KfW Development Bank

Ex post evaluation
Smallholder Irrigation SIPMK III, Kenya

Title	Private Sector Development in the Agricultural Sector - Smallholder Irrigation Program Mount Kenya (SIPMK) Phase III		
Sector and CRS code	Agriculture (CRS-Code: 31120)		
Project number	BMZ 2011 660 40		
Commissioned by	German Federal Ministry of Economic Cooperation and Development (BMZ)		
Recipient/ Implementing agency	Republic of Kenya/Ministry of Water, Department of Irrigation and Drainage		
Project volume/ Financing instrument	3.5 million EUR (3.0 million EUR BMZ budget fund loan plus 0.5 million EUR BMZ SBF grant funds)		
Project duration	07/2011 – 09/2018		
Year of Report	2020	**Year of random sample**	2019

Objectives and project outline

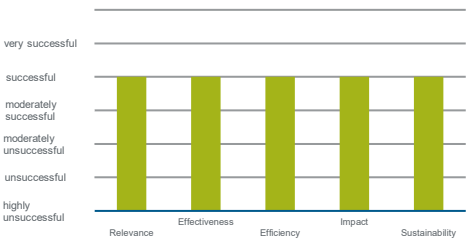
The objective of the program at the outcome level was an increase in the agricultural production. The overarching development objective (impact level) of the program was to improve the living conditions of rural households in the Mount Kenya program region.

The program supported the transition from rainfed agriculture to irrigated agriculture with small and medium-sized perimeters in the east and south-eastern slopes of Mount Kenya. The program consists of four phases, three of which are concluded. This evaluation focuses on Phase III. The irrigatable agricultural production areas were increased by 561 hectares at the four irrigation schemes in Kirinyaga and Meru counties in Phase III. Before implementation, those farmer groups were organized in self-help groups and developed into cooperatives as a pre-requisite to become a bankable legal entity. In an innovative group lending approach, 50 % of the irrigation infrastructure cost was financed with grant funds and 50 % with a loan, both channelled through a Kenyan commercial bank. This approach familiarized farmers with financial literacy.

Key findings

- High effectiveness: The availability of irrigation water allowed in most years to plant new and higher-value crops (increased cropping intensity) and to harvest and produce more continuously, as compared to the previously practiced rainfed agriculture. Most smallholders are now cultivating additionally to the maize and beans of traditional rainfed agriculture also horticulture, e.g. cabbage, tomatoes, French beans, papaya, chard (mangold), bananas, some also Macadamia, avocados and animal fodder. The choice of which crop to produce was taken by farmers based on market demand and expected higher value crops.
- Highly relevant: Demand for the program support by smallholder farmers has been and continues to be much larger than the available funding, such that the Ministry of Water considers to integrate the approach into the national strategy for replication.
- Risk for sustainability: Structural challenges exist in Kenya regarding the application of an effective Integrated Water Resource Management to manage the different uses of the increasingly scarce resource. The Water Resource Authority faces political pressure to allow water use for development, while being responsible for protecting the base flow in rivers. More specifically regarding the program, illegal abstraction of water upstream of the intervention sites reduces available water in the program area, particularly during the dry season.

Overall rating:
successful



Conclusions

- This program is a positive example for smallholder agriculture promotion by 50 %-loan financing
- Success Factor: the target group were smallholders with sufficient ownership and market understanding to establish a saving scheme, qualify for a loan and to take market-oriented cropping decisions
- Success Factor: Kenyan commercial bank staff with agricultural (academic) background and financial services guided by farmer needs (cropping cycles)
- Early retrieval of GIZ left a gap in support for value chain integration: Joint marketing of agricultural products and contract farming by cooperatives could be improved to increase bargaining power of smallholders

Rating according to DAC criteria

Overall rating: 2

Sub-rating:

	Phase III
Relevance	2
Effectiveness	2
Efficiency	2
Impact	2
Sustainability	2

Overall context

The Smallholder Irrigation Program Mount Kenya (SIPMK) consists of four phases. The first phase started in 2005, the second in 2008 and the third in 2011. Currently, the fourth phase is under implementation, more precisely in the technical design phase. Phase I received an overall rating of "3", Phase II received a good ("2") overall assessment in a previous FC ex-post evaluation of both phases (2014). This evaluation focuses on Phase III, under which four smallholder irrigation schemes (Mitooini, Kandiu, Karia and Kiga) from four respective cooperatives were financed. Each irrigation scheme targeted one cooperative, of which the following number of households participated in the SIPMK:

Name of Irrigation Project	County	No of households	Project area (ha)
Mitooini	Kirinyaga	500	196.2
Kandiu	Kirinyaga	365	138.2
Kiga	Meru	360	140
Karia	Kirinyaga	300	60

Before program implementation, the farmer groups in the target region used to be organized in self-help groups, then developed into cooperatives and registered as such in accordance with the Cooperative Law of Kenya in order to qualify for the program. This was a pre-requisite in order to become a bankable legal entity. Each cooperative saved 10 % of the ex-ante estimated loan amount in a group-lending approach based on farmer groups being organized in smaller sub-units within one cooperative. The 10 % served as collateral to a Kenyan commercial bank and as a pre-requisite for signing of each cooperative's loan contract. The FC loan with IDA conditions was on-channelled by the Kenyan government through the commercial bank to cover 50 % of the irrigation infrastructure costs as grant and 50 % as a loan. This approach familiarized farmers with financial literacy and concepts such as establishing a household budget and savings system and deciding for crops based on expected positive cash flows through technical assistance by the program management unit (PMU)[1] and training by decentralized bank officers. Many of the farmers may not have been bankable before the program, particularly not as individuals.

Relevance

The program contributed to the implementation of the Kenyan Strategy for Revitalizing Agriculture (SRA) and was part of the Kenyan Private Sector Development Program in Agriculture (PSDA), which was concluded in 2013 and replaced by the Kenyan Food Security and Drought Resilience Program (FSDR). The Smallholder Irrigation Program Mount Kenya Region (SIPMK) is part of the FSDR.

[1] a decentralized consulting team based in Embu and commissioned by the Department of Irrigation of the Kenyan Government

The challenges of food security, poverty reduction and transforming agriculture from subsistence to farming as a business - i.e. gaining access to markets, efficient use of inputs and agricultural credit - still persist in the Kenyan agricultural sector at the time of the evaluation (Agricultural Sector Development Strategy 2010-2020 of the Kenyan Government, ASDS). Two aspects are crucial in the Kenyan Agricultural Sector Development Strategy: (1) increasing productivity, commercialization and competitiveness of agricultural commodities and enterprises and (2) developing and managing key factors of production. About 84 % of Kenya's area is characterized by arid or semi-arid land and is only with strong limitations suitable for rain-fed farming due to low and erratic rainfall. In the Mount Kenya Region, which is characterized by medium to high agricultural potential, harvests in rain-fed agriculture are limited to a number of two on average. However, crop failures due to i.a. dry spells affected every third harvest (ASDS 2010). Against this background, the country's strategy seeks to lead agricultural growth by intensification and substitution towards more high-value products, and expansion of the cultivated area through irrigation. The SIPMK was in line with these strategic objectives of the Kenyan government and still is in line with the most recent Agricultural Sector Transformation and Growth Strategy (ASTGS, 2019-2029). Despite a stronger focus on large-scale irrigation schemes than previous agricultural strategies, the ASTGS's "anchor 1" (of 3 main anchors of the strategy) aims to improve the lives of ~3.3 million small-scale farming households (~15 million Kenyans, which corresponds to at least 25 % of the country's population at an average household size of 3.6, UNDP 2015).

Of the total land area, 48.5 % were agricultural land in 2016, but only 10.2 % were arable land. Less than 7 % of land in Kenya is irrigated, most arable land is rainfed. Of irrigated land, 42 % is cultivated by small-scale schemes of ~15ha/scheme. According to a study by the Kenyan Department of Irrigation (DOI) supported by JICA, 520,000 ha of irrigated agricultural cultivated land can be developed in Kenya based on surface water and 180,000 ha have been developed until today. Thus, there exists still vast potential for development of irrigated agricultural land.

The sector is dominated by smallholder production on farms of between 0.2 and 3 hectares, which account for 78 percent of total agricultural production and 70 percent of commercial production.[2] Smallholders contribute 60-70 % of the country's maize production, but only 10-15 % of incomes for these farmers come from maize (ASTGS). A huge potential existed and still exists to increase the productivity and incomes of these smallholders.

Most smallholders are organized in self-help groups or cooperatives. Agricultural cooperatives had over 4 million members in 2010 and are recognized by the government for their role in reviving the economy and in marketing of agricultural products. Joint marketing of products still bears potential for improvement, as many smallholders still prefer "fast cash" by selling to middlemen instead of bulk marketing, e.g. in steady contracts with larger buyers that may also provide quality inputs in contract farming arrangements.

Less than 5 % of total gross commercial loans in Kenya are directed to agriculture (~KES 94bn). Access to credit remains difficult for farmers despite the relatively well developed Kenyan financial sector. Risks that are inherent to farming cycles (fluctuating household incomes) and complicated land tenure systems limit possibilities for conventional collateral by banks.

The project concept intended to transform rain-fed agriculture of smallholder farmers into irrigated market-oriented agriculture by financing small to medium-sized irrigation schemes. That way, smallholders were to shift from subsistence farming based on maize and beans to farming of additional cash crops, i.e. crops that are attractive for commercialization and profit generation for smallholders. Farming of horticulture, bananas and nut trees would generate a positive and more constant cash flow, enabled by a more continuous availability of water through irrigation, thus yielding larger harvests more frequently and with an improved quality. The challenge of smallholder farmers' lack of individual bankability due to the risks inherent to agriculture were to be mitigated by a group-lending approach, in which each cooperative, consisting of 250-500 members, would hold a loan agreement with the Kenyan commercial bank and would monitor the repayment of the loan by the cooperative's sub-units.

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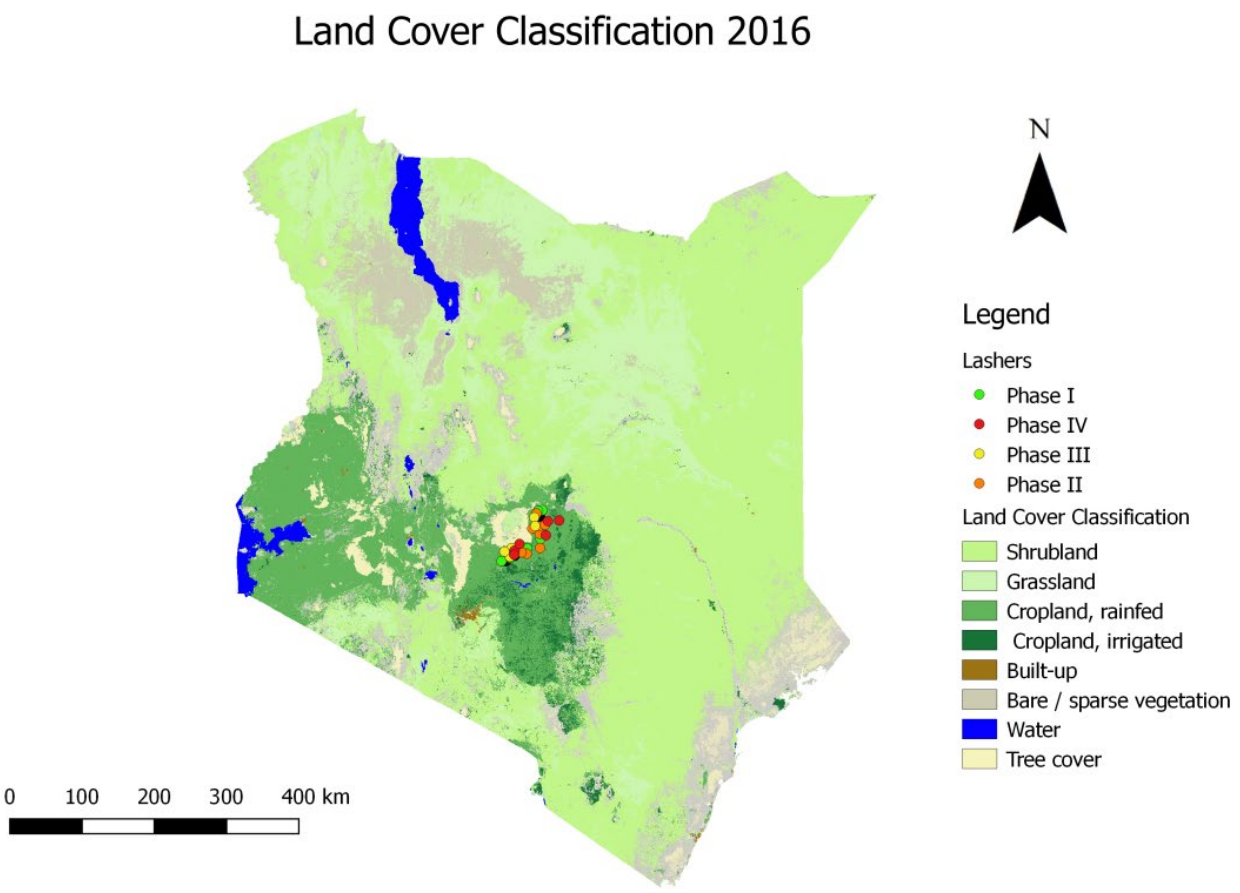
[2] World Bank & CIAT (2015). Climate-smart agriculture in Kenya. CSA Country Profile. Washington D.C.: The World Bank Group. Retrieved from: https://cgspace.cgiar.org/handle/10568/69545

Map 1: Rainfed and irrigated cropland in Kenya, 2016



Source: Own elaboration based on FAO WaPOR

Higher revenues from higher-value crops were to increase farmers' household incomes and improve their living conditions by providing better financial means to cover household expenses, such as school fees, health care, transport, nutrition and electricity. Due to a higher diversity of planted crops, farmer households would also consume a larger variety of nutrients from own cultivation instead of having to buy vegetables etc. at markets. The theory of change was logical: The socio-economic situation of the smallholders can improve via three channels: (i) the change to agriculture products, which yield higher margins when sold, (ii) more harvests and (iii) more diversified own nutrition (vegetable and fruit in addition to the already previously planted maize and beans). If the benefits via these channels exceed the costs of irrigation and inputs, the smallholders are better off than before. The program concept was adequate to tackle the main bottlenecks to an intensified market-oriented agricultural production by smallholders at project appraisal and it remains relevant at the time of evaluation. In times of increasingly unpredictable rainfall patterns, the irrigation infrastructure was also adequate for adaptation to climate change by allowing a more continuous water availability.

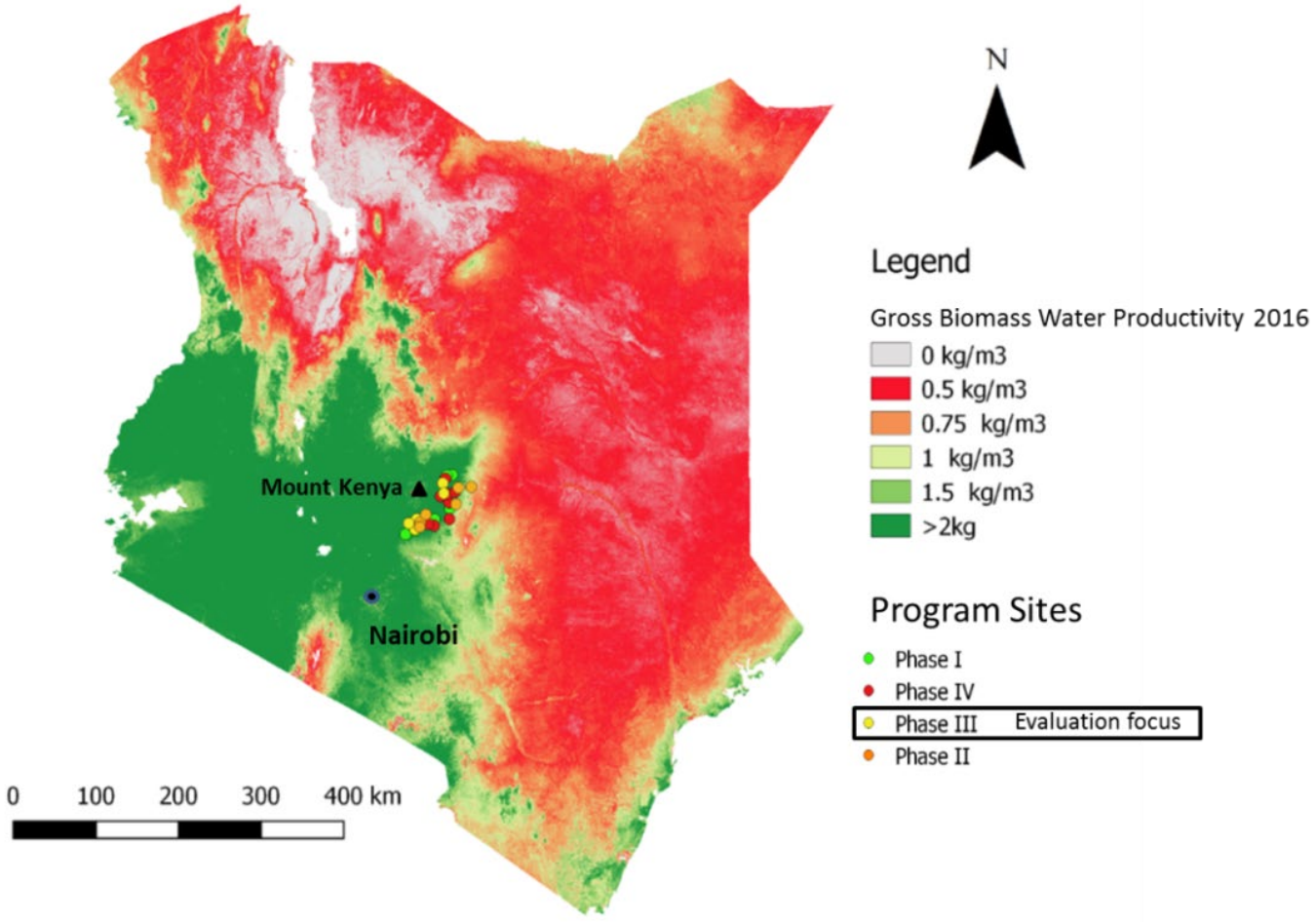
Currently, the government holds a list of 270 smallholder farmer cooperatives, which have applied for irrigation funding support but could not be provided with any funding. The demand for the program support by smallholder farmers has been and continues to be much larger than the available funding: In Phase III, four schemes (i.e. four cooperatives) were selected based on a two-step assessment and priority ranking by the PMU from a total of 27 farmers' cooperatives from five districts that had previously been identified by the district irrigation officers and proposed to the National Department of Irrigation. In Phase IV, six cooperatives were selected from a total of 126 cooperatives' applications that followed a media campaign. In both phases, the following criteria were applied to determine which cooperatives and areas would participate in the program: distance from the river intake (maximum 5 km), suitability of a gravity irrigation system (contrary to energy-consuming pumping system) with a surface water source (contrary to groundwater sources), number of cooperative members, land owned by the smallholder farmers, registration as a Cooperative Society under the Cooperative Act of Kenya, proven ability of the farmer cooperatives to raise the funds in the amount of 10 % of the estimated loan amount as collateral and affirmed willingness of farmers to participate under a cost sharing financing mechanism (formal written request). The technical designs of the irrigation schemes, as well as the farmers' cooperatives and their sub-groups were developed in a participatory process including farmers and the project management unit (consisting of the implementation consultant team, also responsible for construction supervision), among others.

The Mount Kenya region is characterized by a high population density and growth. Due to the good soil quality, a system of mostly (still) year-round rivers and altitude-related beneficial climate, the prerequisites for agricultural development are given. The program approach including the targeting criteria was adequate to identify agricultural areas cultivated by smallholders with a good potential for agricultural intensification by irrigation and for implementation of a cost-sharing approach. Map 2 shows in green those areas with a high amount of above-ground biomass in relation to water evaporation. The program is located mostly within the area of high gross biomass water productivity, which coincides with the agro-ecological zone of good agricultural potential.

Summing up, it can be concluded that the projects' relevance was and remains high given that it addresses the development bottlenecks of the agricultural sector and smallholders in particular in a region of Kenya that has large agricultural potential. Agricultural production and income generation are negatively affected by the fluctuations of rainfall and increasingly so due to climate change. Irrigation - as long as it is monitored by the Water Resource Authority - is an adequate approach to promote agricultural production in this context and the 50 %-loan sharing approach was promising and innovative in terms of providing smallholders access to credit, efficient use of government funds and beneficiaries' ownership for program success. The main reason why relevance is not rated as "very good" here is that the program concept relied exclusively on GIZ (technical cooperation, TC) for the integration of the smallholder cooperatives' production activities in value chains, despite the generally known risk of difficult harmonization of implementation time lines of FC and TC.

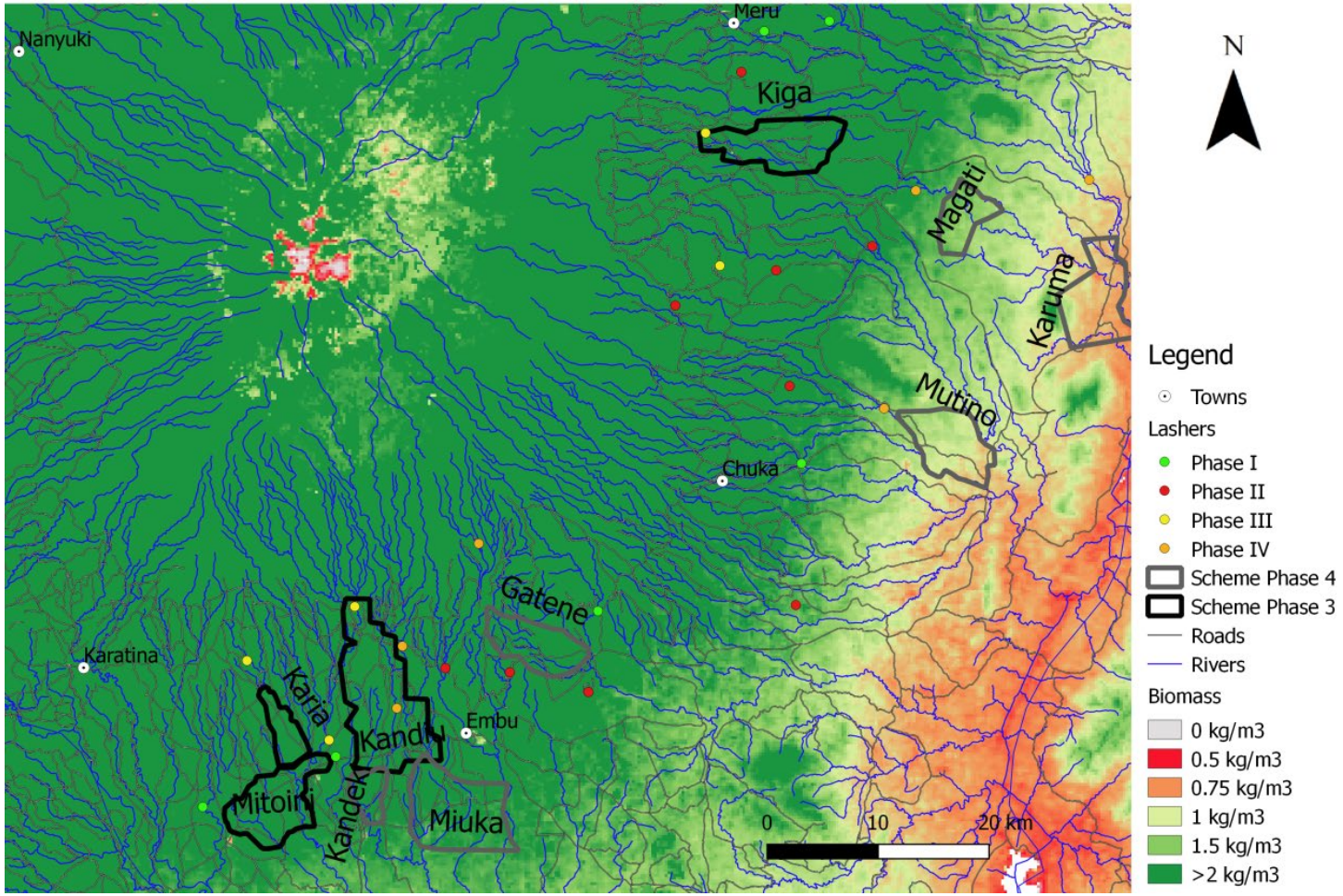
Relevance rating: Successful (2)

Map 2: Agricultural potential in Kenya illustrated by Gross Biomass Water Productivity (GBWP) 2016



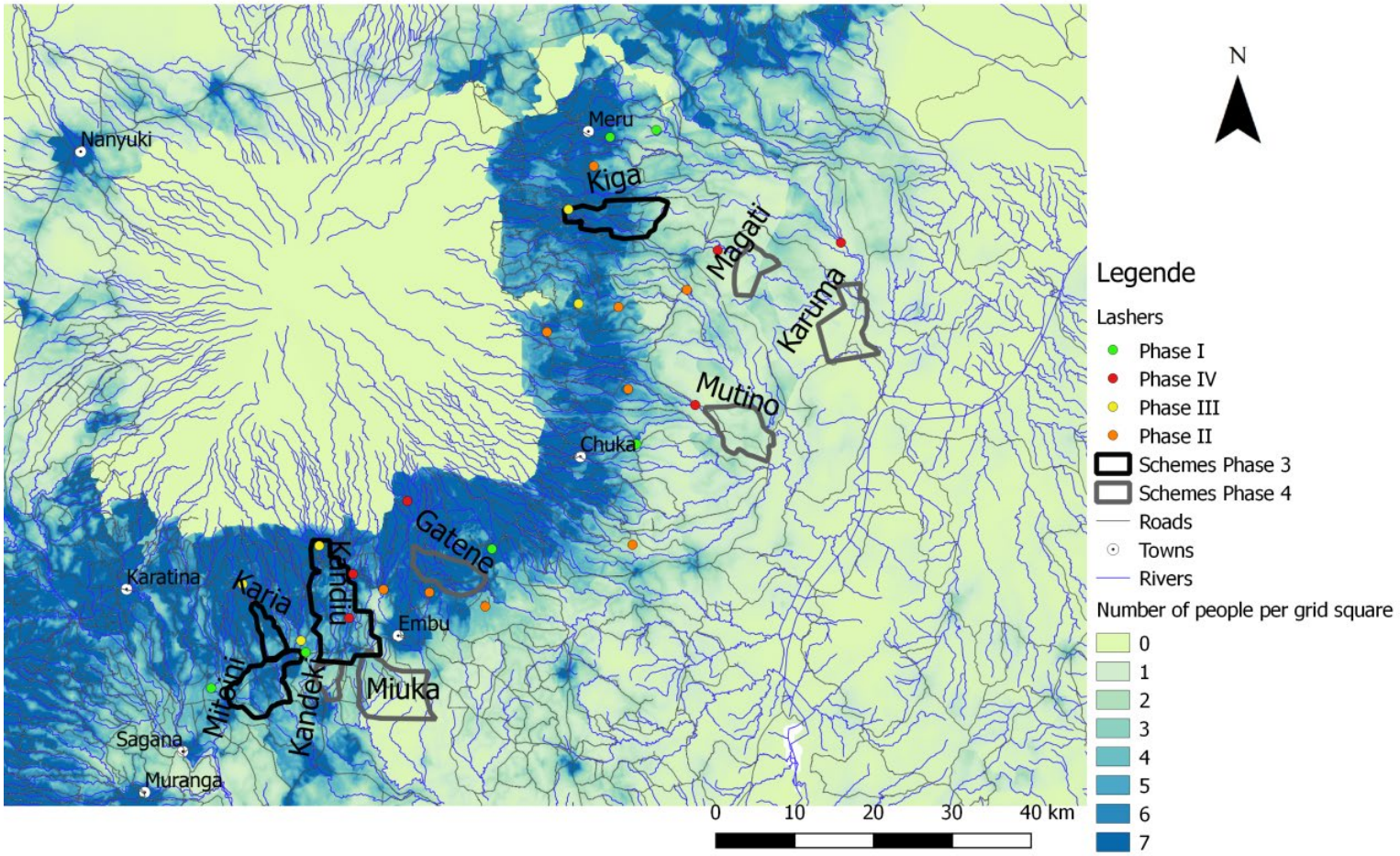
Source: Own elaboration based on FAO WaPOR, https://wapor.apps.fao.org/catalog/1/L1_GBWP_A

Map 3: Agricultural potential in Mount Kenya Program area illustrated by GBWP 2016



Source: Own elaboration based on FAO WaPOR, https://wapor.apps.fao.org/catalog/1/L1_GBWP_A

Map 4: Population density Mount Kenya program region 2015



Source: Own elaboration based on Population density, v. 4.11 of the Gridded Population of the World (GPWv4) data collection. A grid square denotes the number of persons per square kilometre, https://sedac.ciesin.columbia.edu/binaries/web/sedac/collections/gpw-v4/gpw-v4-documentation-rev11.pdf

Effectiveness

The project objective (outcome level) as defined at appraisal was an increase in the agricultural production.

Table 1: Achievement of program objectives - Outcome level indicators (Phase III)

Indicator	Status PA (2010)	Targets	Ex post evaluation (2019)	Comment
(1) Irrigated area, in hectares (within project schemes)	0 ha; indicator amended at EPE	Increase	561 hectares reported by cooperatives (544.4 as per design) - Mitooini 203 ha - Kandiu 148 ha - Karia 60 ha - Kiga 150 ha	Some farmers harvest (rain and irrigation system) water with individual farm level storage tanks overnight, thus allowing effectively a larger area to be irrigated
(2) Irrigated cropping intensity (number of crops/ year) three years after finalization of construction, in %[3]	166 % (without irrigation system)	220 %	Almost fulfilled - note: indicator has to be carefully interpreted, given that it is good for measuring the number of crops but not for measuring changes to higher-value/ perennial crops. Kandiu (2018): 201 % Mitooini (2018): 202 %[4] Karia, Kiga: no data available	The large positive effect of banana cultivation is not reflected in this indicator, given that bananas are an all-year yielding (perennial) cash crop (cropping intensity = 100 %).
(3) Average annual above-ground biomass[5]	amended at EPE;	Increase after beginning of irrigation	Fullfilled. Comparing the average annual biomass between 2000 and the year of start of irrigation with the period after start of irrigation (2014/2015) until end of 2018 for each scheme, average annual biomass inside the scheme increased by 6 to 10 % (own calculation at EPE)	Only at Karia, where irrigation started one year later and where water levels in the river have been reported as lower and floods destroyed some crops in 2018, biomass did not increase yet in 2019.

[3] Defined as the number of crops a farmer grows in a given agricultural year on the same field. Assumption: For smallholder households in Sub-Saharan Africa, increasing the number of crops, i.e. increasing the cropping intensity, is a common agricultural intensification strategy.

[4] AHT Consultancy (2018), Cropping Intensity Report SIPMK Phase III: Mitooini and Kandiu

[5] Given that the smallholders' yields are not documented for any of the program irrigation schemes, the Normalized Difference Vegetation Index (NDVI), a measure for above-ground biomass, is used as a proxy indicator for yields, cf. Lambert, Marie-Julie; Traoré, pierre C. Sibiry; Blaes, Xavier et al: Estimating smallholder crops production at village level from Sentinel-2 time series in Mali's cotton belt. In: Remote Sensing of Environment 216 (2018), pp. 647-657. Data Source NDVI: https://www.sentinel-hub.com/eoproducts/ndvi-normalized-difference-vegetation-index)

The four irrigation schemes of Phase III are functional and in use, as stated by the four cooperatives and demonstrated exemplarily by the visits of two farmer plots per irrigation scheme at evaluation. The main conveyance pipe of Kiga irrigation scheme was damaged and displaced by a landslide in the rainy season in 2016, but was remedied by replacement with a better quality galvanized steel pipe, financed by a further loan, which was extended by the Kenyan commercial bank to the cooperative without any FC or other donor support. The intake of Karia, which was not part of the program design, but constructed in a project of the county, required gabions to help contain water during the April/May rains.

Regarding the three channels in the theory of change mentioned in the Section “Relevance”, it can be stated that (i) a change to agriculture products, which yield higher margins when sold took indeed place.

With only one exception, all farmers interviewed in focus group discussions and interviews during plot visits stated that they had increased the quantity of different cultivated crops since they use irrigation water: Most are now cultivating additionally to the maize and beans of traditional rain-fed agriculture also horticulture, e.g. cabbage, tomatoes, French beans, papaya, chard (mangold), bananas, some also Macadamia, avocados and animal fodder. The cropping decisions are guided by market demand and expected positive cash flow. The Kenyan commercial bank provides financial literacy training and horticulture expertise to farmers, including training on business orientation in farming activities and orientation towards “fast cash crops" such as bananas, which yield already one year after planting and can easily be harvested and marketed at the farm gate. The bank has a Foundation that develops the financial literacy programs, which are financed by own fund raising.

A report (AHT 2018) on cropping intensity in terms of the number of crops a farmer grows in a given agricultural year on the same field of the schemes Mitooini and Kandiu assessed changes based on surveys conducted in 2013 and 2018 with 892 households. Due to time and budget limitations, data was not collected at Karia and Kiga. The results show a substantial increase in cropping intensity for Mitooini and Kandiu: Maize (55.5 % of total cropped area in Mitooini, 40.1 % in Kandiu) and beans (22.4 % of cropped area in Mitooini, 29 % in Kandiu) were the most prominent crops produced in 2013, i.e. before the start of irrigation. After irrigation, i.e. in 2018, the production of bananas had increased from 0.8 % of cropped area to 10.1 % in Mitooini (7.6 % to 12.3 % in Kandiu) and sweet potato from 0.2 % to 16 %, the production of tomatoes had increased from 1.6 % of total cropped area to 5.2 % in Mitooini (0 % to 3.8 % in Kandiu). Cabbage, coffee and French beans also accounted for relevant shares of irrigated cropped area in 2018. This shows the successful transformation of cropping patterns towards higher-value crops with stable yields under irrigation: bananas, sweet potatoes, horticulture. With regard to revenue and income generation this compares positively to the previously predominant staple crops maize and beans with large yield fluctuations due to rainfall patterns.

Table 2: Share of important crops on total cropped area (rainfed/irrigated), Kandiu and Mitooini, 2013 and 2018

	Share of crop on total cropped area			
	Kandiu		Mitooini	
Crop	without project (2013) *(%)*	with project (2018) *(%)*	without project (2013) *(%)*	with project (2018) *(%)*
Banana	7.6	***12.3***	0.8	10.1
Beans	**29.0**	10.2	**22.4**	***14.6***
Cabbage	0.0	4.9	0.0	1.1
Coffee	***22.0***	**23.2**	0.6	0.7
French Bean	0.2	6.4	0.0	2.1
Maize	**40.1**	**21.9**	**55.5**	**32.9**
Pawpaw	0.0	0.1	***17.5***	0.3
Sweet Potato	0.8	0.3	0.2	**16.0**
Tomato	0.0	3.8	1.6	5.2

highest | **second highest** | ***third highest***

Table 3: Share of crops on irrigated cropped area in Kandiu and Mitooini in 2018

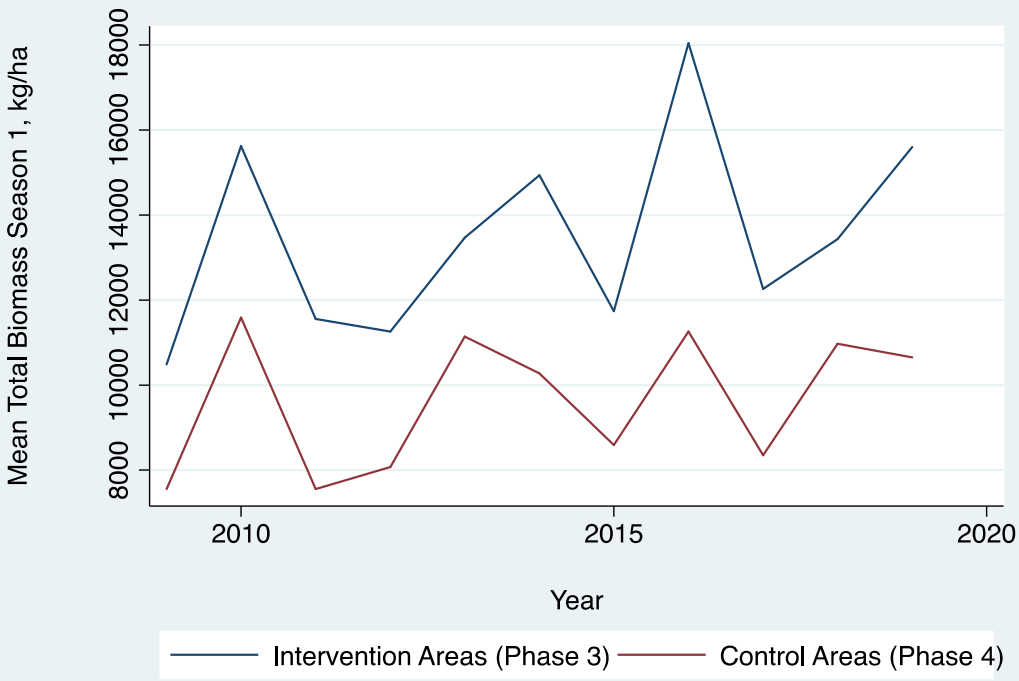
Crop	Share of crop on irrigated cropped area		
	Kandiu	Mitooini	Total
	(%)	(%)	(%)
Arrow Root	1.3	0.7	1.0
Baby Corn	1.5	0.0	0.6
Banana	16.8	20.0	18.7
Beans	4.0	4.0	4.0
Cabbage	10.1	2.2	5.6
Coffee	5.9	0.6	2.8
French Bean	***13.3***	4.2	8.0
Green Maize	2.0	0.0	0.8
Maize	22.3	***15.3***	18.2
Napier Grass	3.0	2.2	2.5
Passion Fruit	0.0	4.9	2.8
Spinach	1.3	1.1	1.2
Sukuma wiki	3.1	3.9	3.6
Sweet Potato	0.7	26.0	***15.4***
Tomato	7.8	6.6	7.1
Other	8.1	8.9	8.6

highest | second highest | *third highest*

In addition, the second channel of the theory of change, namely (ii) more harvests, was achieved as well.

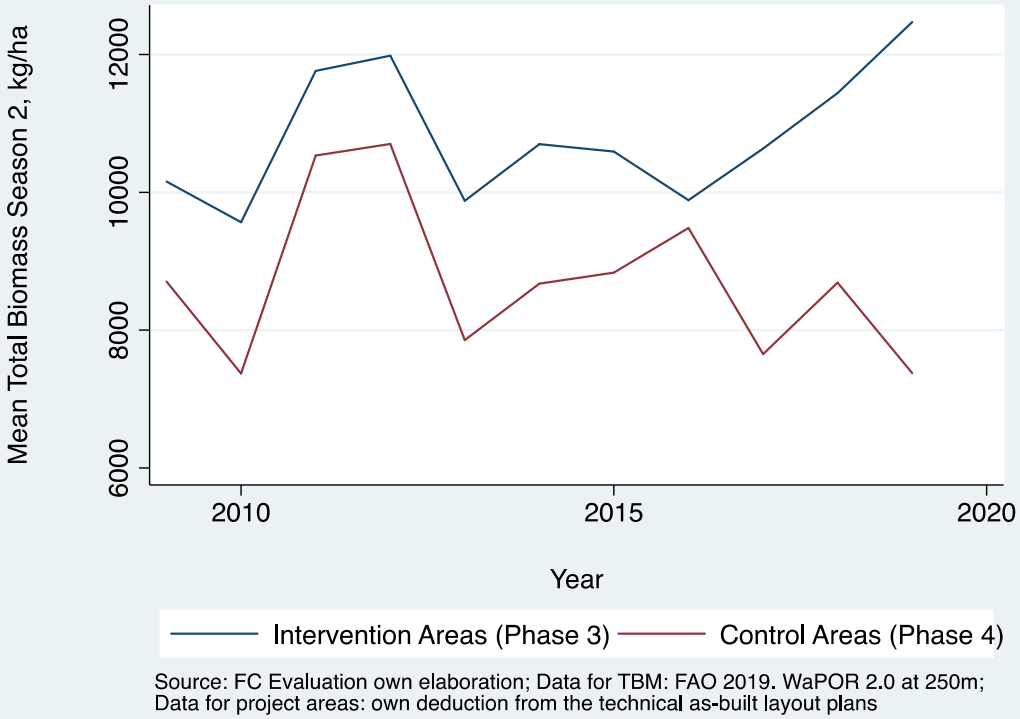
In rain-fed agriculture, most farmers could only plant crops twice a year due to the two rainy seasons. The availability of irrigation water allowed in most years to plant new crops more often and to harvest and produce more continuously.

Graph 1: Mean Total Biomass Season 1, Intervention and Control Areas



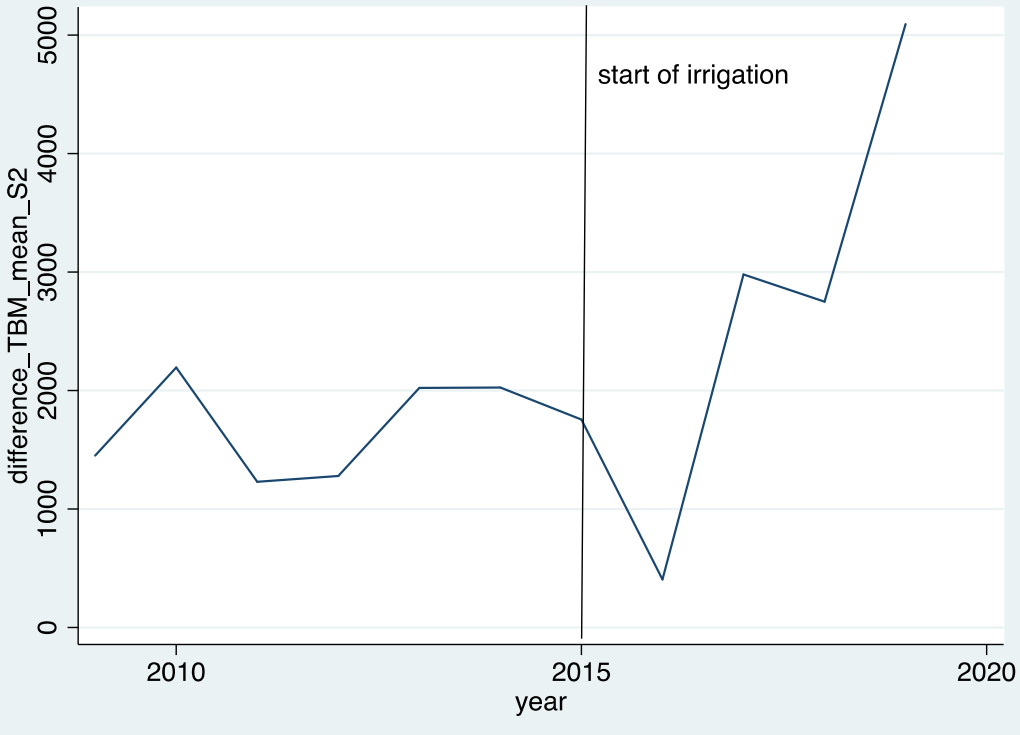
Source: FC Evaluation own elaboration; Data for TBM: FAO 2019. WaPOR 2.0 at 250m; Data for project areas: own deduction from the technical as-built layout plans

Graph 2: Mean Total Biomass Season 2, Intervention and Control Areas



Source: FC Evaluation own elaboration; Data for TBM: FAO 2019. WaPOR 2.0 at 250m; Data for project areas: own deduction from the technical as-built layout plans

Graph 3: Mean Total Biomass Season 2, Difference Intervention and Control Areas (start of irrigation between 3/2014 and 8/2015)



Graphs 1 to 3 show how the Total Biomass evolved in the years prior to and after the start of irrigation. The blue lines in Graphs 1 (Season 1) and 2 (Season 2) depict the development of the Total Biomass in kg/ha inside the borders of the four irrigation schemes that were built within Phase III (intervention areas, evaluated here). The red lines show the development of the Total Biomass in kg/ha in those six areas that are supposed to receive irrigation infrastructure within Phase IV, which is currently in the technical planning phase (technical design layouts of the areas were available for the evaluation). Given that smallholders in these six areas predominantly practice rainfed agriculture, but are similar in other characteristics relevant for comparison (household socio-economic situation, geography, precipitation, distance to rivers), they serve as an adequate control area (control group). The graphs demonstrate that particularly in Season 2, the total biomass increased stronger in the irrigated intervention areas than in the on-irrigated (rainfed) control areas between 2016 and 2019. However, a difference-in-difference regression analysis did not yield statistically significant treatment effects. This may be due to the fact that only observations for four years after the start of irrigation are available (2016-2019) at the time of evaluation.

Changes in harvested crops were already obtained within the first year of the start of irrigation. Main factor influencing the increase in cropping intensity and yield/quality increases was likely the availability of water. Better financial means to procure inputs such as seedlings, fertilizers, pesticides and herbicides were not prominently assessed in the evaluation. Smallholders stated that they had more funds available for inputs after the loan had been repaid (2018 in Kandiu, Mitooini). Monthly instalments amounted to ca. 19.50 EUR per month per connected farmer household. The loans had a five-year maturity with two years grace period and an interest rate of 12 % p.a. These conditions were affordable for most of the farmer households (cf. below regarding procedures in case of payment difficulties). The spread resulting from the difference in loan conditions between the on-lending from the Government of Kenya to the bank and the conditions for on-lending to the cooperatives is considered reasonable to cover the commercial bank's transaction costs also for on-channeling the grant, implementing the programme financially and some profit. Some buyers provide seeds and other inputs to the farmers and deduct the cost for inputs from the payment for the produce. Given that the first years of irrigated agriculture (2014/15 until 2018/19) were characterized by the loan repayment, it is possible that yields will increase further after 2020 and onwards once farmers have more funds available for inputs.

Support to farmers to find market access, i.e. adequate wholesale buyers, was lower in Phase III as compared to Phases I and II, given that GIZ had retrieved from the program. Outcomes with regard to market integration, i.e. integration in value chains, may have been improved, if GIZ had continued its activities or if the FC would have had additional grant funds available for Accompanying Measures to fill the gap left by GIZ. In FC projects, particularly those including infrastructure, budgets cannot be shifted easily once it has started and construction companies have been contracted. Many farmers stated that they sell their produce individually to wholesale buyers such as the Kenyan agricultural companies TWIGAFOOD and FRIGAKEN or to middlemen. Some of these producer-buyer-relations can be considered contract farming. Most farmers market their produce individually, while Mitooini markets bananas collectively as a cooperative with 500 members (41 tonnes generating revenues of 6,570 EUR in 2015, increasing each year up to 417 tonnes and generating revenues of 67,727 EUR in the first nine months of 2019). One of the success factors of Mitooini's joint marketing activities seem to be strict cooperative rules and their enforcement, including a rule for each farmer to plant 50-60 stems of bananas, in order to produce a sufficient quantity for collective marketing. Most products are placed on national markets (local, regional and Nairobi), only some of the produce of French Beans is purchased by brokers who also export. A challenge for some farmers towards more contract farming are the increasing quality requirements (e.g. size and shape of agricultural products, limits of pesticide application), which result in some share of the production being rejected by some buyers. Overall, the program has improved the smallholders' position to sell their harvest to wholesale buyers, as the above examples for business relations with wholesale buyers illustrate. However, room for improvement for collective marketing remains.

The Mitooini cooperative has established a cooperative saving scheme, a so-called SACCO, which indicates a rather high level of development and organization of the cooperative. The cooperatives, especially Mitooini, mentioned plans to process their products in the future in order to increase the product value. Two farmers of Kiga cooperative possess a processing unit for drying and scalping coffee beans.

A major factor of success of the program was the financing scheme of the irrigation infrastructure with a 50 % loan portion and 50 % grant portion in the loans to the cooperatives: Farmers who did not have enough equity to invest in irrigation on their own were introduced to a saving culture by the Kenyan com-

mercial bank and the PMU and developed certain pride and ownership by contributing in their sub-groups on a monthly basis to save at first for a 10 % collateral, followed by a monthly interest rate that is due after loan contract signing and instalments for loan repayment that are due after a two-year grace period. A factor of success of the financing scheme were the strict rules of the cooperatives regarding payment obligations and consequences for payment delays, including the disconnection from the irrigation water and the exchange of about 10 % of the cooperative members of Mitooini, Kandiu and Karia cooperatives in cases where members defaulted on their debt obligations (after six months of payment delay). Such an exchange meant that a different farmer within the same scheme would take over the debt obligations and would receive the connection to the main irrigation pipe.[6] Mitooini, Kandiu and Karia have fully repaid their loans, while Kiga has rescheduled its loan and has a new due date for repayment in 2020. Some farmers have experienced (temporary) difficulties in repaying the loan, others were able to repay their loan shares (each has the same loan share and receives an irrigation connection to irrigate one acre) with the first harvests. One challenge for the saving discipline that farmers of Kiga cooperative mentioned was the interference of politicians that had promised prior to elections to take over payment obligations, which never materialized. In addition, payment obligations increased at Kiga because the negotiated a new loan to fix the main irrigation pipe.

The Kenyan commercial bank that had agreed to participate in the program was an adequate partner for implementation of the program, given that it offers financial products and conditions that are adjusted to the needs of farmers, whose cash flow is characterized by the seasonality of agricultural production and cropping cycles. According to their statements, the bank has expanded recently and hired more than 150 new employees with an agricultural academic background who are trained in banking and employed in the decentralized branches of the bank, liaising directly with the farmers and knowing well the particular challenges that smallholders face. Given that the bank has not financed any irrigation schemes of similar scale outside of the program despite existing demand, it may be assumed that the financing of the program is additional. Representatives of the bank stated that they would not be in the position to implement such programs without the engineering expertise provided by the project management unit.

Summing up, we conclude that the effectiveness of the program Phase III was good.

Effectiveness rating: Successful (2)

Efficiency

In Phase I, the construction cost (financed 50 % by loan funds, 50 % by grant funds) of the irrigation schemes was 3,648 EUR/ha, in Phase II 3,147 EUR/ha and in Phase III 3,139 EUR/ha. Especially in the face of inflation, this is a positive development. The costs are considered adequate and according to the Department of Irrigation lower than the average cost of 5,462 EUR/ha incurred by the National Irrigation Board government programs.

The costs for the implementation consultant amounted to 1.38 million EUR from the FC loan and 0.51 million EUR from FC grant funds (SBF for preparatory studies and supervision during defects notification period). Construction costs amounted to 1.67 million EUR in Phase III. Phase III funds were also used for filling financing gaps in Phases I and II in the amount of 0.17 million EUR. Consulting costs were higher than budgeted, given that delays were caused – mainly by the late signing of the subsidiary loan agreement between the government and the Kenyan commercial bank and by the substitution of Gakirene by Karia scheme. Gakirene had not been able to raise the 10 % collateral, while the design had already been financed. Consulting costs are considered adequate and comparable to similar FC irrigation projects. The PMU was a somewhat parallel structure given that the devolution process, i.e. decentralization, was initiated at the start of the programme and no capacities (staff with the required high engineering expertise, financial resources) were in place at the counties that could have been involved in the programme. GIZ was originally working with the counties to support these capacities but retrieved in 2014, arguing in their reports that due to devolution the county irrigation offices and extension services should take over the services previously provided by GIZ. However, the decentralized capacities of the county offices were not in place yet at that time and are still lacking them today.

[6] In each area that belongs to a scheme, farmer parcels with irrigation exist and farmer parcels without irrigation. Each famer household can chose whether to participate or not in the program.

From a macroeconomic (state budget) perspective, the allocation efficiency was higher than in most other FC irrigation financing programs due to the financing scheme with a 50 % loan portion, which is repaid by the bank to the Government of Kenya and thus returns to the national budget. Contractually, no use of the spread between loan conditions provided by FC to the Kenyan government and the conditions of on-lending to the commercial bank was agreed, but the spread benefits the Kenyan budget and can be used by the Kenyan government to help serve the FC loan. Summing up, the efficiency is rated as good.

Efficiency rating: Successful (2)

Impact

The overarching developmental objective (impact) of the program as defined at appraisal was to improve the living conditions of rural households in the Mount Kenya program region. Unfortunately, no socio-economic surveys were conducted for Phase III, such that no representative data is available on household incomes or living conditions. The following information is based on focus group interviews with beneficiaries.

Table 4: Achievement of developmental objectives - Impact level indicators (Phase III)

Indicator	Status PA (2010)	Targets	Ex post evaluation (2019)
Agricultural household income	No baseline available	+ 88-160 % Based on experiences of Phase I	No data available. Socioeconomic surveys were only conducted by the implementation consultant for Phases I and II.

Despite only slight increases in biomass production (cf. Effectiveness), the program has had positive impacts on farmers' households. The satellite data on biomass productivity also show that the farming cycle changed and planting and harvesting became possible more frequently over the year. The availability of irrigation water allowed in most years to plant new crops more often and to harvest and produce more continuously. This allowed the members of the cooperative according to their own statements (non-representative sample of farmers in focus group interviews) to become full-time self-employed farmers that can live from their farming as a main and constant income source and generate financial revenues from marketing of the produce.

The main change in income must come rather from the crop changes to cash crops - planted additionally to staple crops - than from yield increases. Bananas, tomatoes, French beans, papaya, avocado and macadamia allow higher margins than the traditionally cultivated maize and dry beans. Coffee was planted as well by some farmers, but as in other parts of the world, coffee prices have in recent years decreased and farmers start to replace coffee plants with higher margin crops. Several farmers in the focus group interviews stated that they appreciate that they do not have to buy vegetables at the market anymore. However, no data was available regarding potentially improved/ diversified nutrition of the beneficiary households (channel iii of the theory of change in the Section "Relevance").

Potential future increases in income could be achieved by conducting more activities collectively as a cooperative, especially marketing and input procurement, in order to increase bargaining power and to achieve better prices for the farmers.

Some farmers have stated that they employ more seasonal and some permanent workers on their land than before irrigation, e.g. because more harvests accrue. Cooperatives have created permanent employment for five to seven persons each.

Most households were and still are not connected to the centralized water supply system. A main co-benefit of the program for many farmers – and for some even the principal motivation to join the program – is the availability of water for domestic uses and animal husbandry. The topic of hygiene in water supply

for domestic uses was not a focus of the evaluation, but some few farmers were asked about treatment of water and stated that most use chlorine (2 KSh per tablet) or boiling to treat drinking water.

Another co-benefit of the program is its positive impact on adaptation to climate change in the sense that farmers who irrigate become less dependent on the increasingly changing rainfall patterns.

Benefits by the program that were stated repeatedly by the farmers were increased ability to pay school fees up to university and other bills, e.g. electricity, in addition to the availability of vegetables and fruit for own consumption, which had previously been bought at higher cost at markets located in the region. Several farmers mentioned that the revenues from irrigated agriculture had allowed them to improve housing and to purchase a car or a motorcycle – despite still repaying the loan. Two farmers stated the irrigated agriculture had allowed them to raise the endowment for getting married. With the average age in farming in Kenya being rather high, the program may also have a positive impact on attracting younger farmers to agriculture. This aspect was particularly emphasized by members of Mitooini cooperative.

Summarizing, we consider the development impact as good.

Impact rating: Successful (2)

Sustainability

All cooperatives were still fully functional at evaluation and are regulated and even annually audited under the Kenya Cooperative Act. The management committee is elected by the members. All cooperatives have an operation and maintenance (O&M) system in place and have hired 3 to 5 plumbers for operation of the irrigation system. Members pay O&M fees on a monthly basis in the amount of 300 KSh (Mitooini, Kiga, Kandiu), the O&M budget accrued is shown in the audited cooperative annual budget. Log books were kept on repairs that had become necessary since construction completion.

The case of the damaged and subsequently successfully replaced conveyance pipe in Kiga, the activities of the plumbers, as well as creativity by farmers in repairing sprinklers demonstrate that the cooperatives are in the position to find solutions for pipe bursts and damages to the irrigation system.

The central risk to the sustainability of irrigation agriculture in the Mounty Kenya region in general – not only affecting the program sites – is the reliable water availability in rivers, not only for irrigation purposes. Water levels in some rivers of the region have been lower in 2018 than expected by authorities according to average observations in the past, which implied that even the quantities of abstracted water authorized by the Water Resource Authority (WRA) at start of construction were not available at all times. At the same time, illegal abstractors upstream, especially in Meru County, reduce the water availability downstream (Kirinyaga county is downstream of Meru). Illegal abstractors include both large farms and small irrigation pumps for temporary cash crop cultivation. The problem is thus not caused by the smallholders of the program, who have applied for their water permits in line with regulations, but they can be affected by the illegal abstractions. The WRA communicates and implements a strict disconnection policy towards illegal abstractors. However, the results seem to be only temporary, as new or repeated illegal abstraction occurs. The WRA clearly has received the mandate by the government to enable yield increases by irrigation and agricultural intensification. Therefore, the WRA is facing a very difficult task of distributing the available water quantities in a way that allows sufficient renewal of water resources. In order for irrigated agriculture in the Mount Kenya to be sustainable, illegal abstraction will have to be fought even harder by the WRA. Furthermore, there is a systematic problem in the process of water abstraction permit delivery by WRA as illegal abstractions are not measured and can thus not be considered by WRA when assessing water availability as a result of a sound hydrological analysis. Kenyan administration fears any symbol of formal legalisation when considering even illegal abstractions. But they are a fact and cannot be excluded to properly assess the capacity of a given water course. WRA is facing a tough situation being confronted with ambiguous expectations: There is political pressure on WRA to allow the expansion of water use for development in various sectors, while at the same time WRA is the crucial authority in Kenya that would be responsible for an effective Integrated Water Resource Management. The recent renaming of the Water Resource Management Authority to Water Resource Authority also poses questions regarding the political mandate of WRA.

The irrigation schemes of the program – as all other irrigation schemes – have to ensure that they are always in possession of a valid water use permit issued by the WRA, which has to be renewed every five years.

The irrigation schemes of the program have found good solutions for times of water scarcity with their respective county governments and have applied rationing rules during dry spells with low water levels in the river, during which they used irrigation water only e.g. on two days per week. The cooperatives have established strict water use rules and seem to have mechanisms to enforce them.

The program financed sprinkler irrigation schemes. Some farmers are aware that drip irrigation could increase efficiency and thus environmental sustainability of water use to a higher level. However, based on the observations, efficiency increases in water use are also possible with the sprinkler technology, by further optimizing when and in which quantity to irrigate. Plans exist by the government to introduce dam construction along the river for water storage purposes in order to balance water availability between dry and rainy season. However, functional Integrated Water Resource Management systems in a performing and independent (from political interference) institutional setup would be a basic requirement. The development of such systems is a prior condition for further investments in any irrigation or water storage infrastructure, given the increasing shortage of water resources in combination with basic ecosystem requirements, climate change challenges and the pressure from a growing population.

It was positively noted that many farmers applied agroforestry principles by planting trees (nut, avocado and other) in and around their plots. Some mentioned also that they plant those trees as protection against wind erosion. Soil quality was observed to be quite good in the irrigation schemes as in the Mount Kenya region in general. Mitooini had conducted soil quality tests to determine the optimal level of fertilization. Farmers have planted predominantly “rapid cash crops”. They do practice crop rotation on the one hand – on the other hand it should be monitored further in the future, which impacts these crops have on the soil quality and water consumption in the medium and longer term.

The program allowed the farmers to become bankable as a group and some even as individuals. This allows the farmers to plan further ahead. Some cooperatives plan joint investments in trucks for transportation of produce or processing equipment for further value addition. Mitooini cooperative has developed the largest capacity to finance future plans by having developed an own saving/financing scheme (SACCO), a permanent bank liaison at the scheme office and cooperations e.g. with Jomo Kenyatta University of Agriculture and Technology for a charcoal based cooling storage that had been installed.

The Department of Irrigation and German FC have started discussions on how to replicate the program and its very positive outcomes and impacts on a larger scale in the future. The German Government has shifted its focus to other regions of Kenya and is unlikely to contribute further budget funds to agriculture in the Mount Kenya region. Therefore, it is of utmost importance for the DOI to discuss with commercial banks like the one that was involved in Phase II and which is currently not using the FC funds in a revolving manner, and other donors what is necessary in order to meet the large demand for smallholder irrigation schemes in the Mount Kenya region. The replication of the financing mechanism of the SIPMK with a substantial loan portion seems promising, given that larger financial volumes may be possible and given that this approach creates important ownership for the program and its success by the farmers. A potential approach for scaling up may be the creation of an Irrigation Fund, where revolving loan funds enter and are dedicated for future financing of smallholder irrigation schemes. This proposal can also be found in the recent Irrigation Law 2019, Article 15 d). Such a revolving fund would allow to provide irrigation infrastructure for a larger area than it would be possible with only grant funds. At the same time upscaling is always limited in a certain water catchment by the maximum amount of water that can be extracted for irrigation purpose without harming the resource in the longer term. Integrated Water Resource Management and law enforcement are thus prerequisites for upscaling. The locust swarms that have negatively affected other parts of Kenya, have fortunately spared the program areas. The Covid-19 pandemic, however, has limited farmers possibilities to market their products as some local and regional markets remained closed temporarily and some unquantified share of the harvests rotted. All loans, including the one still under repayment by Kiga cooperative, benefitted from a 3-month additional grace period that was introduced due to Covid-19. The most harsh lock-down in Kenya has ended by the time of publication of this evaluation; thus, it seems now that new measures of the Kenyan government are better suited to maintain the production and marketing of food stuff.

Summing up, the sustainability, i.e. the durability of positive outcomes and impacts of this programme (economically, socially and environmentally) is rated as good and successful.

Sustainability rating: Successful (2)

Notes on the methods used to evaluate project success (project rating)

Projects are evaluated on a six-point scale, the criteria being **relevance, effectiveness, efficiency** and **overarching developmental impact**. The ratings are also used to arrive at a **final assessment** of a project's overall developmental efficacy. The scale is as follows:

Level 1	Very good result that clearly exceeds expectations
Level 2	Good result, fully in line with expectations and without any significant shortcomings
Level 3	Satisfactory result – project falls short of expectations but the positive results dominate
Level 4	Unsatisfactory result – significantly below expectations, with negative results dominating despite discernible positive results
Level 5	Clearly inadequate result – despite some positive partial results, the negative results clearly dominate
Level 6	The project has no impact or the situation has actually deteriorated

Rating levels 1-3 denote a positive assessment or successful project while rating levels 4-6 denote a negative assessment.

Sustainability is evaluated according to the following four-point scale:

Sustainability level 1 (very good sustainability): The developmental efficacy of the project (positive to date) is very likely to continue undiminished or even increase.

Sustainability level 2 (good sustainability): The developmental efficacy of the project (positive to date) is very likely to decline only minimally but remain positive overall. (This is what can normally be expected).

Sustainability level 3 (satisfactory sustainability): The developmental efficacy of the project (positive to date) is very likely to decline significantly but remain positive overall. This rating is also assigned if the sustainability of a project is considered inadequate up to the time of the ex post evaluation but is very likely to evolve positively so that the project will ultimately achieve positive developmental efficacy.

Sustainability level 4 (inadequate sustainability): The developmental efficacy of the project is inadequate up to the time of the ex post evaluation and is very unlikely to improve. This rating is also assigned if the sustainability that has been positively evaluated to date is very likely to deteriorate severely and no longer meet the level 3 criteria.

The **overall rating** on the six-point scale is compiled from a weighting of all five individual criteria as appropriate to the project in question. 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 a project can generally be considered developmentally "successful" only if the achievement of the project objective ("effectiveness"), the impact on the overall objective ("overarching developmental impact") and the sustainability are rated at least "satisfactory" (level 3).