systems", had the aim of upgrading selected agricultural irrigation systems. For this purpose, central underground irrigation lines first had to be laid in the users' general surrounding area. In addition, larger reservoirs – including filtration systems, pressure reducers, deaeration valves, regulators and slide valves for water distribution – had to be installed. The aim then was to provide users with subsidised irrigation systems – spray irrigation systems for mixed crops and drip irrigation systems for orchards. At the same time, the target groups were to be trained in the proper operation of the irrigation systems through a combination of guidance and training.

The move away from the traditional water rights that have existed for generations can be considered a major challenge for the project. These traditional water usage rights needed to be updated – in close cooperation with user communities – to adapt them to the newly created, modern irrigation infrastructure. Component 3 included the establishment and implementation of a "hydrometeorological monitoring information system" by installing hydrometric and meteorological monitoring stations in various regions of Tungurahua Province. The fourth component of the project was to include agricultural advisory services on the "protection of water catchment areas" and thus contribute to the preservation of the páramos and the protection of the water catchment areas in the higher-lying mountain ranges. Finally, component 5 provided for the written summary and publication of the lessons learned from the programme.

The strategy of the programme particularly focused on components 1 and 2, for which 80% of the project funds were earmarked. The last three components, which account for only a fraction (3.6%)¹⁷ of the overall financial resources, should contribute primarily to embedding the technical expertise and lessons learned from the project, protecting water resources and informing user communities and the executing agency about relevant weather-related changes. All components appeared and continue to appear to be relevant for achieving the objectives, with the result that the holistic approach is rated as appropriate in terms of the concept.

The target system and the underlying impact assumptions are generally comprehensible and sufficiently plausible, albeit with some small compromises. The original objectives of the project were as follows: "Improved water management and increased agricultural production" (outcome level) and "Contribute to improving the living conditions of the population of Tungurahua Province and protecting their water catchment areas" (impact level). As part of the evaluation, the objectives were adapted to ensure their clearer formulation and differentiated allocation of impacts, e.g. with regard to the area of intervention. Accordingly, the objectives underpinning this evaluation are: "Water management in the Tungurahua project area is more environmentally friendly and the agricultural production of local smallholders has increased" (outcome level) and "A qualitatively measurable contribution was made to improve the economic living conditions of the population in the Tungurahua project area and to protect the adjacent water catchment area." (impact level). The objectives at outcome and impact level are conclusively derived from the problem analysis, are appropriate in terms of content, and are located and achievable at the

¹⁷ In this context, the focus is placed on components 1 and 2 in this EPE. Components 3, 4 and 5 are considered solely as influencing factors for the overall achievement of the objectives.

correct impact level. The expedient interlinking of the impact levels was confirmed in various discussions with those responsible for the project.

The interplay between the social, environmental and economic aspects of sustainability was likewise taken into account in the design. The holistic approach to sustainable development is reflected, for example, in the measures to preserve the environment, especially component 4 (protection of water catchment areas) (environmental), the opportunities for marginalised population groups to participate (social) within the context of component 1 (integrated irrigation projects) and component 2 (technifying modular irrigation systems) and the establishment of economic incentives within the context of components 1, 2 and 3 (information system for hydrometeorological monitoring) to ensure the irrigation systems installed are used appropriately (economic). From today's perspective, it was only the timing that was too ambitious for a pilot project, which was realised with a partner new to KfW and as an open programme (see Efficiency). A significantly longer term of at least five years would have been appropriate for such a demanding project.

Response to changes/adaptability

In the interviews, neither the project managers nor the user communities gave any indications of changed framework conditions, meaning there was no need to adjust the project.

Summary of the rating:

The objectives of the project measures were very successfully linked to the Ecuadorian, German and international policies and development strategies and take into account the relevant political and institutional framework conditions of the affected region. The objectives of the measures were aligned with the core problem and the development policy requirements and capacities of the target group, including particularly disadvantaged or vulnerable sections of the target group. This sub-dimension can therefore also be assessed as very successful. In terms of design, the project showed weaknesses in the timing, which was too ambitious for a pilot project based on an open programme approach, leading to compromises in the evaluation. The chosen programmes are appropriate, realistic and fundamentally suitable for helping to solve the core problem. The project design, the underlying target system and the underlying results chain are plausible and follow a holistic approach. The adaptability dimension is not relevant for the evaluation due to the consistent framework conditions and is therefore not included in the overall evaluation. In the context of the evaluation, the project's objectives are classified as highly relevant from a development policy perspective and apply an innovative approach to address an issue that is of continuous importance due to climate change; the overly ambitious schedule is the only drawback, meaning that the overall relevance is rated as – completely – successful.

Relevance: 2

Coherence

Internal coherence:

As part of this project, the instruments of the German development cooperation interlock meaningfully with each other. Synergy was created by means of the close integration of the Financial Cooperation (FC) and the Technical Cooperation (TC) within the framework of the overarching DC programme. The FC project benefits, for example, from the preliminary work of the PROMACH TC project, through which an overall water management strategy (Plan Maestro Hídrico)¹⁸ was financed using FC funds in 2005. This master plan defined the core topics to be addressed in Tungurahua, such as the protection of the páramos, the upgrading of the irrigation technology and the development of a hydrometric and meteorological information network. The latter was implemented via the GIZ project GESOREN (Gestión Sostenible de Recursos Naturales) starting in 2014. In close cooperation between PACT I and GESOREN, 15 meteorological measuring stations and 4 hydrometric measuring stations were installed and integrated into the structures of the partner Honourable Gobierno Provincial de Tungurahua (HGPT) by setting up a meteorological information centre. Starting in 2016, PACT I cooperated primarily with the GIZ's Fortalecer la resiliencia frente al cambio climático y preservar la biodiversidad (ProCamBio) project, in particular with regard to the provision of agroclimatic information to farmers and in the area of ensuring the

¹⁸ Gobierno Provincial de Tungurahua (2015): Plan Maestro de los Recursos Hídricos de la Provincia de Tungurahua, available online at: <https://rrnn.tungurahua.gob.ec/documentos/ver/56cc9a4283ba88c90ac8c289>.

ecological function of the páramos. The creation of moorland management plans and the development of policies for the conservation of the páramos took place in close coordination between both institutions.

This close cooperation within German development cooperation was confirmed by all parties involved (GIZ and KfW) and presented as extremely successful and effective. According to interview partners, the decisive factor for this successful cooperation was that both KfW and GIZ focused on long-term cooperation with the partner in the project region and pursued similar goals and approaches. As a result, the basic understanding behind the problem, approach and objective was shared by both institutions. This, in turn, facilitated regular coordination, which was carried out, for example, through the joint annual planning of activities and programmes. In particular, synergy was created thanks to the geographical proximity of both institutions, which were located on the same floor as the executing agency HGPT for a long time. At the same time, both organisations tasked with implementing the project worked on different, complementary work areas and fields with similar objectives. For example, the KfW project was primarily concerned with the procurement and installation of the hydrometric and meteorological information network, while GIZ was concerned with technical training and the automatic forwarding of agroclimatic information to the target group. Synergies between the implementing organisations involved in the context of the intervention were therefore used appropriately and complemented each other well.

The project was also consistent with the international norms and standards to which the German development cooperation is committed. In addition to respecting human rights, the Paris Declaration was observed, for example, by firmly establishing a strong sense of ownership – one of the five basic principles of effective cooperation – in the design of the project through the close involvement of the Tungurahua provincial government and the farmers as the project target group. Thanks to the highly intensive involvement and consideration of the interests of the indigenous target groups, the project is also based on the German Federal Government's strategy of cooperation with indigenous peoples in Latin America and the Caribbean. The project's inclusiveness claim is also visible in the involvement of marginalised groups, especially women, and thus shows that the “leave no one behind” principle has been respected. The sustainable management of natural resources pursued in the project shows that it is also consistent with the Paris Agreement from today's perspective.

Based on the very good cooperation and complementary effect between the TC and FC, the project achieved a very high level of internal coherence that far exceeded expectations.

External coherence

The project and the individual programmes implemented complement and support Ecuador's own efforts to improve the technological development of its agricultural irrigation and to make beneficial changes to its water management with the involvement of the population.

The province of Tungurahua has been working for many years with non-governmental organisations (NGOs) such as CESA (Central Ecuatoriana de Servicios Agrícolas) in the area of agricultural irrigation. The experience gained from this cooperation, especially from a previous Welthungerhilfe and CESA project where funds from the EU Development Fund were used to technify around 3,000 hectares of irrigated land, was also incorporated into the design of the KfW project. In particular, experiences with water usage rights and the establishment of a water parliament¹⁹ were taken into account in PACT I. The project concept is therefore also in line with the self-image of regional policy in the agricultural sector, e.g. with regard to the participative approach and the desire to reach a broad consensus among the population.

Ultimately, the project was linked to a programme initiated and financed by the World Bank and the Ministry of Agriculture since 2015 and which supports the technification of irrigation systems for smallholdings nationwide. Under the leadership of the Tungurahua provincial government, the respective intervention areas of the various individual programmes implemented by the donors and the NGOs were coordinated and it was ensured they were complementary. This alignment and coordination between the organisations and intuitions prevented the duplication of actions in the different regions within Tungurahua.

¹⁹ In a water parliament, state and civil stakeholders from various national and regional organisations are represented and involved in the organisation of water management.

Summary of the rating:

The project is highly complementary to other German development cooperation projects in Ecuador and has made a significant contribution to the targeted use of existing synergies. The focus of the project's individual programmes is in line with international norms and standards, with the result that internal coherence is assessed as highly successful overall. In terms of external coherence, the project meaningfully complements Ecuador's own efforts to technify its agricultural irrigation. Ultimately, the strategy was based on experiences from previous projects carried out in Tungurahua Province. Coordination via the Tungurahua provincial government ensured the complementary effect of various donor programmes so that external coherence is assessed as highly successful. Internal coherence, which was critical to the success of the project's implementation, was significantly above expectations and external coherence was likewise very successful, with the result that the overall coherence of the project is rated as very successful.

Coherence: 1

Effectiveness

The objective underlying this EPE at outcome level was: "Water management in the Tungurahua project area is more environmentally friendly and the agricultural production of local smallholders has increased." The achievement of the objective based on the indicators adjusted²⁰ as part of this EPE can be summarised as follows:

Indicator	Status PA (2007)	Target value PA/EPE	Actual value at final inspection (2017)	Actual value at EPE (2023)
(1) Key local stakeholders confirm increased irrigation efficiency (supply, distribution and utilisation of irrigation water).	15–25%, depending on individual project	PA: >20% EPE: Qualitative evaluation of irrigation efficiency	Not specified	Achieved – according to interview partners and monitoring data, irrigation efficiency has increased significantly
(2) Key local stakeholders confirm increased intensity of land use due to improved water management.	86–95%, depending on individual project	PA: 86–115 EPE: Qualitative assessment of the intensity of land use	Not specified	Achieved – according to interview partners and monitoring data, the intensity of land use has increased significantly

For indicator (1): increased irrigation efficiency.

Overall, irrigation efficiency has increased significantly in all project regions since the implementation of the modernised irrigation systems, which was completed in 2017.

Prior to the implementation of the project, only the traditional method of gravity-fed irrigation²¹ was employed in the project regions (some areas were also subject to rainfed agriculture without irrigation). This only enabled a maximum average irrigation efficiency of approx. 50% (based on the project's monitoring data). The effects of the project – in particular the switch to sprinkler or drip irrigation – enabled efficiency to be improved virtually across the board by approx. 80%, which is very high. Specifically, irrigation efficiency in Andahualo and Poaló as well as in San Juan Cusín was previously recorded at 50%. Today, according to the interviewees, irrigation efficiency in these regions is at 80%. In Puñapi, the switch was made to drip irrigation instead of sprinkler irrigation. According to interview partners, irrigation efficiency is highest here, at 80–90%, of all the project regions visited. The water user groups interviewed confirmed this positive development. They indicated that unaccounted for water has

²⁰ Indicator 1, "Irrigation efficiency (supply, distribution and application of sprinkler water)", was replaced with the alternative proposal, "Key local stakeholders confirm increased irrigation efficiency (supply, distribution and application of sprinkler water)". Indicator 2, "Intensity of land use", was replaced by the alternative proposal, "Key local stakeholders confirm increased intensity of land use due to improved water management" (see annex).

²¹ Gravity-fed irrigation is a synonym for the type of intermittent surface irrigation described above.

decreased significantly while water use through sprinkler and drip irrigation is much more targeted. Based on the various statements of the user communities, this is leading to noticeably higher irrigation efficiency in the project regions. It was only in Tunga, where efficiency was already at 60–70% prior to the start of the project, that a comparatively lower increase in efficiency to 75–80% was recorded.

For indicator (2): increased intensity of land use.

As with irrigation efficiency, there is a very significant increase in the intensity of land use in the project regions, according to information from the interview partners. Before the start of the project, a maximum of 81% of the potential cropland in Mundug Yamate or in some cases, only 25% in San Juan Cusín was cultivated in the regions in question using traditional irrigation methods (gravity-fed irrigation). In CORICAM Alto, rainfed agriculture was possible, which also significantly reduced the intensity of land use. According to the monitoring data of the PACT project, average land use intensity in the affected regions was around 70% at the time of the project appraisal in 2007. At the time of the EPE in 2023, land use intensity of almost 100% will be achieved in the areas that were converted to sprinkler irrigation. In Puñapi, where drip irrigation is practised, the intensity of land use is 90%. This development is in line with the increased field yields in the intervention areas. Land use intensity at the time of the EPE can also be seen in the drone images (see appendix).

The increase in land use intensity was also confirmed in the interviews with the user communities. According to users, the more intensive use of land can be attributed to several factors and must be considered against the background of the respective soil properties. On the one hand, there is a lot of previously unmanaged arable land, which lies primarily on steeper slopes. Gravity-fed irrigation of these arable areas would only have been possible when factoring in a major loss of water due to the gradient of the slope. At the same time, gravity-fed irrigation on these fields leads to soil erosion, which, among other things, reduces the nitrogen and other minerals in the soil. Furthermore, gravity-fed irrigation often results in arable areas being irrigated very heavily at specific points, so the arable area as a whole is not evenly watered. This also led to a lower intensity of land use. In addition, some areas exclusively consisted of rainfed agriculture. This meant that the potential for cultivation and thus the intensity of land use was low (and the economic losses very high) for these areas, especially during dry periods. This was especially the case in CORICAM Alto.

Table 2: Development of irrigation efficiency and land use²²

	Andahualo Poaló	Puñapi	Tunga	San Juan Cusín	Mundug Yamate	Mulanleo	Overall average	Percentage change
Irrigation efficiency (%) before implementation (2014–2016)²³	EUR 50	55	65	EUR 50	EUR 50	EUR 50	53	
Irrigation efficiency (%) after implementation (2022)	80	85	77.5	80	80	80	80	+51%
Land use intensity (%) with gravity-fed irrigation		70	EUR 50	45	81	EUR 50	59	
Land use intensity (%) with sprinkler or drip irrigation	100	90	100	100	100	100	98	+66%

Source: Information based on monitoring data from the implementation consultant.

Contribution to achieving targets

Overall, the project contributed to a very strong improvement in the water supply and distribution and resulted in a significant improvement in irrigation efficiency. The decisive factor here was the switch from traditional gravity-fed irrigation to much more effective and targeted sprinkler or drip irrigation. For example, irrigation efficiency in Tunga increased from 60%–70% to 75%–80% and from 50%–60% to up to 90% in Puñapí. The project also contributed to a significant reduction in seepage and evaporation through the programmes to construct service reservoirs and the central water distribution infrastructure (water supply and distribution, partly through underground pipe systems), and thus to an increase in irrigation efficiency.

At the same time, the programmes to protect the páramos have contributed to a reduction in land use in the water catchment areas – the páramos – according to the interviewees, and water availability is secured more effectively by preserving the natural water retention capacity. Equally positive effects of the project were identified as

²² No data could be collected for the CORICAM Alto project area.

²³ Due to the incremental implementation and the associated different commissioning of the irrigation systems, an exact year cannot be specified.

part of this evaluation with regard to the intensity of land use. Here, too, the project plays an essential role by switching from traditional gravity-fed irrigation to innovative sprinkler or drip irrigation. As described above, the technification of the irrigation systems makes it possible for users to irrigate larger areas of their fields more efficiently and effectively. This is particularly evident on steeper slopes, where the introduction and use of sprinkler systems makes it possible to manage the fields there for the first time. The project's approach of providing users with information on sprinkler or drip irrigation systems through advice activities, subsidising the costs of these systems and providing training in their use, maintenance and servicing has therefore helped to increase the intensity of land use significantly.

A link between the project's activities and the achievement of the objectives is therefore plausible. All measures of the project, from capacity development and training of users to the provision of subsidised irrigation infrastructure and the protection of the páramos, contributed to the achievement of the outcome indicators and thus to the achievement of the project's overall outcome objective. At the same time, according to the interviewees, no other factors, such as economic or climatic changes, had a positive influence on the achievement of the targets. The opposite is usually the case. Climatic changes in particular in the form of reduced precipitation volumes and noticeably reduced glacial outflows have presented the population dependent on agriculture in the project region with growing challenges in recent years. Despite these counteracting external factors, the objectives of the project were achieved.

Vulnerable users in particular, especially women and indigenous sections of the population, benefited from the project. First of all, it should be noted that in many cases women were responsible for implementing the traditional gravity-fed irrigation approach. Based on the original water usage rights in the project regions, some user households only had the right to use water in select areas in the early hours of the morning. This meant that the women in the households in particular had to get up very early in the morning – or even at night – to capitalise on the right to use water and to irrigate their fields using gravity-fed irrigation.²⁴ According to the user communities, the implementation consultant and the executing agency, this was associated with a certain risk for the women due to the darkness and the fact that they were alone. Technification and conversion to sprinkler or drip irrigation, as well as the corresponding adjustment of water usage rights via the cooperative work between the project managers and user groups, has meant that the fields can be irrigated during the day. This adjustment is derived from the project's efforts to technify the irrigation systems. This has contributed to an important reduction in risk for women and, at the same time, led to a significantly improved quality of life. The strong participation of women in the administration of user communities has also been observed to date. For example, in most of the intervention areas visited, women were involved in the maintenance of the infrastructure and indicated that they had a say in the decision-making processes.

For socio-economic reasons, indigenous populations in the project region have often settled in less productive agricultural locations. This applies in particular to higher or drier regions, which are more affordable but less productive for agriculture. The low productivity at these locations is mainly due to limited access to water. For example, CORICAM Alto is mainly populated by indigenous peoples and had no access to water from the páramos due to its geographical location. Technification and conversion to sprinkler or drip irrigation have led to a significant improvement in the intensity of land use and to better irrigation efficiency in these intervention areas, which has greatly improved the socio-economic situation of users (see Impact).

The internal factors that contributed significantly to achieving the goals included the holistic, highly participative implementation approach based on various components. The project's focus was on programmes to technify the irrigation systems. They were supplemented by programmes to protect the páramos and through the provision of meteorological and hydrometric measuring stations (provision of agroclimatic information for farmers). This also helped to increase the productivity of the agricultural land. Now, for example, farmers find out earlier when there is a risk of frost and can use sprinkler systems to irrigate their potato fields to protect them from frost and therefore harvest losses. The intensive work with the user communities also ensured that the use and maintenance of the irrigation systems is still effective today (see also Sustainability).

The project's approach as an open programme represents another internal success factor. The open programme approach enabled a criteria-based selection of the project regions and individual programmes based on the specific needs of people. This ensured that only those regions that were highly agricultural and dependent on the

²⁴ To water the fields, the women opened a slide valve early in the morning according to the watering plan and flooded the fields.

water inflow from the páramos, used traditional irrigation methods and suffered noticeably from water scarcity were eligible to take part in the project.

One outcome of the project that is crucial for the successful achievement of objectives and the project's high level of sustainability is that its very positive successes, which were clearly visible at a target group level, resulted in the outstanding motivation and involvement of the responsible provincial government. The Water Directorate in particular played a decisive role in the implementation of the project. The vast majority of participants interviewed reported that their strong and consistent support was decisive for the successful implementation of the measures. This helped to ensure that challenges which arose during implementation were addressed straight away.

The very strong climatic changes that have been noticeable for years are external factors. These changes result in lower precipitation volumes and water outflows (e.g. due to declining glaciers) as well as a higher evaporation rate. Against this background, it is impossible to overemphasise the significance and positive impact of the project on the effectiveness and efficiency of the irrigation, and consequently the resilience of users.

Quality of implementation

With regard to the quality of the implementation, the first element to mention is the good choice of implementation consultant; this consultant was decisive for the achievement of the objectives due to his thematic and regional experience. For example, the consultant's international team had experience in implementing similar projects in Bolivia and Peru, for example, giving them the necessary expertise and administrative experience to support the partner. At the same time, the exceptionally high level of participation in the project programmes by the Tungurahua provincial government can be assessed as positive and expedient. The provincial government provided a team that was suitable in terms of staff and quality to handle implementation alone. This team was not affected by personnel changes or by the provincial government's day-to-day political business. The majority of employees in this team continue to be involved in the implementation of the successor project PACT II. The sound selection of the implementation consultant and the executing agency's own competent team therefore fulfilled an important basic requirement when it came to successful implementation.

At the same time, the project established an effective and efficient management structure. To this end, detailed implementation plans for the individual project regions were developed as part of a participatory process. This is where important details on technifying the irrigation infrastructure were determined. In addition, a detailed monitoring system was set up, showing the progress of implementation and the results of the project. The management structure was also favoured by the close coordination between the Tungurahua provincial government and the implementation consultant, as well as the selective involvement of KfW, for example in central decisions such as the selection of the project regions.

Unintended consequences (positive or negative)

Neither positive nor negative unintended direct consequences or results could be identified during the evaluation. Neither the project managers nor the user communities indicated there were unintended direct consequences, so the project did not have to respond to potential effects or risks that could arise from any unintended direct consequences.

Summary of the rating:

The effectiveness rating consists of the individual dimensions of achievement of intended objectives, contribution to the achievement of objectives, quality of the implementation and unintended consequences. At outcome level, the objectives were clearly and completely achieved above the target level – both the irrigation efficiency and the intensity of land use in the intervention areas were increased by much more than expected. This dimension is therefore rated as very successful. The project's activities directly contributed to achieving the indicators and the outcome objective, and had positive effects on the intended target group and vulnerable and disadvantaged groups, in particular. The programmes were inclusive and took into account the gender-specific dimensions of the project. Exclusively internal factors, such as the open programme approach and close cooperation with the user communities, were decisive for achieving the objectives. This partial dimension can therefore also be rated as successful. Ultimately, the project was based on an effective and efficient management structure. Likewise, the good selection of the implementation consultant and the participation of the executing agencies contributed to the achievement of the project's objectives. The dimension of unintended consequences is not included in the overall

assessment due to insufficient identification. In view of the clearly positive results that largely exceeded expectations, the effectiveness of the project is rated as very successful overall.

Effectiveness: 1

Efficiency

Production efficiency

The total cost of the project is around EUR 16.2 million. The FC contribution amounted to EUR 10 million; the partner contributed EUR 4.8 million and the target group (user communities of the irrigation infrastructure) contributed labour and purchases worth close to EUR 1.4 million²⁵. This meant the project was around EUR 3.2 million more expensive than planned at the time of the project appraisal.

The additional costs resulted mainly from delays caused by the various feasibility studies, the procurement of the materials for the irrigation infrastructure and the subsequent implementation. Initially, there was disagreement between KfW and HGPT regarding procurement procedures and the awarding of the contract. The procurement costs of the planned components of the irrigation infrastructure, including pipes, regulators, slide valves, de-aeration valves and filters, were greater than initially estimated. Experiences from commissioning the initial irrigation systems also showed that sediment in the water frequently clogged the slide valves and regulators, severely restricting their functionality, so that more filters had to be installed than was initially assumed. The needs-based selection of individual programmes in line with the open programme approach also led to delays, especially in the definitive identification of the project regions. Finally, the evaluation revealed that the work involving the user communities in particular, such as advisory activities, training sessions and the adjustment of water usage rights, was very time-consuming. These communities were initially extremely critical of the changes to their traditional water rights, which had become necessary due to the new irrigation concept. Due to these significant delays, the project implementation period was significantly extended, amounting to six years instead of three years as originally planned. The delays led to a 188.4% increase in management costs. This was due in particular to the additional costs for the implementation consultant deployed and was borne in full by the executing agency. Based on the interviews with KfW's project managers, the implementation consultant and the responsible executing agency, these additional costs are assessed as appropriate in the context of the evaluation in view of the uncertainty in planning and budgeting due to the project being a pilot and the open programme approach. These costs are therefore not negatively weighted in the evaluation.

The costs of the project were predominantly distributed between component 1, "integral irrigation projects", and component 2, "technifying modular irrigation systems", out of a total of 5 project components. The costs for constructing the irrigation infrastructure amounted to around EUR 12.8 million, representing 79% of the total costs. The programmes to establish a hydrometric and meteorological information network (component 3), the programmes to protect the páramos (component 4) and the sharing of learning experiences (component 5) amounted to only a fraction of the total costs, at 3.64%. Administrative and logistics expenses totalled 1.63% and implementation consultant expenses were the second highest cost factor at over 12.46%.

Table 3: Costs and financing sources per component PP (2007) versus actual costs (2016)

	Planned costs in %	Actual costs in %
Components 1 & 2 "Irrigation infrastructure"	63.51%	79.01%
Component 3 "Hydrometric and meteorological information network"	4.42%	1.39%
Component 4 "Programmes to protect the páramos"	10.55%	2.09%
Component 5 "Sharing of learning experiences"	4.47%	0.16%
Costs for administration & logistics	3.82%	1.63%
Consultancy fees	5.37%	12.46%

Source: Figures based on KfW's final audit report (2017) and project appraisal report (2007).

²⁵ User participation consisted primarily of providing labour to excavate trenches and a monetary contribution to purchase of part of the irrigation and drip irrigation systems for their own plots of land.

Due to the heterogeneity of the areas and family units, the direct costs vary for the infrastructure involved in the individual programmes financed under the respective components. According to the appraisal of KfW's project managers and the implementation consultant, these costs were above the regional average, but are assessed as appropriate due to the very high level of technology (basis for sustainable use) used in the installed irrigation systems. Compared to other irrigation systems and approaches in the region, for this project the central irrigation pipes were installed at a depth of at least 1.2 metres to prevent external damage and so increase the longevity of the systems (see Sustainability). This justifies the relatively higher construction costs. The financial resources used for the project were therefore proportionate to the services provided. Alternative implementation approaches for components 1 and 2, such as above-ground, central water pipes or more tailored irrigation approaches, such as smaller individual service reservoirs for each user, would have led to lower total costs but would have significantly affected sustainability. The project's exemplary nature, which led to the strategy being adopted by other projects and interested parties, would also be significantly less pronounced.

Allocation efficiency

Allocation efficiency is evaluated on the basis of the cost-benefit ratio, which compares the investment costs of the project with the overarching intended effect. Due to its relevance for the objective at impact level – an improvement in the economic living conditions of the population in the affected Tungurahua region – this analysis used the users' operating income as a proxy indicator to measure output. The partially limited data situation was also decisive for this, as insufficient data was available for the second indicator at impact level (which measures water access) at the time of the EPE.

Table 1 below shows the difference between the average monthly operating income of the user households before and after completion of the project measures. This difference in income was then divided by the investment volume spent on constructing the irrigation infrastructure, furnishing the plots with equipment, and the training and education activities. This results in the cost-benefit ratio, which shows the average costs of the project to achieve a monthly income increase of one dollar.²⁶ According to this calculation, the balance sheet is positive for the return on investment, which, on average, is around USD 38,500 for the various implementation regions where the corresponding monitoring data on income increases was available. This results in a cost-benefit ratio of USD 16.73 per user on average when allocated to the approximately 2,300 users who benefit from the project. With investment costs per user of USD 1, an increase in monthly income of USD 16.73 was therefore achieved.

The cost-benefit ratio's value can be interpreted as good when comparing the investment costs with the annual additional income since the completion of the project in 2018. The additional monthly income of USD 234.17 per user on average corresponds to USD 538,600 in additional income per month for the approximately 2,300 users. Users therefore generate an additional average income of USD 6,463,210 per year. Most of the irrigation infrastructure construction programmes were concluded in 2017. It can therefore be assumed that the users of the irrigation infrastructure have now recorded additional revenue for around five years, totalling more than USD 32.3 million. The additional revenue generated by the project therefore amounts to approximately 3.5 times the investment costs of USD 9 million.

However, it is important to mention the significant additional income in Tunga, which is largely due to the significantly higher cultivation of blackberries and potatoes and the associated profits. Prior to the project, for example, 1.7 hectares of blackberries were cultivated in Tunga based on data from the implementation consultant. Thanks to the irrigation systems, this area could be expanded to 11.7 hectares. This development was confirmed by the various on-site interviews with users. Subject to possible measurement errors in the monitoring data, the cost-benefit ratio was also calculated excluding the project area of Tunga. Although this is reduced to USD 72,661 on average and the average additional income is increased to USD 105, it continues to show a significant increase. Since the results in Tunga are directly attributable to the project, the data is classified as valid. Other factors, such as the exploitation of other possible sources of household income, could also have had a positive impact on income and were not taken into account in the calculation. Data quality could likewise not be checked, as the data was collected by the implementation consultant before and after project implementation and only the average values were available to the evaluation team, which ruled out a differentiated analysis.

²⁶ This is to be understood in the light of other income-increasing effects that are unrelated to the FC project and that do not influence the cost-benefit ratio.

Table 4: Results of the cost-benefit analysis²⁷

	Andahuayo Poaló	Puñapi	Tunga	San Juan Cusin	Mundug Yamate	Mulanleo	Total
Operating income before the project²⁸ (2014–2016) (family/month/USD)	\$ 135.82	\$ 260.60	\$ 303.48	\$ 191.90	\$ 170.50	\$ 81.25	\$ 182.77
Operating income after the project (2022) (family/month/USD)	\$ 265.5	\$ 448.50	\$ 1,313.30	\$ 269.40	\$ 224.40	\$ 132.00	\$ 416.94
Income difference	\$ 129.67	\$ 187.90	\$ 1,009.82	\$ 77.50	\$ 53.90	\$ 50.75	\$ 234.17
Investment volume (infrastructure, plot equipment, training)	\$ 4,100,085.00	\$ 746,005.00	\$ 1,388.75,00	\$ 730,735.00	\$ 1,649,966.00	\$ 395,357.00	\$ 9,010,897.00
Costs per USD 1 increase in income	\$ 50,222.55	\$ 3,970.22	\$ 1,375.24	\$ 9,428.84	\$ 30,611.61	\$ 7,790.29	\$ 38,479.45

Source: Information is based on the implementation consultant's monitoring data and calculations from Syspons.

Summary of the rating:

Due to the significant additional costs caused by the delay, the project's production efficiency is rated as moderately successful. Although uncertainties regarding budgeting and the timeliness of implementation were inherent to the project due to it being a pilot and the open programme approach, these uncertainties should have been anticipated more effectively in the planning stage (see Relevance). The executing agency's full assumption of the additional costs continued to ensure the unrestricted provision of the project outputs, albeit at the expense of the project's individual economic profitability. With regard to the cost-benefit ratio regarding the use of the project's funds, the allocation efficiency can be assessed as very successful in view of the monthly income increases achieved by the user communities in comparison with recent years. The efficiency of the project is thus rated as successful overall.

Efficiency: 2

Impact

Overarching developmental changes (intended)

The objective underlying this EPE at impact level was: "A qualitatively measurable contribution was made to improving the economic living conditions of the population in the Tungurahua project area and to protecting the adjacent water catchment area." The achievement of the objective at impact level can be summarised as follows in line with the indicators,²⁹ which had in some cases, been adjusted as part of this EPE:

Indicator	PP status (2007)	Target value according to PA and EPE	Actual value at final inspection (2017)	Actual value at EPE (2023)
(1) Central local stakeholders confirm a positive development in the operating income of local smallholders due to the programmes implemented by the project.	USD 900–3,700/operation/year, depending on the individual project	PA: No target level defined EPE: Qualitative evaluation of the development of operating income	Not specified	Achieved - according to interview partners and monitoring data, operating income has increased

²⁷ No data could be collected for the CORICAM Alto project area.

²⁸ Due to the incremental implementation and the associated different commissioning of the irrigation systems, an exact year cannot be specified.

²⁹ Indicator 1, "Development of farm income", was replaced by the alternative proposal, "Key local stakeholders confirm a positive development in the operating income of resident smallholders due to the measures implemented by the project" (see annex).

(2) Access to sufficient and safe water.	0.012–0.015 l/sec/ha, depending on the individual project	PA: No target level defined EPE: Assessment of water quality and qualitative assessment of water access	Not specified	Achieved – according to interview partners and monitoring data – and based on water tests – there is sufficient and safe water
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Note on indicator (1): Positive development of operating income.

Based on the project's monitoring data and the information from the interviews, operating income developed along a positive trajectory after the local smallholders completed implementation. A significant increase in the average operating income of user households was recorded, rising from around USD 180 to close to USD 420 (233%) in the project regions (see Table 3). An especially strong increase in income can be seen in the Tunga intervention area, which, as already described under Efficiency, is due to the greatly increased cultivation of blackberries (from 1.7 to 11.7 hectares) and the associated profits. Here, the average income per user household rose from USD 303 in 2016 to USD 1,313 in 2022, representing an increase of 433%. Even in the region that profited the least, Mulanleo, the average income per household increased by around 63% from USD 81 to USD 132.³⁰

According to the user communities and project managers interviewed, this positive development in the operating income of the user households is due primarily to the increased harvest yield of more intensively irrigated varieties of fruit, such as mandarins, blackberries, strawberries and avocados. Nevertheless, the rise in the cultivation of potatoes, carrots, garlic or leeks, the production of dairy produce, and fodder (grass) for the raising of guinea pigs had a very positive effect on the financial situation of the user families. Furthermore, the monitoring data collected for the project shows that the use of arable land has increased (see Effectiveness). At the same time, the yield volume of the land shows (sometimes very strong) positive changes. Due to production increases, the annual quantity of potatoes harvested in Tunga, for example, increased by 150% (from 9,500 kg to close to 14,250 kg per hectare and year), while blackberry production increased by 249% (from 6,000 kg to close to 15,000 kg per hectare and year). Similar developments can be observed in all project regions between the completion of the project activities in 2016 and 2022, such as in Poaló, where potatoes and maize production increased in particular. In Puñapí, a region where mandarins and avocados are primarily grown, there was an increase in mandarin production from 20 kg to up to 100 kg per tree according to users of the drip irrigation infrastructure. According to users, there is a similarly strong increase in the production of avocados. In CORICAM Alto, for example, the resulting increase in operating incomes meant that the local indigenous user community was able to acquire further agricultural production equipment, such as milk cooling systems. These agricultural means of production also led to an increase in farm income, as it meant that products such as milk could be stored for longer.

Note on indicator (2): Access to sufficient and safe water.

The data collected indicates a significant improvement in access to water for smallholders. Before the start of the project, access to irrigation water for agricultural areas in most project regions was dependent on the speed of the inflow of water from higher altitudes and was supplied to the fields via gravity-fed irrigation. Furthermore, due to a lack of other water supplies, agricultural production in CORICAM Alto was focused exclusively on rainfed agriculture. By technifying the irrigation systems, water availability increased by an average of 72% when measured in litres per second. This enabled the introduction of more frequent and more regular watering routines, that continue to allow the even distribution of water over the cultivated areas through to the present. In Andahualo Poaló and Mulanleo, for example, gravity-fed irrigation per user was only possible every 15 days before the start of the project, while today regular irrigation every 8 days is possible.³¹

³⁰ It should be noted that this data is not adjusted for inflation. As a result, the increase in operating income is less, relatively speaking, than the absolute figures. However, according to the World Bank, inflation in Ecuador was only 1.98% on average between 2016 and 2021. The documented increases in operating income are therefore significantly higher than inflation in the country as a whole.

³¹ This information comes from the implementation consultant's monitoring data.

Table 5: Changes in operating income and water availability³²

	Andahualo Poaló	Puñapi	Tunga	San Juan Cusín	Mundug Yamate	Mulanleo	Total average	Percentage change
Operating income (family/month/USD) before implementation (2014–2016) ³³	\$ 135.82	\$ 260.60	\$ 303.48	\$ 191.90	\$ 170.50	\$ 81.25	\$ 182.77	
Operating income (family/month/USD) after implementation (2022)	\$ 265.5	\$ 448.50	\$ 1,313.30	\$ 269.40	\$ 224.40	\$ 132.00	\$ 416.94	+228%
Water availability (l/s) before implementation	59.47	60.4	60.4	20.36	89.05	21.4	53	
Water availability (l/s) after implementation	133.45	74.5	68.5	59.7	110.4	56	91	+72%

Source: Information based on monitoring data from the implementation consultant.

An ever-increasing challenge concerning the indicator is the rise in the number of drought periods, which are intensified by advancing climate change. This increase is already having a negative impact on the constant availability of water from the páramos and thus on agriculture. According to project managers and user communities, the drought periods have been longer in recent years, a fact acknowledged with a rising level of anxiety. The protection of the páramos and the measurement of precipitation and weather data by the installed meteorological and hydrometric measuring stations will therefore remain of key importance in the future.

The water quality of the intervention areas visited is completely safe and rated as adequate overall. Portable laboratory tests were carried out on-site to monitor the quality of the water. The results of the parameters collected show that the water is suitable for agronomic use. The measured pH value lies between 7.5 and 8.5 in all project regions and, like the measured values for the general and carbonate hardness of the water (GH and KH), is therefore within the normal range for natural water bodies³⁴ (see Table 2). Nitrate (NO₃⁻), and nitrite (NO₂⁻) – important nitrogen load and pollution indicators – could not be detected in any of the samples. The same is true of ammonia/ammonium (NH₄⁺), which was only detected in small quantities in Tunga. The phosphate values (PO₄³⁻) are classified as slightly elevated in all samples taken. However, this has a positive effect overall on the irrigation of agricultural areas. Only the iron value (mg/L) was 1 mg/L in Andahualo Poaló and in CORICAM Alto. These values are classified as slightly elevated for natural water bodies and can probably be attributed to ore in volcanic rock or to a low oxygen content in the ground water. However, a more precise investigation into the cause is not possible in the context of this EPE and the values are non-critical due to the use of the water for agricultural cultivation.

Table 6: Results of the water quality measurement³⁵

	Normal values	Tunga	San Juan Cusín	Puñapi	Mundug Yamate	Andahualo Poaló	Mulanleo	CORICAM Alto
pH value	>6.5 to <8.4	7.5	8.5	8.5	8	7.5	8.5	8.5
General hardness (GH)	5 to 18 °dGH	5 °dGH	7.8 °dGH	11 °dGH	8 °dGH	10 °dGH	9.5 °dGH	9.5 °dGH
Carbonate hardness (KH)	3 to 14 °dKH	5 °dKH	5 °dKH	8.5 °dKH	5 °dKH	3.5 °dKH	6 °dKH	6 °dKH
Phosphate (PO₄³⁻)	up to 6.7 mg/l	1 mg/l	0.25 mg/l	1 mg/l	1.5 mg/l	0.25 mg/l	0.25 mg/l	0.25 mg/l
Nitrite (NO₂⁻)	up to 0.5 mg/l	0 mg/l	0 mg/l	0 mg/l	0 mg/l	0 mg/l	0 mg/l	0 mg/l
Nitrate (NO₃⁻)	up to 50 mg/l	0 mg/l	0 mg/l	0 mg/l	0 mg/l	0 mg/l	0 mg/l	0 mg/l
Ammonium (NH₄⁺)	up to 0.5 mg/l	0.5 mg/l	0 mg/l	0 mg/l	0 mg/l	0 mg/l	0 mg/l	0 mg/l
Iron (mg/L)	up to 0.5 mg/l	0.5 mg/l	0.25 mg/l	0 mg/l	0.25 mg/l	1 mg/l	1 mg/l	1 mg/l

Source: Based on on-site water samples taken by Syspons, February 2023.

³² No data could be collected for the CORICAM Alto project area.

³³ Due to the incremental implementation and associated different commissioning of the irrigation systems, an exact year cannot be specified.

³⁴ The normal values stated in the table refer to water values considered as standard in Europe/Germany. Sources: Food and Agriculture Organization of the United Nations (1985): Water quality for agriculture, Rom and Bayer, A. Parameters for evaluating a water sample. Chair of Applied Geology at the University of Erlangen, available online at: <http://www.angewandte-geologie.geol.uni-erlangen.de/paramete.htm>.

³⁵ The irrigation systems in Mulanleo and CORICAM alto receive the water from the same supply, so that both project areas have the same values (see also location map).

Contribution to overarching developmental changes (intended)

According to the various interview partners, the increased operating income in particular – but also sufficient access to water in the project regions – can be attributed exclusively to the project programmes implemented. For example, technification of the irrigation systems and the installation of sprinkler or drip irrigation led to increases in production and a significant reduction in production risks, which – as mentioned above – enabled users, in part, to quadruple their crop yields. The reclamation of agricultural land situated on slopes that had previously not been irrigable also had a positive effect on agricultural production.

Furthermore, technification of the irrigation systems and the work to conserve the páramos promoted the availability of sufficient, qualitatively safe water. On a technical level, the conversion from superficial, gravity-fed distribution systems to an underground piping system resulted in reduced water loss due to evaporation and seepage, thereby increasing water utilisation efficiency (see Effectiveness). On the other hand, the construction of the reservoir means that the water from the páramos can, to date, be stored for longer periods of time and later distributed evenly to smallholders on their fields in accordance with water usage rights. This ensures continuous water availability even in periods of low precipitation. From an ecological point of view, water availability was promoted via the measures to protect the páramos. Above all, the project's close cooperation with the local communities and villages has contributed to a greater awareness among the population regarding the protection of the páramos. In some cases, this awareness goes hand in hand with the fact that less livestock is kept in the páramos in order to maintain the water-retaining function of these high moorlands and to continue to ensure access to this natural water source.

With regard to water quality, no measures had to be taken to achieve the water values listed above. Due to the fact that there are no industrial or mining activities in the higher-lying regions that affect the water inflow, the water quality does not deviate significantly from the accepted normal values.

Overall, it can be stated that the project's programmes have contributed to the achievement of the objectives at impact level. There is no allocation gap. The effects of the project are still clear to see at the overarching development policy level.

As a result of these positive changes and impacts, there was a strong demand in most of the participating communities and villages from other smallholders who had not previously been involved in the project measures to likewise be connected to the central irrigation infrastructure. In many cases, the PACT II successor project and other programmes undertaken by the provincial government (executing agency) have made this possible for these smallholders.

According to those responsible, other provinces and regions in Ecuador are also showing great interest in the project's approach. The possibility of sharing learning experiences gained from the project with potential beneficiaries was assessed as extremely relevant in this context. In Ecuador, there are currently also other projects initiated by other donors and Ecuadorian initiatives that, like PACT I, are seeking to technify the irrigation infrastructure used by smallholders. According to the interviewees, this approach is not comparable to PACT I in some areas, but the general replication and the specific replication via the follow-up project PACT II shows the very broad impact of PACT I.

Contribution to impact (unintended)

In addition to the positive development of operating income and sufficient access to water, the evaluation also identified a positive unintended consequence. The improved water access also significantly reduced conflicts arising from water access and distribution within the villages in the project regions. This development was confirmed by users in all visited project regions. According to the interview partners, there were many conflicts surrounding water resources before the start of the project and the implementation of the technified irrigation systems. For example, the interviews often referred to "water-stealing" neighbours and fellow villagers – in most cases they had diverted the water flow to their fields at higher altitudes. As a result, the villagers with fields on lower slopes had only limited or no access to water, which was to be supplied through gravity-fed irrigation. This was despite the fact that these inhabitants had the right to use the water at the time under the prevailing water usage laws. This "water theft" no longer takes place today due to the water supply channels primarily being underground, and because it is no longer technically feasible. Women in the user communities also benefit from this above all because, as discussed above, they assume most of the responsibility in the households for the

irrigation of the fields. This work is made significantly easier for them thanks to the technification of the irrigation systems. In addition, user communities report that the reduction in conflicts arising from access to and distribution of water has had a positive impact on the quality of life for the local smallholders and made interaction in the communities and village communities more harmonious.

Summary of the rating:

The evaluation identified several overarching development policy changes that were in line with the project's objectives. The users' operating incomes have increased to date and access to sufficient and safe water has improved. The project successfully contributed to these development policy changes through technification of irrigation systems, the adjustment to water usage rights and the programmes to protect the páramos. The reduction in conflicts arising from access to and distribution of water in the villages and communities can also be attributed to the project measures and is an unintended positive consequence. Due to the unequivocally positive results, the developmental impact of the project is rated as very successful.

Impact: 1

Sustainability

Capacities of participants and stakeholders

The sustainability of the project's programmes and impacts is primarily supported by the increased capacities of the user communities as a result of the project. It is important to emphasise that users incur annual costs of USD 30 to 100 per hectare for the maintenance of the irrigation systems. Initial fears that these annual maintenance costs are too high could not be confirmed during the EPE. According to the various interviewees and the user communities, the costs can be covered without any problems by the additional operating income generated by the improved water supply. The user communities – which are organised by municipal irrigation bodies – are also generally able to maintain the irrigation system infrastructure and repair it in the event of minor defects and problems.

The provincial government of Tungurahua is responsible for the maintenance of the meteorological and hydro-metric measuring stations and updating the data obtained in the meteorological information centre. The provincial government provides two employees for this. The provincial government also provides these employees with an annual budget of USD 7,000 for minor repairs and maintenance work, which is usually sufficient. Major maintenance work must be requested as part of the annual budget process. By providing institutional, human and financial resources, the provincial government is making a significant contribution to the long-term maintenance of the infrastructure financed under PACT I. Although it is unclear to what extent these financial resources will continue to be made available in the future, the evaluation did not reveal any indications that they would no longer be provided in the future.

Contribution to supporting sustainable capacities

The project's extremely close cooperation with the user communities involved, especially in the form of technical support, capacity building and translating water usage rights into the new system, has enabled users to utilise their irrigation infrastructure effectively and sustainably. The project initially worked intensively with the village communities and communities that use the water. During village community meetings and in working parties involving the irrigation committees, the approach and advantages of the planned irrigation infrastructure were discussed, while future users were supported through the transfer of the old water rights to the new irrigation approach. The project then built up users' capacities where they were required for the correct management of the irrigation systems in terms of agriculture and cultivation practices. Based on statements from users and those responsible for the project, these measures were of central importance for increasing production, as users were trained in the efficient and effective use of sprinkler and drip irrigation.

The project made a significant contribution to strengthening the organisations and the capacities of the target group, in particular through the introduction of *Operadores*. The *Operadores* are jointly financed by the users in all of the village communities visited, based on the volume of water consumed. In consultation with the irrigation bodies, they monitor the condition of the irrigation infrastructure and ensure it functions correctly. The work of the

Operadores focuses in particular on maintaining the reservoirs and the central water distribution infrastructure, which transports the water from the reservoirs to the users' fields. They clean the filters and the inlets from the páramos into the reservoirs, are responsible for de-aerating the central water pipes, and ensure that the water pressure in the irrigation systems is sufficient.

Smaller repair and improvement work by the user communities is also carried out according to the recommendations of the *Operadores*. For example, the users of Tunga jointly purchased mechanical machinery to rid the reservoir of sediment. In San Juan Cusín, dirt traps, coarse filters and suspended matter separators were installed in the reservoir inlets to reduce the build-up of sediment and the need to service the irrigation system filters. In Puñapí, the users modified the inlet to the reservoir and installed a grille to prevent larger pieces of sediment from entering the reservoir.

For major maintenance work on the irrigation infrastructure, as well as to obtain technical assistance or spare parts for damaged infrastructure, the *Operadores* and irrigation committees contact the provincial government. The Tungurahua provincial government is responsible for the basic maintenance of the financed system and is further expanding the irrigation infrastructure in the project region. Among other things, the provincial government ensures that the major inlets to the reservoirs retain their functionality and, for example, remove any debris and earth blocking the water flow in the event of landslides. At the time of the evaluation mission, this type of work was being carried out on the main inflows at Puñapí, which had been buried by a major landslide.

In addition to these capacity-building programmes, the project aimed to ensure that as many users as possible participated in the construction work on the irrigation infrastructure. This proved successful in most – but not all – areas of the project. One reason for this was that the construction companies contracted by the project preferred to use their own employees for most stages of construction. Nevertheless, most of the users actively participated in some aspects of the construction measures. For example, they installed the irrigation infrastructure in their fields and laid the pipes to the central main line of the irrigation system. This enabled users to gain a better understanding of the irrigation system and its components, such as how the regulators and slide valves work. In conjunction with the capacity-building programmes, the direct involvement of users enabled the user communities to maintain the irrigation infrastructure in the long term. The project thus contributed significantly to strengthening the target group's resilience.

The *Operadores* designated by the respective user communities were also primarily involved in the construction programmes. Knowing all the details of the irrigation infrastructure is still particularly relevant for the work of the *Operadores*. In particular, it is essential to know which fields and areas are operated via the regulator and slider system, how the filters, de-aeration valves and pressure reducers work, and where the various water pipes run. To anchor this knowledge in the long term, the *Operadores* were trained under PACT I through specific training in the handling and maintenance of the irrigation system as well as theoretical knowledge of technical irrigation systems and sprinkler and drip irrigation methods. These training courses are still offered by the project executing agency through *Escuelas para los Operadores* (schools for *Operadores*). In particular, for user communities involved in sub-projects where there has been change of *Operadores* since the commissioning of the irrigation system, these courses and training sessions provided by the partner are very important in order to guarantee the uninterrupted functioning of the system and so achieve the desired level of sustainability.

Durability of impacts over time

To this day, the user communities and *Operadores* have a broad understanding of the maintenance, servicing and correct application of the financed irrigation infrastructure, to which the programmes under PACT I have made a significant contribution. This was confirmed by the project managers, the current and former officials of the Tungurahua provincial government, and the users. As long as the financed irrigation systems remain in operation, the increases in agricultural production and income for the user communities can be guaranteed (see Impact).

Against this background, the impacts achieved by the project are long-term, especially for the disadvantaged groups within the target group, such as women and the indigenous population living in Tungurahua. Technifying the field irrigation systems and the associated translation of the traditional water usage rights have resulted, for example, in women no longer having to go to the fields at night. At the same time, it enables indigenous user communities, such as in CORICAM Alto, to significantly increase their agricultural production and acquire further

agricultural production resources based on their higher operating income (see Impact). This enables the users to secure their production revenue in the long term.

At the time of the evaluation, there was no evidence of context-related political, economic or social challenges that could jeopardise the sustainability of the impacts or jeopardise them in the future. However, a number of interviewees pointed out the advancing climate change in the project region and the associated environmental challenges. The inflow of water from the páramos into the reservoirs has noticeably reduced in recent years, especially during the dry season. This challenge was highlighted by individual users, the *Operadores* and the chairs of the irrigation bodies, as well as by the technical officials of the provincial government and the responsible implementation consultant. During the evaluation mission, the observation was made, for example, that the reservoir in the Andahualo and Poaló region has the lowest water levels ever recorded. Even so, the extent to which the long-term nature of the impacts is threatened by advancing climate change cannot be conclusively assessed based on the qualitative interviews or the monitoring data available to the evaluation team. However, the efficiency of water use as promoted by the project lays important foundations regarding the resilience of the target groups, as they can maintain their productivity and therefore their income level even in times of increasing water scarcity thanks to water-saving irrigation methods.

Summary of the rating:

The capacities of the parties involved and those affected are rated as very high in the evaluation, as the user communities continue to carry out the maintenance and servicing of the irrigation systems independently to this day and are therefore able and willing to maintain the positive effects. The project's measures made a significant contribution to strengthening the target group's capacities. The project's close cooperation with the user communities involved, in particular in terms of technical support and the adjustment of the water usage rights to the new irrigation system, as well as the introduction of *Operadores*, had a very positive effect on the project's sustainability. Due to the user communities' knowledge of the operation, maintenance and servicing of the irrigation infrastructure as well as the establishment of amended water usage rights and collective irrigation systems, it appears that impacts reaching beyond the defined end of the project are plausible in the absence of any evidence of structural underfinancing. The active technical and financial involvement of the provincial government also contributes to the longevity of the project outcomes, which is therefore assessed as guaranteed at the time of the evaluation. For this reason, the project's sustainability is rated as successful overall.

Sustainability: 2

Overall rating: 1

The project is highly relevant both at the time the project appraisal was carried out and from today's perspective. This is mainly due to the fact that the project was exceptionally successful at addressing the core problem and the needs of the target group as well as the clearly appropriate selection of programmes. The objective of introducing modern irrigation systems in a region characterised by traditional water usage rights was very innovative and represented a contemporary response to the climate-change-related challenges of increasing water scarcity. The underlying target system, the participative approach and the alignment with Ecuadorian, German and international development strategies also proved to be very relevant. Only the appropriateness of the design can be assessed as moderately successful, as the timing of the project proved to be far too ambitious for the underlying complexity of the project approach.

The project exhibits a very high degree of internal and external coherence. The former is due to the fact that the project has an above-average complementary overlap with other German DC projects in Ecuador as well as with international norms and standards while also contributing to the creation of synergies with other German TC projects. The project's very high degree of external coherence can be explained by the fact that the project specifically supplements Ecuador's own efforts to technify its agricultural irrigation systems and supports cooperation with other national and international programmes in this area. Ultimately, the design of the project was based on experience from previous projects in the province.

The project was very effective, as the objectives at outcome level – namely the rise in irrigation efficiency and the increase in the intensity of land use – were clearly achieved. The irrigation systems financed by the project contributed directly to the achievement of the objectives and are assessed as critical for its success. At the same

time, the project programmes helped disadvantaged people within the target group, especially women and indigenous groups, to benefit from the project's results. Internal factors, such as the close cooperation with the user communities and the open programme approach, were entirely decisive for the achievement of the objectives. The quality of implementation is due to the strong selection of the implementation consultant and the efficient management structure.

As a result of the delayed implementation, significant additional costs have arisen, with the result that production efficiency is only assessed as moderately successful. On the other hand, allocation efficiency is rated as very successful. On the one hand, the project has an above-average value-for-money ratio with regard to the funds used. On the other hand, synergies created through cooperation with other projects and initiatives were harnessed in a targeted manner.

Overall, the project's measures contributed to a very positive development of users' operating incomes and to securing adequate access to water. At the same time, the project was able to reduce water access and distribution conflicts within the villages in the project regions thanks to improved water access. The project also demonstrates a very broad-based impact, which is particularly evident in the strong demand from other local authorities for comparable irrigation systems and the continuation of the approach as part of the successor project to PACT II. To this day, the project and its measures therefore contribute to both intended and unintended, positive overarching changes to development policy.

Finally, the sustainability of the project is primarily ensured by the capacity of the user communities, which were able and remain willing to carry out the maintenance and servicing of the irrigation systems independently following the completion of the project. The project made a significant contribution to strengthening capacities through the close involvement of user communities and irrigation bodies, as well as the introduction of *Operadores*. The knowledge of the user communities with regard to the maintenance, servicing and correct use of the financed irrigation infrastructure also meant that the effects achieved can still be observed and have lasted even after several years.

Based on its high degree of relevance and sustainability and its very strong coherence, effectiveness and contribution to the overarching effects of the programmes, the project is rated as "very successful" overall.

Contributions to the 2030 Agenda

The success of the project has contributed to the goals of the UN Agenda 2030 in a number of ways. SDG 6, which aims to improve water management and promote the integrated management of water resources, should be mentioned here. The programmes to technify the irrigation systems that were successfully implemented as part of the project contributed in particular to achieving this objective. Furthermore, the project was able to contribute to SDG 1, "No Poverty", and SDG 2, "Zero Hunger", through programmes to increase agricultural productivity and the increases in income achieved by users living at higher altitudes. The production approaches promoted by the project also contributed to SDG 12, "Responsible consumption and production". In addition, the various programmes of the project promoted the protection of water catchment areas and addressed the adaptation of agricultural production practices in the face of climate change, thereby contributing to SDG 13, "Climate action".

Universal application, shared responsibility and accountability

The project's objectives are in line with relevant development strategies, such as the Rio Convention on Biological Diversity, and therefore dovetail with ubiquitous problems at global level. The project has a multi-dimensional effect, as it makes a sustainable contribution to improving the living conditions of the target groups in Tungurahua Province and promotes the protection of natural water resources, which are more threatened than ever by climate change.

Interaction between economic, ecological and social development

The project's participatory, open programme approach, which featured the close involvement of the provincial government, enabled the implementation of programmes aligned with actual needs. These programmes were democratically supported by the target groups, financially secured and at the same time contributed to the maintenance of natural water retention basins.

Inclusivity

Despite the absence of explicit inclusion approaches in the project, it had positive effects for women and indigenous communities, who were able to benefit from improved water access.

Project-specific strengths and weaknesses as well as cross-project conclusions and lessons learned

The project had the following strengths and weaknesses in particular:

- One of the project's strengths is the precise selection of the regions involved as part of the open programme. Based on criteria such as the relevance of agricultural production or the willingness of users to provide their own services, this selection contributed significantly to the relevance, effectiveness and efficiency of the project.
- Another strength of the project was the close cooperation with the user communities. This focused on advice on the use of technology, the adjustment of water usage rights and the maintenance of the irrigation infrastructure. This close cooperation made a significant contribution to the overarching developmental impacts and sustainability of the project.
- Close cooperation with the German TC, especially during the installation and commissioning of the meteorological and hydrometric measuring stations (component 3) and when ensuring the ecological functioning of the páramos (component 4), is also considered a factor for success.
- The selection of a qualified implementation consultant is critical for the success of small-scale, technologically complex projects. Based on experiences from similar irrigation projects in Peru and Bolivia, the implementation consultant was able to support the provincial government in Tungurahua with the implementation and in administration and management matters, ensuring a smooth implementation.
- One weakness of the project was the time schedule, which was too ambitious for a pilot project implemented as an open programme. Since the open program called for applications from user communities to participate in the project and the subsequent selection of individual programmes was based on feasibility studies and various criteria, the selection of individual programmes was time-consuming. This should have been taken into account more effectively at the design stage.

Conclusions and lessons learned:

From the results of the evaluation, the following conclusions can be drawn:

- (1) For projects focusing on the technification of irrigation systems for smallholders, it is essential that future users receive in-depth education and training on the maintenance, servicing and operation of the technified irrigation systems. This will contribute to the effective use of the systems while also ensuring their sustainability.
- (2) For effective, impactful and efficient implementation, it is expedient to strive for close cooperation with other German DC projects. In this regard, it should be ensured that the timing is realistic and that cooperation takes place preferably for activities that can be implemented independently of larger procurement activities.
- (3) Selection procedures under open programme approaches should be based on transparent and objective criteria.
- (4) Open programme approaches are time-consuming and require a realistic time plan.
- (5) When implementing projects with regional government agencies that do not yet have experience in implementing KfW projects, the selection of an implementation consultant with many years of experience in the region, the sector and the implementation of development projects for international donors such as KfW is crucial to ensure efficient, effective implementation.
- (6) Irrigation projects are a useful tool not only for dealing with climate change-related risks promptly, but for adequately addressing potential conflicts relating to water.

Evaluation approach and methods

Methodology of the ex post evaluation

The ex post evaluation follows the methodology of a rapid appraisal, which is a data-supported qualitative contribution analysis and constitutes an expert judgement. This approach ascribes impacts to the project through plausibility considerations which are based on a careful analysis of documents, data, facts and impressions. This also includes – when possible – the use of digital data sources and the use of modern technologies (e.g. satellite data, online surveys, geocoding). The reasons for any contradicting information are investigated and attempts are made to clarify such issues and base the evaluation on statements that can be confirmed by several sources of information wherever possible (triangulation).

Documents:

- Documents analysed in the context of the EPE include a wide range of internal project documents from KfW and the implementation consultant, strategy documents from the German DC, development strategy documents from Ecuador, as well as context analyses and literature on the agricultural sector in the project region and irrigation approaches.

data sources and analysis tools:

- EPE data sources include qualitative interviews with relevant stakeholders, water quality data, the partner's monitoring data, GPS data and drone images of the project regions.

Interview partners:

- Interviews took place with the provincial government of Tungurahua (partner/executing agency), the implementation consultant, KfW project managers, KfW technical experts, in focus group discussions with users, with irrigation bodies of the user communities, *Operadores*, NGOs and other donor organisations such as CESA.

The analysis of impacts is based on assumed causal relationships, documented in the results matrix already developed during the project appraisal and, if necessary, updated during the ex post evaluation. The evaluation report sets out arguments as to why the influencing factors in question were identified for the effects experienced and why the project under review was likely to make the contribution that it did (contribution analysis). The context of the development measure and its influence on results is taken into account. The conclusions are reported in relation to the availability and quality of the data. An evaluation concept is the frame of reference for the evaluation.

On average, the method offers a balanced cost-benefit ratio for project evaluations that maintains a balance between the knowledge gained and the evaluation costs, and allows an assessment of the effectiveness of FC projects across all project evaluations. The individual ex post evaluation therefore does not meet the requirements of a scientific assessment in line with a clear causal analysis.

The following aspects limit the evaluation:

There were no aspects that limited the evaluation.

Methods used to evaluate project success

To evaluate the project according to OECD DAC criteria, a six-step scale is used for all criteria except for the sustainability criterion. The scale is as follows:

- Level 1** very successful: result that clearly exceeds expectations
- Level 2** successful: fully in line with expectations and without any significant shortcomings
- Level 3** moderately successful: project falls short of expectations but the positive results dominate
- Level 4** moderately unsuccessful: significantly below expectations, with negative results dominating despite discernible positive results
- Level 5** unsuccessful: despite some positive partial results, the negative results clearly dominate
- Level 6** highly unsuccessful: the project has no impact or the situation has actually deteriorated

The overall rating on the six-point scale is based on a project-specific weighting of the six individual criteria. Rating levels 1-3 of the overall rating denote a “successful” project while rating levels 4-6 denote an “unsuccessful” project. It should be noted that generally, a project can only be considered developmentally “successful” if the achievement of the project objective (“effectiveness”), the impact on the overall objective (“impact”) and sustainability are rated at least “moderately successful” (level 3).

List of abbreviations:

GDP	Gross domestic product
BMZ	German Federal Ministry for Economic Cooperation and Development
CESA	Central Ecuatoriana de Servicios Agrícolas
DAC	Development Assistance Committee
EPE	Ex-post evaluation
EU	European Union
EUR	Euro
DC	Development cooperation
FC	Financial cooperation
FC E	FC evaluation
GESOREN	Gestión Sostenible de Recursos Naturales
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
HDI	Human Development Index
HGPT	Honorable Gobierno Provincial de Tungurahua
KfW	Kreditanstalt für Wiederaufbau
NGO	Non-governmental organisation
PA	Project appraisal
PAR	Project appraisal report
ProCamBío	Fortalecer la resiliencia frente al cambio climático y preservar la biodiversidad
PROMACH	Programa de Manejo de Cuencas Hidrográficas
PP	Programme proposal
SDG	Sustainable Development Goal
TC	Technical cooperation
USD	US dollar

Publication details

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List of annexes:

Annex: Target system and indicators

Annex: Theory of change

Annex: Risk analysis

Annex: Project measures and results

Annex: Recommendations for operation

Annex: Evaluation questions in line with OECD DAC criteria/ex-post evaluation matrix

Annex: Target system and indicators

Project objective at outcome level		Rating of appropriateness (former and current view)			
During project appraisal: Improved water management and increased agricultural production		The project objective is derived conclusively from the problem analysis, is appropriate in terms of content, is defined at the right level and is generally achievable. However, it has not been sufficiently differentiated or formulated as a clear objective. For this reason, the project objective was adapted during the design of this EPE.			
During EPE (if target modified): Water management in the Tungurahua project area is more environmentally friendly and agricultural production among local smallholders has increased.					
Indicator	Rating of appropriateness (for example, regarding impact level, accuracy of fit, target level, smart criteria)	PA target level Optional: EPE target level	PA status (2007)	Status at final inspection (2017)	Optional: Status at EPE (2023)
Indicator 1 (PA): Irrigation efficiency (sprinkler water supply, distribution and application) Alternative proposal: Key local stakeholders confirm increased irrigation efficiency (supply, distribution and utilisation of irrigation water).	Is the indicator specific, measurable, achievable, relevant and time-bound (SMART)? – No, the indicator is not specific, measurable or time-bound. It is likewise unclear whether the indicator is relevant or achievable. Does the indicator cover an essential aspect of the target system? – Yes. Is the indicator defined at the correct target level (output, outcome or impact)? – Yes. Is the form of the indicator formulated in a way that is measurable in the EPE? – Unclear, as it is not yet certain whether irrigation efficiency can be discussed in the on-site appraisal. An alternative proposal was	PP: >20% EPE: Qualitative evaluation of irrigation efficiency	15–25%, depending on the individual project	15–25%	Value achieved

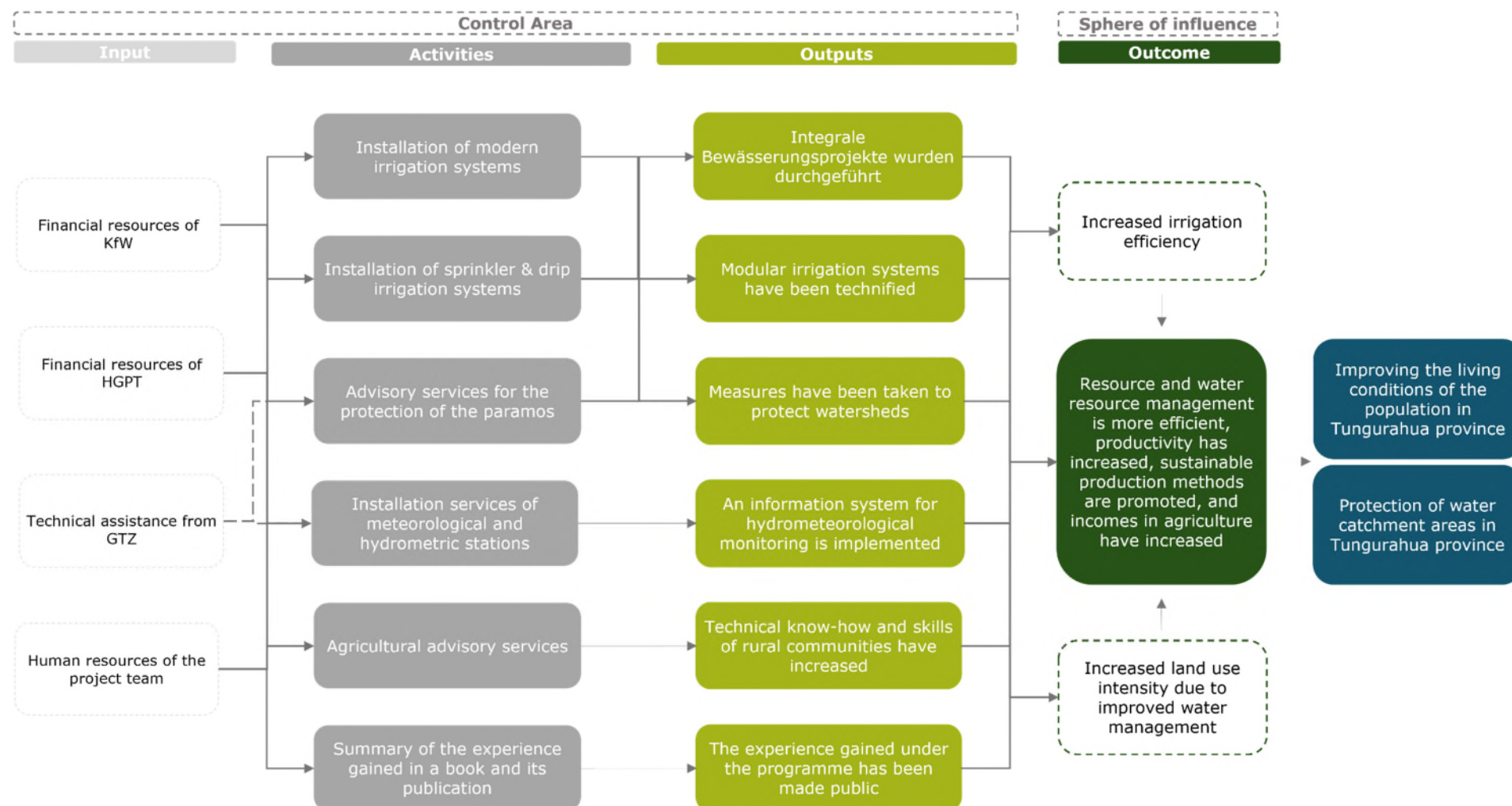
	submitted in the event that the indicator could not be measured during the EPE. Can existing data be used as a comparative measurement? – Unclear, as no relevant data is currently available.				
Indicator 2 (PA): Intensity of land use Alternative proposal: Key local stakeholders confirm increased intensity of land use due to improved water management.	Is the indicator specific, measurable, achievable, relevant and time-bound (SMART)? – No, the indicator is not specific, measurable or time-bound. It is likewise unclear whether the indicator is relevant or achievable. Does the indicator cover an essential aspect of the target system? – Yes. Is the indicator defined at the correct target level (output, outcome or impact)? – Yes. Is the indicator formulated in a way that is measurable in the EPE? No, as the intensity of land use could not be measured during the on-site appraisal. A proposal for an alternative indicator was therefore formulated. Can existing data be used as a comparative measurement? – Unclear, as no relevant data is currently available.	PA: 86–115 EPE: Qualitative evaluation of the intensity of land use.	86–95%, depending on the individual project	85–95%	Value achieved

Project objective at impact level	Rating of appropriateness (former and current view)
During project appraisal: Contribution to improving the living conditions of the population in Tungurahua Province and to protecting its water catchment areas	The ultimate objective is derived conclusively from the problem analysis, is appropriate in terms of content and is defined at the right level. However, like the project objective, it is neither differentiated nor formulated as a clear objective. Furthermore, no target level has been defined, which means it cannot be verified whether the objective has been achieved. It was therefore also adapted and truncated during the design of this EPE.

During EPE (if target modified): A qualitatively measurable contribution has been made to improving the economic living conditions of the population in the Tun-gurahua project area and to protecting the adjacent water catchment area.					
Indicator	Rating of appropriateness (for example, regarding impact level, accuracy of fit, target level, smart criteria)	Target level PA / EPE (new)	PA status (2007)	Status at final inspection (2017)	Status at EPE (2023)
Indicator 1 (PA): Development of operating income Alternative proposal: Key local stakeholders confirm a positive development in the operating income of local small-holders as the result of the programmes implemented by the project.	Is the indicator specific, measurable, achievable, relevant and time-bound (SMART)? – No, the indicator is not specific, measurable or time-bound. It is likewise unclear whether the indicator is relevant or achievable. Does the indicator cover an essential aspect of the target system? – Yes, but it is difficult to attribute the operating income to the project. Is the indicator defined at the correct target level (output, outcome or impact)? – Yes. Is the indicator formulated in a way that is measurable in the EPE? – No, because it is unclear what the operating income is and what form of development is being pursued. Can existing data be used as a comparative measurement? – Unclear, as no raw data is currently available.	PA: No target level defined EPE: Qualitative evaluation of the development of the operating income.	USD 900–3,700/operation/year, depending on the individual project	Not specified	Value achieved
Indicator 2 (PA): Access to sufficient and safe water	Is the indicator defined as specific, measurable, achievable, relevant and time-bound (SMART)? – No, the indicator is not specific, measurable or time-bound. It is likewise unclear whether the indicator is relevant or achievable. Does the indicator cover an essential aspect of the target system? – Yes. Is the indicator defined at the correct target level (output, outcome or impact)? – Yes.	PA: No target level defined NEW EPE: Evaluation of water quality and qualitative evaluation of access to water.	0.012–0.015 l/sec/ha, depending on the individual project	Not specified	Value achieved

	Is the indicator formulated in a way that is measurable in the EPE? – Yes. Can existing data be used as a comparative measurement? – Unclear, as no relevant data is currently available.				
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Annex: Theory of change



Risk analysis annex

Risk	Relevant OECD-DAC criterion
Lack of staff continuity in the executing agency (especially technical staff). The risk was rated as moderate.	Effectiveness, impact and sustainability
Implementation only partially delegated to decentralised institutions such as municipalities and NGOs. By increasing this quota, it is possible to better reach the target group and involve users. The risk was rated as moderate.	Effectiveness, impact and sustainability
Occurrence of natural disasters. The reservoir of the Puñapí system was filled in by landslides and had to be restored and made safe. The risk was rated as moderate.	Impact and sustainability
Lack of willingness of users to pay high water tariffs for the operation and maintenance of the systems (especially for small businesses (< 0.5 ha). The loss of tariffs could lead to limited operation and maintenance of the systems. The risk was rated as moderate.	Impact and sustainability
Potential for conflict among rural communities due to their different potential for production and therefore income (especially disadvantaged indigenous for populations living at higher altitudes). The risk was rated as moderate.	Effectiveness, impact and sustainability

Annex: Project measures and their results

Components	Programmes	Results of final inspection	EPE results
1. Integrated irrigation system	1.1 Andahulao Poaló Spray irrigation – fixed	System works at 80% capacity; training programme is being carried out	In operation
	1.2 Tamboloma Spray irrigation – mobile	Repairs and adjustments for commissioning	In operation
	1.3 Mulanleo Spray irrigation – partially fixed	In the commissioning phase	In operation
	1.4 Yatzaputzán – San Antonio Spray irrigation – mobile	Sections 1 and 2 are working. Section 3: Adjustments for commissioning	In operation
	1.5 Coricam Zona Baja-Alobamba Spray irrigation – drip irrigation	Repair of reservoir for commissioning	In operation
2. Technically upgrade modular irrigation systems	2.1 Puñapí Drip irrigation	In the commissioning phase	In operation
	2.2 Mundug Yamate Spray irrigation – fixed	Financing of the spray irrigation installation is pending	In operation
	2.3 Tunga Spray irrigation – fixed	In operation	In operation
	2.4 San Juan Cusín Spray irrigation – mobile	In operation	In operation
	2.5 Llantantoma Spray irrigation – mobile	Adjustment of system for commissioning	In operation
3. Hydrometeorological monitoring information system	19 meteorological and 39 hydrometric stations	Installed and in operation	In operation
4. Protection of water catchment areas	Cooperation with GIZ as part of the ProCamBio project (previously GESOREN and NAMARES).	Successfully completed	Successfully completed
5. Publishing and disseminating learning experiences	Publication of a book about the various lessons learned. This is publicly available on the executing agency's geo-portal.	Published	Published

Annex: Recommendations for operation

At the time of the project completion report, KfW made the following recommendations to the executing agency in terms of operational management, which are important for ensuring the sustainability of the investments:

- It was highly recommended that the systems that have not yet been completed or are defective be completed as quickly as possible in order to avoid the affected water users losing their motivation and, in the worst case, withdrawing from the project. This took place at the time of the EPE and none of the affected water users left the project.
- To ensure the technical sustainability of the systems, it was considered very important for the executing agency to ensure the irrigation communities have technical support in the medium and long term and expand it, if possible, especially for those irrigation systems that face greater difficulties in terms of operation, repair and maintenance. This took place at the time of the EPE and technical support for the irrigation communities is still in place to this day.
- In this context, it was important that the provincial government (HGPT) complied with the compromises to ensure the sustainability of the investments made under the project, in particular with regard to the following aspects:
 - Completion of systems that have not yet been put into operation, including outstanding training and repair measures. This was taken care of by the provincial government at the time of the EPE.
 - Continuity of the technical staff trained within the scope of the project to ensure completion of outstanding work, the required long-term accompanying measures and the operation of the hydrometeorological information system. This took place at the time of the EPE.
 - Provision of funds agreed within in the framework of an agreement with various state institutions and “Fondo de Páramo” and about protection measures for water catchment areas (páramos) located at high altitudes. No information on this could be obtained during the EPE.
- Many water users were not sufficiently familiar with the internal rules and standards of their irrigation community. It was therefore recommended that these are distributed to all water users in the form of small softback books. No information on this could be obtained during the EPE.
- For future projects, cooperation with the DP (Dirección de Producción) should be strengthened, as, in addition to water security, one of the most important ways to increase the income of smallholders is to improve and diversify agricultural production. This happened at the time of the EPE.
- Increasing & diversifying agricultural production: In terms of agriculture, it is generally difficult to clearly assess the effects of technological changes on the yield situation during the first production cycles. It is therefore considered very important to continue to conduct annual surveys of yields and family income in selected farms and different main cultures over the next few years. To this end, the executing agency has developed a working method that will enable adequate monitoring to be performed for the collective irrigation systems. This was done at the time of the EPE (see the monitoring data of the implementation consultant)
- Water usage rights: The provincial government (HGPT) should increasingly strive to revise the licences in this context, as interventions when it comes to upgrading irrigation systems should generally always be accompanied by an adjustment to the water licences. No information on this could be obtained during the EPE.
- Construction programmes: For future projects, it is recommended that the quality of the construction measures is ensured by increasing the number of on-site inspections to prevent defects or the need for repairs, especially in the pipelines, later on.
- Economic aspects: In future projects, care will be taken to ensure the investment costs are in reasonable proportion to the reduced benefit; this can be achieved, e.g. with the aid of the above-mentioned cost reductions by using the corresponding, cheaper alternatives in the hydraulic proposals.

Annex: Evaluation questions in line with OECD DAC criteria/ex-post evaluation matrix

Relevance

Evaluation question	Specification of the question for the present project	Data source (or rationale if the question is not relevant/applicable)	Rating	Weighting (- / o / +)	Reason for weighting
Evaluation dimension: Policy and priority focus			1	o	
Are the objectives of the programme aligned with the (global, regional and country-specific) policies and priorities, in particular those of the (development policy) partners involved and affected and the BMZ?	Is the project concept aligned with the most important specifications of BMZ and the partner country?	1. Document analysis: Primary strategic frameworks: - Agenda 2030 - BMZ concept, "Promotion of sustainable agriculture" from 2013 - BMZ 2017 water strategy Additional strategic frameworks: - BMZ reform concept 2030 - UN Conference on Environment and Development (Rio Conventions) (1992) 2. Semi-structured interviews with project managers, implementation consultants, executing agencies and partners, and the target group			
Do the objectives of the programme take into account the relevant political and institutional framework conditions (e.g. legislation, administrative capacity, actual power structures (including those related to ethnicity, gender, etc.))?	- Which Ecuadorian/administrative structures, capacities, etc. should be used? - To what extent did these offer sufficient absorption potential for programme implementation? - To what extent was the implementation approach via the regional province of Tungurahua relevant for the success of the project?	1. Document analysis: - National strategy on climate change in Ecuador 2012–2025: Estrategia Nacional de Cambio Climático del Ecuador 2012–2025 - National development plan: Plan Nacional para el Buen Vivir 2013-2017 - National rural development strategy: Estrategia Nacional para el Buen Vivir Rural (2013)			

		• Provincial development strategy: Agenda Tungurahua 2. Semi-structured interviews with project managers, implementation consultants, executing agencies and partners, and the target group			
Evaluation dimension: Focus on needs and capacities of participants and stakeholders			1	0	
Are the programme objectives focused on the developmental needs and capacities of the target group? Was the core problem identified correctly?	• Is the project design tailored to the needs of the target groups (specialist advice, skills development and knowledge management in sustainable water resource management and agriculture)? • Are a lack of water supply and high losses in water use the central problems for the population living there?	1. Project review report, progress reports, final review and strategic reference documents 2. Semi-structured interviews with project managers, implementation consultants, executing agencies and partners, and the target group 3. Needs analysis (interviews, document analysis)			
Were the needs and capacities of particularly disadvantaged or vulnerable parts of the target group taken into account (possible differentiation according to age, income, gender, ethnicity, etc.)? How was the target group selected?	• When designing the project, was there a suitable analysis of the impact of the programmes on particularly disadvantaged population groups? • Was the design partly targeted at these groups? • What role did the farm size structure and socio-economic factors play in selecting project locations and establishing the measures? Disadvantaged and vulnerable people within the target group are: • Local indigenous population • Poorer rural population • Women	1. Project review report, progress reports, final review and strategic reference documents 2. Semi-structured interviews with project managers, implementation consultants, executing agencies and partners, and the target group			

Would the programme (from an ex-post perspective) have had other significant gender impact potentials if the concept had been designed differently? (FC-E-specific question)	• To what extent was there a minimum quota of farms run by women that should benefit from the measures? • To what extent were the project's measures strategically aligned with the potential gender impacts?	1. Project review report, progress reports, final inspection 2. Semi-structured interviews with project managers, implementation consultants and the target group	3	0	
Evaluation dimension: Appropriateness of design					
Was the design of the programme appropriate and realistic (technically, organisationally and financially) and in principle suitable for contributing to solving the core problem?	• How realistic are the module objective and the implementation concept from a past and current perspective and in view of the available resources (in terms of time, finances, the partner's capacities and modality of implementation)? • To what extent can possible changes to the framework conditions be taken into account when designing the intervention? • To what extent were external influences taken into account in the intervention? • To what extent did the project concept have to be changed during implementation?	1. Project audit report, progress reports, final inspection 2. Semi-structured interviews with project managers and the implementation consultant			
Is the programme design sufficiently precise and plausible (transparency and verifiability of the target system and the underlying impact assumptions)?	• How plausible are the module and the overall objective? Are they formulated precisely? • How plausible are the target system and the underlying impact hypotheses?	1. Project review report, progress reports, final inspection 2. Semi-structured interviews with project managers and the implementation consultant			
Please describe the results chain, incl. complementary measures, if necessary in the form of a graphical representation. Is this plausible? As well as specifying the original and,	The theory of change graphically depicts the project's results chain for the purpose of analysing the following aspects: • How are the project's programmes linked to the intended impact?	1. Project review report, progress reports, final inspection 2. Semi-structured interviews with project managers			

if necessary, adjusted target system, taking into account the impact levels (outcome and impact). The (adjusted) target system can also be displayed graphically. (FC-E-specific question)	• How plausible is the results chain?			
To what extent is the design of the programme based on a holistic approach to sustainable development (interplay of the social, environmental and economic dimensions of sustainability)?	• To what extent did the project address the social, environmental and economic aspects holistically? • To what extent was the project aimed at promoting the independence and self-sufficiency of farmers?	1. Project review report, progress reports, final inspection 2. Semi-structured interviews with project managers and the implementation consultant		
For projects within the scope of DC programmes: is the programme, based on its design, suitable for achieving the objectives of the DC programme? To what extent is the impact level of the FC module meaningfully linked to the DC programme (e.g. outcome impact or output outcome)? (FC-E-specific question)	• To what extent did the project contribute to the objectives of the DC programme to protect the environment and natural resources? • Is there a logical connection between the module objective and the associated DC programme objective? Which sub-element of the DC programme objective was targeted by the present FC module?	1. Project review report, progress reports, final inspection 2. Semi-structured interviews with project managers and the implementation consultant		
Evaluation dimension: Response to changes/adaptability			–	As no changes were made to the general conditions
Has the programme been adapted in the course of its implementation due to changed framework conditions (risks and potential)?	• To what extent are the changes in the general conditions reflected in an adjustment to the project?	1. Project review report, progress reports, final inspection 2. Semi-structured interviews with project managers and the implementation consultant No changes to the general conditions could be determined.		

Coherence

Evaluation question	Specification of the question for the present project	Data source (or rationale if the question is not relevant/applicable)	Rating	Weighting (- / 0 / +)	Reason for weighting
Evaluation dimension: Internal coherence (division of tasks and synergies within German development cooperation):			1	0	
To what extent is the programme designed in a complementary and collaborative manner within the German development cooperation (e.g. integration into DC programme, country/sector strategy)?	• What operational environment/stakeholder landscape was relevant for the project? • To what extent did the project's design and implementation approaches complement other projects in the sector?	Semi-structured interviews with project managers and the implementation consultant Documents and objectives of other German development projects: • NAMARES (Sustainable Management of Natural Resources, 2004–2013) GIZ project • GESOREN (Sustainable Management of Natural Resources, 2004–2013) GIZ project • ProCamBio (climate change, biodiversity and sustainable development, 2014–2016) GIZ project			
Do the instruments of the German development cooperation dovetail in a conceptually meaningful way, and are synergies put to use?	• To what extent did the implementation, as a cooperation project with GIZ, affect internal coherence? • In this context, to what extent was the implementation coherent and complementary to the development cooperation instruments? • What difference did the implementation as a cooperative project make to the project's internal coherence (e.g. with regard to monitoring/implementation of activities)?	1. Semi-structured interviews with project managers, implementation consultant and GIZ 2. Documents and objectives of other German development projects: • NAMARES (Sustainable Management of Natural Resources, 2006) GIZ project • GESOREN (Sustainable Management of Natural Resources, 2004–2013) GIZ project • ProCamBio (climate change, biodiversity and sustainable development, 2014–2016) GIZ project			

Is the programme consistent with international norms and standards to which the German development cooperation is committed (e.g. human rights, Paris Climate Agreement, etc.)?	To what extent are the project design and programmes aligned with the identified norms and standards (e.g. the Paris Declaration or the principle of “leave no one behind”)?	1. Project review report, progress reports, final inspection 2. Semi-structured interviews with project managers and the implementation consultant			
Evaluation dimension: External coherence (complementarity and co-ordination with actors external to German DC):			1	0	
To what extent does the programme complement and support the partner’s own efforts (subsidiarity principle)?	- To what extent does the project complement the partner’s programmes (e.g. national irrigation and drainage plan, overall plan for water resources in Tungurahua Province, etc.)? - To what extent did the use of implementation consultants support the promotion of the regional province of Tungurahua’s existing capacity with regard to managing water resource conservation?	1. Strategy documents of partner • Plan Nacional de Riego y Drenaje • Plan Nacional para Buen Vivir • Plan Maestro de los Recursos Hídricos de la Provincia de Tungurahua • Plan de la Provincia Tungurahua (2014-2029) 2. Semi-structured interviews with project managers, implementation consultants, executing agencies and partners			
Is the design of the programme and its implementation coordinated with the activities of other donors?	- Which other donors are active in the region? - To what extent does the project complement other projects of other donors in the area of application?	1. Programme documents of external IC stakeholders: • AECID & World Bank: Sustainable Family Farming Modernisation Project, since 2015 • AECID: Project to technify the irrigation system for small and medium-sized producers, 2016–2021 • USAID: Protecting water sources for biodiversity conservation: Financial Mechanisms for the Protection of Watersheds in Ecuador 2007–2014			

		2. Semi-structured interviews with project managers, implementation consultants, executing agencies and partners
Was the programme designed to use the existing systems and structures (of partners/other donors/international organisations) for the implementation of its activities and to what extent are these used?	- To what extent were there potential effects resulting from of synergy with regard to existing systems and structures? - To what extent did the project activities correspond to the identified potential synergies?	1. Programme documents of external IC stakeholders: - AECID & World Bank: Sustainable Family Farming Modernisation Project, since 2015 - AECID: Project to technify the irrigation system for small and medium-sized producers, 2016–2021 - USAID: Protecting water sources for biodiversity conservation: Financial Mechanisms for the Protection of Watersheds in Ecuador 2007–2014 2. Semi-structured interviews with project managers, implementation consultants, executing agencies and partners
Are common systems (of partners/other donors/international organisations) used for monitoring/evaluation, learning and accountability?	- To what extent are there common monitoring, evaluation and learning systems? - To what extent have they been used?	1. Semi-structured interviews with project managers, implementation consultants, executing agencies and partners

Effectiveness

Evaluation question	Specification of the question for the present project	Data source (or rationale if the question is not relevant/applicable)	Rating	Weighting (- / 0 / +)	Reason for weighting
Evaluation dimension: Achievement of (intended) targets			1	0	
Were the (if necessary, adjusted) objectives of the programme (incl.	Indicator 1: How efficient are the irrigation stems at present?	1. Project review report, progress reports, final inspection			

capacity development measures) achieved? Table of indicators: Comparison of actual/target	• <u>In the event of no data:</u> Is the increased irrigation efficiency due to the improved infrastructure confirmed by central local stakeholders? Indicator 2: • What is the current average intensity of land use? • <u>If no data is available:</u> Is the average increase in land use intensity confirmed by key local stakeholders?	2. Semi-structured interviews with project managers, implementation consultants, executing agencies and partners 3. Target/actual comparison based on indicator table			
Evaluation dimension: Contribution to achieving objectives:			1	0	
To what extent were the outputs of the programme delivered as planned (or adapted to new developments)? (<i>Learning/help question</i>)	• To what extent were the outputs of the project activities and measures achieved (qualitative evaluation)? • Outputs 1 & 2: Has the irrigation infrastructure been upgraded in all planned project regions? • Output 3: Was the hydrometeorological monitoring system installed and commissioned as planned? • Output 4: Was the protection of the water catchment areas promoted? • Output 5: Have gained learning experiences been shared?	1. Project review report, progress reports, final inspection 2. Semi-structured interviews with project managers, implementation consultants, executing agencies and partners, and the target group			
Are the outputs provided and the capacities created used?	• To what extent did the project improve or create capacities (qualitative evaluation)? • To what extent are the irrigated areas used? • Are the irrigation systems adequately operated?	1. Semi-structured interviews with project managers, implementation consultants, executing agencies and partners, and the target group			
To what extent is equal access to the outputs provided and the	• To what extent did the project pay attention to the inclusiveness of its	1. Semi-structured interviews with project managers, implementation consultants,			

capacities created guaranteed (e.g. non-discriminatory, physically accessible, financially affordable, qualitatively, socially and culturally acceptable)?	programmes (e.g. do the user communities benefit equally from the improved irrigation system)? (qualitative evaluation) • Are certain project areas disadvantaged compared to others?	executing agencies and partners, and the target group
To what extent did the programme contribute to achieving the objectives?	• To what extent have the project programmes contributed to achieving the objectives? (qualitative evaluation)	1. Project review report, progress reports, final inspection 2. Semi-structured interviews with project managers, implementation consultants, executing agencies and partners, and the target group
To what extent did the programme contribute to achieving the objectives at the level of the intended beneficiaries?	• To what extent have the project programmes impacted the target group? (qualitative evaluation)	1. Semi-structured interviews with project managers, implementation consultants, executing agencies and partners, and the target group
Did the programme contribute to the achievement of objectives at the level of the particularly disadvantaged or vulnerable groups involved and affected (potential differentiation according to age, income, gender, ethnicity, etc.)?	• To what extent did the project programmes impact disadvantaged and vulnerable groups (e.g. poorer rural population and women)? (qualitative evaluation)	1. Semi-structured interviews with project managers, implementation consultants, executing agencies and partners, and the target group
Were there measures that specifically addressed gender impact potential (e.g. through the involvement of women in project committees, water committees, use of social workers for women, etc.)? (FC-E-specific question)	• To what extent have programmes been implemented that focus on any potential gender-specific outcomes (e.g. participation of women in irrigation associations)? • To what extent have the programmes had an impact on gender-specific issues?	1. Project review report, progress reports, final inspection 2. Semi-structured interviews with project managers, implementation consultants, executing agencies and partners, and the target group

Which project-internal factors (technical, organisational or financial) were decisive for the achievement or non-achievement of the intended objectives of the programme? <i>(Learning/help question)</i>	• To what extent were internal project factors considered decisive for achieving the objectives? This is specifically at the level of: - Financing modalities (what role did the executing agency's own contribution play in achieving the objectives?) - Technical support from the implementation consultant - Organisational and administrative capacities of the executing agency - Training of user groups	1. Semi-structured interviews with project managers, implementation consultants, executing agencies and partners				
Which external factors were decisive for the achievement or non-achievement of the intended objectives of the programme (also taking into account the risks anticipated beforehand)? <i>(Learning/help question)</i>	• To what extent were external factors considered decisive for achieving the objectives? - Demand from project beneficiaries for irrigation systems - Active participation of the target group in the renewal of its irrigation systems in line with the infrastructure provided	1. Semi-structured interviews with project managers, implementation consultants, executing agencies and partners				
Evaluation dimension: Quality of implementation				1	0	
How is the quality of the management and implementation of the programme (e.g. executing agency, consultant, taking into account ethnicity and gender in decision-making committees) evaluated with regard to the achievement of objectives?	• To what extent did the application of the project planning and monitoring system by the executing agency and the implementation consultant correspond to the project concept? • To what extent was the decision-making process timely and evidence-based? • To what extent was the project able to document the change processes during implementation? • To what extent did the executing agency's capacities (approach/staff	1. Project review report, progress reports, final inspection 2. Semi-structured interviews with project managers, implementation consultants, executing agencies and partners				

	qualifications, process flow, etc.) contribute to achieving the objectives?			
How is the quality of the management, implementation and participation in the programme by the partners/sponsors evaluated?	• Which partners and executing agencies were involved in the project? - Honorable Gobierno Provincial de Tungurahua - GLZ DC programme projects - Other relevant development organisations and projects as required • To what extent was the cooperation with the partners involved in the project conducive to achieving the objectives? • Did the project management unit (Honorable Gobierno Provincial de Tungurahua) have sufficient staff? • How well did the interaction between partners, the user groups and the implementation consultant work? • How should the degree of coordination, supervision and quality assurance be assessed?	1. Project review report, progress reports, final inspection 2. Semi-structured interviews with project managers, implementation consultants, executing agencies and partners		
Were gender results and relevant risks in/through the project (gender-based violence, e.g. in the context of infrastructure or empowerment projects) regularly monitored or otherwise taken into account during implementation? Have corresponding measures (e.g. as part of a CM) been implemented in a timely manner? (FC-E-specific question)	• To what extent were gender dimensions and the relevant risks included in the monitoring system?	1. Project review report, progress reports, final inspection 2. Semi-structured interviews with project managers and the implementation consultant		
Evaluation dimension: Unintended consequences (positive or negative)			–	Due to there being no unintended consequences

Can unintended positive/negative direct impacts (social, economic, ecological and, where applicable, those affecting vulnerable groups) be seen (or are they foreseeable)?	• Were negative (unintended) or positive (not formally agreed) impacts observed by respondents a) at economic level? b) at social level? c) at ecological level?	1. Semi-structured interviews with project managers, implementation consultants, executing agencies and partners, and the target group
What potential/risks arise from the positive/negative unintended effects and how should they be evaluated?	• Qualitative evaluation of benefits/risks	1. Semi-structured interviews with project managers, implementation consultants, executing agencies and partners, and the target group
How did the programme respond to the potential/risks of the positive/negative unintended effects?	• To what extent can unintended consequences be attributed to the project (contribution analysis)? • To what extent has the project taken suitable adjustment measures?	1. Semi-structured interviews with project managers and the implementation consultant
Was it possible to diversify agricultural production?	• To what extent has the target group's use of production resources and methods changed in the project area?	1. Semi-structured interviews with project managers, implementation consultants, executing agencies and partners, and the target group

Efficiency

Evaluation question	Specification of the question for the present project	Data source (or rationale if the question is not relevant/applicable)	Rating	Weighting (- / 0 / +)	Reason for weighting
Evaluation dimension: Production efficiency			3	0	
How are the inputs (financial and material resources) of the programme distributed (e.g. by instruments, sectors, sub-measures, also taking into account the cost	• How are the costs divided according to output? • What is the nature of the costs (costs per component)? • What contributions have been agreed and achieved by the partners?	1. Project review report, progress reports, final inspection 2. Semi-structured interviews with project managers and the implementation consultant			

contributions of the partners/executing agency/other participants and affected parties, etc.)? (Learning and help question)	• To what extent are there any discrepancies between the originally planned and actual costs (with rationale)?	
To what extent were the inputs of the programme used sparingly in relation to the outputs produced (products, capital goods and services) (if possible in a comparison with data from other evaluations of a region, sector, etc.)? For example, comparison of specific costs.	• To what extent were internal/external benchmarks used to maximise effectiveness?	1. Semi-structured interviews with project managers and the implementation consultant
If necessary, as a complementary perspective: To what extent could the outputs of the programme have been increased by an alternative use of inputs (if possible in a comparison with data from other evaluations of a region, sector, etc.)?	• To what extent and how often did the project conduct an internal reflection on how to maximise output? • To what extent were potential alternatives that would maximise output discussed, considered and/or implemented?	1. Semi-structured interviews with project managers and the implementation consultant
Were the outputs produced on time and within the planned period?	• To what extent were the results of the project achieved within the planned timeframe? • Was the original implementation deadline met?	1. Project review report, progress reports, final inspection 2. Semi-structured interviews with project managers and the implementation consultant
Were the coordination and management costs reasonable (e.g. implementation consultant's cost component)? (FC-E-specific question)	• To what extent were the total costs for coordination and management reasonable? • To what extent were the costs for the implementation consultant reasonable in relation to the relevance and provision of services within the scope of the project?	1. Project review report, progress reports, final inspection 2. Semi-structured interviews with project managers and the implementation consultant

Evaluation dimension: Allocation efficiency			1	0	
In what other ways and at what costs could the effects achieved (outcome/impact) have been attained? (<i>Learning/help question</i>)	To what extent can other ways be found to achieve the expected results of the project?	1. Semi-structured interviews with project managers, implementation consultants and executing agencies			
To what extent could the effects achieved have been attained in a more cost-effective manner, compared with an alternatively designed programme?	- How should the relationship between expenditure and results be assessed? - To what extent were the partners' contributions appropriate in relation to the results achieved?	1. Project review report, progress reports, final inspection 2. Semi-structured interviews with project managers and the implementation consultant			
If necessary, as a complementary perspective: To what extent could the positive effects have been increased with the resources available, compared to an alternatively designed programme?	- To what extent were potential synergies with the cooperation partners harnessed? - To what extent has the project harnessed the cooperation potential within the German development cooperation?	1. Project review report, progress reports, final inspection 2. Semi-structured interviews with project managers, implementation consultants and executing agencies			

Impact

Evaluation question	Specification of the question for the present project	Data source (or rationale if the question is not relevant/applicable)	Rating	Weighting (- / o / +)	Reason for weighting
Evaluation dimension: Overarching developmental changes (intended)			1	0	
Is it possible to identify overarching developmental changes to which the programme should contribute? (Or if foreseeable, please be as	In this context, the achievement of the project's developmental impact is assessed on the basis of its indicators. The focus here is on impact level (overall objective). The	1. Project review report, progress reports, final inspection 2. Semi-structured interviews with project managers, implementation			

specific as possible in terms of time.)	indicators were assessed by the evaluators and adjusted as required. Indicator 1: Central local stakeholders confirm a positive development in the operating income of local smallholders due to the programmes implemented by projects. Indicator 2: Access to sufficient and safe water Have the objectives associated with ensuring environmentally sound resource and water management in the Tungurahua water catchment areas been achieved? Have the objectives associated with ensuring more efficient resource and water management in the Tungurahua water catchment areas been achieved?	consultants, executing agencies and partners, and the target group 3. Target/actual comparison based on indicator table
Is it possible to identify overarching developmental changes (social, economic, environmental and their interactions) at the level of the intended beneficiaries? (Or if foreseeable, please be as specific as possible in terms of time)	• To what extent can potential changes in development policy be observed at target group level in the following aspects? a. Social nature b. Economical nature c. Ecological nature	1. Semi-structured interviews with project managers, implementation consultants, executing agencies and partners, and the target group
To what extent can overarching developmental changes be identified at the level of particularly disadvantaged or vulnerable parts of the target group to which the programme should contribute? (Or, if foreseeable, please be as specific as possible in terms of time)	• To what extent can general changes in development policy be observed regarding disadvantaged and vulnerable groups (e.g. indigenous people, the poorer rural population and women)?	1. Semi-structured interviews with project managers, implementation consultants, executing agencies and partners, and the target group

Evaluation dimension: Contribution to overarching developmental changes (intended)		1	0	
To what extent did the programme actually contribute to the identified or foreseeable overarching developmental changes (also taking into account the political stability) to which the programme should contribute?	To what extent did the project influence the achievement of the impact indicators (qualitative evaluation)? Can this contribution be determined directly or through plausibility considerations?	1. Semi-structured interviews with project managers, implementation consultants, executing agencies and partners, and the target group		
To what extent did the programme achieve its intended (possibly adjusted) developmental objectives? In other words, are the project impacts sufficiently tangible not only at outcome level, but at impact level? (e.g. drinking water supply/health effects)	To what extent has the project affected broader potential changes in development policy (qualitative evaluation)?	1. Semi-structured interviews with project managers, implementation consultants, executing agencies and partners, and the target group		
Did the programme contribute to achieving its (possibly adjusted) developmental objectives at the level of the intended beneficiaries?	- To what extent has the project contributed to any changes in the income situation of the target group (Qualitative evaluation)? - Does the programme lead to an improved water supply (outcome) and does this, in turn, lead to the intensification and adjustment of the cultivation programme with a view to higher-quality crops?	1. Semi-structured interviews with project managers, implementation consultants, executing agencies and partners, and the target group		
Has the programme contributed to overarching developmental changes or changes in life situations at the level of particularly disadvantaged or vulnerable parts of the target group (potential differentiation according to age, income,	To what extent has the project affected potential changes in development policy for disadvantaged and vulnerable groups (e.g. indigenous peoples, poorer rural populations and women)? (Qualitative evaluation)	1. Semi-structured interviews with project managers, implementation consultants, executing agencies and partners, and the target group		

gender, ethnicity, etc.) to which the programme was intended to contribute?		
Which project-internal factors (technical, organisational or financial) were decisive for the achievement or non-achievement of the intended developmental objectives of the programme? (<i>Learning/help question</i>)	To what extent can internal project factors be regarded as decisive for achieving the intended development policy objectives? (Qualitative evaluation)	- Project review report, progress reports, final inspection - Semi-structured interviews with project managers and the implementation consultant
Which external factors were decisive for the achievement or non-achievement of the intended developmental objectives of the programme? (<i>Learning/help question</i>)	To what extent can external factors be considered decisive for achieving the intended development policy objectives? (Qualitative evaluation)	- Project review report, progress reports, final inspection - Semi-structured interviews with project managers and the implementation consultant
Does the project have a broad-based impact? - To what extent has the programme led to structural or institutional changes (e.g. in organisations, systems and regulations)? (Structure formation) - Was the programme exemplary and/or broadly effective and is it reproducible? (Model character)	- What structural or institutional changes made by the executing agency and the partners can be observed? - To what extent has the project influenced these structural or institutional changes (qualitative evaluation), e.g. with a view to strengthening self-reliance and participation of agricultural holdings? - To what extent has the project influenced other programmes? - To what extent were the project's approaches replicated, e.g. as part of follow-up projects (example)? (Qualitative evaluation)	Semi-structured interviews with project managers, implementation consultants, executing agencies and partners, and the target group
How would the development have gone without the programme? (<i>Learning and help question</i>)	To what extent can alternative scenarios representing the development of the project's context without the actual project itself be identified? (Qualitative evaluation)	Semi-structured interviews with project managers, implementation consultants, executing agencies and partners, and the target group

Evaluation dimension: Contribution to (unintended) overarching developmental changes		2	0	
To what extent can unintended overarching developmental changes (also taking into account political stability) be identified (or, if foreseeable, please be as specific as possible in terms of time)?	• To what extent can contextual factors of the development policy be observed in this sector? (Qualitative evaluation) • To what extent were they foreseeable? (Qualitative evaluation)	1. Project review report, progress reports, final inspection 2. Semi-structured interviews with project managers, implementation consultants, executing agencies and partners, and the target group		
Did the programme noticeably or foreseeably contribute to unintended (positive and/or negative) overarching developmental impacts?	• To what extent were unintended (positive and/or negative) development effects foreseen in the design phase of the project? (Qualitative evaluation) • To what extent were programmes linked with unintended (positive and/or negative) effects on development? (Qualitative evaluation) • To what extent did the project take measures to address conflicting objectives relating to the economic, social and environmental dimensions of development? (Qualitative evaluation) • Has any adjustment to the farming programme in favour of higher-value crops (if it has indeed taken place) led to greater dependence on prevailing market conditions or a deterioration in self-sufficiency?	1. Project review report, progress reports, final inspection 2. Semi-structured interviews with project managers, implementation consultants, executing agencies and partners, and the target group		
Did the programme noticeably (or foreseeably) contribute to unintended (positive or negative) overarching developmental changes at the level of particularly disadvantaged or vulnerable groups (within or outside the target group) (do no	To what extent do unintended (positive and/or negative) consequences of development policy affect disadvantaged and vulnerable groups (e.g. indigenous peoples, poor rural populations and women)?	1. Semi-structured interviews with project managers, implementation consultants, executing agencies and partners, and the target group		

harm, e.g. no strengthening of inequality (gender/ethnicity)?		
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Sustainability

Evaluation question	Specification of the question for the present project	Data source (or rationale if the question is not relevant/applicable)	Rating	Weighting (- / 0 / +)	Reason for weighting
Evaluation dimension: Capacities of participants and stakeholders			2	0	
Are the target group, executing agencies and partners institutionally, personally and financially able and willing (ownership) to maintain the positive effects of the programme over time (after the end of the promotion)?	- To what extent are the general resources adequate for maintaining the - organisational; - personnel; - financial results? - To what extent are external risk factors observable with regard to the published results (qualitative evaluation)? - Are the farms willing and financially able to pay the water fees?	- Project review report, progress reports, final inspection - Semi-structured interviews with project managers, implementation consultants, executing agencies and partners, and the target group			
To what extent do the target group, executing agencies and partners demonstrate resilience to future risks that could jeopardise the impact of the programme?	To what extent can a boost in resilience be observed with regard to the framework conditions/risk factors identified during the evaluation? (Qualitative evaluation)	- Project review report, progress reports, final inspection - Semi-structured interviews with project managers, implementation consultants, executing agencies and partners, and the target group			
Evaluation dimension: Contribution to supporting sustainable capacities:			1	0	

Did the programme contribute to the target group, executing agencies and partners being institutionally, personally and financially able and willing (ownership) to maintain the positive effects of the programme over time and, where necessary, to curb negative effects?	• To what extent has the project contributed to boosting (organisational, personnel and financial) resources? (Target group, executing agency and partner); (qualitative evaluation) • To what extent was the exit strategy appropriate in relation to the resources of the target group, the executing agency and the partners (qualitative evaluation)? • To what extent has the project promoted the development of sufficient local capacities to maintain the irrigation systems (in the form of training)? • To what extent were the operators ("operadores") still active at the time of the evaluation? Is the financing of these operators still ensured to guarantee the uninterrupted operation of the systems and has the executing agency taken over the technical supervision of the systems to date? • To what extent do the user communities have the technical and administrative expertise to assume responsibility for the administration and maintenance of the irrigation systems?	1. Project review report, progress reports, final inspection 2. Semi-structured interviews with project managers, implementation consultants, executing agencies and partners, and the target group
Did the programme contribute to strengthening the resilience of the target group, executing agencies and partners to risks that could jeopardise the effects of the programme?	• To what extent did the project contribute to resilience? (Target group, executing agency and partners); (qualitative evaluation)	1. Semi-structured interviews with project managers, implementation consultants, executing agencies and partners, and the target group
Did the programme contribute to strengthening the resilience of particularly disadvantaged groups to	• To what extent has the project contributed to the resilience of	1. Semi-structured interviews with project managers, implementation consultants,

risks that could jeopardise the effects of the programme?	disadvantaged groups? (Qualitative evaluation)	executing agencies and partners, and the target group			
Evaluation dimension: Durability of impacts over time			2	0	
How stable is the context of the programme (e.g. social justice, economic performance, political stability, environmental balance)? (Learning/help question)	How can the central context and influencing factors for the sustainable use of the upgraded irrigation systems be assessed? (Qualitative evaluation)	1. Project review report, progress reports, final inspection 2. Semi-structured interviews with project managers, implementation consultants, executing agencies and partners, and the target group			
To what extent is the durability of the positive effects of the programme influenced by the context? (Learning/help question)	- To what extent can risks and potential for securing long-term effects be identified? (Qualitative evaluation) - To what extent has the project responded to potential risks and the potential for sustainability?	1. Project review report, progress reports, final inspection 2. Semi-structured interviews with project managers, implementation consultants, executing agencies and partners, and the target group			
To what extent are the positive and, where applicable, the negative effects of the programme likely to be long-lasting?	To what extent is the sustainability of the analysed results and effects plausible?	1. Semi-structured interviews with project managers, implementation consultants, executing agencies and partners, and the target group			
To what extent are the gender results of the measure to be considered permanent (ownership, capacities, etc.)? (FC-E-specific question)	To what extent is the sustainability of the analysed gender-relevant results plausible?	1. Semi-structured interviews with project managers, implementation consultants, executing agencies and partners, and the target group			
Other evaluation questions			2	0	
To what extent were the recommendations made in the final inspection and the associated final construction measures – some of which had not	To what extent were the recommendations made during the final inspection implemented? (Qualitative evaluation)	1. Final inspection			

been carried out by that point – actually carried out after the end of the project?		2. Semi-structured interviews with project managers, implementation consultants, executing agencies and partners
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