Final Report

End of Project Evaluation

Of the project “Postharvest Management in Sub-Saharan Africa”

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Front picture: Workshop Mozambique 2017

1. Executive Summary

The project "Postharvest Management in Sub-Saharan Africa" (PHM-SSA) is part of a portfolio of projects on postharvest management (PHM), which the Swiss Agency for Development and Cooperation (SDC) has been funding in Sub-Saharan Africa since 2008. The PHM-SSA was implemented between 2013 and 2020 in the two focus countries, Mozambique and Benin, with components on dissemination and advocacy at the regional level of Sub-Saharan Africa. The project was carried out in a consortium with FANRPAN (Food, Agriculture and Natural Resources Policy Analysis Network) and the partners AFAAS (African Forum for Agricultural Advisory Services) and AGRIDEA (Swiss Association for the Development of Agriculture and Rural Areas; until Nov. 2018). With the overall goal to improve food security and livelihood of the beneficiary population, the PHM-SSA had the following projected outcomes:

1. Improved handling and storage options within the grains and pulses value chains are benefitting smallholder farmers in focus countries.
2. Good practice options for reducing postharvest losses are compiled, disseminated and scaled-up.
3. Appropriate regulatory frameworks (policies, standards, norms and protocols) on reducing postharvest losses in food supply chains are introduced and implemented at national and regional levels and financing is secured.

The current report on the evaluation of the PHM-SSA was carried out under the circumstances of the Covid-19 pandemic. The methodology was adapted to a fully online exercise, based on a review of available reports and literature. 37 interviews were conducted through different online means (WhatsApp, Skype, Zoom, Email) in order to assess the results from the literature review. The interviews in French, Spanish/Portuguese and English were completed through feedback from the project teams and collaborators in different countries.

The evaluation concludes that the project induced potentially lasting changes at different levels, such as the smallholder communities it worked with in the focus countries, the partner organisations and relevant institutions in Benin and Mozambique, and at the institutional level in Sub-Saharan Africa.

The project developed a basket of postharvest management (PHM) practices and technologies with its partners, which were introduced in the project regions in Northern Mozambique and in the two departments of Collines and Atakora in Benin. As of the end of 2019, 10'272 direct **beneficiaries** benefitted from capacity building in postharvest practices. According to available data, it is estimated that direct beneficiaries of the project were able to improve their handling and storage so that up to 7000 t of crops per year are saved, leading to average increased incomes of USD 225 per household. This is due to the improved post-harvest practices and storage technologies that the majority of beneficiaries learnt to use during the project. Indirect beneficiaries (more than 50'000 expected by the end of the project) were included in outreach activities to build their awareness of the benefits of good PHM. It is reported that the postharvest practices, such as simple testing of moisture content, were widely adopted even among non-direct beneficiaries. Postharvest losses could be reduced (no quantification is possible with the data available) so that the number of food-secure households could be increased during the project duration. The improved traditional granaries are an innovation of the project that is also used by other development partners now.

Due to the facilitation of the PHM-SSA, private sector actors in Mozambique integrate PHM technologies in their business models. A functioning network of agro-business companies and -dealers

was established to market hermetic bags for storage and drying tarpaulins, with the agro-dealers acting as private agricultural advisory services providers. A basis for demand and supply exists also for the metal silos. In Benin, supply- and demand-side factors have so far hindered the installation of a functioning market system for new postharvest technologies. More than 300 farmers instead practice a warehouse receipt system (warrantage) supported by the project, which was particularly successful in combination with grouped sales. The main challenges of the project were in fully achieving the objective of sustainable market systems for postharvest technologies (outcome 1).

The project induced important developments at the **institutional level in the focus countries**. In particular, farmers' organisations and 17 technical schools have integrated PHM in their communications and/or teaching programmes. With the support of governments, the theme found its way into training of public extension services and agronomy students. In addition, research institutes in the two focus countries have become knowledge centres for PHM through their integration in project activities. In Mozambique, a stand-alone national strategy on PHM is far advanced. In Benin, the project was also successful in anchoring PHM in the national development plans on food security, agriculture and livestock.

Through working in partnership with regional organisations, the project spurred changes at the **institutional level in Sub-Saharan Africa**. The networks of AFAAS (agricultural advisory services) and FANRPAN (policy and advocacy) integrate PHM in their current work and are known as knowledge holders for PHM. Through its partners, the PHM-SSA has contributed to making PHM a theme in the political arena, where until now such policies were rarely integrated.

From the available reports and the interviews, it can be concluded that the project has spurred changes that make a good basis for further improvements in food security if the momentum can be continued. Within its broad scope and relatively limited budget, the project was successful in reaching a great majority of its objectives. A number of lessons learnt can be drawn, they include:

- A conducive business environment and the capacity to facilitate multiple market links greatly influences the outcome of a market system development approach.
- The PHM-SSA successfully collaborated with a broad range of local, national and regional (SSA) organisations. This was key for institutionalising PHM.
- Studies that inform a project should include transdisciplinary views to better include business analysis and understanding of socio-cultural and market factors.
- Higher visibility at the national level could have increased demand for hermetic solutions.

Although the SDC is phasing out its support to postharvest initiatives, it is recommended that the lessons learnt from PHM-SSA and other projects on PHM will be used in other projects with a focus on food security. Considering climate change, pressure on land, deteriorating soils etc., PHM can be an important element of its strategy on nutrition, food safety and agro-ecology.

Abbreviations

AFAAS	African Forum for Agricultural Advisory Services
ADA	Austrian Development Agency
AGRIDEA	Swiss Association for the Development of Agriculture and Rural Areas
APHLIS	African Postharvest Loss Information System
ATDA	Agences Territoriales de Développement Agricole (Bénin)
AU	African Union
BMG	Bill & Melinda Gates Foundation
CAPEX	Capitalisation of Experience
CBA	Cost-Benefit-Analysis
CF	Country Forum/Fora
CGIAR	Consultative Group on International Agricultural Research
CIMMYT	International Maize and Wheat Improvement Center
CoP	Community of Practice
CSO	Civil Society Organization
DAC	Development Assistance Committee (OECD)
DLEC	Developing Local Extension Capacity
ERAD	Études Recherches Appliquées pour le développement durable (Bénin)
FANRPAN	Food, Agriculture and Natural Resources Policy Analysis Network
FAO	Food and Agirculture Organization
FCFA	Franc de la Communauté Financière Africaine
F2F	Face-to-face
GAP	Good Agricultural Practices
GDP	Gross Domestic Product
GFRAS	Global Forum for Rural Advisory Service
GPFS	Global Programme Food Security
GPLP	Grain Post Harvest Loss Prevention Project (Tanzania)
GIZ	Gesellschaft für Internationale Zusammenarbeit
GSE	Gender and Social Equity
HELVETAS	HELVETAS Swiss Intercooperation
HO	Head Office
IFAD	International Fund for Agriculture Development
IIAM	Institute of Agricultural Research Mozambique
INOVAGRO	Innovation for Agrobusiness (Mozambique)
INRAB	Institut National de Recherches Agricoles
IRR	Internal Rate of Return
ICT	Information and Communication Technologies
LED	Lichtensteinischer Entwicklungsdienst
MAEP	Ministère de l'Agriculture de l'Elevage et de la Pêche
M&E	Monitoring and Evaluation
MFI	Micro-Finance Institute
MSD	Market Systems Development
NGO	Non-governmental organization
NPV	Net present value
NRI	Natural Resource Institute
OECD	Organisation for Economic Co-operation and Development
PASCIB	Platform for Civil-Society Actors in Benin
PASDER	Programme d'Appui à l'Amélioration de la Productivité des Exploitations Familiales
PHL	Post Harvest Losses
PHM	Post Harvest Management
PHP	Post-Harvest Practices
PHT	Post-Harvest Technologies

PHM-SSA	Postharvest Management in Sub-Saharan Africa
PICS	Purdue Improved Crop Storage
Prodoc	Project Document
PSDSA	Plan Stratégique de Développement du Secteur Agricole (Bénin)
RAS	Rural Advisory Services
SDC	Swiss Agency for Development and Cooperation
SDG	Sustainable Development Goals
SSA	Sub-Saharan Africa
ToR	Terms of Reference
WFP	World Food Programme

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2. Introduction

2.1. Context

Since the adoption of the 2030 Agenda for Sustainable Development in 2015, food insecurity has risen again. The prevalence of severe food insecurity is increasing and now affects 10.2% of the world's population (FAO, 2018). The prevalence of food insecurity is highest in Sub-Saharan Africa, with 29.8% of the population affected by severe food insecurity (FAO, 2018). The Food and Agriculture Organization of the United Nations (FAO) warns that without increased efforts, the Sustainable Development Goal (SDG) of ending hunger (SDG2) will be missed by far (Brander et al. 2020).

Brander et al. 2020 cited several studies showing that food insecurity is prevalent in the lean season, the time shortly before a new harvest is brought in. However, many development initiatives and research studies still concentrate on productivity rather than on saving food, although postharvest management (PHM) is more efficient compared with production interventions (Brander et al. 2020). Currently, the Covid-19 pandemic shows that PHM could be an important element to increase resilience in food systems (SDC 2020, FANRPAN communication).

Among a number of actors, it is increasingly becoming clear that postharvest loss reduction is a key element to render the food and nutrition system more sustainable. In addition, food losses are costly in particular to Africa, as the African governments have noted in the landmark 2014 Malabo Declaration. Postharvest loss reduction is one of the "Drivers of Agricultural Transformation in Africa", according to the 2nd All Africa Postharvest Congress and Exhibition that took place in Addis Ababa in September 2019. The importance of food loss reduction is also reflected in a special target under the Sustainable Development Goals (SDGs). As a sub-indicator of SDG 12 on responsible consumption and production, SDG 12.3 aims at reducing food waste and postharvest losses by half.

The Global Programme Food Security (GPFS) of the Swiss Agency for Development and Cooperation (SDC) began its support to initiatives to improve postharvest management (PHM) in Africa in 2008, based on successful experiences in Central America between 1980 and 2003 (SDC 2015). As stated in the ToRs of this evaluation, "the 'Postharvest Management in Sub-Saharan Africa' project is one of three projects mandated by the GPFS umbrella programme on postharvest management in SSA. The overall goal of the project is to test and promote simple technical solutions and storages options for grains and pulses value chains namely metal silos, improved traditional clay bins, community warehouses and hermetic bags in two focus countries, Benin and Mozambique, at farm and community levels in different agro-ecological zones." In addition to the technical solutions, the project has a component on the policy level and one on the dissemination of results in the whole region of Sub-Saharan Africa. Primary beneficiaries are rural households directly adopting and benefitting from new PHM practices and systems, local farmers' organisations, women groups, Rural Advisory Service (RAS) agents, private sector actors, NGOs and government staff, and policy makers.

2.2. Project Milestones/short history of the PHM-SSA

The 'Postharvest Management in Sub-Saharan Africa' (PHM-SSA) project had two phases (2013 - 2017 and 2017 -v2020) with a total budget of approximately 4.7 mio. CHF. HELVETAS Swiss Intercooperation was the contract partner of SDC. The project's implementation was carried out in a consortium with FANRPAN (Food, Agriculture and Natural Resources Policy Analysis Network), and with AFAAS (African Forum for Agricultural Advisory Services) and AGRIDEA (Swiss Association for the Development of Agriculture and Rural Areas; until Nov. 2018) as further partners. Organisationally, HELVETAS was responsible for overall coordination and implementation of national activities in the focus countries,

Benin and Mozambique. The AFAAS regional office (based in Uganda, Kampala) was responsible for regional activities related to documentation and dissemination. In turn, the AFAAS country fora, based on sub-contracts with the respective country offices of HELVETAS, supported HELVETAS and FANRPAN in national activities related to dissemination and network building. FANRPAN's role was to lead the advocacy processes and support policy implementation. AGRIDEA's task was technical and methodological backstopping of the AFAAS Head Office. The main outcomes of the project were formulated as follows:

1. Smallholder farm families benefit directly from improved handling and storage options within the grains and pulses value chains,

2. Good practice options for reducing postharvest losses are compiled, disseminated and scaled up,

3. Appropriate regulatory frameworks on reducing post-harvest losses in food supply chains are introduced and implemented at national and regional levels and financing is secured.

The main focus of the first project phase (April 2013 – March 2017) was on the validation and dissemination of improved postharvest management practices and technologies in focus countries of two sub-regions, Benin (Western Africa) and Mozambique (Southern Africa). The second phase (2017 - 2020) focused on scaling up (focus countries) and scaling out (regional level) of successfully tested good practice PHM options.

2.3. Background, rationale and objectives of the evaluation

The evaluation covers the two implementation periods of the PHM-SSA, 2013 - 2017 and 2017 - 2020. It is a part of the evaluation process for the GPFS-PHM portfolio, responding to SDC's requirements for impact assessment, accountability and learning. According to the ToRs, the external evaluation has two main objectives:

- To assess the relevance, effectiveness, efficiency and prospects for sustainability and impact of the 'Postharvest Management in Sub-Saharan Africa' project and its activities, and
- To identify lessons learned and provide recommendations for a future engagement of partners.

The evaluation has thus a summative and a formative part. The summative part is oriented at the standard OECD/DAC evaluation criteria. As for the longer-term criteria of sustainability and impact, the ToRs rightly state that at the time when the project ends, only prospects can be assessed. The scope of the evaluation was to respond to specific questions as given in the ToRs (section 4).

The entire PHM programme of SDC underwent an experience capitalisation (CAPEX) in 2019. The objective of the CAPEX was to "inform future PHM interventions by SDC partners and others, based on best practices and lessons learned" (Crole-Rees A, de Meyer J 2020a:2).

2.4. Methodology

Due to the current pandemic situation, this evaluation could not take the usual form of evaluations with field visits. The methodology and other key processes were adapted to be carried out on a **fully online basis** due to international and local travel restrictions and lockdowns imposed. The methodology is described in detail in the inception report. In short, it consisted in three parts:

- A systematic approach to existing data, analysing literature with the programme Citavi[1]. The literature review included mainly grey literature (reports), complemented by relevant articles and internet documents.
- Verification and completion of data with semi-structured online interviews with local actors from public and private sector in the focus countries, as well as online expert interviews. Selected stakeholders were proposed to be interviewed, and the contacts provided by the Helvetas offices in the focus countries. In addition, some further contacts were established to complement with missing information.
- A consultative process with the project teams in the countries, the consortium partners and the Head Office.

The analysis of the end of project evaluation was based on the OECD-DAC criteria (Development Assistance Committee). It combined qualitative and quantitative approaches to enhance the confidence of the evaluations' results. Quantitative results to assess the project achievements were based on the available data from project reports, monitoring and studies. This part was limited due to the online methodology and the limitations described below. For the financial analysis, standard approaches such as Net Present Value, Internal Rate of Return and Cost-Benefit-Analysis were used, based on the available data.

The online survey of the CAPEX did not contain useful data from beneficiaries for this particular project evaluation as it had another focus. An important data source for this evaluation were the end line surveys of phase II, conceived by Helvetas, but mandated to local consultants in Benin and Mozambique.

The qualitative part consisted of nearly 40 semi-structured interviews that were conducted through WhatsApp, Skype, Zoom, sometimes with or exclusively written exchange (due to bad internet connection), in French, English and in Portuguese/Spanish. The interviews were anonymized; a list of interview partners can be found in appendix 8.6. The respondents (10 women, 27 men) belonged to different groups, for each of which a specific questionnaire was designed and translated:

Farmers and farmers' organisations, private sector actors, public sector including education and research, NGOs and international development actors, AFAAS Country Fora.

Due to the circumstances, an iterative procedure as proposed by the grounded theory (Strauss/Corbin) was the most appropriate to follow. The methodology drew also from the Outcome Mapping method (behavioural change).

Due to agenda issues, six facilitated online discussions were held instead of the planned three.

1. Key informants who are not based in the two project focus countries:
    - FAO representative of the Community of Practice on Postharvest Loss,
    - AFAAS project coordinator, and
    - FANRPAN representatives (coordinator and CEO),
2. Project team Mozambique,
3. Project team Benin.

Finally, regular contact with the SDC office in Addis Ababa was sought to coordinate the adaptations of the methodology and timeframe due to the current situation.

[1] Citavi is a program for literature research, knowledge organization and reference management (https://www.citavi.com/en).

The online methodology was a new experience as much for the consultant as for the SDC GPFS. This merits some reflections on it. Before going into the limitations, some lessons learnt can be summarized as follows:

- The quality, comprehensiveness and reflection of the project's monitoring and reports are very important for this kind of evaluation. For instance, the yearly reports contained sections with a "strategic review" and one with lessons learnt, which very well reflected the developments in the project over both phases.
- The availability of data from the baseline and end line survey studies was crucial for this evaluation. The quality and comparability of the monitoring data is decisive in an online methodology.
- It could have been beneficial to discuss the results of the evaluation with an independent local consultant with field experience in each focus country to further verify financial data, adoption questions, geographical differences etc.
- It was an advantage in this particular case that the evaluator has had the chance to visit some of the project sites before and in part knew the persons involved in the project.
- The organisation of interviews in the online format is challenging regarding the coordination time needed, as the appropriate channel differs from person to person and where they are. Emails are often not responded to (which might in part have been a problem of the lockdown). WhatsApp proved to be indispensable for talking or at least writing to beneficiaries or other stakeholders in remote areas. Sometimes, normal telephone was the only possible choice to understand each other well.
- To establish a certain familiarity in the interviews, it is beneficial to adapt the languages of the interviews if not to local than at least to the national languages.
- It can be an advantage to have more time flexibility for an interview than normally on a field visit where programmes are very dense most of the times.
- A combination with an online survey would be desirable, but instruments to carry this out in a self-explaining way on beneficiary level by mobile phone need to be further developed.

2.4.1. Limitations

The online methodology had the main limitation that no field study could be carried out. In this way, it was not possible to make any quantitative assessment at beneficiaries' level or a direct verification of information and data gathered from secondary sources. The interviews with different stakeholders and available independent studies were thus the means by which to verify the results from the internal monitoring system. Information in this report is based on at least two non-connected sources, where not mentioned otherwise.

The main challenges of this approach were the high organisational input for the interviews (repeated requests in some cases, failed appointments due to technical issues), connection problems and linguistic challenges where French or English was not the first language. However, the approach also offered some opportunities, such as the time for individual conversations (in comparison to normal evaluation travels), and some interviews with unforeseen persons.

Other limitations include:

- The end line report cannot be considered fully independent as the methodology was conceived by the head office and the project team assisted in the selection of the study communities. In Mozambique, half of the control group was located in a vegetable growing region, where the

technologies for grains and pulses are less used. In Benin, beneficiary groups were included that were new beneficiaries of the project.

- It is delicate to use databases like the ones from the end line survey, if one doesn't know how the questions were asked. Therefore, only limited further analysis is made in this assessment, as far as it is not verifiable in the corresponding reports.
- The quality of the end line survey report is limited in the case of Mozambique (linguistically and methodologically). Data quality for both countries is limited; entries in the datasheets were probably not checked regarding plausibility (e.g. seasonal price differences). The end line reports don't refer to the baseline studies.
- The use of baseline studies for comparisons is limited. They don't provide the necessary data to serve as a (quantitative) basis for a beneficiary analysis as was planned in the M&E manual of the project. In Benin, the sampling included a number of farmers who didn't belong to the project's target group.
- As for the data on food losses, it is in general difficult to get reliable data in short-term studies.

3. Project results and fulfilment of log-frame objectives

This section refers to key question 3 on the evaluation of the progress towards achieving the log-frame outputs and outcomes by the end of the project.

This report refers to the logframe of phase II (Appendix 8.4). Some Outcome-level indicators were adapted in phase II. In particular, the outreach to indirect beneficiaries was decreased; in outcome two the focus shifted from personal and institutional capacities to measuring the use of produced information material by non-direct stakeholders. As far as possible, this report compares outcome measurements from the baseline studies done in 2014 – 2015 to the end line studies' reports, all done by independent consultants. The interviews allowed an assessment of the results from various sources.

It will be shown that the project's overall achievements are remarkable, but in some areas, it was more successful than in others.

3.1. Improved handling and storage

In both focus countries, the project supported a number of postharvest practices and technologies. The "basket of options" included timely harvesting, sorting, sufficient drying, threshing and shelling techniques for the practices. As storage technologies, the project promoted hermetic bags, the metallic silos and the improved traditional granaries (Nhacolo M E. und Castro E 2020:9). In the first phase, the effectiveness of the technologies was tested in some selected communities. In brief, hermetic storage was found to be the most effective option to avoid PHL, before the improved traditional granaries (Helvetas 2017). In phase II, the technologies were introduced to more communities.

Outcome Indicator 1.1 - Directly supported households

According to the baseline studies of 2014 - 2015, practices to limit PHL like sorting, appropriate drying, cleaning or treatment against insects are not widely used (Benin) and almost only simple manual practices were paramount (Mozambique). Grains and pulses (mostly black-eyed peas or "niébé") were stored also in Benin, ranging from 2 to 7 months on average for maize according to the storage means (platform, traditional granary or polyethylene bag) and 4 to 7 months for pulses (Helvetas Swiss Intercooperation Benin 2015:32-33).

Comparing the initial situation with results from the end line reports and interviews, **a major success of the project is the adoption of pre- and post-storage practices** (end line reports, not quantified, interviews[2]). The project relied on practicable methods (e.g. to measure moisture content, better drying surfaces), which were more easily adopted than the new storage technologies, according to experts in both countries.

In general, farmers use a variety of PHM options in parallel. In phase II, 87% of total survey respondents adopted one or more PHP, according to Nhacolo M E. und Castro E (2020:12). 15% of adopting families were female-headed households, according to this study in Mozambique. For Benin, 16% of 120 beneficiaries surveyed use the PICS bags either for maize or for pulses and 20% the silo mostly for maize. The improved traditional granaries are widely used, with only 3% saying they had abandoned the technique. Under the project, 326 improved clay granaries were constructed. From the available data, it can be concluded that improved pre-storage practices are widely used among beneficiaries. For the storage options, the adoption is less uniform. The end line reports do not provide quantifications. However, some conclusions can be drawn from the available data. Whereas the improved traditional or clay granaries are used by a high number of beneficiaries (see above for Benin), the hermetic bags are not widely adopted in Benin because only few farmers have access to them. In Mozambique, the distribution of PICS bags is further advanced and they are frequently used in particular for pulses. Silos are continuously used by the farmers who got access to them, but are not further demanded mainly due to the high price. Regarding gender differences, it was observed that women tend to prefer the low-initial-investment technologies. Reasons for this would need to be further investigated. A table summarising the different storage options and adoption assessment can be found in appendix 8.2.

The storage technologies introduced by the PHM-SSA mostly benefitted the groups that the project worked with directly, as they had better access to the technologies and handling knowledge, and consequently also experienced less losses. No quantification on concrete losses is available for phase II. According to the internal reporting of phase I, “average loss reduction reported from farmers using improved PHM practices was 13-17%” in Mozambique, and in Benin 3-6% (Boukombé) or 2-12% (Savalou) (Helvetas 2017a). Three innovations that the PHM-SSA introduced in the project regions are summarized in appendix 8.1, including some lessons learnt from the experiences.

Outcome Indicator 1.2 - Indirectly benefitting households

Both baseline studies indicate that farmers’ access to information on PHM was very limited. The PHM-SSA reached farmers in neighbouring communities of the direct beneficiaries through sensitisation workshops or promotion activities (13’000 households in total in phase II, 9’945 households in phase I). According to several interviewees, this had the effect that postharvest practices were adopted also in those communities, with benefit to the farmers. The PHP tested and promoted by the PHM-SSA were integrated in the current practices of farmers and deemed very useful. How far the outreach through media in the focus countries (to 50’000- 60’000 additional households in phase II) resulted in a change of behaviour would need to be further investigated. In a survey in 2020 by the National Association of Agricultural Extension among 700 farmers in 10 districts of Nampula, Mozambique, it was said that 20% of farmers now use post-harvest technologies (single interview source).

Indirect beneficiaries are also groups that are working with other NGOs who use the technologies developed by the project. This is the case with the improved traditional granaries, which are further

[2] Due to the limitations of the end line studies, calculating an adoption rate would not be representative for the project.

distributed by an NGO in Benin and the WFP in Mozambique. The warrantage system is now further promoted by other NGOs in Benin, and other PHM options are included in the work of WFP and other development partners.

Outcome Indicator 1.3 – Grains and pulses stored and saved

As mentioned, storing technologies in the project regions were very basic at the outset of the project. In Benin, maize was mainly stored in traditional granaries or polyethylene bags, pulses in polyethylene bags. The storage in bags and traditional granaries result in large losses in both countries. In Mozambique, where 75% of the farming families in the project region used traditional granaries, 35% losses for maize were reported, 28-34% for pulses. In the tests conducted by Miruku Coop (2014), up to 62% of maize and 90% of pulses were infested by insect pests. The same report mentions that this was in fact considered a major problem by farming families. In Benin, losses between 20% to 40%, reaching up to 60% in certain communities were reported. A word of caution needs to be made on these measures. Farmers are conscient about losses, but they are not used to quantifying them (Miruku Coop 2014, Brander et al. 2020)[3]. Miruku Coop (2014:30) states that another indicator could be that 70-75% of the grains are considered edible by farming families (despite the high incidence of fungi (8-12%) and insects (60-90%) measured). According to APHLIS, losses that occur at storing are about 2 to 5 %. Losses occurring at pre-storage are calculated at about 9 to 20% in this comprehensive analysis of cereal losses in SSA (Hodges et al 2014:1). This also explains the importance of PHP.

Important for this result was that farmers changed their view on PHL from something that is unavoidable to something that can be tackled (Crole-Rees A, de Meyer J 2020:2). A farmers' union representative in Mozambique noted that the project beneficiaries' perception of PHM changed significantly. For Benin also, the respective end line survey concludes that beneficiaries have less losses than the control group. On average, beneficiary households stored 753 kg of maize and 142 kg of pulses in improved storage technologies in Benin, and 390 or 142 kg respectively in Mozambique, in the year 2019 (end line surveys). This is a clear sign for the adoption of the storage technologies among beneficiaries of the project.

Nhacolo and Castro (2020:9) conclude that as a result of the use of the technologies described above, "small producers were able to protect their products from deterioration and pests, keeping them for later consumption or to wait for better sales prices, as needed, with higher volumes of grains available for consumption and sales that resulted in more food security and family income".

Outcome Indicator 1.4 - Increased incomes

If it is assumed that the stored grain can be sold at an average price, the average gain per household would be around USD 70 with maize and USD 44 with pulses in Mozambique in 2019, for 390 kg of maize and 142 kg of pulses stored. For Benin, it is estimated based on end line report figures that average per household gains from stored maize are USD 169 and USD 65 from pulses. However, from the existing data we cannot know how much this is an improvement to the situation before the project. Assuming that grains and pulses stored in improved PHM technologies would have otherwise been lost, the direct beneficiaries only had an aggregated additional gain of USD 1.680 million. This result is based on different sources and can only be an approximation. Internal project sources estimate an aggregated household income of USD 2.308 million resulting from sales of stored grains in the two countries over the project period of phase II.

[3] APHLIS proposes some ways to collect data on losses (Hodges et al. 2014).

According to the Cost-Benefit Analysis studies that were conducted in the focus countries in 2017, the income of farmers as a proportion of the agricultural GDP could increase by 2.77 – 3.87% in Mozambique, or 1 - 2% in Benin. Benefit to cost ratios are different depending on the crops and countries and vary between 1.95 for hermetic bags in Benin to 22.72 for metal silos in Mozambique.

The evaluation of the project in 2016 questioned if the price differences needed to result in farmers' gains from storing products would really exist. Several sources of the present evaluation confirm that sometimes considerable seasonal differences exist in both countries. Price differences are therefore seen as a valid incentive to store. In fact, high price differences could even be a result of insufficient means to store produce safely.

The improvement in income can be seen as a composition of the produce that is not lost due to better storage, a better price due to sales off-season and potentially a better price for better quality (no chemical preservatives, good practices). In addition, the project led farmers to sell in groups, which enabled these groups to fetch a higher price (10 % improvement was mentioned for Benin).

3.2. Dissemination

The second pillar of the PHM-SSA was the production of information and fostering knowledge exchange. The aim was to compile, disseminate and scale up and out good practice options for reducing postharvest losses.

At the start of the project, concrete information and didactic material on PHM was scarce (Miruku Coop 2014:26). At the end of phase I, dissemination products' quantity and variety were considered appropriate, and the quality high (Schaltegger E, Sikirou R, Sualehe Cauio A 2016: 23). After the production of information material in the 1st phase, the 2nd phase focused on a wider dissemination of information and knowledge, using the business models as concrete examples of how PHM solutions can be installed. A variety of approaches were used in this part of the project (both phases), as was also observed in the CAPEX (Crole-Rees A, de Meyer J 2020b):

- Written sources: factsheets (original in French, translated in English and Portuguese), manuals, studies,
- Other formats: local radio emissions, theatre/drama, videos (with subsequent debates), WhatsApp,
- Participation/exhibitions at agricultural weeks/fairs, extension conferences, international conferences.

In using multiple channels, it was assured that a wide variety of stakeholders could be informed about PHM. For instance, local radio still plays an important role in informing rural populations. Therefore, it was very appreciated (Felber G, Witteween A 2019) and was even multiplied by agro-dealers.

Outcome Indicator 2.1 - Use of produced material in focus countries

The objective of phase II was that public and private extension services and technical/professional schools would use the good practice options provided by the PHM-SSA.

To anchor PHM in local institutions, the PHM-SSA collaborated with partners in research and agricultural education. In phase II, key organizations have integrated PHM knowledge in their processes, training activities and advisory work[4]. National research institutes like IIAM in

[4] The internal end-of-phase report of March 2020 mentions for Benin: Ministry of Agriculture (MAEP, including Directorate for entrepreneurial training), 77 municipalities; 2 producer unions, various NGOs. For Mozambique: 6 Agric. Technical Schools; 2 research institutes, 15 District Extension Services, 3 provincial

Mozambique, the University of Calavi and INRAB in Benin were included in research work for the project and built up their own capacities in this way. They confirm to further replicate the knowledge on PHM in their activities. In Mozambique, the project implemented 3 cycles of training of trainers' sessions, with around 15-20 participants each. In Nampula, they now work in 10 districts and reached at least 120'000 farmers so far, according to the National Association of Agricultural Extension. This is a considerable achievement in capacity building.

In Benin, the public agricultural sector underwent profound changes during the projects' implementation time. However, Helvetas and its partners achieved that PHM is already integrated in some of the new structures like the Agences Territoriales de Développement Agricole (ATDA) at district level. Also, departments and municipalities integrate PHM in their development and extension plans (Felber G, Witteween A 2019:38, several reports). A question from the interviews was if the level of involvement with the public extension structures in phase II was strong enough to remain on the agenda.

Picture from Workshop in Mozambique 2017

The project worked with technical schools and the related ministries to include PHM in the training of young professionals (11 schools in Benin, 7 schools in Mozambique). In Benin, the introduction of PHM was even brought to the level of curricula that is nationally approved by the Ministry of professional education. It can be concluded that PHM is now established in the education sector in Benin and will reach 2000 students per year. However, capacity development for college teachers needs to be extended and the results to be monitored. Didactic material will also need being reviewed after the first experiences.

The CAPEX concluded that the anchorage of PHM in national training curricula is an important part of the dissemination strategy (Crole-Rees A, de Meyer J 2020b:1). In several interviews, it was confirmed that the knowledge diffused in this way will be further diffused and taught in the respective countries, including through farmers' unions.

Private extension was involved in the project in Mozambique through the outreach to small and medium scale agro-dealers (Felber G, Witteween A 2019:38). The case of agro-dealers in Mozambique is particularly interesting. In the province of Cabo Delgado there are now 15 traders who sell AgroZ bags to farmers. The agro-dealer interviewed understands his role not only as a re-seller, but as a professional in agricultural markets and as such providing advice to farmers.

In both focus countries, the dissemination material is used by partners in academia, related ministries and agricultural extensions, e.g. by district services in Mozambique or at agricultural schools. For Benin, the end line report clarifies that sources of knowledge on PHM are diverse and that many organizations would draw their knowledge also from other projects and institutions than the PHM-SSA (Egah J, 2020: 18). In conclusion, the PHM-SSA was successful in institutionalizing PHM in key organizations in the project's focus countries.

governments; 4 agro-businesses, 5 (I)NGOs. Regional: 13 organizations from government, research and CSO's in 5 countries (Uganda, Malawi, Cameroon, Madagascar, Nigeria).

Outcome Indicator 2.2 – Uptake of PHM by strategic partners and media in focus countries

Strategic partners and networks in focus countries base their training at least in part on evidence produced and information material from the project. As mentioned, radio programs in both focus countries disseminated PHM information to the local population, based on material of the project. In Benin, local initiatives to spread the word can be observed, as by a young extensionist who informs about silos in his blog (Djegbenou 2017).

Several stakeholders, even project collaborators, questioned if the dissemination strategy went far enough on a national level. In both countries, many activities seem to remain concentrated in the selected regions. This made it also difficult for other interested parties to adopt the theme, as in their regions other solutions might have been needed because of other prevalent crops or ecologic conditions.

The consortium also made attempts to use new means of communication. In Benin, a WhatsApp group was established, but failed to remain active because of a lack of facilitation. In Mozambique, the country forum also used a WhatsApp group for information exchange for some time.

Not all potential partners in the development area have included PHM in a prominent way (which was not the objective of the PHM-SSA). It is however observed that in a recent study on extension and advisory services EAS in Mozambique, PHM is hardly mentioned (Feed the Future 2018:39).

Outcome Indicator 2.3 - Dissemination and use of material by strategic partners in other countries

The project informed and trained strategic partners in other countries mainly through the networks of AFAAS[5] and FANRPAN. The consortium partners AFAAS and AGRIDEA emphasized the dissemination rather than production of material in phase II. Five country fora, the national structures of AFAAS, were increasingly included in the activities. AFAAS conducted various workshops in those five non-focus countries (Nigeria, Cameroon, Uganda, Malawi and Madagascar) and assisted in national activities such as agricultural fairs or weeks. Training events were often integrated in other events in order to assure higher participation. With the assistance of AGRIDEA, they were in part adapted to specific countries' needs.

The AFAAS led workshops in the countries were very much appreciated. In the course of the project, the AFAAS coordinator gained much experience in these activities. Face-to-face activities are a strong instrument to interest people in the subject. The workshops had a considerable influence on the dynamics in particular in Nigeria, where a group of actors issued from the country forum (CF) further promotes PHM. Due to the geographical circumstances (AFAAS secretariat being in Kampala), the collaboration with the CF of Uganda was particularly close. The CF was critical for out-scaling PHM in Uganda. The workshops in the mentioned countries benefited from the practical experience that the PHM-SSA was able to provide. A lack of material in the respective language hampered the diffusion in

[5] In 2016 already, AFAAS reported the following 12 organizations from nine countries that have taken up some of the PHM tools and contents of PHM-SSA: IIAM Mozambique, Farmers' Union of Liberia, CASE (Care Society and Environment) in Cameroon, Nigerian Women Agro Allied Farmers' Association, Uganda National Farmers Federation, NECOFAM/TMF in Uganda, FOSCAR-Mali, Cameroon Youth initiative for Rural Development (CAMYIRD), Activities for Development Cooperation (ISCO) in Democratic Republic of the Congo, Haramya University from Ethiopia, Botswana University of Agriculture and Natural Resources, and Farmideas project in Nigeria funded by YPARD (Young professionals for Agriculture development).

some cases. A difficulty encountered was that storage technologies promoted by the project were not widely available in other countries.

In phase II, the consortium partners also conducted two webinars per year, which contributed to the awareness of PHM in the RAS community in SSA. Based on conversations with CF representatives, there is in fact a basic awareness in RAS communities of other countries in SSA. This was influenced by the SDC programs on PHM, but also other actors such as Sasakawa Association or the WFP.

Materials produced by the PHM-SSA were also made available to a wider public on platforms such as those of AFAAS and FAO. However, both platforms were limited in their outreach. AFAAS had internal constraints to make the website work smoothly. The Community of Practice (CoP) of FAO (financed by SDC) made the material available upon request of the consortium partners.

The FAO CoP has about 380 registered members worldwide, ranging from private sector to research, NGOs and development agencies (personal communication). In 2016, there were 650 members. Around 2,040 users a month were registered on the forum's page (average for 2019). The FAO CoP conducted two discussion rounds on the theme of food loss assessment and losses in the maize value chain in 2016 and 2017. Since then, not much dynamic or pro-activeness from the CoP was observed.

FANRPAN contributes to the global availability of information on PHM on the internet. Currently, it makes several policy briefs and reports from countries on policy processes in SSA available on its internet page). The policy briefs make the link between PHM and environment themes, nutrition/food standards or the economic dimension of PHM, among other subjects.

A successful means of outreach is the uploading of videos produced in Benin on the Access Agriculture platform. Four of them are uploaded in French and English on the Access Agriculture platform. They are used in campaigns of other NGOs, who invite communities for a discussion on the contents.

At the continental level, the project's results were also disseminated at side events of the Global Forum Rural Advisory Services (GFRAS) in 2016 and at several other regional fairs. Finally, the project contributed with further side-events, exhibitions and conference contributions to the Africa-wide diffusion of knowledge on PHM (AFAAS extension weeks, 1st and 2nd All Africa Postharvest Congress and Exhibition in 2017 and 2019).

3.3. Regulatory Frameworks

Outcome Indicator 3.1 - Regulatory framework includes PHM

The PHM-SSA invested considerably in the advocacy of PHM in the focus countries and SSA. The results combined from both phases of the project can be summarised as follows:

Benin: PHM is included in the agricultural policy on several levels. First, PHM is included in the Development Plan of the agricultural sector (PSDSA). This translates to 3 levels: a programme which means that a budget is accorded to PHM, the strategy on nutrition sensitive agriculture, and in the development plans per value chain that are linked to the ATDA. In the project regions, PHM is taken into account in several communities/municipalities .

Mozambique: A stand-alone policy on PHM is prepared. It is in the policy process and should be published the latest in spring 2021. A working group on PHM includes a representation of Helvetas; continuing even after the end of the PHM-SSA.

An advantage of the project was its ability to present a "proof of concept" to the related Ministries, which helps for government buy-in. The policy briefs (developed under the coordination of FANRPAN) were important to support the policy development.

Despite these successes, the implementation of the policies will be another step. Nhacolo and Castro (Nhacolo M E. und Castro E 2020:17) observe that in general, the focus of agricultural policy remains on productivity.

Sub-Saharan Africa

For Sub-Saharan Africa, an uptake in policies is also visible. It is meaningful that the African Union (AU) hosted the 2nd All Africa Postharvest Congress in 2019 (at which the project contributed). The AU also has a project with FAO to reduce postharvest food losses.

A survey of FANRPAN in 15 countries about the current status of PH policies in their countries can be summarised as follows (based on a datasheet in work by FANRPAN):

- 9 countries have policies which address PHM at national level,
- Tanzania, Rwanda and Madagascar (3) have a stand-alone policy on PHM,
- If formulated, the main objectives of PHM policies are reducing loss, good agricultural practices (GAP), improvement of income for producers.

In at least 12 out of 54 African countries, PHM is thus an explicit part of the policies. There is, however, potential to make PHM more explicit in the policies of many countries. Also, the quality of food and nutrition are not a prominent theme yet in the perceived objectives. In a study of RBA for Uganda as an example, it is noted that strategies against PHL are not yet conceptualized at government level: "there is no nationally integrated strategy to curb these food losses" (FAO, WFP, IFAD 2019:73).

The developments in the policy agendas of course are not based exclusively on the PHM-SSA. Other organisations like the Japanese or German Development Agencies, BMG, research institutions (e.g. CIMMYT) or the RBA address PHM and were influential. For the PHM-SSA, a vast range of potential partners in SSA to collaborate or network with "to establish linkages for advocacy work on PHM" was listed in Annex 8 of the Prodoc for phase II. Except the "champions 12.3", where FANRPAN is a member, it is unknown if they were explored further.

Outcome Indicator 3.2, 3.3 - Investment in PHM and regulatory frameworks

In both focus countries, new programs were launched where public entities invest themselves. For Mozambique, the Provincial Directorate of Agriculture in Nampula set up a demonstration for the promotion of metal silos. At the national level, a new program now promotes hermetic storage solutions instead of the traditional silos. The project has triggered investments of the private sector to build up a distribution network for hermetic bags. Nhacolo and Castro note that PHM is present to the level of operational strategies (2020:21).

In Benin, new collective storage programs were launched that should allow more communities to have magazines and form warrantage groups. Responding to the PSDSA, the ATDA have the obligation to carry out activities with 8% of their budget in the area of PHM. Anchoring PHM in this plan is an important achievement of the project partners' advocacy activities.

Other institutions or donors such as the WFP, Swiss Solidarity, ADA and LED have invested recently in PHM in the focus countries, in part even with a market system approach. However, buying metal silos seems to have been a single action (as for ADA). For the NGO BUDPOS in the North of Benin, PHM is

in turn part of their programmes. Its representative adds: “All the projects that work with PHM went to the school at Helvetas. This meant that many communities in the vicinity of Boukombé [project locality] have adopted good postharvest practices”.

According to internal project sources, national and provincial governments in the focus countries increasingly engage in PHM. As it becomes more and more evident that good PHM practices can reduce aflatoxin[6] contamination of crops, new projects in Mozambique and Tanzania use the experience of the PHM-SSA to manage this risk.

3.4. Overall Goal

Data for the following section was collected from the baseline and end line reports of the project. Their comparability is limited, as the baseline studies were not carried out in the same communities as the end line studies and the characteristics of households are not recorded in the same way. The data is therefore to be read with caution.

Overall Goal Indicator 1 - Food secure months

Baseline reports	End line reports
Benin: 43 % of households in non-target groups have maize for 12 months, 22% pulses. Mozambique: 73% of families are self-sufficient in maize, 62% have enough pulses for the whole year.	Benin: 40% of the control group did not have enough maize between April and July, while this applied to only 4% of the beneficiaries. The beneficiaries were also better able to cover their needs in pulses. Mozambique: around 79% of households are self-sufficient in maize throughout year, and another 63% in cowpeas.

Of the beneficiaries surveyed in Benin (Egah J 2020), only 5% report that they couldn’t cover family consumption needs during the past 12 months. In the control group, 47% had difficulties to cover the consumption needs in the same period. For Mozambique, the corresponding findings are 12% in comparison with 32% in the control group. In general, farming families who practice PHM with the methods of the project are thus better off.

Overall Goal Indicator 2 - Reduced vulnerability to famine

Baseline reports	End line reports
Benin*: Mozambique: 31% of families have to skip meals in the lean season. Less than 10% have access to credit.	Benin: Improved income through later sales, higher proportion of respondents satisfied with their household income (33% against 24%). Mozambique: 98% of households are able to meet their food needs.

*In the baseline study for Benin, livelihood indicators are average data. In the end line survey, the satisfaction with the level of livelihood was measured. Therefore, no quantitative comparison can be made to the end line survey. In turn, the end line survey used a control group, so a synchronic comparison to beneficiaries can be made.

[6] Aflatoxin is formed by fungal poisoning, which can occur during or after the harvest. Aflatoxins are carcinogenic. They are often found on nuts and grains.

Both end line studies confirm that the beneficiaries of the project use the PHM options to reduce their vulnerability to famine.

Another important feature is that the safe storage of food enhances climate change adaptation, as the hermetic storage protected the crops better from damages of a cyclone in Mozambique (Helvetas 2020, end of phase report).

According to a farmer in Benin, the project is the reason why they are no longer exposed to famine. Another respondent thanks the project for the insight that badly managed grains can lead to intoxication.

Overall Goal Indicator 3 - Livelihood and gender improvements

Baseline reports	End line reports
Benin* Mozambique: Living conditions described as good by 28% and middle by 55%.	Benin: improvements reported by beneficiaries, e.g. distribution of work and women's access to storage Mozambique: General livelihood impacted by droughts. Influence of project on distribution of decision power.

Several interview participants in both countries confirmed that the adoption of good PHM resulted in livelihood improvements for the beneficiaries. Nhacolo and Castro (2020:12) observe that 95% of families started to cover school expenses and that beneficiaries now meet their basic nutritional needs. They attribute the change to the good practices learned from the project (Nhacolo M E. und Castro E 2020:12).

The project included gender and equity aspects from the start. In phase I, an analysis was made on PHM and gender, and workshops were conducted in the focus countries. In the reports, gender disaggregated data on participation of women was recorded. However, measurement was not systematically done on gender dynamics (Felber G, Witteween A 2019:30).

The CAPEX report retains that "Improvement of PHM meant a positive development and recognition of the role of women" (Felber G, Witteween A 2019:29). Throughout the activities, the project included women and experienced that they more easily adopt PHM as they have a higher tendency to store food. In Benin, warrantage groups consist of a majority of women. This is in part due to the fact that they have less access to other credit schemes than men (who often are in cash crop production), and that they have a better rate for repayment. An expert interviewed mentioned that because of their participation in the saving groups, particularly single women benefitted from the project.

Particularly for women, the improved traditional granaries are key. Due to the improvements, women now have access to granaries and thus have more control on the stored food. Women also mentioned the fact that the market values better quality of grains. In this study, the health aspect was not directly referred to. However, the link between PHM and nutrition/health is becoming an area of research, not least because hermetic storage helps avoid storage insecticides.

4. Assessment according to key questions

This section follows the key questions as asked by SDC for this evaluation. The order of key questions was slightly adapted from the ToR and Inception report.

4.1. Assessment of objectives

According to consulted resource persons, the ambitions of the project are assessed as "enormous" or even as too ambitious. Already the evaluation of phase I pointed to the high ambitions and complexity of the PHM-SSA (Schaltegger E, Sikirou R, Sualehe Cauio A 2016:21). Its conclusion that phase II of the project should be planned for 3 instead of only 2 years was taken up by the project management and SDC. Schneider (2015:24) proposed even 5 - 7 years for the introduction of a functional post-harvest system. For the introduction of the metal silos in Africa, feasibility and scoping studies had concluded that this was a viable option to African farmers (SDC 2012). The RBA in a newer publication again confirms the cost efficiency of PHM and in particular of hermetic solutions (FAO, WFP, IFAD 2019:109).

The ambition of the PHM-SSA was to produce viable results in two focus countries as well as on the regional level for SSA at the same time. It had to allocate its resources between those three "construction sites", in a tri-lingual setting. Comparing the allocated budget to other projects that were more concentrated, the expectations were rather too high, in particular with regard to the market system development in the selected project regions.

According to the scoping studies in both countries, the project fitted well into the policies of both focus countries (Araújo B, Bucuane J 2013:7-8; Gbaguidi B, Adeoti R 2012:32-33), at least the agricultural policies. Trade or market policies were not included in the studies.

4.2. Relevance to beneficiaries

The PHM-SSA focussed on staple food that is very relevant in the project countries, and on the relevant food loss causes. In both countries, the main crops in the region are corn, black-eyed pea, other pulses or peanuts, tubers and cashew. As basic elements of local nutrition, corn, pulses and groundnuts are the most often stored products, besides tubers, in Mozambique (Miruku Coop 2014: 22, 23). According to Schneider (2015:9), 25 - 40% of the yield is sold at harvesting time, 10 - 20% later in the year, and 20 - 30% in the lean season. Storage of grains and pulses is thus practiced for up to 7 - 10 months with the current techniques in Benin. The baseline study includes a comprehensive review of the options used for storage and the challenges farmers face (HELVETAS Swiss Intercooperation Bénin 2015). Farmers in the prospective project regions thus have the capacity to produce a surplus to store for later use.

Relevant literature comes to the conclusion that harvesting and storage are "critical loss points" at farmer level. Causes of food losses are the inappropriate harvest practices, inappropriate growing practices[7], inappropriate post-harvest techniques /practices and inappropriate storage techniques/ practices (FAO, WFP, IFAD 2019:27). Thus, it comes as no surprise that the PHM technologies introduced by the PHM-SSA are considered important to farmers and were even said to "make them happy".

The population in the project region recognises food security issues and partially makes a link to PHL. The scoping and baseline studies all inform about the food losses occurring at storage. Farmers in both countries mention that insects and pests are main causes of loss. For Benin, 92,74 % of interviewed persons mentioned that insect ravage is a problem at storage level (HELVETAS Swiss Intercooperation Bénin 2015). Maize and pulses are the crops with highest losses (Schneider 2015:12). Farming families consider PHL as an issue for food security, according to the baseline study in Mozambique (Miruku Coop 2014: 25). Beneficiaries in Benin appreciate the hermetic technologies to conserve seeds in good

[7] Growing practices can influence PHL in particular when the agronomic calendar is not well observed and harvest time falls into a rainy season.

quality (Egah J 2020: 13). Yields in the project regions were thus important enough for farmers to store corn and pulses (HELVETAS Swiss Intercooperation Bénin 2015).

A lack of knowledge about the importance of quality or safety of food might be a reason why farmers might not be strongly motivated to improve harvest and post-harvest techniques . “The motivation for farmers in storage lies in keeping the harvest safe from thieves and water” (FAO, WFP, IFAD 2019:27). In Mozambique, the project experience was that the (smaller sized) silos were appreciated because they can be kept in the house.

The project also filled a gap with awareness and training on PHM. Farmers considered PHL as an unavoidable fact at the start of the project. Very few farmers had access to information on PHM through extension services. Training in pre-storage handling was proposed as a major need (HELVETAS Swiss Intercooperation Bénin 2015). The end line survey in Mozambique mentions that “useful and understandable knowledge [was] diffused to farmers” (Nhacolo M E. und Castro E 2020:20), which is still in demand.

Not only the training, but also the very focus on PHM filled a gap among institutions that concentrate more on production in the project regions. Thus, the relevance of a project on PHM was rated extremely high among the interviewed persons, all but one out of 8 giving a 5 on a scale from 1 to 5.

A critical point is the selection of initial strategies in the relation to the population addressed. The focus on metal silos was questioned by local NGO partners from the start, particularly in Benin, due to the high price and preferences for the traditional granaries. It seemed however that the promotion of silos was set in the project and could not be challenged by local partners.

4.3. Progress towards achieving log-frame outputs and outcomes

The achievements related to the log-frame outputs and outcomes of the project by the end of phase II are described mainly in section 3. To attempt a quantitative assessment, it is concluded here that 8 out of 9 outcome indicators were achieved satisfactorily (table in appendix 8.3). The target for the outreach to indirect households was very high, but also achieved according to the yearly report of 2019 (between 50’000 and 60’000 persons). For one indicator, data from the end line survey is still pending. Several indicators were not quantified; the calculation of increased household income can be seen as a best estimation.

Regarding the outputs on the three project levels (technology, dissemination and advocacy), this study’s base is the end line report, which is based in turn on the yearly project reports that meticulously monitored the outputs. Overall, the outputs listed are considerable on all three levels of the project. However, the objective to implement functional business models in phase II was only reached with good performance for the hermetic bags (and drying tarpaulins) in Mozambique, with medium performance for the hermetic bags in Benin and silos in Mozambique, and so far with low performance for the silos in Benin (section 3, Appendix 8.1).

After phase I, the mid-term evaluation observed a "status of relative inconclusiveness" (Schaltegger E, Sikirou R, Sualehe Cauio A 2016:21). At the end of phase II, the project made important progresses as described above. A certain “inconclusiveness” however persists on the level of the storage technologies and their markets. In particular in Benin, a feeling of “unfinished business” is left among some partners and project beneficiaries.

4.4. Quality of Outputs

Phase I: The identification and validation of "promising PHM practices" was well implemented. The innovations for the improved traditional granaries were key and benefitted women in particular. Projected outputs regarding outreach were not reached as expected. Factsheets and information produced in phase I served well throughout phase II. For outcome 3, the relevant outputs were on track and included relevant pieces for advocacy in phase II. However, some of the studies were rather generic (Schaltegger 2015:17).

Phase II: For outcome 2 and 3, the quality of outputs overall is satisfactory in both countries. For outcome 1, the business models have, as described above, not been fully implemented. Market linkages were developed successfully in Mozambique. Financing options and services developed under output 1.1 are functioning and led to good results on a small scale. Apparently, the mechanical thresher, which was introduced in Benin, is prone to break maize seeds (Egah J 2020:8).

4.5. Approaches and structures

Several factors influenced the delivery of outputs. This evaluation considers that approaches and structures were rather effective and bear some learnings:

- Storage systems for households are an adapted approach for small-holder farmers. They don't have access to big storage facilities, like the warehouses in Mozambique. Beneficiaries experienced that they can improve their income with storage and selling in the lean season.
- The market systems development (MSD) approach (e.g. Prodoc, Helvetas 2017b) was chosen as a systemic approach to analysing market constraints and finding sustainable solutions for interconnected market systems (Grain Market System, RAS Market System -> Postharvest Market System). When market connections start to work, the system offers a range of new opportunities to local actors, as can be seen with the hermetic bags in Mozambique. However, the constraints in the system were underestimated in particular for Benin. The approach needs a long breath, considering also that many are not yet familiar with it. This concerns project collaborators and partners as well as the beneficiaries and general public who are expecting subsidies in the first place, not a facilitation approach. Therefore, communication and training needs can be high. Pioneers and lead farmers need to be found and associated to the development of the system. A further challenge is that other projects continue to highly subsidise or even distribute inputs, which creates market distortions and expectations on the farmers side to get inputs for free.
- The project structure with a consortium of institutions helped to integrate specialist knowledge and access to a network. Each of the partners worked in its respective competency field. This was a condition in order to achieve high levels of institutionalisation.
- An adaptive management approach was followed throughout the project; be it regarding the project activities (e.g. from the metal silo to warrantage, a more "comprehensive view" of PHM (Schaltegger et al 2015), or working with partner countries in outcome 2.3) at the level of management (e.g. for the country fora or increasing staff numbers).
- Structure of M&E: The PHM-SSA produced well-reflected and comprehensive reports, based on a detailed monitoring of indicators. It disposed of an ambitious M&E manual that was developed in 2013.
- Knowledge & learning: Improved performance of implementing partners was observed in Mozambique over the lifetime of the project (Nhacolo M E. und Castro E 2020:20).

4.6. Influencing factors

There were relevant external and internal factors that contributed positively or negatively to the project implementation. External factors included:

- Extreme (rural) poverty in the project countries and regions, as described in the Prodoc (Helvetas 2013b, 2017b).
- Thin markets in agricultural inputs.
- Limited professional skills among artisans.
- Microfinance institutions are present but so far very reluctant to include the rural sector perceived as very risky by them. It helped that saving groups are a well-known instrument (Crole-Rees A, de Meyer J 2020d).
- The public sector in the remote regions is constrained by very low budget, even more so in the allocations for agriculture. This concerns also Rural Advisory Services.

As for the internal factors, they related mainly to project management:

- It was said among consortium partners that they felt like a project "family". This has enhanced motivation and has likely improved the results in particular in phase I. In phase II, this connection was felt less. A reason for this might have been some changes in personnel, budgetary constraints and/or the big geographical distances, not only between the countries but also within them. The project management was very professional.
- In Benin, the budget in phase II had to cover late reported expenses of phase I, which made painful reallocations necessary. It was noted that some partners have reduced their engagement in phase II, which was probably related to limited funds.
- The consortium with its well anchored local organizations proved to be fruitful for dissemination and contributed to institutional change in various organizations. However, the consortium governance was also challenging. It took more than a year in phase I until the consortium was able to operate fully. In particular in phase II, capacity challenges in consortium partners' organizations and personnel changes as well as in Helvetas (project coordination in Benin) as in partner organizations led to delays in project implementation. The FANRPAN country node, after an organizational assessment, needed capacity strengthening of the FANRPAN secretariat in financial management. For the AFAAS country fora, new contractual arrangements had to be implemented, with a higher involvement of the HELVETAS country offices. The collaboration modalities with the AFAAS country forum in Mozambique remained a challenge until the end of the project.
- In the collaboration with local implementing NGOs in Benin, the contracts were changed from subcontracting in phase I to service contracts in phase II with the aim to strengthen the exit strategy of the project. Despite communicating the background of this decision, an NGO encountered difficulties to adapt to this new form and limited contract duration.
- The capacities of project collaborators and NGOs on MSD in the focus countries needed to be built, as the approach was new to them. Despite the training received, the newness of the approach stretched the capacities of a part of the agents. For instance, searching and keeping frequent contact with market actors seems not to have received due attention.
- Internally, it was said that the roles of the different partners were clear, which is a very important factor for effective implementation. To the outside, e.g. private sector stakeholders, it was more difficult to understand.

4.7. Project budget and funds

The initial budget for the entire project was over 4 Mio. CHF (HELVETAS). The actual expenditures in phase I were of almost 2'670'000 CHF, and of nearly 2'000'000 for phase II. CHF 316'473 remained by end of 2019 for the last 3 months of the project.

The input/output ratio of the project is considered high. Comparing the budget and scope of the PHM-SSA to the budget of the more geographically concentrated GPLP project in Tanzania, the PHM-SSA had a comparably small budget. This directly influenced the achievements of results, not the least through limited human resources (Felber G, Witteween A 2019:31). Budget lines are considered plausible, in particular as the human resource investments for a systemic approach is high in general.

Several partners of the project felt their budget was too small in phase II, contrary to phase I of the project. This might have to do in part with a higher pace that the project needed to take in the second part in order to reach the objectives. However, it contributed to some discord among partners.

In the first 3 years of the project (phase I), the expenditures were considerably lower than budgeted. On average, the budget was 76% over the costs between 2013 to 2016. However, this has to do with underreporting in those years. In phase II, the deviances were reduced and only were around 12% on average between 2017 to 2019. According to the management, adaptations to the budget were discussed and agreed with SDC.

In Benin, the project office was relocated from Cotonou to Natitingou during the course of the project. Considering the high transaction costs observed in phase I (Schaltegger E, Sikirou R, Sualehe Cauio A 2016), this was an efficient move. The impact on the level of personnel is, however, not assessed here.

For the financial analysis carried out for phase II of the PHM-SSA[8], it was assumed that the total budget will be used by the end of the project phase (USD 2.12 million). The project costs are thus regarded as the investment costs. In fact, incremental costs would need to include also the costs for PHM technologies at the farmers side, for which the necessary data is lacking. Therefore, and to account for potential fluctuations in harvest, only 80% of the calculated additional income are included as gains. It was further assumed that the increased household incomes from stored goods estimated in End-of-Phase Report (USD 2.3 million for both project countries) were a useful approximation for the benefits of the project. The value is based on the average crop volume stored according to the end line surveys, multiplied by average seasonal market prices and the number of direct beneficiaries. To assume this value as the benefits of the project is a conservative estimation, as it does not contain the opportunity costs of grains and pulses that were saved due to better PHM for own consumption, nor the potential additional income of indirect beneficiaries of the project who saved food through PHM. On the other hand, it assumes that farmers continue to use storage technologies as they did in 2019. Given the 7 years-duration of the project, the net present value (NPV, as explained in appendix 8.5) is calculated over a respective time span of 7 years as well. Further assumptions made are described in the appendix 8.5, which also contains the calculation table for the following results.

Assuming high capital costs and taxes (20% and 30% respectively), the NPV_7 of phase II of the PHM-SSA is USD 2'538'600. The internal rate of return (IRR), with the same assumptions, is 58.54% and thus twice as high than the assumed capital costs of 20%. Benefit to Cost Ratio (BCR) results in 2.20 and thus points to a positive return of the project too. Even with a more conservative estimation of additional household gains of USD 1.680 million per year (using the average prices of maize and pulses

[8] The financial analysis is made for phase II as this phase is considered more relevant for the final results of the project.

in the end line databases), the project clearly generates a positive return (NPV = USD 1'269'843, IRR 40.19%, BCR 1.60).

The financial analysis of this project is based on the monitoring data of the project. It is to be read with caution, as in the framework of this evaluation, the data could not be verified empirically.

Finally, it was noted that regarding cost efficiency, several studies funded under the project were not of satisfactory quality (Assumptions made in CBA on unclear sources, baseline studies not collecting the needed data, linguistic limitations). While this does have cost implications, the efficiency might have been higher with either more intensive guidance from Helvetas, or the contracting of renown research institutions as partners (in order to still include local researchers).

4.8. Project tools and instruments

It is widely acknowledged that the rather simple postharvest practices that the project promoted are deemed very useful by farmers and experts. With regards to the storage stage, the hermetic bags have proven particularly relevant. Their potential to reduce PHL is also recognised in relevant literature (Brander et al. 2020, Regassa 2014).

To improve the traditional granaries is a highly relevant contribution of the project. Those granaries enable a larger number of farmers to reduce PHL with great success, given the local availability of materials thus making it inexpensive. It is relevant for the conservation of traditional knowledge and techniques, as well as providing work for local artisans.

This is not to say that the metal silos would not be relevant. Persons who had access to silos are convinced about their usefulness, not least because no chemicals are needed for pest control and the produce is kept fresh for a long time. Still, the adoption of the metal silo was not successful so far either in other Western or Central African countries. Other organisations have rather opted for the traditional granaries, or for hermetic bags and plastic silos (FAO, WFP, IFAD 2019:28), but without trying to create a local market system.

The PHM-SSA produced a range of studies, such as the cost-benefit analysis (CBA) that were important basis for the dissemination and advocacy part of the project. It seems, however, that a large number of those studies were carried out by agro-economists or agronomists. It is therefore not surprising that the focus of the studies was very technological. Transdisciplinary teams could have helped to put attention to factors that enable or hinder adoption earlier in the project.

The activities in capacity building were of a wide range and addressed to different actors (farmers, public sector, agricultural extension, agro-dealers, saving and credit groups). This is intensive work, but relevant in a systemic approach. To make this approach work, it could have been beneficial to train the project partners even more in this field.

As for the communication and outreach tools used, the videos and drama were the instruments most mentioned by interview partners. It was observed that the TV was "rather underused" in both countries. However, from a perspective of vulnerable groups, the use of (cheaper) radio spots was the appropriate decision. The project also used communication via WhatsApp. It proved, however, necessary that such a group be facilitated. At international level, the project used Webinars, which is relevant to reach a wider community.

To assure that PHM is reflected in policies is an important part of the project. Advocacy activities need to be fed by convincing examples for officials to buy in. The PHM-SSA was able to provide such stories e.g. in the form of policy briefs. However, it might in some instances have been critical to have more (quantified) information at hand e.g. on the option of tariff waivers, when speaking with politicians.

In summary, the inputs or activities carried out by the project were well chosen. For the direct beneficiaries of the project in the focus countries, PHL reduction was observed and improved food security can be assumed (though not measured in sufficient quality). Within the scope of the project, the tools and instruments used were relevant.

4.9. Support of SDC

According to the project management, SDC GPFS was very supportive of the project during the entire duration. A constructive dialogue regarding content and management was possible. Flexible solutions were sought when adaptations were necessary. SDC also responded positively when evaluation of phase I recommended to plan the second phase for more than the first foreseen 2 years. Initially, implementation was foreseen to take 6 years (HELVETAS).

In both focus countries, bilateral programs of SDC also implemented PHM components (Hortisempre in Mozambique, PASDER in Benin). However, the exchange with bilateral programs would have had more potential, it was observed by Helvetas. Also, synergies with programs of other donors (WB) could have been supported more. The implication of SDC country offices in advocacy strategies for PHM seems not to have been systematic.

4.10. Beneficiaries' livelihoods

> Farmer of a cooperative in the district of Collines: "Our cooperative works with the project since 3 years. We will all continue with the warrantage, because it is beneficial to us. I could even buy a motorcycle from the gains, as I harvested 4 tons of soya and 1.5 tons of maize. "

As described in section 3.6, improvements in beneficiaries' livelihoods were observed, with little quantitative information available. According to interviewees, the project has helped farmers to reduce food insecurity. Through the introduction of PHM innovations, beneficiaries could a) improve their provision of quality food throughout the year and b) benefit from selling their produce later at higher prices and therefore alleviate the poverty trap caused by the urge to sell produced grains or pulses right after harvest. An MFI manager confirmed that with the warrantage system, farmers were able to finance inputs and/or workforce, which resulted in higher productivity. For Mozambique, it was emphasised that farmer families benefitted from the fact that the project changed their view on PHL. When they learned that something could be done about, and applied it, they were able to reduce losses of grains and therefore improved their livelihoods.

4.11. Social inclusion and Gender

The project included a focus on gender equity from the beginning. In phase I, a manual was conceived and workshops for the project team and partners conducted. According to the internal monitoring, 41% of beneficiary households were women headed in Benin, 30% in Mozambique. The end line survey in 2020, however, only found 15% of women headed households who adopted PHM for their sample in Mozambique (Nhacolo M E. und Castro E 2020:9). The higher rate in Benin is related to the high percentage of women in the warrantage groups.

The project was said to have been gender sensitive from the start and worked in an integrative way with the communities. A report from Benin shows, however, that the understanding of the concept was rather limited regarding gender and cultural groups (one single condition described as "normal"). The gender specialist recommended radio broadcasts in local languages. This evaluation could not assess how far the recommendation was followed.

The approach of the project to support a basket of options for PHM can be seen as an inclusive approach, enabling each producer to use the solution that is accessible to her/him. Women benefitted from the project in various forms:

- The improved traditional granary allowed women to be able to remove grains on their own, which gave them more control over the food.
- Smaller silos (200 kg instead of 300-500) benefitted the needs of smaller producers, among them often women.
- Beneficiary women could also improve their decision making power as part of the management in farmer committees. They became more confident in interacting with group and village leaders.
- The instruments for access to credit benefitted women in Benin in particular, as their access to formal credit is more limited because they are less present in cash crop production.
- Good PHM is seen to be more relevant to women, as they pay more attention to the quality of food in preparing the diets of their families.

Finally, an important positive aspect is the inclusion of traditional knowledge in the project. Improving the local granaries is an innovation that contributes to maintaining traditional heritage of communities in Benin (HELVETAS Swiss Intercooperation 2017a) and has a high cultural value.

4.12. Local ownership

The PHM-SSA worked strongly with local partners to enhance local knowledge and ownership. This included farmers' unions, local NGOs, educational institutions, local government as well as civil society actors. To engage the local government was part of the exit strategy. Project partners that affirmed to continue promoting PHM were farmers' unions, INRAB, IIAM, ERAD, as well as the AFAAS country fora of Nigeria, Malawi, Madagascar and Uganda.

A critical point was mentioned in Benin: The dissemination material of the project bears the logos of the consortium partners. However, these partners are not necessarily known by the beneficiaries or rural population in the project region, as their contacts are with the local NGO. For a farmer who might want more information on PHM, and comes across a factsheet of the PHM-SSA, they may therefore have difficulties to understand where to get more information if the local NGO is not mentioned.

Local ownership is key to work further on the adoption of PHM. As recognised by Hans-Moëvi (2015), non-adoption of practices (not technologies) is mostly caused by lack of knowledge or understanding of the benefit. Local organisations may have a better understanding of socio-cultural factors that influence adoption, such as gender roles. The impression that farmers give less attention to PHL might be influenced by the fact that external organisations have for a very long time prioritized production and are still doing it. The focus on productivity that influences low adoption might therefore be wrongly interpreted as a socio-cultural barrier to PHM.

4.13. Participation by institutions and beneficiaries

Local institutions were associated to the project and felt they could contribute. An NGO in Benin even spoke of a "perfect collaboration". Important actors were farmers' organisations, research institutes, educational institutions, NGOs and governmental organisations. It was mentioned that a process of learning among the institutions was initiated within the project. Also, the learnings were shared with other civil sector agents, as was remarked in Benin. The good collaboration with local governments was said to have spurred the policy uptake of PHM in Mozambique. Not surprisingly, the local organisations interviewed confirm that they will continue to promote PHM also after the end of this project. However, not all of them felt their proposals were taken seriously (e.g. INRAB). It is suspected that this "frustration" has to do with a low understanding of the market system approach.

It was also decisive that the project "diffused useful and understandable knowledge to farmers" (Nhacolo M E. und Castro E 2020:20). The collaboration with local farmer organisations is crucial for covering remote rural areas, as the CAPEX concluded (Crole-Rees A, de Meyer J 2020d). This is in partial contrast with the observation from phase I that farmers participating in testing the PHM solutions were not well informed about the "conditions and prospects of the test periods", leaving them without an understanding about the potential costs of PHM solutions (Schaltegger E, Sikirou R, Sualehe Cauio A 2016).

At regional level, the "collaboration with FANRPAN and AFAAS contributed to dissemination and political momentum for PHM in SSA" (Crole-Rees A, de Meyer J 2020c). FANRPAN and AFAAS both having their structures on national level in the focus countries as well as in other countries of SSA helped for the dissemination of PHM information. This is however of limited usefulness as long as solutions to postharvest management are scarcely available in other countries of SSA. The good advocacy results will need to be translated into practical changes in many countries. In Uganda, it worked well as hermetic bags are at least partially available.

To foster the knowledge diffusion at international level, FAO was made a partner of the project. FAO facilitated online discussions in phase I and makes the studies of the PHM-SSA available to a wider audience on their website. However, their engagement in the CoP for food loss reduction was said to be limited at least in phase II of the project (Crole-Rees A, de Meyer J 2020b:2). The potential of the cooperation between the three UN agencies was therefore not really exploited.

4.14. Influence of overall context

During the implementation of the PHM-SSA, agricultural policy in Benin underwent radical changes. This had several effects, among them the loss of important interlocutors in the public sector and influenced the implementation speed negatively. This is also a reason why it is felt that the information on PHM in local structures of the Ministry of Agriculture is still limited.

In Mozambique, the security situation in the Province of Cabo Delgado disrupted or slowed down some of the activities in 2019 (Annual Report).

Regarding influences at global level, two interesting influences were observed. One issue is food safety, often related with aflatoxin. This discussion played into the arms of the project and facilitated the promotion e.g. of safe drying techniques. Also, the risks for food safety involved with the use of chemicals are perceived more widely (Crole-Rees A, de Meyer J 2020d). This also helps to promote hermetic storage technologies, in which grains and pulses don't need to be treated with chemicals for conservation.

The other influence observed was the value of safe food conservation when natural disasters occur. This has been shown with the cyclone Kenneth in Mozambique in 2019. Farmers using hermetic technologies benefitted from their better protection to extreme rain than with traditional storage means (End of phase report 2020).

The effects of the current pandemic on grain conservation will need to be assessed. On the one hand, safe storage is an advantage. On the other hand, border closures have high effects on prices, and the prices have a direct influence on the rentability of the storage technologies. The demand for safe food storage as a means to enhance resilience could rise due to the experience with Covid-19.

4.15. First impact

The achievements through advocacy are remarkable (section 3.5), but changes have happened rather recently and their impact therefore too early to assess. Impacts are already in agricultural schools,

where, due at least in part to the advocacy of the project, PHM is now included in the curricula or training units. To turn into measurable effects, more time will be needed. The vast and well-cast collaboration at institutional level will help PHM be further promoted in the focus countries, benefitting from the national mandate of several of the partner organisations. All institutions interviewed for this evaluation wanted to continue working on PHM, including in the countries sensitised through the AFAAS. Not all of them, however, dispose of the financial means to do so. At the institutional level, the changes cannot be attributed to the PHM-SSA only, as other organisations also work on the reduction for PHL. However, the PHM-SSA is unique in the use of the MSD approach, which has more potential for impact than the often-used subsidies.

A potentially lasting change at beneficiary level attributable to the project is the "change in the mode of thinking" with regards to the opportunities that farmers have in their hands to reduce PHL. The dissemination of knowledge on good postharvest practices has had a considerable impact in the project regions that is already observable.

In the micro-finance sector, the project fostered links that could help making financial products for small-farmers available also in the future. But these results are still on a very small scale and could not be investigated enough within the present study.

4.16. Spill-over and systemic changes

Spill-over effects that were confirmed in interviews are that other NGOs and donor programs, based on the demonstrated utility of PHM, also started to work with improved PHM. For example, the ADA bought metallic silos for another district in Mozambique. Spill-over has also happened to other production sectors, e.g. groundnuts. A reason for this is that systematic drying and hermetic storage have proven to be less prone to aflatoxin contamination.

With the market system approach, the project's aim was explicitly a systemic change in the market for PHM (and related grains and RAS systems). As mentioned, the PHM-SSA succeeded in setting up a functional market system for hermetic bags in Mozambique and in lying important basis for other PHM markets. It had considerable influence in institutionalising PHM in the focus countries, which makes that PHM knowledge could be further spread through initiatives such as the current massive hiring of agricultural extensionists in Mozambique.

5. Conclusions

This section summarizes the findings described above according to the "traditional" DAC criteria (coherence within relevance).

5.1. Relevance

The present material has proven that the PHM-SSA is relevant, due mainly to high food losses in the countries in SSA. Also, PHM is still not addressed much in comparison to approaches in production. As described, PHM can also enhance resilience against extreme weather events. And as production increase often is at the expense of land change, the reduction of PHL is relevant to mitigation of climate change too, and can help reduce pressure on land.

Finally, Helvetas did pioneer work on PHM in the specific project regions (provinces of Cabo Delgado and Nampula in Mozambique, departments of Atacora and Collines in Benin). Relevance is therefore rated very high by the interview partners. In addition to the postharvest practices promoted in the

PHM-SSA, storing technologies for the small-holder households are relevant, as the big public storage facilities are not trusted or not available.

5.2. Effectiveness

Many of the project approaches were effective. In particular, the institutionalisation of PHM in local organisations such as agricultural extension, research, civil society and the public sector has reached a considerable level in the focus countries. To collaborate directly with a large range of stakeholders has improved local ownership. Dissemination materials of the project are widely used in various institutions and stakeholders benefitted from extensive capacity building. In its multi-sectorial approach, the PHM-SSA also had an influence on policy dialogue and uptake of PHM in extension networks in other countries of SSA, through the consortium partners AFAAS and FANRPAN.

The project's approach to install functional market systems for postharvest technologies was highly successful in the case of hermetic bags in Mozambique. If the demand increases, the system could also become functional with metal silos in Mozambique. In Benin, the market systems for hermetic solutions are not yet functional. However, the warrantage system in Benin was effective and a stronger focus on this development in phase II was justified.

The high levels of commitment of the collaborators in the project teams and many of the partners, have made the promising achievements possible.

5.3. Efficiency

The PHM-SSA had a considerable output with the given means, considering its complexity and large geographical scope. In the first years, the budget/expenditures relation was over 70%. In phase II the budget deviations (mainly underspending) were reduced to 12% per year. The need of human resources was underestimated at the start, particularly in Mozambique. In phase II, more human resources were recruited.

The results of a financial analysis show that the project funds were well invested. Even with conservative estimations, NPV, IRR and CBR have positive values. The financial analysis, however, is limited. For a deeper economic analysis, field data would be needed, e.g. regarding jobs created in the market system or the value of the institutionalised learnings.

A few points, which could have improved the efficiency, came to light during the evaluation. Although the metal silo market system was not a focus anymore in phase II in Benin, an earlier consequent move to the technologies that were easier adopted could have freed capacities for the more promising options. Also, it was suggested that public awareness on PHM at a larger scale should have taken a larger part of the budget to spur demand. However, it is questionable in which instances this would really have helped to dynamize the market, given the difficulties on the supply side on the other hand.

5.4. Prospects for Impact[9]

The impact of the project should be assessed again in a few years. This evaluation was carried out too close to the project's end, and could not be based on extensive field data due to the pandemic. The following arguments, however, are given for likely further impacts of the project:

- Food security has been improved with direct beneficiaries in the focus countries, as compared to non-beneficiaries in the end line studies. Due to improved PHM, beneficiaries with access to

[9] Term as used in the ToRs.

storage technologies were able to better cover their costs for inputs, workforce, school fees or other needs.

- The market system for hermetic bags in Mozambique has the potential, according to the evaluation findings, to have further positive impact at farmers' and agro-dealers' level.
- Due to the collaboration with local organisations, good postharvest practices have become part of their own programmes. Should they keep the focus and the quality of the knowledge diffusion, further impact can be expected at the level of other farming communities in the project regions.
- On a national and SSA-regional level, the "PHM-community" established among the project partners is prone to outlive the project's end, as it is already keeping active in the current Covid-19 situation.

5.5. Prospects for Sustainability

The impacts of the project are not to be underestimated. It supported systemic changes that potentially leads to sustainable results. Most importantly, these include:

- Institutionalisation: PHM is now a focus of local organisations, in curricula, projects, training material, extension work or private sector actors. Institutions learned to collaborate during the project and have a better understanding of how others function. The implementation with a systemic approach, including in education and at the policy level, builds a fertile ground for continuation.
- Knowledge dissemination and capacity building: The project fostered knowledge and innovations that will continue to be passed on, like the information on good postharvest practices through some farmers' unions, rural extension services and NGOs.
- Market linkages: The connections between industry, artisans and commercial actors in Mozambique are likely to be explored even further. A condition for this, however, is an increasing demand.
- Policy uptake: Potential for sustainability is also given through the policy uptake mainly in the focus countries. Governments in SSA are recognizing agriculture as a critical sector in the Covid-19 crises (FANRPAN 2020), this could also generate momentum for PHM, if advocacy is kept up.
- Interest of other organisations: Other development partners are also investing in PHM, albeit often not with the approach of systemic change. However, even if metallic silos are bought for beneficiaries (e.g. by the RBA), it could benefit the actors in the market system fostered by the PHM-SSA, in particular local artisans. FAO continues to work on PHM within their regular budget, which gives it more elevated importance than an SDC-funded program.
- The regional partners of the PHM-SSA, FANRPAN and AFAAS, both have PHM embedded in their strategies, also in collaboration with new partners (the AU and IFAD for AFAAS, SDG 12.3 champions for FANRPAN).

As we are living in a fast turning world, continuous work will be needed to reduce postharvest losses. This might be in further collaboration with other organisations that work currently on PHM, such as the WFP, AU, CGIAR-agencies, Sasakawa Africa Association, ADA, AGRA, Perdue University Foundation as well as private companies like AgroZ, Crest Tanks and so on.

6. Lessons Learnt

1. Transdisciplinary views

   - The inclusion of a variety of options to reduce PHL was decisive for the success of the project. In the course of the project, the focus changed from storage technologies to a more comprehensive “field to fork”-view of PHL reduction.
   - A more transdisciplinary view could have helped for an earlier focus on the adoption of technical solutions in different socio-economic groups. Scoping and baseline studies need to have a larger focus than agronomy/agro-economy (also methodologically) and take socio-cultural perspectives into account, as well as deeper market studies.
   - This includes to “gain a clear understanding of what motivates individuals and organisations to change” (Crole-Rees A, de Meyer J 2019e). A cost-benefit analysis could be seen as a contribution to study different aspects of decision making at farmers level.
   - The inclusion of gender perspectives in a team approach facilitated real transformation such as increasing the decision-making power of women.

2. Systemic change

   - The MSD-approach builds on the capacities of market participants. To integrate market options as early as possible in a project, an intensive search for leading individuals with capacities to follow commercial strategies is needed. This concerns the demand as well as the supply side.
   - The size of key actors can be decisive; working with local actors that are too small risks having too little market power to spur change.
   - Internal capacities in the project management team(s) are also critical. Persons might need different levels of training to be able to integrate the new approach and explain it to persons who are mostly new to a facilitating approach (in contrast to subsidies).
   - With an increasing importance of access to finance, corresponding internal capacities might also need to be upscaled. Measures to improve access to finance (including saving) can benefit women in particular.
   - The business environment in Mozambique and Benin is rather different, due to factors that would need to be analysed further. Such an analysis might have revealed that some assumptions made at the outset were rather too positive in particular regarding outputs 1.1 to 1.3.
   - The geographical limitations of the project in the focus countries was probably too small/too restricting for a market to develop in the private sector.

3. Communication/ out-scaling

   - The adaptation of communication material to different stakeholder groups and methods like drama and videos are key to get the message through.
   - Bigger media campaigns in the focus countries could have increased the demand for PHM innovations, in particular in phase II of the project.

- Collaboration with the RAS community at the regional scale (CF AFAAS) could have benefitted from earlier face-to-face activities in the countries.

4. Partnerships

   - The project structure included different partners, which strengthened awareness of and ultimately spurred the institutionalisation of PHM. However, a considerable effort is needed for communication and a good connection between the partners / levels of a complex project like PHM-SSA is essential.
   - Several attempts are sometimes needed to find the appropriate partners, especially in the private sector.
   - The internal capacities of the partner organisations can have a negative influence on the implementation speed. The output needs to be transparent.

5. Sustainability

   - Integrating PHM training for public extension is key for sustainability.
   - The issue of food quality has helped to give PHM more importance and should be considered / used further, especially regarding aflatoxin contamination.
   - The integration of PHM into policies of focus countries was a time consuming process, as would be expected. Project cycles can be limiting in this process.

Other influencing factors and lessons learnt on the PHM projects of the SDC portfolio are described in the CAPEX report on the PHM-SSA and GPLP (Felber G, Witteveen A 2019: 30-36) as well as in the CAPEX factsheets (Crole-Rees A, de Meyer J 2019 a-e).

7. Recommendations

7.1. Recommendations to project implementers/consortium

PHM options and MSD for food security projects

1. As it is intended, it is only underlined here that the consortium partners should continue in developing and promoting adapted PHM solutions to increase food security for the beneficiaries as a part of new or current projects. The PHM-SSA has been successful in the institutionalisation of PHM in the focus countries and has contributed to setting a base for it in SSA.
2. In order to "save the results" of PHM-SSA (and the other projects in the SDC-PHM portfolio), it is recommended that the efforts to set up a market system with local actors is continued as far as possible in other projects. The example in Mozambique shows that the approach enables the local market actors to tap into new opportunities.
3. The MSD approach often struggles with the still common subsidizing of inputs. Profound market analysis is beneficial to design interventions that show effective results within the lifetime of a project through the establishment of market linkages.
4. In particular in the focus countries, including PHM efforts in other ongoing projects or programs could help to stabilize the achievements of the PHM-SSA. In Benin, the market dynamization for hermetic bags could be the first point with an initial focus on less remote communities (lower transportation costs and time effort for the private sector) and approaching lead farmers.

Improved traditional silos are still an option for more remote communities. In Mozambique, a focus on dynamics of the metal silo market and production is proposed. In both countries, accompanying the technical schools in further PHM implementation and advocating at government level could be valuable to further promote good PHP.

5. The project didn't develop a strategy regarding the plastic residues of the hermetic bags and/or tarpaulins. It is not alone in this. However, it is recommended that while countries are developing "no-plastic" policies, that this issue is integrated in other projects. In general, recycling can also promote skills development and local entrepreneurship.
6. As far as not already done, consider the inclusion of the experiences on PHM in the South-South Cooperation Unit of Helvetas.

Outreach and dissemination

7. Continue/professionalize the use of other "modern" modes of knowledge sharing (WhatsApp, Webinars) in a learning approach with local teams.
8. Make dissemination material (better) available at the level of the local NGOs so that they can easily reproduce it (e.g. the factsheets in pdf. for the NGOs in Benin).
9. The local partners (NGOs) should be made visible on the products like factsheets. People would more easily connect to it and know where to ask for information.
10. Collaboration with research institutes and agricultural advisory organizations at local, regional and global levels is a beneficial approach to leverage solutions.

Advocacy

11. There is growing evidence that governments are including PHM in their policies. In order to avoid budgets invested for unsuccessful projects (big public silos Mozambique as an example), benefits of the solutions developed for the rural population need to be continuously communicated and made visible.
12. Within programs on food security, effective PHM is a component to be included as it links to nutrition, food quality and safety as well as environmental concerns.
13. Further use the reputation as innovator in the field of PHM that Helvetas developed.

7.2. Recommendations to SDC

14. The PHM-SSA project shows that interventions for improved PHM can have a positive influence on food security and food safety. Current literature confirms it is an efficient approach in comparison with interventions on the production side. This experience can be used in new programs of SDC geared towards increasing food security.
15. As adapted PHM supports the achievement of agroecological objectives (conservation without chemical inputs, higher availability of food without further land use change), it should be a part the SDCs strategy in agroecology.
16. The experiences of the PHM-SSA can be used in the context of the rural-urban nexus (and other bilateral programs), as mentioned in the summary of the e-discussion in May 2020: "Systemic investments in storage facilities, built by local people & companies and using local materials, allowing to reduce post-harvest losses and to distribute sales over a longer period."
17. Monitoring nutrition outcomes should be included in efforts to improve food security (SDC GPFS 2016).
18. Outcome level M&E should be oriented more on qualitative changes.

19. As it can be expected that further evaluations have to be carried out in an online format in the future (as it is already the case in some high-risk countries), the following points should be taken into account:
    - Assure that especially large projects have reliable monitoring data, and in particular good baseline and end line data from independent studies.
    - Allow enough time for organising the interviews on different channels.
    - A collaboration with local consultants with profound field knowledge should be considered also in this format.
20. The impact of the PHM-SSA should be assessed in 3-5 years in order to draw further lessons also on the sustainability of the project's interventions.

8. Appendices

8.1. Description of hermetic storage and "warrantage" solutions

8.1.1. The hermetic bags experience in the PHM-SSA

Hermetic bags were one of the efficient storage technologies tested in phase I. Meanwhile, they exist in different trademarks, such as the PICS, AgroZ, ZeroFly or GrainPro. The PHM-SSA attempted to introduce this technical solution in its focus countries through the market system development approach. This required an analysis of the actors and institutions that make a market work or hinder its development. The project team then linked and assisted market actors so that they would consequently be able and willing to provide the market service themselves. This also worked on the level of institutions, removing potential barriers to the market system. This approach is understood as more sustainable than subsidizing or granting the input to beneficiaries, as a local value chain can be built.

In Mozambique, the introduction of hermetic bags is a success; the market system is established in the districts of Nampula and Cabo Delgado (Nhacoloa and Castro 2020), where the bags were not known before. The distributor "Casa do Agricultor" sold 11'763 AgroZ bags in 2019 (Casa do Agricultor, personal communication). Two other actors sell hermetic bags in the country.

The conditions for this success can be summarized as follows:

- Training of farmers; good agricultural practices including pre-storage handling is a condition for good storage, training in financial management.
- Fostering market linkages: the project first worked with small distributors. The model with the country-wide and bigger seller Casa do Agricultor is more successful.
- Training of agro-dealers/ inclusion of private extension services.
- Support of local government (e.g. demonstration with silo).

Sales for 2020, before the Covid19 impact, were below expectations so far. Through the Casa do Agricultor, the distribution net includes 9 shops in the whole country and an online shop.

In Benin, the PHM-SSA consortium also attempted to foster the commercialization of hermetic bags, in this case the PICS bags. Despite showing promising results at the end of phase I (HELVETAS Swiss Intercooperation 2017a), the system seems currently to be blocked. The bags were available to direct beneficiaries of the project if the local partner NGO brought them, but no distribution network took root so far and remained very limited. Negotiations with market actors have not yet resulted in a deblocking of the situation. Reasons mentioned for this are:

- The bag's prices are perceived as too high by farmers in relation to the gains they make (especially for maize, for pulses the relation is more favorable), demand thus remains small. In other words, the potential losses with ordinary bags is considered lower than the costs of hermetic bags.
- For a retailor, the costs to bring the bags in small quantities to very remote villages are too high.
- The retailor in the North is too small and hasn't enough means to make the necessary upfront payments.
- There is one single licensed buyer in Cotonou who is a friend of the producer in Kano.

- For the producer of the bags, Lela Agro Industries in Kano, Northern Nigeria, PICS bags are only a small fraction of their business (1.1 mio in 2018, 2 mio in 2019 in comparison to 50 mio different bags produced a month). The role of the public sector, according to the business man, would be to support with depots and enable easier trade (including North-Nigeria to North-Benin).
- Contrary to the Casa do Agricultor, the private market actors in Benin don't understand it as their responsibility to contribute to the promotion of the bags.
- Storing facilities/magazines are still scarce and too small.

To put these results into perspective: The Bill & Melina Gates Foundation tried to introduce PICS bags on a large scale, including in Benin, in 2013 or before, apparently without much success in the country after the distribution.

8.1.2. The metal silo experience in the PHM-SSA

The metal silo was one of the options for the storage of grains and pulses promoted by the PHM-SSA, inspired by the success of the technology in Central America. The MSD approach in this case meant building a complex value chain, including training of artisans. Feasibility studies in phase I concluded that the introduction of metal silos would be a viable option in both focus countries, if special attention was given to foster market relationships e.g. for the importation of galvanized sheets, and the quality monitoring of the product. In addition, it was concluded that the hermetic silos proved efficient in curbing losses and were very economical, in particular taking into account its lifetime of about 20 years. However, the feasibility study for Benin already warned that the upfront costs for farmers were too high, even with local production.

In both focus countries, the PHM-SSA worked towards the introduction of a business model for metal silos, including production, marketing and dissemination. Several hundred silos were produced[10] and artisans trained in their production. In Mozambique, the production still continues at a low level according to local informants and around 20 tinsmiths have the capacities needed to produce them. In addition, the PHM-SSA team in 2019 engaged with middle-sized tinsmith manufacturers in order to enhance production quantity and quality, and started to facilitate artisan cooperatives. Chances that the system endures beyond the end of the project are promising, despite the risks of limited demand by farmers. Institutional demand by other NGOs for the moment dynamizes the market, as well as community seed banks. In Benin, the system did not take root. Silos are currently not produced anymore. Some of the challenges:

- The market system had to be built from scratch, including finding an industry partner to produce/import the galvanized sheets, training of artisans, awareness raising.
- Small scale artisans had limited skills in Benin and can have difficulties in negotiating with industrial companies, e.g. provider of metal sheets in Mozambique. The risk is they continue to rely on the support of NGOs to procure themselves with metal sheets.
- The price is (too) high for the expected buyers among poor small-scale farmers. Financial services are scarce, specific financing schemes had to be developed/adapted.

[10] Phase I: 175 metal silos in Benin, 370 in Mozambique; phase II: 60 silos sold in Benin, 225 silos in Mozambique (project reports). In Benin, 48 silos were provided to farmers in 2016 with the aim that they could pay 50% back. According to the end line report, none of the beneficiaries bought his or her silo. 50 silos remained unsold/unused by end of 2019 (yearly report). An unknown number of metal silos was bought by a monastery in Northern Benin.

- Awareness raising for market actors on the advantages of the silo, e.g. the beneficial cost-benefit ratio and the fact that it can be used without chemicals (contrary to the traditional silos) did not offset the disadvantage of the high initial investment needed.
- The good handling pre- and post-harvest for successful storage needs considerable training for users.
- The business environment in general was considered difficult in Benin (e.g. pilot study).

Moreover, it is a thin market with a limited number of actors. For the raw material, good quality sheets needed to be imported from Europe for Benin. In Mozambique, the project had the advantage that a metal sheet manufacturer is located in the North of the country.

Lessons learned

- Facilitating market linkages needs considerable upfront investment and sometimes a change of strategy with regard to partners.
- A diversity of market actors is necessary. Considering project areas with a higher density of potential buyers could have been advantageous.
- Artisans need training and/or assistance in business management and sales.
- Finding first adopters/champions/pioneers: the choice of artisans is important as well as finding lead farmers (commercial thinking).
- Local availability of the material is key and meant that the improved clay silos became a success in Benin (236 improved clay granaries built by end of 2019).
- Socio-cultural factors should be considered as opportunities to support implementation (not primarily as barriers). Traditional granaries have a meaning for social status in Northern Benin. In turn, the metal silos can be empowering for women in the sense of better control on the stored goods, as a study found in Tanzania (Hans-Moëvi, 2018:20).
- In Benin, a certain insistence on the metal silo solution in the course of the project can be observed. Improved traditional granaries were favored by most of the local actors and experts already in phase I of the project.

According to a personal communication, through the mediation of the Helvetas country director, metal silos are now built in Mali on the basis of information in Benin. The construction of silos in different sizes is financed by the WFP (implementation model is unknown).

8.1.3. The warrantage experience

In Benin, the PHM-SSA incorporated the local system of “warrantage” with the objective to improve financial means of farmers at the time of harvest. This is critical so that the harvest is not sold at a low price leaving no means to invest in postharvest technologies. In this system, farmer groups store their harvested grains and/or pulses in a warehouse (hence the English expression of warehouse receipt system for warrantage). The locked up produce serves as a guarantee/collateral, for which a local micro-finance institution (MFI) provides credit to the farmers. The produce is sold later, when the supply is low and the prices thus higher. This mechanism should enable farmers to pay the interest back and make higher gains from their produce. The mid-term evaluation recommended to invest in the scheme in phase II, seeing the “incredibly good short term investment” that collaterals can be, “increasing their value twice in a few months”, as was the hope (Schaltegger E, Sikirou R, Sualehe Cauio A 2020:22). The tendency for higher prices in the lean season is real, however it might not always

amount to 100%. In 2019, price differences were between FCFA 110,0 to 183,3 per kg of maize (Egah J 2020:13).

From the 24 groups in which warrantage was initiated, 13 are operational at the end of the project. The assessment of the Helvetas project team that they are autonomous by now is not fully shared by the interview partners. The system is much appreciated in terms of gains for beneficiaries. The credits at harvest time are used to finance inputs or work force to prepare the next cycle or to pay school or medical fees. It was reported that the inputs financed through the system, with support of the MAEP and including training on good agricultural practices, do lead to higher productivity. In one project region, the credits were used to finance economic activities in particular of women, and contributed in this way to higher revenues for farmer families.

Reasons why some of the farmers abandoned the warrantage were mentioned in the end line survey database:

- The production was too small to put grains away for the warrantage.
- The quality of stored goods could not be kept up because of lack of PICS bags or silos, or management issues.
- The warehouse room was not available in sufficient quantity. (In one case a school room had been temporarily used as a warehouse but was then taken back by the school).
- The freedom to sell when the individual farmer needs it is given up in the warrantage system.

The groups and persons that abandoned show that the system is still fragile. However the farmers who were succeeding with it are, in turn, very much convinced by it, e.g. because they were able to improve the quality of the stored goods due to the project's support in warehouse management.

Lessons learned

- Financing schemes in the agricultural sector still seldom work without public or NGO support (in this case supporting warehouse building, training or providing a guarantee to lower the risk and thus the interest). One of the MFI partners in Benin sees potential increases in the interest rates, if the "educational support of the NGO is missing".
- Financing schemes in the agricultural sector go hand in hand with the development of insurances. Also, these services are currently very scarce in SSA.
- It is often a risk that the MFI operations are seen only or primordially under the aspect of credit, which also contributes to high default rates. The system will not become sustainable without the saving part. Farmers, particularly women, appreciate the opportunity to make savings, albeit small ones at a time, according to an internationally active MFI.

In Mozambique, the project's approach regarding financial services was to support 55 credit & saving (C&S) groups, foster linkages between the Banco Futuro and farmers' organizations, and help creating appropriate products for the rural population with link to PHM. Training to agro-dealers and C&S groups on business management was also supported by the project, which is an important aspect. It is no surprise, however, that the end line survey found very few households (8 out of 120) having access to "credit for postharvest purposes" (Nhacolo M E. und Castro E 2020:14). It cannot be expected from one project to overcome the important bottlenecks in access to appropriate financial services in a phase of 3 years. The activities of the project in the large area of financial services are so far rather discreet initiatives. If the support can be continued through other projects, they have a prospect for sustainability. Activities in this area are very intensive with regards to training.

8.2. Overview on storage solutions

Technical solution	Actions PHM-SSA	Adapted strategy of PHM-SSA	Adoption	Notes regarding sustainability
Improved traditional or clay granaries	Testing and improvements in phase I in both focus countries	Less promoted because less efficient than hermetic solutions and need for storage chemicals	Widely adopted in Benin (including by other (I)NGOs), also used in Mozambique	Other organisations continue to use and promote the solution based on results of PHM-SSA
Hermetic bags	Tested in phase I and considered viable in CBA (depending on crop, losses, sales' prices/price differences)	Widely promoted in phase II with MSD approach	Increasingly used in Mozambique, market system established. Market not yet functional in Benin.	Challenges in establishment of market in Benin due to lack of demand, ineffective provision, thin market, lack of public support etc.
Hermetic/ metallic silos	Tested and in focus in phase I, considered viable in CBA, advantage in the long-term but high initial investment	Promoted in phase II mainly in Mozambique. Training of local artisans, collaboration with farmer unions etc.	Used by direct beneficiaries who got access to them, not widely demanded by small-scale farmers due to the price and probably also handling difficulties	Use for seeds producers tested in Benin, mixed results so far. Used for seeds in Mozambique; small demand and existing production facilities.
Raffia bags/ "normal" bags	Tested and proved inefficient	Not promoted	Bought mainly for maize because of low costs in relation to producer price/amount of production	Distribution to small and remote communities is costly (as with the hermetic bags)
Plastic silos/ airtight containers	Not considered by the project	Not promoted	Increasingly used in Mozambique, market system "establishes itself"	Might pick up despite quality issues for stored crops and disadvantage of plastic residues

(Table: own compilation of author according to interview and literature information; non exhaustive)

8.3. Achievement of Outcomes in phase II

(taken from End-of-Phase Report, Helvetas, 15.3.2020; colour added)

Indicator	Achievement *(target)* – phase II *
IOC 1.1 - Outreach (direct): No. of households directly supported by the project that have adopted improved PHM options, thereof % of women headed households (WH)	10'272 households, thereof 4'236 in Benin (41% WH); 6036 in Mozambique (30 % WH) *(Target: 10'000)*
IOC 1.2 - Outreach (indirect): No. of households indirectly benefitting from improved PHM options as a result of project influence	13'019 households through events organized by project (Benin: 5138; Moz: 7881); 25'000-30'000 additional households per country reached through media, campaigns *(Target: 50'000)*
IOC 1.3 - Quantity of grains/pulses stored (and saved from loss) through improved postharvest handling **	Benin: 3'188 t of maize; 529 t of pulses Moz: 2'352 t of maize, 857 t of pulses
IOC 1.4 - Increased household incomes from sales of stored grains/pulses (value of crop under improved PHM handling/storage) ***	Benin: USD 1'203'830 Moz: USD 1'104'040
IOC 2.1 - Material & tools produced by the project used by stakeholders not directly involved in the project implementation (policy makers, senior technical staff, rural advisors, NGOs, private sector, CSO)	Broad institutional uptake of resources produced by the project in Benin, Mozambique & the SSA region (IOC 2.1). All of the below mentioned actors are implementing improved PHM options (IOC 2.2): Benin: 10 Agric. Technical Schools (country-wide), University of Abomey-Calavi; ministries DQIFE and MAEP, 77 municipalities; producer unions: FUPRO, ANAF; NGOs: Ile de Paix, BUDPOS; Extension Services Network FNPS. Mozambique: 6 Agric. Technical Schools; Research institutes: IIAM, UniLurio; District Extension Services (SDAE) of 15 districts; 3 provincial governments (DPASA); companies: ORUWERA, IKURU, MIRUKU Coop; (I)NGOs: ADPP, AENA, WFP, AMPCM, JNB. Regional: Africa-wide dissemination of materials/tools through AFAAS and other networks. 13 organizations from government, research and CSO's in 5 countries reported to implement PHM options – Uganda, Malawi, Cameroon, Madagascar, Nigeria.
IOC 2.2 - Evidence of good practice options for reducing postharvest losses being used by stakeholders not directly involved in the project implementation (policy makers, senior technical staff, rural advisors, NGOs, private sector, CSO)	
IOC 3.1 - National / regional regulatory frameworks (policies, standards, norms, protocols) that are conducive for reducing postharvest losses are tabled for implementation.	Moz.: New stand-alone national strategy on PHM (finalization by March 2021); hermetic storage defined as a technology promoted by government. Benin: PHM integrated in national development plans on food security, agriculture and livestock (PSDSA, MAEP).
IOC 3.2 - Households and other food crops value chain actors are aware of regulatory frameworks (policies, standards, norms) for grains and pulses storage and commercialization.	… results from survey pending.
IOC 3.3 - Increased level of investments in PHM in focus countries (by gov., donors, private sector)	Nat. & provincial governments in Benin/Moz. launched new programs on PHM, e.g. promotion program for metal silos by DPA Nampula; other donors/initiatives investing in PHM, e.g. WFP, Swiss Solidarity, AMCANE (peanut own project Helvetas / LED); new collective storage programs in Benin.

* as per available monitoring data on 31 December 2019.

** The figures of IOC 1.3 and 1.4 are based on endline surveys conducted in both countries, each covering 120 beneficiary households and 72 non-beneficiary households. For each household, the

study captured the crop quantities (maize/pulses) stored in improved PHM options. Average figures of the endline survey were applied to the total number of direct beneficiary households. In Benin, the average crop volume stored in improved PHM technologies per household was 753 kg for maize, and 125 kg for pulses (cowpea); in Mozambique 390 kg for maize, and 142 kg for pulses (cowpea, peanut).

*** Surveying the effective additional quantities of crop sold and respective prices yielded by the households was not possible (IOC 1.4). As an alternative proxy indicator, the market value of the total volume of crop handled and stored with improved PHM options was calculated, based on average seasonal market prices.

8.4. Logframe phase II, 2017-2020

Hierarchy of objectives / Intervention strategy	Key Indicators	Data Sources Means of Verification	Assumptions & Risks
Impact (Overall Goal)	**Impact Indicators**		
Food security of smallholder farmers in Sub-Saharan Africa is increased through reduced postharvest losses at farm and community level	IOG 1: Number of food secure months at household level (physical and economic access to quality food). IOG 2: Number of rural communities confirming reduced vulnerability to famine due to improved food security IOG 3: Livelihood/gender improvements at household level: reduced workload for women etc.	• National statistics • Case studies at household and community level (Food Consumption Scores -FCS) • Specific study reports (Ministry of Agriculture etc.)	
Outcomes	**Outcome Indicators**		For ***contributing*** to goal/impact: <u>Assumptions:</u> ✓ Stable socio-political environment in pilot countries ✓ Increasing demand for food grain & pulses in SSA ✓ Continuing interest of developing partners in PHM as strategic element for food security ✓ Improved access to rural credit ✓ Social-cultural and religious barriers in relation to new PHM practices can be overcome ✓ Policy environment supportive to issues related to food security issues including PHL reductions (a.o. trade bans, land tenure, crop choice, subsidies, etc.) ✓ Effective and efficient coordination between SDC supported PHM initiatives in SSA <u>Risks:</u>
Outcome 1: Improved handling and storage options within the grains and pulses value chains are benefitting smallholders in pilot countries.	IOC 1.1: Outreach (direct): No. of households directly supported by the project that have adopted improved PHM options: 10'000 households; thereof 30% women headed HH (national average %) IOC 1.2: Outreach (indirect): No. of households indirectly benefitting from improved PHM options as a result of project influence; 50'000 households IOC 1.3: Increased quantity of grains/pulses stored and saved from loss through improved postharvest handling IOC 1.4. Increased household incomes from sales of stored grains/pulses	• Project reports • Household/community surveys • Case studies at household and community level	
Outcome 2: Good practice options for reducing postharvest losses are compiled, disseminated and scaled up and out.	IOC 2.1: Material produced by the project is used by stakeholders not directly involved in the project implementation (policy makers, senior technical staff, rural advisors, NGOs, private sector, CSO) IOC 2.2: Evidence that good practice options for reducing postharvest losses are used by stakeholders not directly involved in the project implementation (policy makers, senior technical staff, rural advisors, NGOs, private sector, CSO)	• Survey among COP members and other actors in pilot countries • Survey among relevant key persons and institutions who received capacity-building / training	

Outcome 3: Appropriate regulatory frameworks (policies, standards, norms, protocols) on reducing postharvest losses in food supply chains are introduced and implemented at national and regional levels and financing is secured.	IOC 3.1: National / regional regulatory frameworks (policies, standards, norms, protocols) that are conducive for reducing postharvest losses are tabled for implementation. IOC 3.2: Increased level of investments in PHM in pilot countries (by gov., donors, private sector) IOC 3.3: Households and other food crops value chain actors are aware of regulatory frameworks (policies, standards, norms) for grains and pulses storage and commercialization.	• Project reports, • Published policy briefs, • Newspaper/website etc. articles, • Survey of households and other VC actors • Proven cases of investments in PHM (survey)	➢ Severe/continued crop losses due to averse climatic conditions (climate change) de-motivating farmers to increase production of grain/pulses for storage. ➢ Unforeseen price fluctuations of grain/pulses commodities

Outputs (per outcome) and costs	**Output Indicators**	**Data sources / means of verification**	**Assumptions & Risks**
For outcome 1:			For ***reaching*** the outcomes:
Output 1.1: Financing options/services to invest in improved PHM are available to smallholder farmers and small enterprises.	IOP 1.1.1: No. of financial service packages for warrantage identified and promoted by MFIs and other schemes (at least 2, Benin) IOP 1.1.2: No. of financial service packages for smallholder farmers, farmer association, small enterprises identified and promoted by MFIs and other schemes (at least 1 per country) IOP 1.1.3: No. of smallholder farmers, farmer groups, small enterprises taking a credit for PHM purposes	• Offer / publication of new or adapted micro finance products • Surveys among micro-credit institutions and credit receivers	✓ Interest of MFIs in engaging in services for PHM ✓ Availability of suitable storehouses for warrantage ✓ Transparency of MFI partners and credit takers ➢ Mismanagement within farmer / warrantage groups
Output 1.2: Business models for production and marketing of new PHM technologies tested and implemented (metal silos, hermetic bags, etc.)	IOP 1.2.1: No. of market actors (specify per type agro-dealers, distributers etc.) identified and engaged in promotion of PHM technologies IOP 1.2.2: No. of hermetic bags, metal silos sold	• Survey among market actors (input suppliers, agro-dealers etc.) • Minutes of meetings • Project reports	✓ Own initiative and risk sharing by market partners ✓ Prove of benefit from improved PHM technologies (result phase I) ✓ Access to seed funding / finance ✓ Critical mass for new PHM technologies in the market is reached ➢ Persistent high input prices for raw materials (metal sheets, solder etc.)

Outputs (per outcome) and costs	Output Indicators	Data sources / means of verification	Assumptions & Risks
Output 1.3: Market linkages between producers and buyers for marketing of quality grains and pulses established, triggered by good PHM.	IOP 1.3.1: No. linkages facilitated by the project (agreements, contracts etc.) IOP 1.3.2: Quantity of quality grains/pulses sold IOP 1.3.3: Price mark-up achieved by quality grains/pulses sales ($, %)	• Contracts, MoUs, agreements • Survey among farmers and buyers who engage in grains/pulses marketing • Offical market price information	✓ Sufficient organization / management of farmer groups for marketing ✓ Interest of buyers in quality grain/pulses ➢ Limited improvement of transport and market infrastructures ➢ Unforeseen price fluctuation of grains/pulses commodities
For outcome 2:			
Output 2.1: Documented good PHM practice options are used in trainings / courses / modules by public and private extension services and technical/professional schools (Ben. / Moz.)	IOP 2.1.1: No. of public/private extension services using the PHM good practice in their training sessions/courses. IOP 2.1.2: No. of technical/professional schools including PHM good practice in their modules.	• Survey among extension service partners and training institutions • Modules, curricula, content of training courses	✓ Interest of training institutions and extension services in PHM ✓ Procedures of training institutions allow for insertion of PHM in courses & modules ➢ Lengthy revision processes exceeding project period
Output 2.2: PHM knowledge, material and tools disseminated and used broadly by selected strategic partners & networks (Ben. / Moz.).	IOP 2.2.1: No. of dissemination events conducted per country (workshops, theatres, fairs etc.). IOP 2.2.2: No. of partners & networks accessing PHM material of the project (physical access, downloads). IOP 2.2.3: No. of media productions (articles, broadcasts, transmissions, etc.) on PHM good practice.	• Minutes of events • Follow-up survey on partners and networks • List of radio, TV, newspaper productions	✓ Interest of partners and networks in disseminating & using materials ✓ Longer-term ownership of RAS networks in PHM ✓ Topic of PHM gaining broader public attention
Output 2.3: PHM knowledge, material and tools are disseminated and used by selected strategic partners & networks in other countries (regional)	IOP 2.3.1: No. of dissemination events conducted at regional level IOP 2.3.2.: No. of strategic partners and networks accessing PHM material (physical access, downloads).	• Minutes of events • Follow-up survey on partners and networks	✓ Interest/capacity of country networks & forums in disseminating PHM ✓ Applicability of knowledge and PHM material in other country contexts

Outputs (per outcome) and costs	Output Indicators	Data sources / means of verification	Assumptions & Risks
For outcome 3:			
Output 3.1: Key national interest groups/networks actively engage in advocacy actions on PHM using evidences and key policy messages from the project (Ben. / Moz.)	IOP 3.1.1: No. of key interest groups identified and engaged to actively participate in PHM advocacy initiatives and policy dialogues. IOP 3.1.2: No. of face to face meetings with key decision makers convened collaboratively with key interest groups. IOP 3.1.3: No. of PHM advocacy initiatives conducted by interest groups	• Survey among interest groups and goverments • Minutes of workshops and policy dialgoues • Documents, material produced out of advocacy initiatives	✓ Relevance of policy messages ✓ Interest groups taking active ownership of PHM topic ✓ Basic interest of actors to address PHM issues at policy level
Output 3.2: PHM activities are integrated in development plans at national, provincial, district/communal level. (Ben. / Moz.)	IOP 3.2.1: No. of stakeholder meetings conducted to identify and advocate for the integration of PHM activities in the development plans. IOP 3.2.2: No. of public institutions engaged in integrating PHM in development plans IOP 3.2.3: No. of development plans reviewed and integrating PHM activities.	• Survey among national, provincial, local goverments • Development plans • Minutes of meetings and workshops	✓ Responsible persons of governments motivated to integrate PHM ✓ Suitable time windows for formulating and revising dev. plans found
Output 3.3: Governments of other countries table strategic PHM issues including food standards and norms in policy development processes. (regional)	IOP 3.3.1: Number of FANRPAN led regional policy side events on specific PHM topics convened. IOP 3.3.2: Number of key decision makers and farmer organisations participating in the regional policy dialogues on specific PHM topics (disaggregated by gender) IOP 3.3.3: Number of PHM key messages generated and tabled to key decision makers for adoption IOP 3.3.4: Number of strategic regional events that project staff and champions are actively participating in.	• Minutes of side events • Statements of key messages generated and tabled. • List of policy champions engaging in strategic regional events	✓ Policy champions taking active ownership of PHM topic ✓ Relevance of policy messages ✓ Basic interest of actors to address PHM issues at policy level

Activities (per output)	Moz	Ben	Reg
List of activities for output 1.1: Financing options/services to invest in improved PHM are available to smallholders and small enterprises.			
1.1.1 Compile / analyse existing experience with warrantage systems in Benin: organisation, management, credit schemes, storage modalities etc. (Exchange with MFI's and other warrantage programmes, e.g.SDC supported)			
1.1.2 Facilitate the identification and making available of storage facilities suitable for warrantage (e.g. warehouses of POs and municipalities, test decentralized storage)			
1.1.3 Identify interest and opportunities for warrantage and facilitate discussions / negotiations between POs, municipalities and MFIs			
1.1.4 Develop information tools about warrantage and PHM investment options for POs, agro-entrepreneurs & MFIs (e.g. factsheets on C/B of PHM technologies, requirements for credits/guaranties, good management of stocks etc.)			
1.1.5 Support MFI's to adjust and develop financial service packages oriented towards PHM investments and credit at time of harvest			
1.1.6 Link PHM to existing credit & saving groups based on opportunities, using synergies with other projects who support C&S groups			
1.1.7 Facilitate linkages and negotiation between POs' / micro-entrepreneurs and MFIs for allocation of credits & contracts (warrantage, investment in PHM technology or business)			
1.1.8 Provide / facilitate capacity building on financial literacy and financial aspects of PHM to farmers / POs through MFIs (GAPI, FIDES, SESAME, SERVICOOP with supported by UPC, SDAE.)			
List of activities for output 1.2: Business models for production and marketing of new PHM technologies are tested and implemented (metal silos, hermetic bags, etc.)			
1.2.1 Conclude on-farm trials and assessment of metal silo technology (PHL reduction potential %, $; perception and acceptability, socio-economic, cultural and ecological appropriateness etc.)			
1.2.2 Conduct / Finalize cost-benefit analysis on metal silo and other PHM technologies and document findings (factsheets etc.)			
1.2.3 Communicate documented results of cost-benefit analysis broadly to key actors (POs, extension agencies, agro-entrepreneurs, policy makers)			
1.2.4 Strengthen distribution networks for hermetic bags (PICS & Superbags) and drying tarpaulins: identify market actors, points of sale; facilitate linkages between wholesalers, agro-entrepreneurs, farmers			
1.2.5 Support promotional activities for PICS, SuperBags and drying tarpaulins of traders, extension services, local NGOs: Develop marketing tools, market place exhibitions, posters in public space.			
1.2.6 Launch competitive fund as seed funding to small agro-entrepreneurs who present promising business ideas of investing in PHM (3-4 start-ups per country / CHF 120'000 in total)			
1.2.7 Provide technical advice to agro-entrepreneurs, POs and other market actors and facilitate implementation of business models.			
1.2.8 Validate options of linking grain/seed trading business of agro-enterpreneurs (COOSEN, SENECOOP, Sahel etc.) with marketing of PHM technologies, e.g.in-kind or rate payment for metal silos			

1.2.9 Follow-up to metal silo artisans and agro-entrepreneurs for strict quality management in the production and handling of hermetic storage systems			
List of activities for output 1.3: Market linkages between producers and buyers established for marketing of quality grains and pulses, triggered by good PHM.			
1.3.1 Engage with FUPRO, COOSEN, grain processors and other market actors to assess local marketing opportunities for pulses & maize for purposes of promoting good PHM practices			
1.3.2 Collaborate with regional development agencies (ATDA, Benin / DPA Mozambique) to identify needs and opportunities to enhance PHM and good quality in grains/pulses value chains.			
1.3.3 Enhance quality management and definition of quality criteria for local/national marketing of pulses & grains, based on product specification sheets ("cahier de charge")			
1.3.4 Facilitate establishing of joint marketing and delivery contracts for cowpea between PO's and institutional buyers applying improved PHM (i.e. hospitals, schools, military etc.). Support organization of farmers for joint marketing.			
1.3.5 Facilitate establishing of joint marketing & delivery contracts for maize between POs (e.g. sales commissions) and local/national buyers (e.g. millers – Socia, Millenium, Novos Horizontes)			
1.3.6 Foster grain market information on local radios, develop formats for emissions; link local radios to the regional platform "Grain-Afrique de l'Ouest"			
List of activities for output 2.1: Documented good PHM practice options are used in trainings / courses / modules by public and private extension services and technical/professional schools (Ben. / Moz.)			
2.1.1 Engage with vocational training centers, agricultural technical schools (Lycées Agricoles) and national universities of agriculture (bachelor) to ingrate PHM tools/materials into their training courses.			
2.1.2 Engage with new regional development centers (ATDA) and control services (DDAEP/MAEP), integrate PHM tools/materials into their training courses and work plans for the conservation specialists/trainers.			
2.1.3 In collaboration with PAFPAA and other similar initiatives, develop a training module(s) for short non-diploma trainings ("formation qualifiante") .			
2.1.4 Support training of private sector actors (input suppliers, agro-entrepreneurs) to insert quality PHM advice into their commercial activities (embedded RAS on PHM).			
2.1.5 Support UPC to integrate PHM topic, materials and tools into their training and capacity buildings.			
2.1.6 Support training and extension institutions to insert PHM into online training tools			
List of activities for output 2.2: PHM knowledge, material and tools are disseminated and used broadly by selected strategic partners & networks (Ben/Moz)			
2.2.1 Liaise with / sensitize strategic partners and networks (multipliers), to integrate PHM knowledge in their institutions and use PHM materials - namely FUPRO, FOBECA, UPC/UNAC, SDAE, networks of cereals and pulses traders, other NGOs.			

2.2.2 Provide relevant information, PHM evidence and tools to be uploaded to existing websites of national networks - FOBECA, MAEP, FUPRO ; UNAC/UPC, MASA, Access Agriculture, AFAAS, SARFAAS …			
2.2.3 Liaise with and sensitize responsible government organs in charge of media work to bring PHM issues as a main topic into radio and TV broadcasting (Ministry of agriculture, ICS etc.)			
2.2.4 Support development of radio and TV programmes on good PHM and broadcasting on local and national channels			
2.2.5 Support the creation and fostering of a national PHM knowledge pool using internet and ICT tools (social media, SMS, etc.)			
2.2.6 Support and foster discussions of PHM issues in existing local and national platforms and thematic groups			
List of activities for output 2.3: PHM knowledge, material and tools are disseminated and used by selected strategic partners & networks in other countries (regional)			
2.3.1 Identify and engage strategic partners / networks in other countries with good capacities and interest to promote PHM.			
2.3.2 Actively present and promote PHM, existing tools and materials of the project (manuals, factsheets, videos, etc.) to partners and networks in other countries,			
2.3.3 Support the translation and adaptation of PHM materials and tools in other countries, and foster dissemination of adapted PHM materials.			
2.3.4 Strengthen AFAAS online platforms for exchange and learning: conduct facilitated online discussions on key PHM topics; upload PHM RAS tools to the platform.			
2.3.5 Provide relevant information, PHM evidence and tools from the project to be uploaded to the global CoP on Food Loss Reduction (FAO) and to online platforms of other initiatives.			
2.3.6 Conduct or contribute to at least one regional / continental event per year on PHM, e.g. AFAAS Extension Week, GFRAS regional meetings etc.			
2.3.7 Support and foster discussions of PHM issues in existing regional platforms and thematic groups			
2.3.8 Monitor use of dissemination materials (survey, download statistics etc.)			
List of activities for output 3.1: Key national interest groups/networks actively engage in advocacy actions on PHM using evidences and key policy messages from the project (Ben. / Moz.)			
3.1.1 Compile key evidences for policy advocacy from the first phase of the project (key facts from trials, surveys, studies, policy dialogues)			
3.1.2 Strengthen the capacity of FANRPAN nodes on Food Agriculture and Natural Resources to effectively conduct PHM advocacy initiatives.			
3.1.3 Conduct meetings with key interests groups to develop priority advocacy topics and key messages (e.g. tax exemption for PHM inputs/materials – PICS, metal sheets etc.) to be utilized for advocacy initiatives			
3.1.4 Produce and publish PHM factsheets and specific policy briefs on priority issues for advocacy initiatives			
3.1.5 Share PHM factsheets and specific policy briefs with government officials and other key stakeholders			

3.1.6 Conduct face-to-face meetings with key decision makers in collaboration with strategic interest groups to advocate for the inclusion of PHM in policies and development plans.			
List of activities for output 3.2: PHM activities integrated in development plans at national, provincial, district/communal level. (Ben. / Moz.)			
3.2.1 Conduct stakeholder meetings (local and provincial) in collaboration with strategic interest groups to identify key PHM topics and advocate for their integration in relevant development plans			
3.2.2 Convene meetings with key local / provincial public administrators to negotiate for the integration of PHM in their development plans			
3.2.3 Provide technical support to local, provincial and national public administrators with the review, revision and drafting of polices and development plans to include PHM activities			
List of activities for output 3.3: Governments of other countries table strategic PHM issues including food standards and norms in policy development processes. (regional)			
3.3.1 Convene regional multi-stakeholder PHM policy side events on the sideline of regional events, e.g. FANRPAN, AGRF, RUFORUM (1 per year)			
3.3.2 Generate and publish/disseminate key PHM messages and advisory notes to be tabled to the key decision makers for adoption (events, website, social media, etc.)			
3.3.3 Constantly update the project web-page with up to date PHM information			
3.3.4 Project staff and champions actively participate in strategic national, regional and international events to advocate for PHM issues.			
3.3.5 Link and engage other SDC supported PHM initiatives (FAO/IFAD/WFP, FAO Ethiopia, GPLP, etc.) in regional policy dialogues.			

8.5. Financial analysis

The objective of a financial analysis is to compare the financial inputs to the financial gains made due to the project's investments. "In other words, the value added by the project is compared with the incremental costs of implementing it" (IFAD 2015:11). The profitability indicators show if the investments were financially worthwhile. The most relevant indicators in this context are the net present value (NPV), the internal rate of return (IRR) and the Benefit to Cost Ratio (BCR).

The NPV is the value of all future cash flows (positive as well as negative) over the entire life of an investment (or the respective period under evaluation) discounted to the present. Therefore, the NPV of a project shows if the discounted gains generated by a project exceed the costs. This takes into account that a present sum of money is more worth than the same amount in e.g. 10 years, as capital gains over time are assumed. The reasons to discount cash flows in NPV analysis are two-fold: the first and main reason is to adjust for the risk of an investment opportunity (the riskier an investment, the higher shall be the discount factor), while the second is to account for the time value of money (covering aspects such as inflation, capital interest rates). The following conclusions may be drawn from the NPV calculation:

a) Positive NPV: Accumulated cash inflows exceed all cash outflows. Thus, investment adds value for the investor or the project beneficiaries and can be considered a financial improvement.
b) Zero NPV: Accumulated cash inflows equals all cash outflows. Hence, there is no change in value from the investment. Other factors to justify the project or investment shall be considered.
c) Negative NPV: Accumulated cash inflows fall short of all cash outflows. No value is added to the investment. Therefore, the investment or project would not be financially justified.

However, some uncertainties remain as an NPV calculated uses variable discount rates. If they are known in detail for the duration of the investment, they may better and more accurately reflect the situation than an NPV calculated from a constant discount rate for the entire investment duration.

When calculating an NPV, the result is an absolute number in respective currency (e.g. USD) whilst the IRR calculates the percentage rate of return. The concept of the IRR calculation is based on the NPV method. The IRR calculation consequently foresees that the NPV of a project equals zero, whereas the discount rate applied in the NPV formula is then equal to the IRR.

In other words: IRR generates the percentage return that the project is expected to create. Whilst the NPV method focuses on project surpluses, IRR focuses on the breakeven cash flow level of a project. The term internal underlines the fact that the IRR calculation excludes external factors, such as inflation, the cost of capital, or various other financial risks. Therefore, the IRR is not to be confused with actually achieved investment returns. For the interpretation of an IRR calculation, the following considerations apply:

a) If the IRR is lower than the capital costs, the NPV is negative. The investment could be more beneficial if made elsewhere.
b) If the IRR equals the capital costs, consequently the capital value is zero. The investment generates the capital costs and is worthwhile to be considered.
c) If the IRR is higher than the capital costs, NPV is positive and the investment generates economic value.

Typically, the higher the IRR, the higher the cash inflow generated by a project can be expected.

The benefit-to-cost ratio (BCR) is a financial ratio that is used to determine whether the amount of money made through a project will be greater than the costs incurred in executing the project. When comparing the investments to the assumed financial gains of the project, discounted values need to be used (time effects such as inflation etc.). The BCR can be interpreted in the following way:

a) BCR = 1: Neither financial benefits nor losses occur; the project is cost-neutral.
b) BCR < 1: The project generates a financial loss as the costs outweigh the benefits.
c) BCR > 1: The project generates a positive return. If the BCR is significantly higher than one, a higher return can be expected.

The BCR is recommended to rank or select mutually exclusive project options, e.g. under budget constraints.

8.5.1. NPV

$$NPV = \sum_{t=1}^{n} \frac{(B_t - C_t)}{(1+r)^t} - I_t$$

Where:

B_t = benefits at time t C_t = costs at time t

I_t = investment costs n = project economic life

r = interest rate used as indicator of opportunity cost: discount rate

(IFAD 2015)

Assumptions:

- Harvests are different over time, so 85% of the 2019 figures account for potential events that influence gross income from stored goods.
- A further 5% gross income reduction has been considered for investments on farmers' side
- Capital costs (interest rates on loans) are considered at 20%.
- Tax rate at 30%. This individual tax rate is a rather conservative approach, assuming that individual and between-country differences might be considerable.
- Value Added Tax (VAT) is not considered as small private sector actors are exempt.

With estimated yearly additional income for beneficiaries from crop handled and stored with technologies promoted by the project of USD 2.3 million:

Year	Investments	Gains	Cashflow	Discount Factor	Present Value	Discounted Value
0	2'120'000		-2'120'000	1.000	-2'120'000	
1		1'846'296	1'292'407	0.833	1'077'006	215'401
2		1'846'296	1'292'407	0.694	897'505	394'902
3		1'846'296	1'292'407	0.579	747'921	544'486
4		1'846'296	1'292'407	0.482	623'267	669'140
5		1'846'296	1'292'407	0.402	519'389	773'018
6		1'846'296	1'292'407	0.335	432'825	859'583
7		1'846'296	1'292'407	0.279	360'687	931'720
				Present Value over 7 years (PV_7):	**4'658'600**	
				Net Present Value over 7 years (NPV_7):	**2'538'600**	

With estimated yearly additional income from storage in technologies promoted by the project of USD 1.68 million:

Year	Investments	Gains	Cashflow	Discount Factor	Present Value	Discounted Value
0	2'120'000		-2'120'000	1.000	-2'120'000	
1		1'343'462	940'424	0.833	783'686	156'737
2		1'343'462	940'424	0.694	653'072	287'352
3		1'343'462	940'424	0.579	544'227	396'197
4		1'343'462	940'424	0.482	453'522	486'901
5		1'343'462	940'424	0.402	377'935	562'488
6		1'343'462	940'424	0.335	314'946	625'478
7		1'343'462	940'424	0.279	262'455	677'969
				Present Value over 7 years (PV_7):	**3'389'843**	
				Net Present Value over 7 years (NPV_7):	**1'269'843**	

8.6. List of interviews

No.	Name	Country & Organisation	Function
1	Berguete Mariquele	MZ, WFP	Smallholder Agricultural Market Support
2	Ali Machemba	MZ, INOVAGRO	Former SDC collaborator
3	Belarmio Divage	MZ, IAAM, Agricultural Research Institute	Head of Department Training and Tech. Transfer
4	HESSAVI Pélagie	BE, INRAB	Agro-economist contributing to PHM-SSA studies
5	AGUEH S.G. Damien	BE, Ministry of Agriculture	Directeur de la Qualité des Innovations et de la Formation
6	Djomamaou B.	BE, Lycée Agricole de Savalou	Teaching Program Director
7	Carlos Jairoce	MZ, Lúrio University, Niassa prov.	Director Adjunto de Pós-graduação , Pesquisa e Extensão
8	PACULE Ernesto Joel	MZ, Departamento de Extensão Agraria, Nampula	Head of RAS department
9	RUFIN Aissan	BE NGO Iles de Paix	Program manager
10	Armando Henriques	MZ, Farmers' Union, Cabo Delgado	Coordinator, collaborating with PHM-SSA
11	Delta Elton	MZ Farmers' Union, Nampula	Coordinator, collaborating with PHM-SSA
12	Fabrice GNONLE	BE, NGO BUDPOS	Program director
13	Jose Abacar	MZ, National Association of Agricultural Extension	Project Manager
14	Ali Hachem	BE, PDG/Africo Sarl.	Private agro-dealer
15	Sylvestre GONGOTCHAME	BE, ATDA Savalou	Communal line responsible, former project manager of partner organization
16	Jean- Pierre BIO YARA	BE, Direction de l'Enseignement Technique et de la Formation Professionnelle	Director
17	Frida Dossa	BE, Pascib	Project manager of partner organization
18	Beatrice Luzobe	CF Uganda	CEO
19	Paul Hossou	BE, Uni Abomey-Calavi/INRAB	Professor/PHM researcher, involved in PHM-SSA studies
20	Margaret Koyenikan	CF Nigeria	
21	Francesca Gianfelici	FAO, Food Loss and Waste team	Coordinator CoP Food Loss Reduction
22	Paul Fatch	CF Malawi	Lecturer in Extension and Rural Development
23	Andrianjafy Rasoanindrainy	CF Madagascar	ICT4Dev, KM and M&E Expert
24	Raul YATZCANGA	BE groupement paysans	Group Leader of a beneficiary group
25	Hasan Fawaz	PICS bags Company, Nigeria	CEO
26	Ahotonji	BE farmer	Group Leader of a beneficiary group

27	Pedro Xavier	MZ, tinsmith, Chiure Dist.	Instructed for metal silos in PHM-SSA
28	Licinia Cossa	MZ, Ministry of Agriculture Maputo	CF Focal point and CF coordinator for PHM-SSA
29	Issa Bah-Agba	BE, Agence CPEF	CEO of MFI working with the PHM-SSA
30	Horacio Morgado	MZ, Intracen	Former SDC collaborator
31	Oblardino Bauque	MZ, Casa do Agricultor	Agro-dealer, involved in PHM-SSA activities for market links
32	Nheta Adamo	MZ	Small agro-dealer instructed by the project
33	Manuel Auzara	MZ, Casa do Agricultor	Senior Brand Manager
34	Bénédicte Mohouanou	BE, FUPRO	Collaborator farmers' organisation, responsible for collaboration with PHM-SSA
35	Heinrich Roth	BE, CFL	School director
36	Maria De Lurdes A. Macuiza	MZ, Ministry of Agriculture Maputo	Involved in PHM-SSA activities
37	Benjamin Ouro	BE, ONG ERAD	Project Manager

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8.9. Terms of Reference

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