“Capitalization of Experience” (CAPEX) on the SDC Africa Postharvest Management Portfolio”

Postharvest Management in Sub-Saharan Africa - Benin & Mozambique
&
Grain Postharvest Loss Prevention Project - Tanzania

Study Report

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Foreword

This CAPEX exercise is a result of the support and encouragement of learning by the Swiss Agency for Development and Cooperation within its programs. Such an effort is highly appropriate in case of Market System Development projects, which need implementation that is adaptive and learns from experiences. It has been very much appreciated by all actors involved in this exercise.

We would like to thank the HELVETAS project teams and all their partners in Benin, Mozambique and Tanzania for giving support during our field visits and the openness in sharing their experiences.

Summary

The Swiss Agency for Development and Cooperation (SDC) has been funding programs on postharvest management (PHM) in Sub-Saharan Africa (SSA) since 2008. SDC is implementing a phase out strategy that includes a capitalisation of experience (CAPEX) to analyse and discuss key insights and lessons learned from its PHM funding.

Two teams are facilitating a CAPEX exercise with five SDC funded PHM project in SSA, two and three projects for each team. Both teams collected information on the various innovation outputs - or assets – promoted, implemented or developed by the projects. This was done with a documentation review, field visits in some countries and an online survey. The assets are first characterised. They can be found at pre-storage, storage, post-storage level and range from technologies, practices, extension strategies, partnership models - including cooperation with the private sector to develop innovative business models- knowledge sharing and capacity building. The experience and results for key assets are then presented, as well as their sustainability and strengths and weaknesses.

The CAPEX teams have then analysed the positive and negative factors influencing success in PHM and compiled a list of lessons learnt. The key conclusions summarised below are related to the key guiding questions that have been identified for this CAPEX exercise and will be revisited during the October learning workshop. This present report presents all results from the CAPEX of one of the two teams. The report of the second team is given in a second document. This summary synthetizes the key conclusions related to the guiding questions. Both CAPEX documents will serve as basis for the learning workshop that will take place in Arusha, Tanzania, in October 2019.

Systemic change in PHM markets: The definition of the PHM market system is not understood in the same manner in the five projects. It is sometimes limited to one specific supply chain, as metal silo for example, and in other cases, it includes the whole agriculture innovation system related to PHM. These differences will be analysed and discussed at the learning workshop. Overall, a sustainable systemic change allowing poor and marginalised households to reduce their post-harvest losses and increase their access to grains and pulses markets could not be observed across all projects.

A sustainable system change, however, seems to be taking place for the relatively cheaper technologies, such as hermetic bags, and practices at farm level. In general, adoption of improved handling, drying and storage of crops at farm and community level has been strengthened by most projects and in most cases private sector actors are being engaged. Market for threshing equipment also seems to have improved. Systemic changes in rural advisory entities supporting this change were evident with the inclusion of PHM concepts in extension messages, either via agents and/or radios. Knowledge holders however, indicated that changes and innovation in the financial system to support PHM were slow or lacking. In several countries, the business case for the metal silos is weak. Farmers' household characteristics influencing adoption are known but sometimes ignored. In Tanzania, Mozambique and Ethiopia there is a business case for metal silos, but the adoption is slow due to the supply chain of raw materials and the high cost upfront

A system change in gender perception is evident. PHM gender roles and responsibilities at household level were recognised by most projects stakeholders and considered, with a different level of understanding and success, in all countries visited. However, public and private institutions engaged in PHM remain male dominated.

A system change in the way actors in PHM are working together was observed with the creation of linkages between suppliers and users, the involvement of different actors in training and the establishment of multi-stakeholder platforms for awareness raising and policy input. These platforms

also contribute to trust building, more or less important in the various countries.

Institutionalisation of PHM in training and advisory services: The institution anchorage of PHM as a topic in public extension services, in training institutions and as embedded service of private companies is mixed and very different results have been achieved in the different countries. In general, positive results have been reached in public institutions, particularly due to the high engagement of specific individuals willing to champion PHM, as well working with both research institutes and agricultural education entities resulted in integration of PHM training in academic and vocational training curricula. Institutionalisation process also took place through facilitating lead roles of the government in developing of training manuals and materials and in providing training. In all countries visited, PHM concepts were included in public extension services and in some countries. Farmers Field schools on PHM had been developed.

The involvement of private sector actors in advisory services to farmers was new in most of the countries visited and in some countries were used as an opportunity for small and medium scale agro-dealers to integrate PHM products and services in their business and collaborate more closely with the public extension system. Several awareness-raising actions (action weeks, drama, use of different media, local debates, metal silo opening ceremonies, etc.) had mixed success across all projects to sensitize producers to PHM and in some cases to initiate demand for PHM solutions. Finally, the sharing of PHM experiences through both AFAAS and FANRPAN raised awareness and promoted action across the continent.

Effective advocacy and shaping of PHM policies: At present many high-level government and policy leaders are well informed and talk about PHM at different events and in the media. The facilitation of multi-stakeholder policy dialogue has contributed to the integration of PHM at national policy level, be it a standalone strategy or integration in existing policies. Policy dialogue on PHM at national level was very much supported by policies at the level of the African Union that recognized PHM as means to address food security problems. Project stakeholders have invested in sharing PHM experiences with other organisations and initiatives, which resulted in disseminating PHM beyond the projects' areas.

However, in many countries, except for Tanzania, the drafting of by-laws and strategies was executed by external consultants. Even though this was done in a participatory and consultative process, the sense of ownership is not always present. In most countries visited, the allocation of public funds to PHM strategies was still left wanting. In some cases, knowledge holders mentioned that a lack of time and funding had negatively influenced ownership and public information campaigns about the new strategies or policies.

Knowledge management and dissemination: Knowledge management and dissemination through, the governments, the private sectors or the NGO community was done by most projects and had a wide outreach. As there was hardly any PHM material available in the countries at the beginning of the projects, the "hunger" for information and the involvement of supporting actors such as research, extension and training officials contributed to the acceptability of the materials. In many countries, materials were translated in local languages and have been used in various extension communication channels.

Looking specifically at the FAO community of practice (CoP). The conclusion is that such a platform is highly relevant, and many people interviewed during this CAPEX had posted material on the CoP. However, and surprisingly, several key knowledge holders of PHM were not aware of the CoP existence and had used other means to gather needed information. Some key informants expressed concern that other similar and/or complementary platforms exist and could eclipse CoP in terms of perceived relevance regarding convening power, knowledge sharing and advocacy, and therefore its

ability to attract new members.

Despite its obvious relevance, the effectiveness of the CoP is not as clear. Knowledge holders have highlighted the issue of the CoP objective. According to them, the CoP is not really interactive tool for dialogue and discussions yet. The publications, videos and information on events are perceived as very useful and already quite important and of quality. Finally, the sustainability of the CoP is still uncertain. More than half of the CoP users who has responded to the online survey would agree to pay fees to use the CoP, conditioning some improvements. This topic will also be part of the discussion at the workshop.

Résumé

La Direction au Développement et Coopération (DDC) a financé des programmes sur la gestion post-récoles (PHM) en Afrique Sub-Saharienne (ASS) depuis 2008. La DDC est en train de supprimer progressivement la thématique de la gestion post-récoltes. A ce titre, elle a commandé une capitalisation des expériences (CAPEX) pour analyser et discuter les connaissances et les leçons apprises clés durant les 10 années de son financement.

Deux équipes ont été recrutées pour mener l'exercice de capitalisation de trois et deux projets post-récoltes en ASS respectivement. Les deux équipes ont collectés des informations sur les différents extrants ou « actifs » de l'innovation promus, mis en œuvre ou développes par les projets. Ces informations ont été glanées sur la base d'une revue de la documentation, de visites dans certains pays et une enquête online. Les « actifs » sont d'abord caractérisés. Ils concernent le pré-stockage, le stockage et le post-stockage. Ils comprennent des technologies, des pratiques, des stratégies de vulgarisation, des modèles de partenariat, y inclus des coopérations avec le secteur privé pour développer des modèles d'affaires, de partages de savoirs et de renforcements de capacité innovants. Les expériences et les résultats relatifs aux actifs clés sont présentés, ainsi que des éléments de durabilité, leurs forces et faiblesses. Les deux équipes CAPEX ont ensuite analyses les facteurs favorisants et contraignants le succès en gestion post-récoltes and ont compilés une liste de leçons apprises. Les conclusions clés sont résumées ci-dessous. Elles sont en lien avec les questions d'orientation qui ont été identifiés pour cet exercice CAPEX. Ce présent rapport présente tous les résultats du CAPEX d'une des deux équipes. Le rapport de la 2ème équipe fait l'objet d'un deuxième document. Ce résumé synthétise les conclusions principales en lien avec les questions d'orientation. Les deux documents CAPEX serviront de base pour l'atelier apprenant, atelier qui aura lieu en octobre 2019 à Arusha, Tanzanie.

Changement systémique au sein des marchés PHM : la définition du système de marché PHM n'a pas été comprise de manière identique au sein des cinq projets. Le système est parfois limité à une chaîne de valeur spécifique, comme par exemple, la chaîne de valeur du silo métallique. Dans d'autres cas, il comprend le système d'innovation agricole en lien avec les pertes post-récoles dans son ensemble. Ces différences seront analysées et discutées durant l'atelier apprenant. Globalement, un changement systémique durable permettant aux ménages pauvres et marginalisé de réduire leurs pertes post-récoltes et d'augmenter leurs accès aux marchés des céréales et légumineuses n'a pas été observé dans tous les projets.

Toutefois, un changement systémique durable semble avoir lieu dans le cadre des technologies et pratiques les moins chères au niveau des exploitations agricoles, comme pour les sacs hermétiques par exemple. En général, l'adoption de manutention, séchage et stockage au niveau des ménages et des communautés a été renforcé dans la plupart des projets. Et dans la plupart des cas, les acteurs du secteur privé sont inclus. Les marchés pour l'équipement de battage semblent aussi avoir été positivement influencés. Des changements systémiques dans les institutions de vulgarisation agricole

accompagnant le changement sont évidents, avec l'inclusion de concepts post-récoltes dans les messages de vulgarisation, au travers de vulgarisateurs et/ou de la radio. Toutefois, les détenteurs du savoir ont mentionné que les changements et les innovations au sein du système financiers en lien avec les pertes post-récoltes sont peu importants, voire inexistants. Dans tous les pays visités, le cas d'affaire ou l'étude de rentabilité pour les silos métalliques ne semble pas clair. Les contraintes clés étant : i) Les déterminants de l'adoption au niveau des ménages agricoles sont connus, mais parfois ignorés, et ii) le coût de production élevé des silos.

Un changement systémique en lien avec la perception du genre est manifeste. Les rôles et responsabilités genre dans les PHM sont reconnus par la plupart des acteurs des projets. Ils sont pris en compte avec des degrés de compréhension variables et donc avec des succès différents dans tous les pays. Toutefois, les institutions engagées dans les PHM, privées et publiques, sont dominées par les hommes.

Un changement systémique en lien avec la manière dont les acteurs PHM collaborent a été observé, avec la création de liens entre les acteurs de la chaîne de valeur, l'engagement de différents acteurs dans la formation et la création de plateformes multi-acteurs pour la conscientisation et la contribution politique. Ces plateformes aident aussi à la création de confiance, plus ou moins importante selon les pays.

Institutionnalisation des pertes post-récoltes et vulgarisation agricole : l'ancrage institutionnel en tant que thématique au sein de la vulgarisation agricole publique et inclus en tant que services des compagnies privés est mitigé et des résultats très variables ont été obtenus dans les différents pays. En général, des résultats positifs ont été réalisés au sein des institutions publiques, particulièrement grâce à l'important engagement d'individus spécifiques, disposés à défendre la thématique PHM ainsi qu'à travailler avec des institutions de recherche et de formation agricole, collaboration qui a abouti à l'intégration de la formation PHM dans les curricula académiques et de formation professionnelle. Le processus d'institutionnalisation a eu lieu grâce aussi au rôle de lead qu'ont pris les gouvernements en développant des manuels et documents de formation et en offrant des formations. Les concepts PHM étaient intégrés dans les services de vulgarisation de tous les pays visités. Dans certains pays, des écoles d'agriculture de terrain (Farmers Field schools) ont été développées.

L'implication des acteurs du secteur privé dans les services aux producteurs était nouvelle dans la plupart des pays visités. Dans certains, ce fut l'occasion pour des petits et moyens agro-commerçants d'intégrer les produits et services PHM dans leurs activités et de collaborer plus étroitement avec le système de vulgarisation agricole public. Des activités de conscientisation (semaines d'action, pièces de théâtre, utilisation de différents médias, débats locaux, cérémonies d'ouverture, etc.), visant une sensibilisation des producteurs à la thématique des pertes post-récoltes et, dans certains cas, pour créer de la demande pour des solutions PHM, ont eu des résultats mitigés dans tous les pays. Finalement, les échanges d'expérience avec AFAAS et FARPAN a permis d'augmenter la sensibilisation et de promouvoir la thématique dans tout le continent.

Plaidoyer efficace et formulation de politique pertes post-récoltes : actuellement, la plupart des leaders politiques et gouvernementaux haut-placés sont bien informés et citent les pertes post-récoltes dans différents événements et dans les médias. La modération de dialogues politiques multi-acteurs a contribués à l'intégration du thème pertes post-récoltes au niveau national, soit en tant que stratégie spécifique ou intégré dans les politiques existantes. Le dialogue politique sur les pertes post-récoltes au niveau national a été grandement appuyé par les politiques au niveau de l'Union Africaine qui a reconnu les pertes post-récoltes comme un moyen pour résoudre les problèmes de sécurité alimentaire. Les acteurs des projets ont investis dans l'échange de savoirs PHM avec d'autres organisations et initiatives, échanges qui ont résulté à une dissémination de la thématique en dehors

des projets.

Toutefois, dans de nombreux pays, sauf la Tanzanie, la rédaction des arrêtés et des documents stratégiques a été réalisée par des consultants externes. Bien que le processus fût consultatif, la perception d'appropriation n'est pas toujours présente. Dans la plupart des visités, l'allocation des fonds aux stratégies de gestion des pertes post-récoltes étaient toujours en attente. Dans certains cas, les détenteurs du savoir ont mentionnés qu'un manque de temps et de moyens financiers avait influencés négativement l'appropriation et les campagnes d'information au public sur les nouvelles stratégies ou politiques.

Gestion du savoir et diffusion : la gestion du savoir et sa diffusion au travers des gouvernements, du secteur privé ou de la communauté des ONGs ont été exécutées dans la plupart des projets et a eu un fort impact de sensibilisation. Comme il n'y avait pratiquement pas de matériel sur la gestion post-récoltes dans les différents pays au début des projets, la « faim » d'information et l'engagement d'acteurs de support comme la recherche, la vulgarisation et la formation ont contribués à l'acceptabilité du matériel. Dans beaucoup de pays, le matériel a été traduits dans les langues locales et ont été utilisés dans différents canaux de communication de la vulgarisation.

Concernant la Communauté de Pratiques (CoP) de la FAO spécifiquement, la conclusion est que ce type de plateforme est très relevant. Beaucoup de personnes interviewées durant ce CAPEX ont postés des documents sur la CoP. Toutefois, et étonnamment, plusieurs détenteurs du savoir clés de la gestion post-récoltes ne connaissaient pas l'existence de la CoP et ont utilisés d'autres moyens pour rechercher les informations requises. Des informateurs clés ont exprimés leur préoccupation que d'autres plateformes similaires et/ou complémentaires existaient et pouvaient éclipser la CoP en termes de relevance perçue en lien avec le pouvoir de convocation, échanges de savoirs et sensibilisation, et ainsi d'attirer de nouveaux membres.

Malgré la relevance évidente de la CoP, l'efficacité de la CoP n'est pas claire. Les détenteurs du savoir ont mis en évidence la question de l'objectif de la CoP. Selon eux, la CoP n'est pas encore vraiment un instrument interactif pour le dialogue et les discussions. Les publications, vidéos et information sur les événements sont nombreuses, très utiles et de qualité. Finalement, la durabilité de la CoP est encore incertaine. Plus de la moitié des utilisateurs de la CoP ayant répondu à l'enquête online seraient d'accord de payer des frais pour utiliser la CoP, ceci sous condition d'amélioration. Cette thématique sera aussi discutée lors de l'atelier.

Abbreviations

AFAAS	African Forum for Agricultural Advisory Services
AGRA	Alliance for Green Revolution in Africa
ANSAF	Agriculture Non-State Actors Forum
ASDP	Agriculture Sector Development Programme
AU	African Union
CAADP	Comprehensive African Agricultural Development Program
CAPEX	Capitalisation of Experience
CoP	Community of Practice
FANRPAN	Food, Agriculture and Natural Resources Policy Analysis Network
FAO	Food and Agriculture Agency of the United Nations
FARIP	Fund for African Rural Innovation Promotion
IFAD	International Fund for Agriculture Development
GPFS	Global Programme Food Security
GPLP	Grain Postharvest Loss Prevention Project
GSE	Gender and Social Equity
HELVETAS	HELVETAS Swiss Intercooperation
IIAM	Institute of Agricultural Research Mozambique
IITA	International Institute of Tropical Agriculture
INRAB	Institut National de Recherches Agricoles
LGA	Local Government Authority
MASA	Ministry of Agriculture and Food Security
MAEP	Ministère de l'Agriculture, Elevage et Pêche
MoA	Ministry of Agriculture
MFI	Micro-Finance Institute
MSD	Market Systems Development
NEPAD	New Partnership for Africa's Development
NGO	Non-Governmental Organisation
PASDER	Programme d'Appui à l'Amélioration de la Productivité des Exploitations Familiales
PICS	Purdue Improved Crop Storage bags
PHL	Post-Harvest Loss and waste
PHM	Post-Harvest Management
PHP	Post-Harvest Practices
PHT	Post-Harvest Technology
PNIASAN	Plan National d'Investissement Agricole et de Sécurité Alimentaire et Nutritionelle
PPTL	Pee Pee Tanzania Limited – manufactures of PICS bags
RAS	Rural Advisory Services
SAHEL	Agro-entrepreneur, Benin
SDC	Swiss Agency for Development and Cooperation
SDG	Sustainable Development Goals
SSA	Sub-Saharan Africa
ToT	Training of Trainers
TPMP	Tanzania Postharvest Management Platform
TSS	Transaction Security System
UPC	Producer Union Provincial level
VC	Value chain
VICOBA	Village Community Bank
WFP	World Food Program

Table of Contents

1. Introduction

Based on the POSTCOSECHA program in Central America that led to successful adoption of the metal silo by more than 400'000 smallholder households, the Swiss Agency for Development and Cooperation (SDC) started in 2008 supporting different initiatives on postharvest management (PHM) in Sub-Saharan Africa (SSA). Currently, there are four ongoing SDC funded PHM projects in their last phase of implementation while one was closed a few years ago. These five projects aim(ed) to achieve similar objectives, have (had) a similar thematic focus and use(d) similar and partly the same key approaches in their implementation. Their common goal is (was) "to increase food security of smallholder farmers in SSA through reduced postharvest losses at farm and community level".

With this commitment, SDC has contributed significantly to an increasing knowledge base on PHM in Africa together with other donors and stakeholders. The projects have both regional and country focuses and have been implemented by UN agencies (Food and Agriculture Organization (FAO), International Fund for Agriculture Development (IFAD), the World Food Program (WFP)), as well as by international and local NGOs and government partners. Three projects under SDC's Global Programme Food Security (GPFS) entered their second and last phases in 2017/2018. In 2017, GPFS decided to phase out PHM as a core thematic focus by 2020/2021. To compile and analyse key insights from these PHM experiences and make these available for future initiatives, SDC decided to conduct a "Capitalization of Experiences" (CAPEX).

This CAPEX exercise consisted of two parallel studies using the same methodological framework and will produce one outcome product to inform future PHM interventions of SDC partners and other interested PHM stakeholders. The first study was mandated by SDC to capitalize experiences of the three projects "Reducing Food Losses through Improved PHM in Ethiopia", "PHM in Sub-Saharan Africa – FAO/IFAD/WFP" and "Effective Grain Storage for Sustainable Livelihoods" and it was implemented by Illudest. **The second study described in this document was mandated to Helvetas to capitalize experiences of the projects "PHM in Sub-Saharan Africa (PHM-SSA)" and "Grain Postharvest Loss Prevention (GPLP)"**.

Both study reports are an input for the discussions during the final learning workshop to be held in October 2019 with representatives from SDC, the projects and partners. The learnings of the workshop and the 2 studies will together produce the final outcome product.

2. Objectives and expected outputs

CAPEX is aimed at changing a specific practice or behaviour – within projects or programs (country programs, sectorial or thematic programs, etc.), or within concepts, strategies and policies. The accumulated and structured experience and capital is thus to be invested and implemented by SDC partners and other development practitioners in future interventions in order to achieve improved performance. This CAPEX study report is part of the overall learning exercise SDC initiated to capitalize on its post-harvest management portfolio in Sub-Saharan Africa and covers the 2 PHM projects implemented by HELVETAS in Benin, Mozambique and in Tanzania respectively.

The objectives of the overall SDC CAPEX are:

I. Get a practical, instructive overview of lessons learned on the approaches, strategies, methodologies used in the five projects by analysing successes and failures,
II. Use this evidence to communicate on SDC experience and expertise in PHM,
III. Use this exercise to define ways to improve approaches and future intervention strategies for tackling Post Harvest Loss and waste (PHL),
IV. To make the lessons learnt accessible to policy makers and other government officials

In collaboration with Illudest the following outputs of the CAPEX mandate will be produced:

- Inception report
- Concept report for the learning workshop
- Two CAPEX study reports
- Learning workshop
- Final CAPEX outcome product (interesting and attractive to the wider public)

3. Post-harvest losses in Sub-Saharan Africa

3.1 Context

The recently launched National Post-Harvest Management Strategy of Tanzania starts its introduction with "The global food security challenge is straight forward: by 2050 the world must feed 9 billion people (Parfitt, et al. 2010). The demand for food will be 60 percent greater than it is today. The United Nations has set ending hunger, achieving food security and improved nutrition, and promoting sustainable agriculture as the second of its 17 Sustainable Development Goals (SDGs) for the year 2030. While considerable attention is directed towards increasing food production by 50–70 percent to meet this target (SDG 12.3 on reduction of food waste and PHL), one important and complementary factor that is often forgotten is reducing food loss and food waste."

SSA countries are mostly low-income food deficit countries for which factors such as low agriculture production, difficulties to handle the high food prices, limited access to credit and difficulties to address the effects of climate change are all contributing to growing food insecurity concerns. The effects of post-harvest losses on food insecurity and low income from farming by smallholder producers is often not recognised and subsequently neglected.
The past 10 years, PHL increasingly gained importance in SSA. The African Union's Comprehensive Africa Agricultural Development Program (CAADP) recognizes PHM as means to address food security problems and launched, during its summit in 2014, the Malabo Declaration on Agriculture and Postharvest Losses. The Declaration has as one of its main goals the commitment to Ending Hunger by 2025 by double productivity, **reduce PHL at least by half**, and reduce stunting to 10%.

A recent report by the World Bank (World Bank et al., 2011) revealed that, each year 13,5% of the grain produced across SSA is lost after harvest, equivalent to USD 4 billion for grains alone, or the annual caloric requirements of 48 million people. This scale of food loss exceeds the value of total food aid received in SSA over the last decade, and further equates to the annual value of cereal imports to SSA.

3.2 The projects

The Postharvest Management in Sub-Saharan Africa project (PHM-SSA) and the Grain Post Harvest Loss Prevention Project (GPLP) have been implemented by HELVETAS and financed by the Swiss Development Cooperation (SDC) from 2013 to 2019 in respectively Benin and Mozambique and in Tanzania. Both projects basically aim at reducing postharvest losses in food grains and improving food security and incomes at farm level:

- **PHM-SSA**: Food security of smallholder farmers in Sub-Saharan Africa is increased through reduced postharvest losses at farm and community level
- **GPLP**: Reduced postharvest losses in food grains in the Central Corridor of Tanzania and improved food security and incomes of targeted farming households

Both PHM-SSA and GPLP used a Market System Development (MSD) approach to strategically implement the projects. The MSD is guided by four underlying principles: systemic action in market systems, sustainable change by involving actors with incentives to contribute to long-term change,

large-scale impact on the lives of poor farmers and taking a facilitative role by the project. The main market system consists of the supply and demand of food grains in which PHM is an important supporting function. To focus on PHM, both projects looked at PHM as a market system in which farming households and communities have access to improved post-harvest practices (PHP) and storage solutions as an important aspect for enhanced market integration. Interventions focused on the creation and development of these core functions of the PHM market system, demand and supply through strengthening the supporting functions and the enabling policy/rules environment. For more information on the two market systems, grains and PHM refer to chapter 5.7.1.

In each of the 3 countries national agricultural policies and strategies in their aim to increase food and income security have not paid adequate attention to PHL issues. At the onset of the first phases of both projects (PHM-SSA 2013, GPLP 2014), no specific PHM policy or strategy was in place and the situation was characterized by:

- Smallholder farmers facing high PHL at different stages of the PHM process
- Lack of awareness of and lack of knowledge and skills on improved PH practices and technologies
- Factual evidence on PHL at different levels of PHM was limited, and therefore difficult to translate into clear policy response
- General knowledge on PHL and training and advisory capacity to address PHL issues amongst public and private stakeholders was lacking and many people did not even recognize PHL as an issue

Both projects have initiated several studies to find answers on questions and analyse different situations such as market assessments, cost-benefit analysis, socio-economic analysis etc. There is a rich amount of both qualitative and quantitative information material available describing and capitalizing different PHM and market development aspects under the projects. This study capitalizes experiences of these 2 PHM projects. It provides insights on the projects' contributions to the market system and resulting achievements and contains lessons learned that can be derived from creating a demand almost from scratch for services and technologies that did not exist in the countries at the start of the projects.

4. CAPEX Methodology

The methodology used for the study is described in the inception report and only briefly outlined here:

1. List the assets being introduced into SDC-funded PHL programmes
2. Characterise all assets/innovations in the capitalisation process
3. Then value them in their diverse context and explore the broad context of the SDC funded PHM innovation process in SSA.

A set of key questions has been prepared to guide the studies:

- Innovation
  - What type of technologies, processes, management practices, communication tools or policies in PHM has made a positive or negative difference for the farmers since 2013/14? Which one of these assets have been promoted or duplicated with SDC funding?
  - Which assets have contributed or failed to contribute to the shift in focus defined by the 2018 Bellagio statement: from reducing PHL in quantity only to focusing as well on food quality, from focusing on PHL reduction in storage to a more holistic approach to PHM from field to fork, from the promotion of technology to an MSD approach and from single actor, single sector led technology promotion to multi-sectorial and multi-actor led innovation.
- Key success factors and constraints

- What are key successes and challenges encountered by men and women in adopting PHM assets? How have they been addressed? Which ones have not been addressed and why?
- Are you aware of the strategic reflection that has guided the promotion of specific assets in PHM by Government, Sub-regional organization, donors and others?
- Lessons learned: What was the role of SDC in supporting, accompanying, promoting, adapting PHL solutions and their support strategy: adaptation to changes?

- Sustainability and replication
  - What are the conditions (institutional, economic, social, and environmental) that need to be in place for any innovation in PHM to be successfully replicated (in a similar context)?
  - What are the elements that need to be put into place for PHM innovation to be institutionally, socially economically and environmentally sustainable?
  - Have business cases been created? and where business cases exist, has the private sector been engaged and how?

As previously indicated, the five projects use(d) similar and partly the same key approaches in their implementation mainly focusing on four major pillars:

- Technology (applied research for development, demonstration and dissemination (scale up))
- Markets linkages (business model development, financing, private sector engagement)
- Policy (regional harmonization, advocacy and institutionalization/mainstreaming of PHM) and
- Capacity building (training/education and infrastructure).

However, the CAPEX will be focusing on selected topics along these pillars that are not particular to a specific project or institutional set-up, but rather linked to issues that are of interest to all projects and future initiatives in PHM. Thus, CAPEX and the final learning event with the outcome document are expected to provide responses to the following key topics and main questions in line with:

I. Systemic change in PHM markets: What intervention strategies under which conditions and circumstances were successful, which failed? What hindered achieving systemic changes?
   a. Access to and adoption of PH Technologies: What were opportunities and constraints to trigger access to, demand and adoption of PHM technologies among smallholder farmers?
   b. Role of private sector: Through which business models could/can improved PHM options be disseminated? How did projects strengthen input markets for PHT? Why did a project fail or succeeded to strengthen input markets? How successful were projects in creating genuine demand for improved PHT?
   c. Value Chain: Have comprehensive Value Chain approaches been applied and if so, which approaches triggered private sector dynamic promoting the uptake of PHT by farmers?

II. Institutionalization of PHM in training and advisory services: How did projects achieve institutional anchorage of PHM as a topic in public extension services, in training institutions and as embedded service of private companies? What were successful strategies to integrate PHM sustainably into training modules of schools and universities, into duty books and competency profiles of extension agents and services provided by agro-dealers? How did projects contribute to national PHM policies/strategies development?

III. Effective advocacy and shaping of PHM policies: What are enabling conditions and strategies to commit decision makers? Which approaches were successful to bring about concrete changes in the formulation or implementation of policies of governments (national, sub-national),? What has led to successful ownership by local/national authorities of PHM?

IV. Knowledge management and dissemination (CoP): Relevance, effectiveness and sustainability of the CoP? what research outputs are available so far?

5. Project innovations

5.1 Post-harvest practices and technologies

5.1.1 Post-harvest – pre-storage practices

Farmers in the project areas have been deprived of very basic knowledge on practices that seem to an outsider logic. In Mozambique for example, harvesting time (humidity rate of the crop) and proper drying were identified as two main problems being important causes for PHL. In SSA it is common to dry crops on the standing plants in the field. This is a major cause for losses due to the prolonged exposure of crops to pests, animals and rain. Success and adoption rate of improved harvest, drying and threshing practices were therefore a win-win situation for the projects at farmer level.

The GPLP project identified during its inception phase "the potential of reduction of PHL losses through awareness raising on best practices at pre-storage level (harvesting, transportation, drying, shelling/threshing, and winnowing). This awareness raising is highly justified as it contributes to improving the income of the poorest farmers without requiring investment/ expenses from them. These stages in PHM are also highly important to improve in order to obtain best results during the storage stage (contributing to reduction of losses)." In Benin, the project developed a series of illustrated fact sheets, posters and videos on harvesting and drying for the training of farmers on good post-harvest practices.

GPLP: Decision making in PHM

Post-harvest steps	Who decides? (1, 2, 3 ranking)	Who does the work?
Harvest	1. Men 2. Both 3. Women	1. Both 2. Men 3. Women
Transport	1. Men 2. Both 3. Women	1. Both 2. Men 3. Women
Drying	1. Both 2. Men 3. Women	1. Both 2. Women 3. Men
Cleaning / Winnowing	1. Both 2. Women 3. Men	1. Women 2. Both 3. Men
Mixing storage pesticides	1. Men 2. Both 3. Women	1. Men 2. Both 3. Women
Selection of storage technologies	1. Both 2. Men 3. Women	

Experiences & results

A good harvest starts with good seed and production techniques. PHM promotion must go hand in hand with information on good agricultural practices. In Mozambique and Benin farmers collect their own seed for the next season. Sorting and cleaning of good seed, and proper storage till planting season are important practices for small farmers so stored grain seeds for the next season don't turn bad. The time of harvest is important as too early harvesting, will lower the yield and give unfilled or immature grains. In Benin and Mozambique harvesting was often too early with cobs not yet matured. One of the main reasons is the need for cash, and it are especially men farmers who want to sell as early as possible. Selecting good from bad cobs (store only the good ones) and remove all leaves from cobs before drying were other practices successfully promoted.

Tarpaulins to keep grains from getting soiled during different PH stages (during harvest, protection during transport from the field to the house, drying at home), are a very important way to keep grains clean and have been widely adopted in Tanzania. The supply of tarpaulins at local markets and places easily accessible to farmers is key and is easily picked up by local agro-dealers. Agro-dealers report that there is a constant demand for tarpaulins and they continuously promote them. In the project area in Tanzania, by the end of 2018, 24,752 tarpaulins were sold by 13 agro-dealers, who had direct links with the project; all tarpaulins were purchased by farmers at full costs.

Drying of cowpeas and maize

In African countries it is common to dry crops on the standing plants in the field. This is a major cause for losses due to the prolonged exposure of crops to pests, animals and rain. Validation with farmers of drying techniques in North Mozambique showed:

- Drying grain after threshing is faster, results in lower moisture contents (up to 12-13%) and eliminates pests more effectively compared to drying in cob/husk.
- The use of clean, dry surfaces avoids secondary infestation with pests or mould. Grains should never get in direct contact with the soil.
- Cement platforms or black tarpaulins are ideal: The drying is accelerated as they heat up with the sun.
- For even and fast drying, spread grains in layers of max. 2-3 cm. Turn the grains several times per day.
- Dry during the hottest period around noon, at least 4 hours per day.
- To avoid condensation water, the grains should be cooled down prior to putting them into bags or other recipients.
- Protect the drying area from animals, e.g. with fences and nets.
- For the repeated spreading and re-collection of grains on drying platforms, grains may get lost. Thorough handling is required to limit losses.

Different actors including farmers mentioned the importance in loss reduction when adopting improved drying and moisture management practices. Women farmers in Mozambique explained how they now check moisture in grains by using a glass jar and some salt (see picture). simple methods like biting in the grain or drop the grain on a hard surface to see if it jumps (jumping grain is dry) were used. The other practice that changed considerably was the stacking of maize in the fields or leaving threshed maize cobs in the fields exposed to the weather. Instead farmers opt for transporting the harvested cobs to the farmhouse for drying. In Mozambique, some farmers mentioned difficulties with drying on a tarpaulin or concrete floor and preferred elevated drying platforms.

Training in better drying and moisture management techniques resulted in new basic skills and change of behaviour of most farmers including those that did not opt for hermetic storage in a silo or bag. Drying on an elevated drying platform is well adopted in Mozambique and can easily be constructed with locally available materials. Elevation is another concept easy to adopt to keep grains dry also for stored grains in bags. With increased awareness and skills of smallholder farmers on improved PHP, adoption rates of different PHP by farmers in the GPLP project areas in Tanzania were above 70% with the highest adoption rate (82%) for using (rented) shelling machines for maize.

Sustainability & replication

PHP were win-win measures in each of the 3 countries. Farmers try new practices that are not expensive and see and feel the results quite quickly. Changes in using improved PHP are easily visible in the field, such as time of harvest, use of tarpaulins, less stacking in the field, use of threshing machines (Tanzania) and behaviour to keep maize clean at the market places. With farmers and advisory service providers trained, these practices have picked up in the project areas and are spreading within the region. In both projects good PHP are also introduced in the curricula of public and private agricultural training institutes, so all advisory staff trained will be equipped with PHP knowledge. Sustainability at local level is reinforced when PHP measures on hygiene and use of chemicals, etc., are taken up in district by-laws such as in Tanzania.

In Tanzania, a national PHM strategy has been approved in August 2019, which contains a lot on improving practices and awareness. PHP are known by government officials and replication can already be observed in a government program (TANIPAC), which includes improved PHP to reduce the risks of aflatoxin and promotes metal silos, including training of new artisans in 16 regions.

Strength and opportunities

- Learning about the need for proper drying; applying relatively simple techniques to test on moisture content, improved threshing techniques proved quick win-win situations for the projects and for the smallholders
- Especially women adopt these practices rapidly as it concerns their roles in PH practices, eases their workload (use of tarpaulin), investments are little, and it prevents a lot of losses during storage, especially important for grain for home consumption.
- For Rural Advisory Services (RAS), both public and private, harvest, transport from the field and drying practices are low input advisory services which create a good basis for recognition by and trust with farmers.
- With improved PHP, farmers start to reflect and opt for different storage strategies, which create opportunities for adopting improved technologies.
- Farmer awareness and training positively influenced adoption of PHP and PHT. A study under GPLP (Hans-Moëvi, M, 2018) concluded that when husband and wife are trained separately, there's is a difference on adoption of PHP, with the wives adopting significantly more the tarpaulins and the husbands shelling machines.

Weaknesses and threats

- Changing behaviour, overcoming traditional practices and adding new steps in the PH process takes time, especially in still very traditional farming communities such as in Benin

5.1.2 Improved traditional storage

Improving and modifying different features of traditional storage systems was addressed in Benin and Mozambique (clay granaries in Benin, bamboo silo and traditional sileiro in Mozambique). The traditional storage systems in Tanzania, vihenge, were at the start of the project already becoming scarce in the Central Corridor due to behaviour change and to limited access to scarce local construction materials (wood) and restrictions by LGAs. Instead farmers used polypropylene (PP) bags often in combination with the use of chemicals.

Experience & results:

Improving local existing traditional storage systems focused on improving humidity and insect and rodent control by roofing or changing the covering, elevation from the ground, protecting the separation from the ground from termites, treating with Actellic liquid of walls or Actellic dust between layers of cobs. Such improvements went hand in hand with improved practices before storing as mentioned in §5.1.1., as well as regular control during storage. Adding a metal outlet at the bottom of the traditional silo eases access and reduces workload as one single person instead of two can extract grains. In an improved traditional granary or silo, grains can be protected up to at least 8 months. Studies in Benin concluded that, though losses might reduce a bit, improved granaries are not an effective means to reduce PHL. In Mozambique the farmer unions also mentioned that improved granaries are a limited success because farmers are more interested in the new technologies. This does not mean they abandon old structures but use new and old storage systems as part of their PHM strategy. Efforts to make improvements remain limited. Proper management and use of storage chemicals were promoted for the use of all storage systems.

> Women farmer in Boukombé, Benin: "with traditional granaries, I needed help of a child or my husband to take out maize through the top of the granary. With the improved model, I can easily access maize on my own, and lock the opening with a padlock, which gives me better control over the use of our food."

In Benin, from 2015, the project through ERAD introduced the technology in its training/sensitization program (posters) and farmers started demanding improved clay silos from local masons. In 2019, this demand is still high.

In Tanzania, by the end of 2017, 35,611 farming households adopted improved PHP practices as part of their traditional system, e.g. use of certified storage chemicals and in proper dosage, (an achievement of 192% against the target of 18,722 HH). A study in Tanzania, concluded that more men make decision and work on the application of chemicals while more women make decision and work on cleaning and winnowing of grains when it concerns general PH practices (Hans-Moëvi, M, 2018).

Sustainability & replication:
The advantage of improved traditional systems is that they are culturally acceptable, knowledge to construct is locally available and that other farmers see and learn from neighbours and can copy the improvement.

Strengths and opportunities
• An improvement of traditional silos makes use of local material and there where materials are not yet scarce or restricted the costs are still relatively low. • Making traditional storage systems is a known system and farming communities have the knowledge and the skills. • In Benin granaries are socially acceptable and still seen as part of status. • Adding a metal outlet at the bottom of the traditional silo eases access and reduces workload as one single person instead of two can extract grains. • The reduction of wood consumption is an incentive/opportunity to promote other improved PHT.
Weaknesses and threats
• Effectiveness to reduce losses are generally lower with traditional methods. Compared to hermetic storage systems. Problems arise when proper drying practices are not followed and regular control or use of Actellic during storage does not take place resulting in limited success of the improved systems. • In areas were wood and clay is scarce, availability of material for construction is a problem.

5.1.3 Hermetic storage systems

Hermetic storage or placing an air and water barrier between grain and the outside air, was in all 3 countries a relatively new and innovative concept. The concept is based on the biological consumption of oxygen with as a result that most insects will die. It provides a storage system without pesticides as moisture and insects are controlled. In the North of Tanzania some farmers have been observed to use plastic drums to store grains and, by pressing grains together and airtight sealing, creating a hermetic drum. In the project areas no such practices have been observed and there was no demand and adoption of improved plastic barrel after the pilot testing in the project area. In Benin, some farmers use airtight 20-liter water containers for storage of maize seeds. Handling and management are very important as opening and closing of hermetic systems allows air to enter.

Metal silos

Issue: A metal silo is a cylindrical structure made from galvanized metal sheets and soldered with tin to be hermetic. It sits on a platform 15 cm above floor level and needs to be in a space protected from rain and sun. A silo has an opening on the top to fill in the grain and an outlet at the bottom side for taking out the grain, both covered with an airtight lid. Before storing grain in a silo, it needs to be sorted, threshed, cleaned, properly dried in the sun and finally cooled to air temperature. Metal silos can be made in different sizes as per farmer needs; in Mozambique they are of 250, 500, 1000, 1200 and 1500 kg, in Benin of 250 and 1000 kg and in Tanzania 500, 1000 and 2000 kg. Periodically checking of the conditions during storage is needed and grain can be protected at least for 12 months.

Experiences & results:
Although CIMMYT started working in 2009 in neighbouring countries (Malawi, Kenya, and later in Zambia and Zimbabwe), metal silos were a radical innovation for both users and producers in the project areas. In each of the countries, the technical feasibility of metal silo production was positively evaluated during feasibility studies (Kurt Schneider, 2014). No metal silos were available or produced in the countries at the start of both projects, so it required investment in a production, supply and distribution system from scratch. Even metal sheet work and tin soldering were completely new for local tinsmiths. This meant that projects had to facilitate the establishment of an entire new metal silo value chain and pilot business models. This included capacity building of artisans, starting the production of silos with market actors, input supply financing and facilitation of a distribution channel on the supply side. On the demand side this included testing and validating of metal silos at smallholder farmer level, raising awareness, capacity building and dissemination, and loans and seed money for farmers.

With no vocational training locally available to train artisans in metal silos, in each country an expert trainer from abroad was hired to train artisans as master trainers, who were then engaged to train local artisans. In Mozambique and Benin artisans selected were tin smiths, while in Tanzania also welders were selected. In Tanzania, there are presently about 71 active artisans making metal silos, and an analysis of gender roles according to work division and decision making in production of metal silo was done during an artisan refresher training. It was observed that women members of the household were also engaged in fabrication of silo, and task division helped artisans to realize the important role and contribution of women in metal silo business. As a result, two women participated in the artisan helper training, and gender roles and task division were then embedded into the artisan training manual. (GPLP, End of Phase I report, 2018)

In Mozambique, and especially in Tanzania, though the metal silo supply chain is in place, it is raw material dependent, the supply of metal sheets (and soldering acid) remains a challenge. In Mozambique there is one large metal sheet dealer (MMI Kiboko Steel from Tanzania) at national level which focuses on roof materials and metal pipes. So far, no intermediate suppliers have been identified to stock sheets who could supply to local agro-dealers or artisans. Import is not done by agro-dealers but by large companies and the use of sheets is for different products. If demand is high for one product, supply for silos construction might face problems. Since the start of the projects, the prices of sheets went up (from 2014 to 2019 prices more than doubled), which affected the price and sales, respectively application (and purchases) by farmers. Skills and knowledge of artisans to construct the silos is well in place and of the 72 active artisans in Tanzania, many have trained own additional staff (youth).

At the end of 2018, projects reported a total of about 800 metal silos produced and sold in Mozambique and about 3100 in Tanzania including other initiatives the projects were collaborating with (e.g. AGRA World Vision). In Tanzania and Mozambique, the metal silo is adopted by a reasonable number of farming households, mostly for storing maize, sorghum and pulses for home consumption but in some cases also for sales. In Benin, the upfront investment was too high for farmers as most couldn't pay off the full amount for a silo in 1 year and adapted financing instruments are not in place. The social acceptability of the metal silo is less in Benin in comparison to traditional granaries which still provides for social status. In the project area in Mozambique (and some in Tanzania), the average maize farming family produces about 400 kg of maize per year. For many households these amounts are too little to opt for a metal silo with a capacity of 500 or 1000 kg. This is one of the reasons why the project in Mozambique chose to promote silos with a capacity of 250 kg.

In Benin, the low capacity and skills of tinsmiths resulted in quality issues in silo production. It also proved difficult to interest an almost absent private sector to be motivated in developing a business model for silos. As a result, it was very difficult for the project to develop a vision on a viable business model. In addition, it was not clear who would be the target clients for silos i.e. for which farmers are

silos most beneficial and for which farmers less. A study done under GPLP (Hans-Moëvi, M, 2018) concluded that women perceive metal silos as empowering as they keep the keys of the lock and controlling the household's food and their husbands cannot sell the maize for other purposes. The latter feel less tempted to "rob" maize from their family to sell it for their own needs. Parents are happy, children cannot open the silo and play with the food as was the case when the maize was stored in bags. In addition, the maize is more easily accessible than it used to be in the traditional silos, also for kids helping in the household with preparation of food. In general, a silo is easy to handle during filling and for daily use. With the use of chemical for the bags, men became responsible for the storage of maize for the household. The silo shifted this again back to the family.

> Farmer: "before, men were not allowed to touch the kihenge otherwise the family would be cursed. So storage was a woman's job. When chemicals arrived, men were the ones going to town buying them and learned how to use them, so it became a men's work. Now with the new technologies, it's family work, everyone can do it. It improved women's involvement, and can easily be passed to the children."

Sustainability & replication:
The interest of farmers in Mozambique and Tanzania proved the potential of metal silos for safe storage of grains (maize). Sustainability of the metal silo value chain depends on the business case for the actors in the VC, their financial capacity, access to credit, technical skills of artisans, and the price and availability of raw materials.

In 2016, districts in Tanzania started allocating budget for PHM promotion and awareness of farmers which contributes to sustainability and replication of the use of hermetic storage technology by farmers. This is reinforced by the inclusion of PHM in district by-laws.

Hermetic bags

Polypropylene (PP) bags were used by farmers to store maize and other crops, especially in Tanzania but also in Mozambique, so the concept of a bag for storage was known and hermetic bags were less of a novelty in the 3 countries than metal silos.

Experiences & results:
No hermetic bags were available in 2013 in the project areas. In Benin and in Mozambique they were also not produced in the country. In Tanzania, there was no supply at project inception but at the end of the 1st phase of GPLP in 2017, there were two producers and 4 brands (2 imported) of hermetic bags on the market.

The big challenge was and continues to be the supply and distribution to smallholders. In Benin till this year adoption of bags has been very low mainly due to few supply chain actors. Only one small family agro-dealer enterprise linked to an importer of bags in the capital is investing in a distribution network; starting in 2016 with selling 2500 PICS bags after intensive promotion, with little progress in 2017 and 2018 due to an unsteady supply of bags from wholesalers. Since 2019 a new start is tried out with the distribution through local grocery stores as promoters to bring the product as close to the farmer as possible. Thanks to the various promotion activities of the project, a good number of farmers are convinced of the effectiveness of hermetic bags for storage and are ready to buy, but a still weak supply chain could so far not satisfy their demand.

In Tanzania, the GrainPro bag was imported and used in the coffee sector. In 2014, PICS bags, that have been developed by Purdue University, were promoted with USAID funding by the company PPTL. GPLP started with the promotion of PICS bags. In 2016, the company AtoZ Textile Mills Ltd brought the AgroZ bag on the market without any donor subsidies. These market actors compete but also influence each other. When AgroZ came with an offer to sell a minimum of 50 bags to agro-dealers, PPTL also changed from a minimum of 100 to 50. GrainPro added another layer to the bags after the layered PICS bag was on the market. During the first phase, the project by far exceeded its hermetic bags targets. Agro-dealers sold by the end of the phase, 60,535 hermetic bags to 12,107 farming

households compared to a phase target of 680 households. By the end of 2018, this number almost doubled, within and outside project target areas.

Mozambique started in 2014-2015 with 1 national level distributor for GrainPro or Superbag. The project developed 3 business models and tested one promising model with public – private cooperation. In 2015-2017, the local cooperative COOSEN adopted the business model with main outlets in the district towns. In 2017 cost of superbags doubled due to increase of importation taxes (linked to a new government law to reduce use and circulation of plastic). It was observed that PICS Global entered the market and the project has facilitated linkages with nationals and distributors and retailers. In 2018, through contacts with HELVETAS Tanzania, the project established contacts with AtoZ. AtoZ produces plastics, packaging and textile products and Mozambique is an interesting market for them. The company agreed to and supported establishment of market linkages and a feasibility study in Mozambique. This exercise ended with the identification of 1 national distributor, Casa da Agricultor, based in Maputo. Today: Over 10,000 AgroZ bags have been marketed and expect to reach 20,000 by the end of 2019. The main outlets are in Nampula, Maputo, Chimoio. Currently 3 actors (Casa da Agricultor, Casa Agraria and MMB) are marketing the bags in the intervention area with an active distribution network of contacts/agents in the communities. This seems the beginning of an effective distribution network, which also depends on the market demand for other products of AtoZ. Due to promotion and facilitation work of the project, networks for hermetic bags have started to diversify with in Northern Mozambique, now three brands (PICS, Super GrainPro, AgroZ) that compete on the markets. Especially with the new market players PICS Global and AgroZ, availability of the products in the districts and villages is improving and a demand for the bags has been established.

Farmers use different PHM strategies and not necessarily opt for only 1 technology. In Tanzania and Mozambique, a PHM strategy depends on combining different technologies like for example a metal silo for storing produce for home consumption, hermetic bags for later sales and PP bags for immediate sales. The strategy depends on different factors such as how much maize is there for storage, what are cash needs, what is needed for home consumption, but can also vary per area and gender.

Sustainability and replication:
In Tanzania and Mozambique, the supply chain for hermetic bags has been developed, market actors are linked and local manufacturers (Tanzania) or importers (Mozambique) are in place, distributors provide supplies to agro-dealers, and agro-dealers have an outreach at farmer level. In both countries the demands of hermetic bags by farmers is growing and spreading. New initiatives of different actors such as donors, government, private sector and NGO (including HELVETAS) further support this upscaling. In Benin, after a difficult start, a distributer of imported PICS bags from Nigeria, Africo SARL, and an agro-dealer in the North, SAHEL, are collaborating more closely to establish a distribution network of hermetic bags.

A GPLP study on postharvest practices and technologies (Hans-Moëvi, M. and Guenat, D, 2018), mentions that household income does influence the adoption of PHT with farmers with lower incomes preferring the hermetic bags, compared to the use of PP bags in combination with chemicals and last the metal silos. The study also highlights that when income increases, adoption of metal silos tends to increase as well. It describes that in theories about adoption of improved farming technologies, different sources say that farmers with surplus production tend to adopt more than those in deficit. The same is confirmed by the study, where farmers who produce generally enough to cover their household's needs adopt more PHT than those who do not produce enough. The adoption rate of metal silos is twice as high in the group who produces enough and almost 3 times as high for hermetic bags. Adopting PHP however, seems not to be influenced by income as also households with a low income have a high adoption rate. This is most probably because the promoted PHPs are no-cost practices / behaviour changes or are not expensive (tarpaulin, renting shelling machine). Non-

adoption relates often to lack of knowledge or understanding of the benefit of the practice (I've always done without it").

Strengths and opportunities

- As mentioned under traditional storage systems in Tanzania, the number of vihenges in the Central Corridor has been decreasing, and reduced availability of wood for construction was an additional incentive for the promotion and use of metal silos and other improved PHT.
- Factors that contributed to the uptake of metal silos were:
  - serious infestations with rodents, i.e. in Mozambique adoption in Nampula was about 65% compared to Cabo Delgado 35%,
  - different organisations involved in the promotion,
  - farmers organized in groups or part of a farmer union facilitated promotion,
  - when seed production at farmer level is well established, silos are a safe way to store seed grain,
  - storage of high value crops with higher loss rates (than maize) e.g. beans
- In Mozambique where shifting cultivation is often still a major practice, metal silos are easy to move when a farmer shifts to new farming land, which is one of the most likely reasons that the Gorongoza Silo (promoted by FAO) was not successful.
- PHP in all 3 countries are easily adopted by farmers and a necessary base for introducing improved PHT such as hermetic systems.
- In Tanzania and to a lesser extent in Mozambique the availability of private sector actors to step into the metal silo value chain was crucial.
- Some actors mentioned that a hermetic storage facilitates a shift to producing for the market at farm household level.
- Farmers rate hermetic storage technologies effective to control storage pests and highly accept them for health reasons.
- Increasing demand for hermetic bags.

Weaknesses and threats

- Feasibility studies in both projects focused mainly on technical feasibility but did not pay much attention to cultural acceptance, potential consumer need and demand, purchasing power, possible marketing strategy, which in the case of Benin proved to be main hurdles to establish a supply chain.
- The maize market does hardly differentiate and value quality, which does not contribute as an incentive for farmers to invest into storage of surplus maize for later sales.
- Main factor for low adoption of metal silos are high initial investment cost
- but also, the competition of the much cheaper hermetic bags that came on the market and gave farmers a choice.
- Absence of a raw material supply chain and high import taxes on raw material
- In Benin, the weak tradition of tinsmiths resulted in quality issues in silo production and to interest an almost absent private sector in a possible business model for silos was difficult
- Difficulties with drying under humid conditions does not favour hermetic storage systems, such as is the case in central Benin, where in Phase I, the project recognized that for this area promotion of drying technologies and techniques before storage is key.

5.2 On-farm research, testing, validation

To promote improved PHM from a market system development perspective, farmers in the system need evidence that PHM can be improved, provides immediate benefits, and thus is offering more food security and better income. Other market actors need evidence that PHM is an interesting business model.

Experiences & results:

In both projects, phase I emphasized testing and evidence building on improved PHM practices and technologies. In Tanzania, the effectiveness of 7 different storage methods for maize were tested under conditions of smallholder farmers, including the use of different hermetic storage technologies (metal silos and plastic barrels with and without fumigation with phostoxin, and PICS bags) and non-hermetic polypropylene (PP) bags combined with insecticide treatment (ZeroFly® bags with yarn treated with Deltamethrin and maize grain treated with Actellic Super). The testing concluded that all hermetic storage techniques tested were effective in preventing maize damage by insects for a storage period of 30 weeks and can be recommended. There was no significant difference between hermetic treatments (with or without phostoxin fumigation). (refer to GPLP & IITA, 2017)

In Benin the project mandated INRAB to conduct on-farm trials in order to evaluate the effectiveness and acceptability of technologies. In 2016, INRAB tested PH innovations in both project areas, i.e. zero fly bags, PICS, improved clay granaries and metal silos at farmer level (more than 50% women). The aim of the trials was to evaluate the loss level of maize of each technology with and without use of chemicals (Actellic) and to calculate cost-benefit of each technology for the farmer. The ranking of cost benefit: Savalou (Central Benin): 1. PICS, 2. Silo, 3. PP Bags, 4. Improved granaries. Boukombé North Benin): 1. Improved Clay Granary, 2. Silo, 3. PICS.

In Mozambique the collaboration with a national research institute (IIAM) consisted of setting up demonstration units at both district and at community level which was done together with training of lead farmers and extension agents on better PH practices. As part of the on-farm validation, GPLP organized demonstration of 3 storage technologies in villages at a farmer's place; a metal silo, PICS bags and a PP bag with chemical treatment all filled with maize. Farmers had to provide their own maize. Some farmers preferred not to show stored harvest to others at their place in fear of it to go bad. What was important of these on-farm demonstrations, was creating experience by farmers to use their testimony in awareness raising events and training. In Mozambique the metal silos and other technologies were demonstrated in public places more easily accessible for farmers. Demonstration sites in more public places such as in Mozambique seem to work well and have a wider outreach. The latter also gives public extension staff opportunity to provide information and promote the technologies.

GPLP applied an action research approach to inform the project and PHM stakeholders with information and data that would guide the project and steer it in an effective manner. This included both technical (e.g. on-farm validation of effectiveness and efficiency of different storage technologies) and socio-economic studies and knowledge. Findings were made available to stakeholders at all levels and used for multi-stakeholder learning, in order to support systemic development. Partners for action research were selected from different actors providing support function services to the PHM value chain such as agricultural research institutes, universities and private consulting companies.

GPLP: In Latin America metal silos are fumed with phosphine. Action research in Tanzania showed that without fuming the results are not different. Based on this result, GPLP stopped promoting the use of chemicals in metal silos. Today, all maize stored in metal silos is safe, i.e free of storage chemicals.

Strengths and opportunities

- Testing and validation of PHT proved very productive, both in terms of ownership by the government and in creating evidence for further dissemination and capacity building.
- Public actors responsible for on-farm research and validation contribute strongly to ownership and integration in other interventions
- Cost-benefit analyses give insights in the feasibility of PHT business cases

Weaknesses and threats

- For demonstration purposes and sharing results with other farmers, the choice of letting the farmers provide the grains did not work out well as the farmer not necessarily see the need to share storage results with others as they own the grain.

5.3 Information & Dissemination

With no or hardly any materials on PHM available in the countries, both projects invested in gathering information and data through on-farm-research, different studies, etc. This process continued throughout the projects' lives and contributed to a rich range of studies, training and information materials on PHM, including manuals, factsheets on different technologies, posters, but also instruction and information videos. Production and validation of material was a multi-stakeholder process. In Benin information and training materials have been produced under the lead of AFAAS. In 2015, AFAAS facilitated the development of a dissemination strategy in a workshop with multi-stakeholders (AFAAS, Ministère de l'Agriculture, Elevage et Pêche (MAEP), Helvetas, Private Sector, media, FO, NGO, Communes, CARDER, MFI, Artisans). The strategy included a roadmap and roles of actors in the dissemination process. In Mozambique IIAM produced a training manual on PHM that is being used for promotion and training in different institutions. IIAM organized write-shop meetings for inputs of different actors. In Benin, dissemination through the government extension system (CARDER) was planned together with MAEP. However, the structural reform of CARDER, which led to its dissolution and the creation of a new service ATDA (Agence Territorial de Développement Agricole), interrupted this initiative for about 2 years. Lately, functioning of and collaboration with ATDA has picked up again with good potential for large dissemination of PHM in Benin.

Dissemination took place using different methods and actors. Action weeks were used in PHM-SSA and were part of mass sensitization in project areas. They included a range of activities, including radio broadcasting, drama, video projections, debates with local leaders, promotion by artisans etc. aimed at raising awareness and providing information on PHM issues. Action weeks are an innovative form of conveying information to large numbers of people from different social backgrounds during a very short time. The project adopted the idea from PHM projects in Latin America.

In Tanzania, local public extension staff and agro-dealers raised awareness through organizing public village level meetings. Especially men participated in the awareness raising events, while the number of women was higher in the training of groups. Farmers who were involved in testing hermetic storage technologies on their farms, were invited to testify during awareness meetings. They very positively promoted the use of the hermetic bags which contributed to their adoption in the villages.

In both projects local and national radio stations were used to raise awareness on PH practices and technologies. For this purpose, the projects produced jingles and spots that would interest the listeners and inspire to adopt good practices around the harvest, transport, drying and threshing, and that promote the use of new technologies such as the metal silos and hermetic bags. The broadcasting would coincide with the agricultural calendar at moments that farming families would plan and prepare for different activities. In Mozambique for example, 12 main PHM messages were spread over the year as per the calendar. In 2015, PHM issues and solutions were also introduced to an existing SMS platform with market information on grains for farmers run by a local organisation AENA. SMS messages with PHM advice (with a structured content with relevant messages following the maize season during the year) are send to farmers. The SMS services still run to date but might end when the funding (by AGRA) stops. In Benin, interactive programs with debates among farmers on their experiences with PICS bags were particularly appreciated by listeners.

PHM-SSA, through its partner AFAAS, has expanded its outreach at the regional level. The wealth of products prepared in Benin and Mozambique has been translated in English making products available in 3 languages, French, Portuguese and English. To reach out into the region and share the materials, AFAAS organized training events and workshops in five other countries – Malawi, Cameroon, Nigeria, Madagascar and Uganda, including a wide range of stakeholders such as farmer organisations, universities and professional schools, local NGOs, and government institutions mainly from ministry of agriculture and extension services, and reaching over 30 new partners and networks. 13 partners trained in these countries were reported to have launched own PHM initiatives and used PHM

contents in their capacity building work. During these ToTs, the MSD approach was seen as an opportunity to develop the PHM supply chain, but it was mentioned that development practitioners, government and private sector actors would need to be oriented and understand. Private sector actors were the only ones hardly represented. Some of the main outcomes of these meetings are different initiatives to group PHM actors i.e. in Nigeria a group of actors joined in an online PHM platform and try to bring along the private sector. Another outcome is that hermetic storage technology is not unknown in the countries, but supply chains hardly exist. In Malawi, leaders of 3 local cooperatives trained over 250 farmers on PHM practices, use of PICS bags and silos.

AFAAS shared that the multi-stakeholder approach promoted by the project resulted in sharing of knowledge and skills (both African and European) on how to handle PHM issues and how to facilitate market-based solutions instead of just providing subsidies by the government. To create opportunities for the private sector without financing them were new insights for many stakeholders. Another lesson for AFAAS was the constructive collaboration through online communication. In future initiatives to develop extension material, AFAAS would recommend a stronger engagement of the government as extension services in Africa are fore and most public. All materials are available on the AFAAS e-platform and on the FAO CoP. AFAAS monitors the use and downloading of material from the e-platform but this is not impressive. AFAAS: "*At present this is totally demand-driven and practitioners in many SSAs do not have the culture to seek information. The question is how to make it more supply driven.*" Or how to increase the demand and / or accessibility of information.

Both projects gave special attention to roles and the needs of women in developing communication materials, based on outcomes of studies on gender roles and on adoption of PHP and PHT.

Sustainability & replication:
Integrating PHM in existing public extension services and the training of extension staff as such is geared towards sustainability.

Good PH practices to reduce PHL have been shared with a wider SSA community. After phase 1, AFAAS reported that through its country fora over 20 organizations in 12 countries (including universities, research institutes, ministries, national and international NGOs and farmer organisations) have integrated PHM in their training activities for farmers and extension workers based on RAS tools and information developed under the project.

The action weeks remained a project instrument but at the level of the "clients" and the organizers, the action week was an important event that stays in clear memory until today. It had an important impact on the perception of the population on PHM issues. Thousands of people from farming communities participated during the weeks. Participation in events of an action week were accessible for all as it took place at market places and the different types of dissemination techniques made it diverse and interesting. Some of the techniques were replicated in later stages such as the radio broadcasts.

For agro-dealers and extension agents-cum-agro-dealers, but also for artisans in Tanzania, mass media and especially local and national radio were new instruments to widen their outreach and sales. Agro-dealers in Tanzania nowadays take own initiative to market their products through the local radio. Social media also proved useful in marketing products by placing pictures and being reachable for potential clients.

Artisan Costa Karodi from Kibaigwa advertised metal silos on the back of his car and through local radio: "because they heard me on the radio or saw the ad on my car, I went to Tanga, Makambako, Iringa, Njombe and other places to make metal silos for clients."

Strengths and opportunities

- Dissemination strategies through the government have a wide outreach and have been facilitated in both projects through integration of PHM in training, in planning of awareness raising, and work on policy development.

- The content of the PHM material is new, as there were no such materials on PHM. The involvement of different stakeholders in preparing these materials contributed greatly to the acceptability of the materials and to the dissemination.
- In general, the combination of embedded services (free advisory services embedded in the selling of inputs) and the supply of PHT provided by private sector actors works well.
- Action weeks assisted in large outreach in the areas and kick-starting of awareness on PHM.
- Use of local radio to market products by local agro-dealers was new but easy to copy.

Weaknesses and threats

- Action weeks were not owned by a system actor, but project driven

5.4 PHM in training and advisory services

At the onset of the projects, promotion of improved PHP and PHT through awareness raising, training and advisory/extension services was in both projects identified as a lacking supporting function to the PHM market system. Consequently, the gap in training and advisory services to advise and train farmers on PHL issues and solutions needed to be addressed to support both, the demand for as well as the supply of PHP and PHT.

Experiences & results:

The following shows the project intervention strategy working towards integrating PHM in training and advisory services:

Initially, GPLP trained both public extension workers and agro-dealers in the districts in PHM through trainers that were selected from within the Ministry of Agriculture. When the project experienced that large agro-dealers initially selected were not interested in PHM, it was decided to invest in strengthening capacity of smaller agro-dealers, especially in marketing, entrepreneurship and supply chain management. For this GPLP used private sector service providers.

In Mozambique, different service providers were engaged to build capacity of key actors such as national and local governments, local service providers, NGOs and farmer organizations. Partnering with the 2 provincial farmer unions (UPC) and with the public provincial and district extension services in the different intervention stages of the project helped in taking PHM further. RAS staff all mentioned that PHM was new to them and being involved, being trained and being responsible for extension and training on PHM, made it easy to integrate PHM in their day to day work. Very recently PH issues have been integrated in Farmer Field Schools as part of extension activities that are operated at district level. As a result of the training of extension workers on PHM, they are now able to monitor and record progress. Both UPCs have integrated PHM in their planning and see PHM as a strategy that supports the trend to more commercial farming and to orient farmers toward the market and towards safe food for their families. "Though PHM was always there, with the project it became an integrated part of the work."

> Armando Enriques, UPC Cabo Delgado:
> "We embedded PHM in all union work with our 9000 members and we integrated it in two other projects. It is very much in line with our advocacy work on safe food without chemicals."

In Benin, AFAAS widely disseminated the didactic material among different public and private stakeholders such as Ministry of Agriculture and its extension service ATDA, projects like AMSANA,

and NGOs like BUDPOS. Capacity building and training of farmers was mainly done through the 2 local partner NGOs. The 24 farmer groups established with the support of the project for running warehouse receipt systems for maize showed to be effective entry points to spread information about PHM. As these farmers were already busy with jointly storing quality maize for later sale, they proved to be specifically receptive for training on PHM issues at farm level. These groups provide a high outreach to women, as 70% of their members are women.

During awareness raising events more men came to the public places where they were held. Women participated in training by extension staff. Through working with savings and credit groups, at least 2/3 of the trainees were women. When GPLP moved in the 2nd phase to a new wards within the same districts and decided not to work with saving and credit groups but with general farmer groups, the members of these groups were mostly men. To tackle this, women were targeted at household level and received training from the extension staff or/and from the artisan during installing metal silos on the farm.

To address the gap in training on PHL issues for advisory services, PHM-SSA analysed the functioning of existing PHM RAS by public and private actors. In Mozambique, the national research institute IIAM was key in a discussion with agricultural education stakeholders. Based on agreement reached in open space multi-stakeholder dialogue, IIAM discussed with different agricultural institutes and agreed on how to proceed to integrate PHM in training per institute; individual assessments of PH in training content and action planning including capacity building for integrating PH in different curricula. This process is still ongoing. In Benin, the project supports the organisation of different workshops with government agricultural education stakeholders at national level to adapt developed training material so that the modules on PHM can be officially integrated in curricula of agricultural colleges and universities. In Tanzania, the Ministry of Agriculture Training Institute (MATI) took the lead in the development of a national level PHM training manual.

In both projects, Gender and Social Equity (GSE) issues were incorporated in training. In Tanzania, each module of PHM training manual developed by the Ministry contains GSE elements. In the training of trainers (ToT), extension agents were oriented on GSE. For example, a special session on gender using audio-visuals tools allowed to observe gender roles and relations and who influences decision making in PHM based on field reality. Gender issues, especially work division and decision making, are discussed with smallholder farmers during PHM training organized by extension/advisory persons.

Sustainability and replication:
Selecting master trainers from within the government and providing them ToT directly contributed to ownership and sustainability. The approach of joint learning of public extension staff and private ago-dealers resulted in:

- Extension workers know the farmers and villages and could introduce the agro-dealers. Most agro-dealers made for the first time a link to farmers in their villages
- Both learned to promote PHP and PHT, they work together on promotion
- Establishing lasting links between the extension agent and the agro-dealer, often resulting in the agent serving as a sales person for the agro-dealer, thereby earning a commission on PHT (tarpaulins, bags) sold

In both Tanzania and Benin, integration of PHM in agricultural education has been taken up at national level, which is an effective way to assure that PHM in rural advisory services will continue at a national scale. A national PHM training manual will guide all public and private agricultural education institutes on PHM and assures PHM as an integrated topic in training of all public and private RAS persons. Sustainability increased with the main responsible actors taking the lead role in developing training. An example is the role MATI in Tanzania took to develop the national level training manual on PHM.

Strengths and opportunities

- Main national level training actors taking the lead role in developing training

• Using multiple “channels” including private and public actors for dissemination and training • Extension workers know the farmers and villages and introduce the agro-dealers • Establishing lasting links between the extension agent and the agro-dealer
Weaknesses and threats • Awareness and farmer training, though organized and provided by system actors, continued being financed by the project. In an initial stage there is no choice as no one else will finance. In a later stage this needs to be taken up by systems actors

5.5 Finance mechanisms

Access to finance for investment in PHM by farmers, agro-dealers, and artisans is in both projects one of the bottlenecks in adoption of appropriate PHTs. Farmers may need only small amounts for bags or for a silo, which can be met by “informal” village saving and credit schemes. Agro-dealers need larger amounts as working capital, i.e. to buy stock. Here the link to formal financing is needed. In general, access to finance for smallholder farmers in the project areas exists and mostly takes place through village saving and credit systems. However, farmers hardly take credits to invest in PHM.

5.5.1 Saving and credit groups

Both projects promoted saving and credit groups, though to a lesser extent in Benin where alternatively to a classical saving and credit group, the warrantage system[1] was promoted. A savings and credit group is a group of 10 - 25 people who save together and take small loans from those savings. The activities of the group (VICOBA and VSLA in Tanzania; Saving and Rotational Credit groups in Mozambique) run in ‘cycles’ of about one year, after which the accumulated savings and profits are shared out among the members according to the amount they have saved.

In Tanzania, cash needs of farmers were addressed through a seed money system involving artisans and VICOBA groups, to introduce metal silos at farmer level. Newly trained artisans were provided by the project with materials to construct 10 metal silos (= seed money in kind). In the VICOBA group, one farmer could buy a metal silo by paying TZS 20’000 to the artisan for the work and by paying in instalments to the VICOBA group for the material. With this money on the group’s account, another farmer as VICOBA member could then take a credit and purchase a silo. Priority was given for women participation while establishing VICOBA groups (65% of VICOBA members are women with 26% from women headed households) (GPLP, 2018). The awareness and promotion through the VICOBA group was successful but the use of credit for PHT did not pick up. One of the reasons was the unstable price of the metal sheets doubling the market price of a silo.

Towards the second half of the 1st phase, the project in Mozambique contacted different MFIs, presented business models for PHM, and shared analysis reports to raise their interest in PHM but without success. Very few MFIs intervene in rural areas and micro loans are considered risky. PHM-SSA started working with existing community-based **saving and credit groups** and training them in financial literacy and business management for the acquisition of PHM technologies as an alternative to looking into linking farmers to MFIs. Since 2017 the project collaborates with the Banco Futuro, an SDC supported initiative. Banco Futuro focuses on microfinancing of small saving groups and SMEs (about 6,000 customers; 5,800 groups, 200 SMEs). After a rapid market assessment, Banco Futuro signed an agreement with the project to look into microfinancing for some of the savings groups, agro-dealers and farmer-traders. Loans would vary between 10,000 to max. 100,000 Mozambican Metical and run max. 1 year, always starting with financial training. At present more evaluation of potential customers needs to be done.

[1] *Warrantage*, is a French word commonly used in West Africa, and describes the inventory credit system (normally called the warehouse receipt system in English).

5.5.2 Communal storage systems

To address post-harvest issues around storage and access to finance, PHM-SSA in Benin introduced a warrantage system (also called inventory credit system) in the project areas, whereby farmers, organized in a cooperative, collectively store their different produce at harvest in a warehouse and use their stored produce as a collateral for credit. They partner with an MFI and based on the quantity and quality they together agree on the value of each product and a credit amount, on average at 80% of the quantity stored. Individual loans are then attributed to member farmers by the management committee of the cooperative based on their respective produce stored. Produce is usually collectively sold when prices are higher and the credit with the MFI is paid back accordingly against an interest rate of 6-10% for a 6-month period. The project worked with service providers (NGOs) to set up cooperatives, introduce the warrantage system and train the farmers. The following timeline shows the steps by the project to introduce the system:

2013	2014	2016	2017
The project organized a study visit to Niger to existing warrantage systems that the FAO introduced in the late 90ties	The system was tested in 2 communes (Boukombé and Savalou) and the positive results were used to train more farmers through farmer to farmer exchange visits to the 2	During an action week, the warrantage system was promoted amongst villages in the intervention area which triggered more demand by farmers	In phase II focused on warrantage as a means to promote PHM, food security and income generation and was promoted amongst 24 farmer groups.

During phase 1 warrantage proved a successful answer to 2 main problems that prevent farmers from adopting PH technologies, namely the need for cash right after harvest leading to selling off the grain and lack of cash to invest in PH technologies. However, at present only 13 of the 24 groups are operational and only 2 of these groups are considered organizationally solid and independent.

In Benin, women are used to collectively safe and provide credit in the Tontine Groups so that they could build on this experience. Women make the lion share of members in warrantage groups. In Mozambique, warrantage and other collective storage schemes are not common. The Department of Commodity Exchange, Ministry of Industries and Trade, promotes big warehouses for storage. Other existing warehouses in the project districts are mostly owned by private operators. In 2014, the project explored working together to see if these warehouses would support a warrantage system. They decided against it as the warehouses are hardly accessible to smallholder farmers due to distances and high quantity of produce required.

In GPLP a model was tested linking grain storage and marketing with micro-credit, the “Silo Receipt System” (TSS model). In 2016 and 2017, piloting of TSS took place and opportunities to work with maize millers for market development for household level PHT such as the metal silo were explored. See next box:

GPLP 2016: The project partnered with Fund for African Rural Innovation Promotion (FARIP) and Tanzania Biashara Mapema (TBM) on piloting the Transaction Security Services (TSS) model to promote metal silos for business purposes. Action research on testing the viability of TSS model in Msowero ward was implemented: 20 selected farmers together stored their maize in metal silos of 1000 kg. Maize was stored for 5 months from September (price TZS 60,000/bag) and sold in February (for TZS 140,000/bag). After deduction of transaction costs and rent of silo, farmers received on average TZS 132,000 per bag or additional TZS 72,000/bag compared to the price paid in September. Although the seasonal price variation of maize that year was very high, the pilot proved that through the TSS model, storing grains at household level using metal silos can boost the income of smallholder farmers.

2017: Based on the lessons from piloting the TSS model in 2016, the trial expanded as a business case with 125 farmers. About 100 new metal silos were disseminated, grains bought from the farmers and filled during the harvest season. TBM and farmers are waiting for the right time (when the price is higher) to sell the grain in the market. With the export ban imposed by the Government and lower price of grain in the market, it seems however that farmers will not get the same amount of bonus as in last year.

GPLP Annual reports 2016 & 2017

Sustainability & replication:

The warrantage system provides a solution for safe storage of grains and pulses, access to credit after harvest and reduced urge to sell the crop directly after harvest to benefit from a better price for the produce at a later stage. Though it is a new system in the project area, in other parts of Benin the system has been promoted by other agencies and as such it was not a new system for MFIs. For those farmers that are part of a warrantage system, access to credit and commercialization are more important incentives to do warrantage than safe storage. Thanks to the organizational support to groups provided by the project, MFIs (CPEC and CCIF) were open to take the risk and test the model.

Even though, warrantage offers farmers a solution to different problems, so far, the business model has not been replicated independently by MFIs. Therefore, organizing and accompanying warrantage systems is still dependent on local NGOs and on donor finance. As mentioned by Schneider (2004) "farmers with substantial surpluses are likely to need options, which allow them to store at low cost and to use their stocks as collateral for finance (inventory credit) to tide them over to such time as they are ready to sell." In both Tanzania[2] and Mozambique, the projects have not promoted the warrantage system in the selected areas but opted for smaller storage systems that will mainly be used by individual households to store food for home consumption.

5.5.3 Input supply finance

PHT input supply financing is a relatively new finance service in project areas (in its simplest form, involves the financing of agricultural activity by other value chain actors - such as input supply companies and other agro-dealers who if needed access financing from banks for working capital to finance farmer customers.).

At the start of the projects, it was assumed that agro-dealers had sufficient financial means, especially in Tanzania where the project started with large agro-dealers. When the large agro-dealers dropped off and the project started working with more and smaller agro-dealers, the need for financing and business skills emerged. In 2016, the project linked agro-dealers and artisans with 2 banks (Equity Bank and Tanzania Postal Bank) through a partner organization (AGRA). As financing PHT was new for the banks, the project had to facilitate meetings with AGRA, the banks, agro-dealers, and artisans to come to a loan arrangement for PHT; whereby 60-100% of the loan are directly paid to PHT manufacturers to supply material and 0-40% are paid to the client.

[2] The warehouse receipt systems (WRS) are known in Tanzania and is promoted by HELVETAS in its rice PHM project.

In Mozambique and Tanzania input supply financing emerged on a small scale in the form of credit by the agro-dealer to a farmer, who buys a metal silo and pays in 2-3 instalments. The agro-dealer in turn also buys supplies from a larger supplier possibly with an in-kind credit. Thirdly, the agro-dealer provides all the material for making silos to artisans, so the artisan is paid for labour only and does not have to make upfront material investments. In Benin, the credit farmers receive from storing under the warrantage system could be used to invest in PHT, and access to credits from MFIs would not be necessary.

Sustainability and replication:
Though no direct funds were invested in agro-dealers, projects invested in linking agro-dealers to other actors to increase their business network. Better linkages to both farmers and input supply actors resulted in direct contacts and building trust which serves as a good basis for input supply finance. In Tanzania, the business development services (BDS) training given to agro-dealers was instrumental in further developing their business in general and to try out input financing models and applying for credit from the banks. Through the linking with 2 banks, in Tanzania 7 agro-dealers and 3 artisans using credit services, mostly for hermetic bags and metal sheets.

Strengths and opportunities

- Saving and credit groups have usually a high women membership, and training to the groups builds capacity of women.
- Saving and credit groups are a safe environment for women to save and take loans. The groups as well are a platform to learn.
- Saving and credit and warrantage groups proved a good platform to introduce PHM investments to farmers when linked to advisory services.
- Members of warrantage groups are obliged to apply good PHM practices to comply with the quality requirements for stocked produce. As a result, members have a higher adoption rate of good PHM practices.
- Lending/advancing through agro-dealers leverages the benefits of farmers; facing trusted parties. The embedded services of agro-dealers combine advice, inputs and provision of finance that enables farmers to increase productivity and income, and for artisans to earn an income. The risk is with the agro-dealer, who minimizes this through trust relations and embedded advice.

Weaknesses and threats

- Support to groups is a long process as the system is relatively complex (credit contracts with MFI, internal management and record keeping, collective marketing etc.).
- S&C / VICOBA groups lend mostly for faster income generating activities, not for PHTs.
- The projects have invested relatively little and rather late in developing financial services.
- Warrantage is a model practiced in other areas in similar ways in Benin, but MFIs are reluctant to enter because of high risks (bad governance of groups, poor stock management resulting in losses of produce), unless there is some project “guarantee”.
- A business model based on NGO support is not fully sustainable. It is local NGOs that facilitate the setting up and capacity building of warrantage groups. They at the same time act as "moral guarantee" to MFIs and are funded by donor money.

5.6 PHM policies – business environment

In each of the 3 countries national agricultural policies and strategies in their aim to increase food and income security have not paid adequate attention to PHL issues, and no specific PHM policies were in place. Both projects aimed at improving policy and framework conditions to reduce postharvest losses in food supply chains, with primary focus on the selected countries and, for PHM-SSA, also on the level of regional institutions and stakeholders.

Experience & results

GPLP worked on advocacy and policy at two level, namely at district level with district fora and at national level with a national multi-stakeholder PHM platform. The Tanzanian Postharvest Management Platform (TPMP) was formed during the project with the aim to bring all possible national level PHM actors together, create a common understanding and advocate for PHM at policy level. The project also partnered with the Agricultural Non-State Actors Forum (ANSAF) for policy advocacy, with ANSAF taking up a secretary role in TPMP. Under TPMP an analysis of Postharvest Policies and Framework Conditions in Tanzania (GPLP, 2014) was done. The study showed that while there were some policies, laws and strategies which aim at addressing the problem of high PHL in Tanzania, there was no specific policy and/or strategy for PHM. The study was presented by TPMP to the Permanent Secretary (PS) of the Ministry of Agriculture. As the agricultural policy for 2013-2018 was still ongoing, a new policy was not an option (with new policies come new laws), but MoA aimed at the development of a national level PHM strategy. It was the PS who decided, after getting a proposal of TPMP to hire a consultant for the said job, that "this can be done by ourselves, as we have the inhouse expertise". The formation of a temporary multi-stakeholder platform has been instrumental to meet with government staff and to present outcomes of multi-stakeholder dialogue to the government. With foresight, GPLP reported in their annual report of 2017, that the "development of a national level strategy incorporating inputs from multiple stakeholders, mobilising support from various organisations and the bureaucratic process of approval takes time.

The following timeline shows the development of the national strategy:

2016	2017	2018	2019
MoA acknowledges proposal to develop strategy, MoU signed with MoA, taskforce established incl. representatives of MoA, HELVETAS and ANSAF (TPMP with oversight role, ANSAF gives technical backstopping), zero draft produced	Zero draft shared in TPMP annual general meeting for consultation, opinions collected in 6 zonal meetings (supported by AGRA), "first draft" shared and endorsed by MoA management Team	Draft strategy expected to be shared for wider stakeholder validation incl. other Ministries and donor communities early 2018 before being finalised & approved by MoA mid 2018	The NPHMS approved mid 2019

Local district level fora consisted of farmer representatives, agro-dealers, private sector, NGO/CBO, government officials, and councillors. The main aim was to push the local government to create an enabling environment for the PHM market, including the development of PHM related by-laws. Members would share and discuss their issues during the meetings. The fora in Kondoa for example assisted in looking for local solution for different issues such as:

- Dust and dirt in grains offered at the market resulted in a by-law on cleanliness
- Misuse of liquid chemicals for storage, resulting in a by-law forbidding the use
- Selling by farmers of "lumbesa", 100 kg bags with an extra 10-20 kg on top, to middle men (today, supported by a by-law, farmers mostly sell at the market were bags can be seen and weighing scales are in use).

The content on PHM was mostly new. To inform policy makers, research results were extensively used in policy dialogue. Policy briefs were a formative element for government officials and other stakeholders. Gender and

2018 GPLP observations:

Increased PHM investment (48.5%) by MoA from TZS 81.5 billion in 2017/18 to TZS 121 billion in 2018/19.

Newly launched ASDP II emphasises PHM by targeting to reduce PHL by 50% in line with Malabo Declaration.

MoA plans to construct 15 grain warehouses with total capacity of 31,000 MT in 15 regions.

At the district level, 5 out of 8 districts allocated budget for PHM in the district development plan.

Climate Change issues including aflatoxin were incorporated as transversal themes in both the strategy and by-laws.

In Benin, the process of integrating PHM in the Agriculture Sector Strategy (PSDSA 2017-2021) and in the Plan National d'Investissement Agricole et de Sécurité Alimentaire et Nutritionelle (PNIASAN), as well as the follow up/control and advice during implementation of the strategy by the government took time. The orientation of the new government including the structural reform of MAEP was the main obstacle for the successful completion of this intervention by the project. Scientific evidence on the PHM situation in Benin was an important factor fostering buy-in by the Ministry. PACIB took the lead in this policy process and its experience and credibility in agriculture policy reforms made it a good interlocuter for MAEP. Its network, be it professional or personnel within the Ministry and other institutions, was an important door opener. The concrete policy messages integrated in the present PSDSA are 1. Capacity building of farmers on safe storage and conservation solutions, 2. Development of conservation and storage infrastructures and 3. Elaboration of a reference document on food norms and strengthen the capacities of control of norms and qualities.

Under the Malabo declaration, AU member countries committed to implement PHL reduction measures. In Mozambique, having no data on PH and the failure to report back to the AU led to discussions and a push for a standalone policy on PHM. It was decided to opt for a National Strategy on PH which is supposed to be drafted by the end of 2019. Different actors had no doubt that the multi-stakeholder platform interventions by the project have contributed to reflection and decisions that led to this decision.

FANRPAN played an important role both at local and regional level, using its regional policy research and advocacy network in disseminating PHM and related policy messages to other governments and policy stakeholders in the region. During their Regional Policy Dialogue in Maputo (November 2018), PHM was showcased prominently with attendance of over 200 key experts from 15 countries. The sharing of PHM experiences under PHM-SSA with a wider SSA community through both AFAAS and FANRPAN raised awareness and promoted action.

Sustainability and replication:
Districts with by-laws on PH issues give the local government a range of instructions from harvest to the market, which can be reinforced up to village level by the village executive officer. In Tanzania results are already observed in some districts, while other districts also started enquiring and some copied the draft by-laws from a district under GPLP for own use.

In both projects the facilitation of multi-stakeholder policy dialogue has contributed to the integration of PHM at national policy level, be it a standalone strategy or integration in existing policies. Actors do not doubt that for both projects, the interventions on policy and advocacy have supported these decisions and that the interventions on evidence creation, sharing and dissemination, etc. have highly contributed to putting PHM on the agenda.

In its annual report of 2018, the GPLP reported that both at district and at national level, an increase in investments was observed in PHM due to the increasing awareness on PHM and its effect on the economy, and on the health benefits of using hermetic technology. Working on national level policy advocacy needed “knocking on the right door”, a long breath and a matter of timing. Though in 2014 a new policy was not an option, the new Tanzanian PHM Strategy, is presently being used to review the old agricultural policy in preparation of a new policy.

Though this was not part of the project’s intentions, in Tanzanian TPMP has registered as a company limited by guarantee as part of its sustainability and it continues engaging in PHM policy advocacy.

Five district fora are planning to formally register as a CBO to continue advocating on PHM at the district level, for which they have developed action plans (covering 3 to 5 years).

Strengths and opportunities • Clear roadmap and responsibilities to develop a strategy are important to work on policy with different stakeholders . • The process facilitated strong ownership by the MoA and good collaboration with different organisations such as AGRA and FAO. • Projects were instrumental in raising the topic of PHM and engaging in policy dialogue. Without the project, PHM would most probably not appear in the PSDSA in Benin. Part of the evidence was produced by others (FAO). • Different actors mentioned positive effects on the creation of ownership through the process of evidence creation - policy message formulation - policy dialogue - integration in sector strategy - follow up the implementation - awareness creation to put PHM on the agenda of different actors. • The formation of a temporary multi-stakeholder platform is a very useful instrument for advocacy on PHM policy to meet with government staff and to present outcomes of multi-stakeholder dialogue to the government.
Weaknesses and threats • The agreed time frame and funding of a project might not be enough to follow a policy development process till the end.

5.7 Market System Development approach

5.7.1 What is it?

Both PHM-SSA and GPLP adopted a market system development approach, looking at the supply and demand of PHM services and technologies as a market system in itself; supply side with viable businesses offering PHM technologies and services responding to a demand for these technologies and services. The PHM market system is directly linked to the grain market system as an important supporting function, i.e. households and communities will have access to improved storage options as an important aspect for enhanced market integration (see figure 1). As explained in the project document of PHM-SSA, “on the supply side, viable businesses for PHM technologies and services are established through capacity building and access to credit, responding to raising demands for affordable and effective PHM facilities. By addressing PHM issues further (e.g. at the policy level, regulatory frameworks), this will result in a better market integration of producers, ultimately leading to improved quantity and quality of food supplies and increased incomes through sales of stored grain at higher prices. In all these aspects, the role of men and women will be specifically considered in order to ensure that possibilities to empower women are optimized.”

The market system development (MSD) approach assists in identifying and assessing functions and actors in the market system and to design interventions that address the root causes of why the market fails to meet the needs of smallholder farmers.

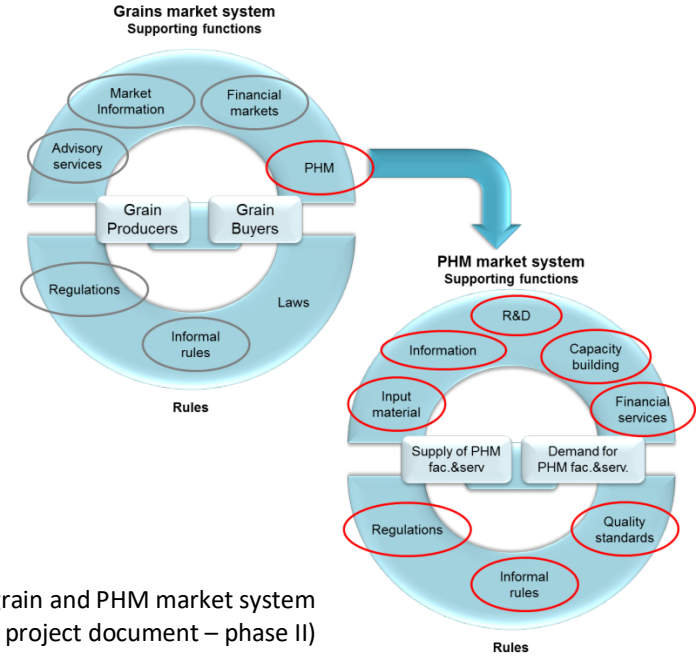


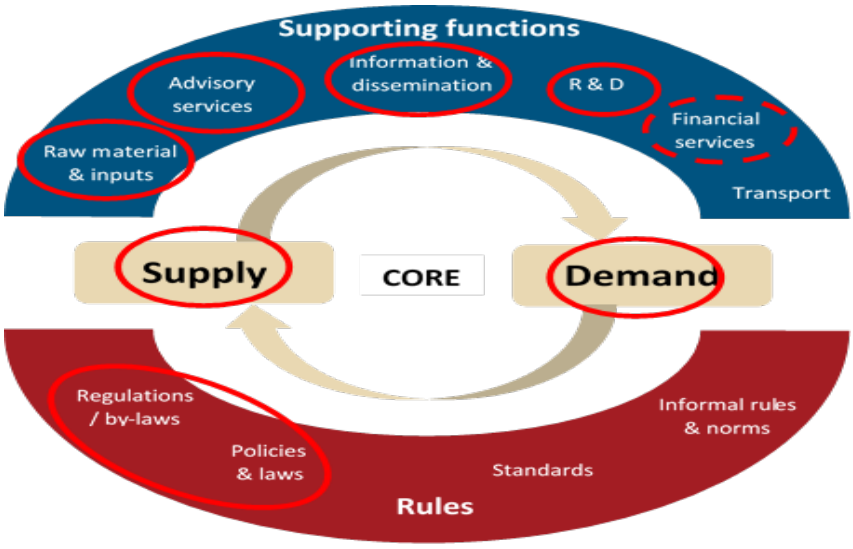
Figure 1: Interconnected grain and PHM market system
(from GPLP project document – phase II)

5.7.2 Market analysis

Both projects' first phases started with an analysis of the PHM market system in the project areas mapping the system and different actors and identifying a series of bottlenecks on the supply and the demand side as well as at the level of support functions (raw material and inputs, advisory services, information and dissemination, research, weak financial services) and policies and rules (no standalone PHM policy and regulations), see figure 2 below. This systems approach lens gave project partners and PHM actors an insight in the system and the status of its different elements, especially of what was lacking. The non-existence or poor quality of support functions was a major constraint in both projects.

Both projects continued to do research, assessments, cost-benefit analysis, etc. to analyse the market system, find indications of change in behaviour of system actors and to steer their facilitation and dialogue with partners.

Figure 2: PHM market system



5.7.3 Selection of and working with partners

Selection of partners in the PHM system is crucial to work on changes in the market system and it is important to distinguish between core actors and market supporters and service providers, which GPLP described as follows:

- Core actors are individuals, organisations, or companies who make up the system, shape it with their activities and often derive income doing core business in their own product (grain, PHTs e.g. metal silo, PIC bags etc.), i.e. agro-dealers and artisans are important market actor partners for the projects.
- Market supporters and service providers are different types of organizations (government, NGOs, private sector e.g. consulting firms) providing a range of services to the market actors.

Both projects delegated roles and responsibilities for different interventions to partner organisations, both core actors and market supporters. This gave the partners a strong role in the projects from the beginning and made the facilitating role of the project team clear. Working with multi-stakeholders to develop the PHM market worked well. In GPLP, key-actors were selected based on the three levels of the market system: core transaction, support services and business environment (see phase 1 doc page 30). The government is an important partner in the approach as it provides extension services to farmers and are responsible for creating an enabling environment. Both at the level of the districts and at national level the project worked with government focal persons, who were responsible for planning, coordinating and monitoring of all PHM activities at district and at national level respectively. The role of the focal persons was particularly important to have the permission and support of local authorities to work with different public and private actors in their districts.

In 2013, in both Benin and Mozambique and to a lesser extent in Tanzania it proved difficult to find core actors along the supply chain of PHT. Performance of actors related to their skills (artisans), size and capital (artisans, small agro-dealers). Input suppliers along the supply chain ideally would have a strong track record of providing a range of inputs to small and medium sized farmers, combining inputs like seeds, fertilizer, and plant protection products, with strong relationships with and closeness to local farmers, and with a knowledge of farming. In case of metal silos, artisans needed to be found to make the silos but also actors who deliver raw materials such as the galvanized sheets. Time was invested in identifying actors who then were supported by building their capacity. Both projects invested considerable time and resources in training of artisans to make the metal silos.

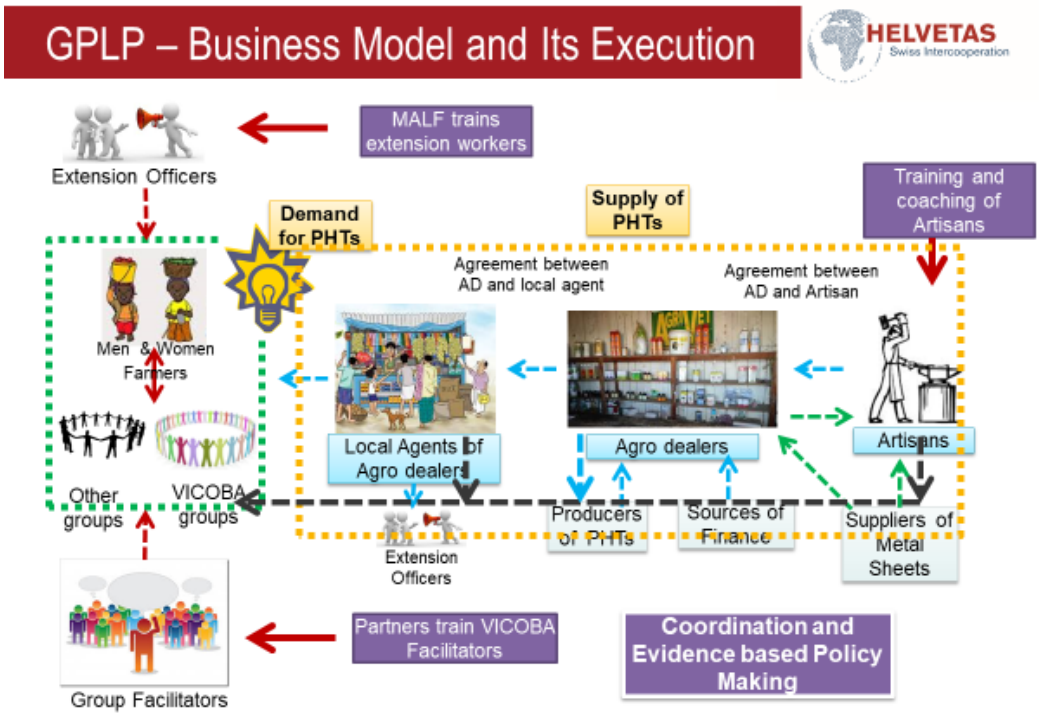
> Mr. Hemant, GM MMI Kiboko Steel, Mozambique: "Our core business is roofing and iron tubes. We deliver in large orders with upfront payment. We can deliver galvanized sheets to make metal silos, but agro-dealers are too small and need to find wholesalers which can buy in bulk from us and store."

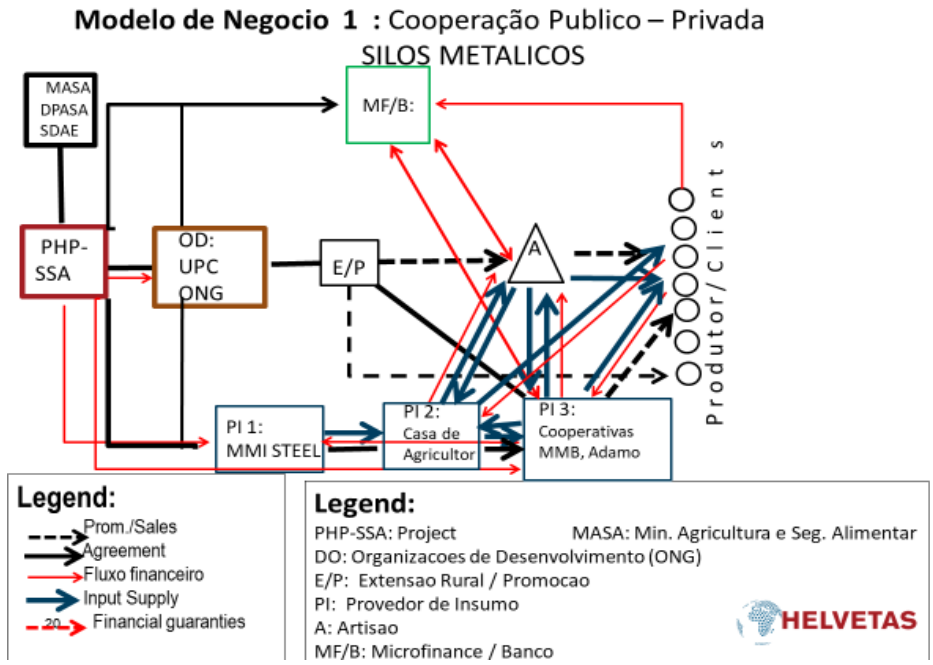
As PHM and business skills of different supporting actors were limited, both projects invested in strengthening capacities; artisans to fabricate metal silos, government extension staff to train farmers, etc. This is a key contribution to developing the market system. Artisans now get requests from agro-dealers to make silos, including from new actors in and outside the project areas. Extension agents are asked for support by agro-dealers and earn commission on promoting PHTs. In fact, different public extension staff stepped into PHT supply, some started an input shop, other do it mobile to get a regular income out of selling PHT, especially hermetic bags and tarpaulins.
An interesting strategy used by GPLP was the use of agro-dealers to mobilise PHM trained extension officers and lead farmers to train farmers. In its end of phase I report, the project reported that 50,615 (49% women) farmers were trained (134% of target) through this strategy.

Different actors mentioned the positive effects of the multi-partner collaboration and the spaces the projects created to reflect and review together. It took stakeholders on a PHM learning by doing journey. It enabled to enlarge their professional network and establish new working relations. It contributed to learning from each other and solving of issues around PHM.

5.7.3 Business models

In both projects, cooperation between public and private organizations was the basis for the business models on PHT as promotion of new technologies costs money and no private actor will invest as long as there is no demand. For the metal silo, for example, projects facilitated the introduction of the metal silo and other PHP to farmers in rural areas by local extension officers and agro-dealers. Extension officers and sales agents were trained with necessary knowledge to train farmers on PHM and were provided with training material. Projects identified and trained artisans to start the production of metal silos. The provision of the promotional and educational material was a shared task between the actors in the supply chain. Both projects tried different business models, see the 2 visualisation of business models for Mozambique and in Tanzania:





Cost – benefit analysis (CBA) have been used in both projects and are an important tool to understand if a PHT is worth the investment for a farmer. This is key to understand if there will be a demand for the technologies and thus a business case for private sector actors. The study on CBA models of GPLP (Guenat, 2017) shows how the overall profitability of improved PHM improves with increasing quantities of maize produced, regardless of the farm size. This assumes that farmers will sell the maize at the right moment to obtain the highest margin. The CBA study in Benin by FANRPAN (FANRPAN, 2017) concludes farmers in Benin, who do not sell immediately after harvest, but choose to store for later use will benefit from the technology as the returns will outweigh the investment costs by approximately 95%. In Mozambique, the CBA analysis of different technologies (Borgia, 2017) concludes that the adoption of each PH technology is economically viable to pursue the objective of reducing post-harvest losses at household level.

In both projects there was initially no business case for big private sector companies, and at the level of raw materials this remains the case as the incentives to invest are not large enough. However, the business case of selling hermetic bags to local agro-dealers has picked up. AtoZ is even exporting them at present to Mozambique together with other products. The business case for small and medium agro-dealers was shaped by the development of a network with other value chain actors, with the government and with clients (farmers), introducing new products on the market, and combine the selling of different products. Agro-dealers shared that PHT is not a separate business case for them but an integrated part of their business. Some also mentioned that at the start they did not think that they would make PHM part of their agro-dealer business. Besides building and expanding their business network, agro-dealers mentioned their growth in confidence and speaking in front of people, gained skills in financial management and record keeping, and marketing skills.

In Tanzania, many of the extension agents including district extension officers, stepped into the supply chain of PHT, some as agent for agro-dealers but others starting off as agro-dealers themselves. The DEO of Konwa, mr. Gwalusajo Kapanda, shared: "*being an extension worker with PHT and other inputs for sale adds a lot to the relation with farmers*".

Awareness raising through local radio, Facebook or WhatsApp enabled some to expand their business. All mentioned the importance of links with the local government officials and the recognition they get from the government in their respective areas. In both Mozambique and Tanzania, agro-dealers mentioned the growth of their business in terms of employees and agents. The increase for 11 agro-dealers and 1 wholesaler in Tanzania was as follows:

GPLP: Changes in employees and agents by 11 agro-dealers and 1 wholesaler

	Agro-dealers		Wholesaler	
	Average no. of employees (range)	Average no. of agents (range)	No. of employees	No. of agents
At the time of joining GPLP (2014-2016)	**1.8** (1-3)	**3.1** (2-5)	**3**	**18**
Today (September 2019)	**4.5** (3-6)	**13.4** (6-22)	**6**	**67**

Most mentioned having plans of growth outside their district areas and a number already expanded business in other regions of the country, mostly through their personal contacts and requests from persons after they heard about their business through the media.

In Benin, cost benefit analysis and farm trials of different PHTs were positive although, for small farmers with up to 500 kg of maize return on investment would only occur after several years,

especially for the silo. The project had difficulties in providing clear recommendations for different farm types on the best package of PHTs resulting in a rather unspecific marketing strategy.

In terms of business models for supplying different PHTs, most effective seems the simple model with local masons that were trained in adapting traditional clay granaries with features like metal outlet at the bottom and clay cover at the top incurring little additional costs and providing clear benefits to the users such as time saving, accessibility, longevity of granaries etc. In a context of very small landholding households, the business case for metal silos is more difficult. The project worked with the national farmer federation (FUPRO) who would promote and sell the Silos within its member network and trained artisans would produce Silos for FUPRO. The priority clients would have been larger seed farmers. However, this model did not really take off and other interested private entrepreneurs could not be identified.

For PICS bags the business case seems more obvious to farmers as purchase price are relatively low and gains from using bags are obvious. Extensive information and promotion campaigns by the project raised awareness and readiness to buy among a high number of farmers. The project identified different market players, namely agro-dealers and importer/distributors as key promotors and was able to facilitate the establishment of one supply system in the northern project area. The model which is still in its construction stage builds on a distributer that provides bags (partly on credit) to a local agro-dealer who collaborates with lead farmers for promotion and order collection which are then passed through to local grocery stores that sell bags to farmers. Besides the PICS Bags, the agro-dealer has multiple linkages for inputs and outputs with the same farmer network, which increases efficiency.

5.7.4 Gender and Social Equity

Gender considerations in the projects assisted partners to integrate both men and women in the PHM value chain. For example, women are more easily focusing on improving PH practices than men who want to sell immediately after harvest. During awareness raising on PHM both men and women at household level started thinking more about PH practices and technologies and jointly agreed on improvements of their farming practices. Improvement of PHM meant a positive development and recognition of the role of women.

Strengths and opportunities

- Looking at PHM through a systems approach lens gives quite quickly an insight in the status of the different elements of a system, and especially of what is lacking in the system.
- Adopted MSD as an approach to look at PHM as a market system itself gives a project team and its partners a good analytical frame to deal with complex realities.
- Both projects delegated roles and responsibilities for different interventions to partner organisations, both core actors and market supporters, which gave the partners a strong role in the projects from the beginning.
- Selecting focal persons both at district and national level in an agreement with the government as the person being responsible for planning, coordinating and monitoring PHM activities at their level, strengthened the supporting role of the government in the system. It worked well and was very much appreciated by the local authorities.
- HELVETAS could build on experiences of other projects, for example for training in MSD of staff, on GSE material for training actors, exchange between GPLP and PHM-SSA Mozambique.

Weaknesses and threats

- It proved challenging to promote the development of PHM technology input markets using the MSD approach when other initiatives provide promoted technologies to farmers for free or highly subsidized and thus create market distortions.

- An MSD approach in contexts where basic structures are lacking such as in Mozambique or in Benin, is very difficult to comprehend for different partners, especially from the public sector (read AFAAP/MASA, country node FANRPAN, provincial and district authorities and institutes). In Tanzania, a service providing company (Intermac) to make metal silos dropped out as they expected to be paid, as service provider to the project.
- Gender disaggregated data are available but gender dynamics with regards to decision making power of PHM/PHT options have not been systematically measured.

6. Influencing factors and lessons learnt

6.1 Factors influencing success in PHM

Success in changes in the PHM market system under the two SDC funded projects can be attributed to a large extent to the design and the approach used but there are external factors that as well contribute to change. Looking at the experiences and results of the projects, different factors influencing success were identified, both internal factors at farmer level, in the market system and within the influence sphere of the projects as well as external factors:

Internal - farmer level

a. The needs and preferences of the farmers regarding PHM solutions for their losses is a factor that affects the success of a new technology and can be positive or negative. Example: The preference of farmers for PICS bags because they can see the 3 different layers of the bag, which makes them preferring PICS above the other brands.
b. Farming and food security strategies of farming households are influencing the uptake of PHP and PHT. As was evident in the 3 countries, no household opts for just one storage system but combines different systems depending on their needs and preferences such as quantities stored for home consumption versus sale, need for cash, financial means, etc.
c. An important factor that possibly **triggered the uptake of PHM and hermetic technologies** is a growing awareness of farming communities (and especially women) of the risks of the use of chemicals and effects of aflatoxins, say the importance of **safe food** for the family. In discussions with different actors (Tanzania, Mozambique), it was mentioned that especially awareness on safe food and risks of aflatoxins has contributed to the uptake of hermetic bags.
d. A factor that influences the marketing of PHP and PHT is the rural setting. Distances are large and reaching farmers needs different distribution channels than in urban areas, where people live close together. For many private sector actors reaching out to farmers in their areas is new. Example: Agro-dealers work with lead farmers or youth as an agent in the villages, so farmers have access to products through this local agent.
e. Directly related to the rural setting is the level of organization of farmers. In the reality of SSA, organized farmers are easier to reach and communicate with than individual farmers. Groups are a good platform to introduce new PHP and PHT.
f. The preference in the North of Benin for traditional storage systems is a socio-cultural factor related to the status of farming households. Socio-cultural factors can seriously influence the adoption and success of a new technology.

Internal - market system

g. The quality of products such as metal silos or hermetic bags and of advisory services needs to be good. If the quality of products or services is good, the first users who adopt it will spread the word. Example: The low capacity and skills of tinsmiths in Benin resulted in quality issues in silo production contribution to low adoption.
h. Competition in the market system can positively and negatively affect the market development of PHT. The competition between different hermetic bag brands gives farmers

a choice and influences the pricing. Competition can also work in a negative way such as in case of the supply chain of metal sheets. Manufacturers preference is to sell sheets in bulk to large buyers and not to small retailers (for the construction of metal silos).

i. Another important factor is the accessibility and availability of financial services for investment in PHM, both for farmers as well as for the supply chain actors.

Internal – project level

j. An internal factor that is very much controlled by the donor and the implementing organization and that influences the evolution and impact of projects, is the choice of intervention strategies. Examples of strategies: continuous creation of space for multi-stakeholder learning to reflect and analyse why things are happening, adapt interventions when the market system changes, be patient and look for opportunities which were not predicted at the onset of a project.

k. Another internal factor is budget made available to invest in human resources (technical and facilitating capacity) that can guide and facilitate a project using an MSD approach. Both projects covered a similar period of 7 years (phase 1, 4 years, phase 2, 3 years). PHM-SSA had a pan African mandate with part of its budget for regional activities and the other part split between the 2 countries. GPLP concentrated solely at Tanzania. When observing the efforts at country level, the facilitating teams in the 2 countries under PHM-SSA, seemed rather small compared to the project team in GPLP and this relates directly to differences in market system change outcomes of projects at country level.

l. The geographical confinement of a project hinders the natural growth of the agro-dealers and consequently the upscaling and spreading of PHM. It was observed in both projects that agro-dealers do not adhere to project boundaries, and that the project could have contributes to a wider geographic outreach when it would have followed this market growth.

External

m. An external factor that influences the grain market system and PHM is climate change. Climate change results in unstable climatic conditions, which are affecting production trends and harvests. Example: In Tanzania the project tried to understand the implication of climate change on grain production and PHM, and measures for adaptation such as growing crop varieties that are less susceptible to climate change and infestation (Aflatoxins), use of early maturing and improved seeds enabling farmers to harvest with a short rainy season, growing of more drought resistant crops such as sorghum and millet. In 2016, in Kongwa, Tanzania several persons died as a result of aflatoxin poisoning. Emerging recognition of the health hazards of aflatoxin in maize and other crops worked as a pushing factor for the local and national government to give PHM attention.

n. Economic factors such as world market prices of raw materials that need to be imported have a direct effect on the price of products such as the metal silos.

o. Regional politics influence the decisions of SSA countries on PHM. Policy dialogue on PHM was not only fuelled by findings on PHM from within the countries, but also at the level of the African Union that recognized PHM as means to address food security problems. AU member states committed (under the Malabo Declaration) to implement measures at national level but many face problems in reporting back on actual PHL. This is no doubt a factor that contributed to successful ownership of PHM by governments.

p. Subsidies on agricultural inputs and subsidies in general are an important factor and tool of the government but also used by NGOs to influence a market system. Example: Subsidized metal silos put on the market by other organizations, highly disturbed the GPLP efforts to work on farmer demand and develop the business case for agro-dealers and artisans.

q. Legal factors such as regulations can influence the manufacturing of a product. Example: Hermetic bags and new regulations on plastic.

6.2 Lessons learnt

Project implementation enabled learning from experiences of exchange and collaboration with partners; generating knowledge on PHM (through on-farm research, studies, etc.), capture knowledge and document (for learning, promotion of evidence, decision making, etc.), and use it for actions and improvements. As a result, both projects have a rich range of different knowledge products with information on PHM and aspects of MSD. Many lessons have been described in these materials. The following lessons are derived from the projects' experiences as described in this report. Lessons are grouped under 1) core value chain, 2) supporting functions, 3) policy & rules and 4) project strategies:

Core value chain

1. PHP in the 3 countries are easily adopted by farmers and are a necessary base for introducing improved PHT such as hermetic systems (metal silos, bags). Public village level awareness raising and training to farmer groups in PHP have been effective ways to introduce PHM. Adoption of postharvest practices and technologies are influenced by several factors (see §6.1) and are not only based on economic or cost considerations. The demand for metal silos depends on the price of the silo, the production and earning of the farm but also on the preferences of the household. The return on investment for a food crop such as maize is low compared to cash crops, so the initial investment in a metal silo is seen as high by farmers. A poorer farmer may opt for a cheaper alternative. Farmers with more financial means opt quicker for a metal silo, and especially for storage of food grains for the household. Farmers in the North of Benin prefer to stay with their traditional storage system.
2. Especially women adopt PHP rapidly as it concerns their roles, eases their workload, investments are low compared to PHT, and the prevention of losses increases the grain quantity and quality for household consumption. Promotion of adoption of simple, easy-to-handle and innovative low-cost technologies benefits poor farmer households and particularly women. With adoption of hermetic storage technologies gender roles can change.
3. Options for different types of storage technologies should be provided so that farmers can choose the best for them. Farmers use different PHM strategies and not necessarily opt for only 1 technology. In Tanzania and Mozambique, a PHM strategy depends on combining different technologies like for example a metal silo for storing produce for home consumption, hermetic bags for later sales and PP bags for immediate sales. The strategy depends on different factors and can vary per area and gender.
4. Though PHM was relatively new to most actors in the grain sector, the relevance was easily accepted. At present the demand for quality grain, though not everywhere felt yet, is slowly growing. More and more imported grain is on the urban markets and big companies are rejecting bad local quality. Different actors in Mozambique and Tanzania mentioned that because of this trend, they expect the demand for hermetic technologies which do not use storage chemicals to grow.
5. Adoption of new technologies for smallholder farmers (e.g. metal silo) is a slow process and only market players with a long-term vision are interested to engage in such business. Small market players/agro-dealers hesitate to take risks in investing in a new business (such as metal silos) that seems to have no immediate benefit but were more open to promote and introduce bags and tarpaulins. It also depends on their interest to invest in the PH product as one of their core businesses. On the other hand, large agro-dealers as initially selected in Tanzania were not even interested to invest in PHT.
6. Interventions introducing new technologies or services, such as training of artisans to construct metal silos, need to be subsidized as the partner in charge of that training and the participants are neither able nor willing to pay for the training. Therefore, the financing of these activities depends strongly on external funds at least at the beginning. This applies to most training activities where behaviour change is an important factor of the process. Once the market picks up and private players see the commercial interest for them their readiness to invest in PHT promotion, information and training increases.

7. The sustainability of the metal silo business, for artisans as well as agro-dealers, is highly depending on how much demand is continuously being created. The sustainability and scaling up of the business model are only possible there where the private sector takes the lead.
8. In 2015, GPLP experienced a lot of challenges when other organisations (AGRA, Lutheran church) distributed subsidized silos for half the market price to farmers. Contradicting approaches by different organisations promoting subsidized PHT threatens building up a sustainable PHM market system. Reflection on subsidizing metal silos or other technologies in view of food security at household level should only take place, if it follows government guidelines and is thus nationwide.
9. In the PHM market for smallholders, agro-dealers ideally offer a value proposition (input supply) that includes technical and information services to farmers, enabling the farmers to receive inputs, technical support and possibly finance. In case an agro-dealer offers input supply financing to farmers, adequate capacity of the lender to handle such agro-loans is key.
10. Agro-dealers and artisans but also public extension staff mentioned the added value of being involved with other actors in different activities to develop their business network. Agro-dealers use this to supply products to farmers, to order technology from distributors and manufacturers and extend their market through extension staff in other areas. On the other hand, artisans have established links with agro-dealers to get orders.

Supporting functions

11. In Mozambique and Tanzania, the projects used agricultural experts mainly from government institutions, to provide the initial PHM training. This is a successful strategy as it involves agencies with a supporting function in capacity building in the system and promotes ownership and sustainability. The use of NGOs to provide the training as was done in Mozambique and in Benin is not a systemic solution and does not contribute to sustainability. This is basically direct implementation though outsourced to NGOs and hinders systemic changes.

    Working with both research institutes and agricultural education entities resulted in integration of PHM training in curricula, for both Benin and Tanzania even at national level. This implies that at national level all students at public and private agricultural education institutions in the future will be trained in PHM. PHM research was promoted and national level institutes have been responsible for on-farm testing and demonstrations. In Mozambique the role of the national research institute in building capacity of agricultural institutions is a good example of ownership of the subject by the government.
12. Training in financial literacy and PHM in VICOBA and other saving and credit groups, contributed to PHM knowledge and skills of especially women farmers. It, however, did not really lead to taking credit to invest in PHT. It must be mentioned that from not taking credit to invest in PHT but into other farm household needs, it should not be concluded that households not invest in PHT. Some of the stories captured by GPLP of women members of VICOBA groups, showed the economic contribution of the woman to her household, her economic and social empowerment.
13. MFIs (Benin) and banks (Tanzania, Mozambique) have learnt about PHT and adapted loan facilities for agro-dealers and artisans (Tanzania) and farmer groups (Benin warrantage groups, Mozambique saving groups though still in process). For the warrantage system, however, no solid business case was created based on systems actors. The setting up and accompanying of the communal system is dependent on local NGOs and donor finance. The project should have invested in identified system actors to take over this role: ATDA, MFIs or a local service provider model, and more analysis on why MFIs do not invest in warrantage would be needed to understand the underlying constraints and disincentives for them.
14. Dependence on imported raw material as it is the case for metal silos was a hindering factor for the development of the metal silo business. Imported metal caters for large-scale

manufacturing of other products and not for small retailer quantities, such as for production of metal silos. A consequence is irregular availability of raw material. Also, the prices of the sheets fluctuated and increased a lot during the project lifetime, which resulted in a doubling of the price of metal silos. There was thus also no supply chain of metal sheets at local level, which again implied high transport costs of sheets to artisans of agro-dealers. In Tanzania, the present availability of metal sheets is reasonable, also thanks to the cooperation between artisans and agro-dealers, but in Mozambique no silos were produced in 2019.

Policy & rules

15. Developing a national level strategy or policy reforms takes time and follows the pace and rules of government procedures. Multi-stakeholder policy making contributes to creating space for learning and sharing and for the views of all stakeholders involved. Use of existing structures is important and builds own capacity. Ultimately, a solid support base for change in policy is created and ownership of the policy development process is with the policy makers.
16. Through dedicated engagement an NGO can contribute to policy dialogue with the example of GPLP in Tanzania as a core actor in the process of developing the national PHM strategy.
17. Hence, it is important not to push a project agenda but find a flow in which good relations are established and ownership of e.g. policy development remains with the government. As a project staff mentioned “take what you have, if no policy is possible, ok then we work on a strategy”. Coordination of various PHM initiatives by the government at national/ministry level is also very important to enhance strategic collaboration between various PHM actors, in a way that will bring about more efficiency, effectiveness, and sustainability.
    The same can be said for local level policy processes such as the district fora and by-law preparations in Tanzania. These contribute to putting a national level policy or strategy into practice. It gives local level government officials guidance in handling and reducing PHL issues in their areas.
18. Sharing of research and study results were used regularly in policy dialogue, and policy briefs were a formative element for government and other stakeholders. This contributed including PHM in policy making. Capacity development efforts at policy maker level also contributed to including issues on gender and climate change in policy and by-laws.
19. Different members of district fora took part in PHM training and were therefore important advocates of PHM in fora discussions. In Tanzania this led to a process of by-law development to regulate PHL reduction and PH related health issues such as Aflatoxins. The process directly contributed to creating a more enabling environment for the local PHM market.
20. In general, for an MSD project that does not directly implement with or through the government, it is important to work closely with the local government. It is not possible to work in farming communities without having LGA actors involved. Local governments in many SSA countries are more decentralized and contribute to the development of the local economy, and they have issues such as food security and livelihoods of farming communities high on their agenda. They are changing towards more community participation and the use of local resources. GPLP team members also mentioned the advantages of having the project office near the government.

Project strategies

21. In Mozambique several partners shared that the sequence of project interventions worked very well. It put PHM on the radar of a wide range of actors both at local and national level. The involvement of farmers in testing and validation was very important to gain acceptability of and “kick-start” PH practices and technologies in farming communities. On-farm validation of PHM technologies through local research and public extension services was successfully used to develop information and training material and to raise awareness and promote PHM in both projects. Especially the adoption of PHP at farmer level has been in each of the 3

countries successful, and many actors mentioned visible changes in PH behaviour at farmer level. The learning cycle applied by projects and the continuous involvement of actors in this process were very instrumental to create ownership of development in the market system.

22. An analysis of the PHM market system involving multiple stakeholders at the beginning of phase 1, was a good start to introduce partners to the three different components of the market system (core actors, supporting functions and the rules and policies influencing the business environment) and to look together at what was missing or not working in reaching smallholder farmers thereby understanding together what could change and how could the project bring about change.
23. Partner selection is key and requires trial and error. Motivated and capable partners who have a shared vision of the market system are key to success and sustainability of market development interventions. Only active and entrepreneurial market actors can trigger the PHM market. A good example here is the case of the hermetic bag supplier AtoZ, who after linkages with a larger distributor started exporting and promoting AgroZ bags in Mozambique.
24. In both the projects looking more in detail into business models and cost-benefit analysis to determine whether an investment is profitable started towards the end of the first phase. The question is whether such analysis would have been useful in earlier stages of the projects to decide on adapting of interventions. At the same time, one lesson learnt was that PHT goes beyond mere cost-benefit aspects; it's a lot about changing farmers' mindset and behaviour towards a low value crop like maize, which however is still their staple food.
25. A project team that guides and facilitates, an MSD project requires adequate technical and facilitating capacity and skills that are very different from the conventional way of directly implementing a project. MSD was new for many of the HELVETAS staff and for almost all partners, including the government. HELVETAS Head Office has provided skills capacity building and backstopping of the teams in the countries. Making resources available by SDC for this type of technical assistance was important as it is difficult to employ MSD experienced staff in the countries and skills in facilitation MSD need to be developed on the job.
26. Both projects used the MSD approach to strategically implement the project. PHM was identified as a weak and mostly absent supporting function in the grain market system. The choice to approach PHM as a market system in which farming households and communities need access to improved PHP and PHT to improve their market integration was well chosen. It assisted the project partners in a clear focus on PHM reality, without mixing it with other supporting functions and the core value chain in the grain market system. Both projects have done different studies which also gave insights in the main grain market systems, but no comprehensive market system analysis took place.
27. The MSD approach forces project partners to revisit plans and adapt to changes. At the design stage of a project that pursues MSD change, it needs to be clear that interventions of a project might need to be changed and adapted and consequently resources need to be reallocated. SDC has to a certain extent allowed the projects to do so, i.e. with the introduction of hermetic bags at a later stage. This also implies a conducive relation between donor and implementor where developments and adaptation to changes can be openly discussed to get the flexibility required in an MSD project. On the other hand, with regard to geographic area there was less flexibility, i.e. the fixed project area is against principles of a systems approach.
28. An MSD project team should never make decisions on their own. The role of the project team is to create space for learning, sharing and reflection and improvement. This seems a slow process, but it ultimately creates space to sow seeds and to make ideas sink with different actors. Example: Sharing of achievement between different private actors contributed to more reflection on possible business and adds to competition between the businesses.
29. Action research and on-farm trials give insights into the different farming systems and farming strategies of smallholders. They give practical insights on sometimes very simple matters: where and how to place a metal silo when the climate is more humid, a metal silo is a good

storage option when there are high infestations of rodents, gender roles and decision taking on PHM, etc. Sharing of these insights is key to the MSD approach.

30. Insights on the facilitating role and the skills required of the project teams were drawn from talks with different GPLP team members:
    a. "Sit back and think" and make that **actors can play their role**, facilitate and don't do direct implementation,
    b. Promote **relationship building** and actively link actor with each other
    c. Support **learning amongst actors**,
    d. When the market system signals change, be innovative and search best ways to react/act, be also intuitive and sense where things are going (or not going) and **adapt**.

7. Conclusions

The following sections refer directly to the four key issues identified for the CAPEX exercise (refer to the CAPEX concept note, SDC 2019).

7.1 Systemic change in PHM markets:

Keeping in mind the 4 underlying principles of the MSD approach, 1) systemic action in market systems, 2) sustainable change by involving actors with incentives to contribute to long-term change, 3) large-scale impact on the lives of poor farmers and 4) taking a facilitative role by the project, the following systemic changes have been observed in the projects:

Awareness raising and developing capacities of individuals and business resulted in changes in the behaviour of different actors in the system.

Demand and supply:

1. The adoption of improved handling and storage of crops and reduced PHL at farm and community level has been strengthened by both projects. A majority of farm households became aware of PHL and started to apply PH practices. In the field these changes in PHP are clearly visible, and losses at different PH stages are reduced. Awareness on storing for home consumption without using chemicals contributed to the demand for hermetic storage solutions. Use of threshing services is more common. Hermetic bags (PICS, AgroZ) are in growing demand in Mozambique and Tanzania. Metal silos picked up slower and it would be very interesting to follow if this will develop further in the future. Especially the demand for silos to store grains for home consumption is slowly growing.
2. Agro-dealers that have been trained in PHM and have been involved in PHT promotion have included PHP services and PHT supply in their business, especially in Tanzania and Mozambique; those who did, have expanded their distribution of input supply to farmer level through more mobility, or through working with different types of village level agents. Supply of hermetic bags and tarpaulins in combination with embedded PHP services seems to be a solid business case. The offer and use of threshing services from private actors in Tanzania became common practice in project areas.
3. Training in PHM included gender roles and responsibilities at household level in PHP and in storage for home consumptions and sales. Agro-dealers, artisans and agents use this in marketing of their services and products, including in awareness raising through local radio.
4. Business and entrepreneurship training to private sector actors contributed to the business case development for hermetic technologies and to developing input supply financing constructions by agro-dealers and of entrepreneurial artisans.
5. Part of the artisans trained in making metal silos in Tanzania and to a lesser extent in Mozambique have established good relations with agro-dealers or farmers and have included metal silos as part of their business. In Tanzania the more entrepreneurial artisans also use

the acquired skills for production of other products. In each of the countries there are qualified master trainers to train new artisans.

Supporting functions

6. Extension staff that has been trained are able to include PHP advice in their advisory work with farmers. As a result, some public extension staff are stepping into supply of hermetic bags, tarpaulins and other inputs to farmers as it gives them additional income and the opportunity to link advice to supply "now I don't come empty handed with advice". Some become agro-dealers after their retirement (Tanzania).
7. Different supporting actors such as farmer unions in Mozambique, district LGAs in Tanzania, and research institutes have integrated PHM in annual planning and budgets and in running / upcoming projects. In fact, after the approval of the NPHMS, the GoT has, with support of GPLP, drafted a national implementation plan covering the next 5 years.
8. Access to rural finance (agro-dealers, artisans, farmers) is a must for developing the supply chain and large-scale adoption of PHT. Saving and Credit / VICOBA groups lend mostly for faster income generating activities and not specifically for PHTs. However, the groups as such were very instrumental in introducing PHP and PHT at farmer level. In terms of energy and resources, the projects have invested relatively little in developing financial services. An interesting system as the warrantage system in Benin so far, did not result into a robust business model that is based on systems actors. The setting up and accompanying of the communal system is dependent on local NGOs and donor finance.
9. A supply chain of raw material for hermetic storage technology is important to answer to a growing demand for the products. Price fluctuation of raw materials and availability as is the case for metal sheets for silos, are disturbing a growing demand for the silos. Farmers opt for an available and cheaper alternative such as hermetic bags, though manufacturers have to import the raw materials as well.

Promotion of linkages & relations between market actors

10. Linkages between suppliers (agro dealers, local agents & artisans) and users (smallholder farmers) of PHT have been well established in Mozambique and Tanzania but less in Benin. Involvement of different actors in training and awareness raising at the start of the project contributed to new relations between these actors in the core value chain.
11. Apart from the hermetic bag producers PPTL and AtoZ, efforts to include large agro-dealers in both projects failed. They were not interested in small benefits of the business case of PHTs.
12. Establishing of linkages and building relations and trust between actors has also resulted in different input supply financing for example in kind credits by distributors or manufacturers, payment in instalments by farmers to agro-dealers or artisans.
13. Linkages to financial institutions were moderately successful. In Mozambique the collaboration with Banco Futuro to link up with saving and credit groups is still being pursued but looks promising. In Tanzania some of the more active agro-dealers and artisans have taken loans from 2 banks. In Benin only a few of the warrantage groups established a credit link to an MFI.

Implementation strategies

The facilitating role of the project team is a very different role compared to direct implementation of a project. HELVETAS invested in building the MSD capacity of the teams through training in the initial stage of the project. Through different support missions and backstopping from the HELVETAS head office, on-the-job capacity building has been supported. Looking at the experiences of the projects in the 3 countries, the MSD competences of the team in Benin resulted in less market system change than in the other 2 countries. Another strategy to build skills in facilitation by the teams was the exchange between the teams. Exchange and learning from each other's experiences worked best between the teams of Tanzania and Mozambique while the exchange within PHM-SSA between Benin

and Mozambique was minimal. Distance and language were most probably important hindering factors. For both donor and implementing agencies, space and adequate resources to build MSD facilitating skills at the start and during project implementation are crucial for MSD projects to deliver because locally it is still difficult to find experienced project staff and experienced staff, if available, is more expensive.

A market system's strength depends on how well the actors in the value chain 1) adopt improved practices and new technologies, 2) launch businesses and 3) obtain financing. In terms of success both projects succeeded well in adoption of improved practices and in 2 countries also of new technology. The launching of business cases was more difficult but especially in Tanzania and Mozambique a good number of sustainable businesses developed. One of the main successes is that agro-dealers were able to incorporate PHT and embedded advices in their existing businesses and in this way made PHM services part of their business model.

The obtaining of financing by core actors has been given the least project attention in comparison to 1 and 2 but has still contributed to some of the business cases (bank loans, in kind credit for raw material) and uptake of PHT (payment in instalments, in kind credit). Access to finance differs also from country to country and agricultural financing is still in an early stage. Overall, different actors shared that the emphasis on financial services could have been stronger from the start which would have contributed to sustainability of some of the access to finance modalities. Input supply financing as a finance service by value chain actors could have received more attention in both projects. Little experience has been documented and more learning could have taken place. An attempt to pilot a silo receipt system in Tanzania was dropped from phase 1 to 2, even though first results were positive. Access to micro-loans by women through saving and lending groups is an important strategy to include economic empowerment of women farmers and inclusion in PHM. The role of saving and credit groups in input demand was to reach farmers and especially women farmers and the potential of loans for farm inputs was not fully explored. An example is the dropping of working with VICOBA groups in new areas during GPLP phase 2.

The choice of deciding to have both projects facilitated by an NGO, instead of direct implementation by the government is appreciated by many of the actors. It allowed the project units to stay independent and promote a multi-stakeholder approach providing space for both public, private and civil society actors.

7.2 Institutionalization of PHM in training and advisory services

The involvement of private sector actors in advisory services to farmers is new, but Mozambique and Tanzania it proved an opportunity for small and medium scale agro-dealers to integrate PHM products and services in their business. New ways of marketing (local radio) and their relations with farmers, directly or through small-scale agents in the villages expands their business.

Through promotion of collaboration between public and private actors, agro-dealers and extension workers started working together. Agro-dealers reach out to new clients with the help of public extension staff; extension staff link agro-dealers to farmers who want to but inputs and, in return receive agreed commission. In Mozambique, the 2 provincial farmer unions integrated PHM in their work, including their extension work at district level (beyond project areas) and use it in their advocacy work on safe food without chemicals. Several awareness raising efforts (action weeks, drama, use of different media, local debates, etc.) remained a project instrument to initiate demand for PHM. Some of the methods such as using local radio to market PHT has been taken up by local agro-dealers. Some of the public extension staff mentioned that, if resources allow, local promotion through the radio would be a good option.

Institutional anchorage of PHM in training curricula of agricultural education institutions has been in both projects successful through the facilitation of multi-actor processes and responsibility for development of PHM curricula with main national actors. Ownership creation took place through facilitating lead roles of the government in developing of training manuals and materials and in providing training. In Benin for example, PHM is increasingly being integrated in development and extension plans of the ATDAs, departments and municipalities. IIAM is nowadays recognized as knowledge centre for PHM in Mozambique, providing training and advice to different stakeholders. MATI in Tanzania is in the process of developing a national level PHM training compendium.
Training of national level trainers is a significant means to influence the content of rural extension/advisor services beyond a project, especially in Africa where public extension workers are still on the ground and often the only source of information for smallholder farmers.

The sharing of PHM experiences under PHM-SSA with a wider SSA community through both AFAAS and FANRPAN raised awareness and promoted action. Over 20 organizations in 12 countries have integrated PHM in their training activities for farmers and extension workers based on RAS tools and information developed under the project.

7.3 Effective advocacy and shaping of PHM policies

At present many high-level government and policy leaders are well informed and talk about PHM at different events (recent example of Tanzania meeting with actors in the grain sector, September 2019) and in the media. This is partly a result of the multi-stakeholder approach used by the projects and of the lead roles which have been taken by the government both at national and at district level. As mentioned in § 6.1, regional politics and commitments made by government influence the decisions of SSA countries on PHM. Policy dialogue on PHM at national level was very much supported by policies at the level of the African Union that recognized PHM as means to address food security problems. The facilitation of multi-stakeholder policy dialogue has contributed to the integration of PHM at national policy level, be it a standalone strategy or integration in existing policies. The PHM strategy process in Tanzania is a good example of harvesting fruits of a long process that was participatory, multi-stakeholder and with contributions from the grassroot level. This process created ownership by the national government and, since the launching of the strategy this year, already resulted in different steps taken at national level (e.g. action plan, national level grain sector meetings).

Investing in local level policy making as was done in Tanzania, were districts developed by-laws on PH issues, give the local government a range of instructions from harvest to the market, which can be reinforced up to village level by the village executive officer. Such local level instructions are in line with the national level strategy and assist local government acting upon national policy. They are a practical tool to implement national level policy at local level. The multi-stakeholder approach which included farmers at community level contributed to ownership of by-laws and PH practices even before drafted by-laws are officially approved. First results have been already observed for example on hygiene behaviour and use of weighing scales at local market places. Other districts also started enquiring and some copied the draft by-laws from a district under GPLP for own use.

Both projects have invested in sharing PHM experiences with other organisations and initiatives, which resulted in multiplying PHM beyond the projects' areas. By 2019, in PHM-SSA multiple collaborations with other projects / platforms have been established. The partners that use PHM materials in Benin are AMSANA/IdP, GIZ/ProAgri3, PASDeR. In Mozambique the project fostered collaboration with a series of initiatives and partners, including: AENA (under the Othumiha project, funded by AGRA/Gates Foundation) for broad integration of PHM in farmer extension, AMPCM to promote PHM options along seed value chains, WFP for joint promotion of PHM options (mainly hermetic bags), the multi-stakeholder Groundnut Working Group (GNWG), and others. Sharing with other stakeholder also resulted in new donor funded initiatives as in Tanzania: EU funded RIPOMA

project implemented by HELVETAS, AMDT on grains (HELVETAS), Danida funded Save Safe Food project on hermetic bags (HELVETAS), initiatives by World Vision, Aga Khan and Redeso.

PHM has been put on the pan-African agenda as was shown during the PHM congress in Nairobi, held March 2017. With FANRPAN and AFAAS as project partners, PHM-SSA made a significant contribution to this progress through the dissemination of PHM messages and tools via the regional networks and the online platforms of both FANRPAN and AFAAS. Especially their engagement as advocates for PHM in key regional events (e.g. FANRPAN regional policy dialogues, AFAAS extension week, FAO's Food loss reduction strategy development workshop in Harare in 2016, or the Africa-wide PHM congress in Nairobi), but also in numerous national events, the permanent liaising of FANRPAN with high-level officials of African governments and the contribution to the wider knowledge exchange on the global CoP on PHL reduction contributed to putting PHM on the agenda of many SSA countries.

7.4 Knowledge management and dissemination (CoP)

Knowledge management and dissemination through the government as was done in both projects have a wide outreach. As there was hardly any PHM material available in the countries, the "hunger" for information and the involvement of supporting actors such as research, extension and training officials contributed to the acceptability of the materials.

Both projects have not shared much on the CoP besides mentioning the availability of materials on the website. AFAAS mentioned that in SSA countries practitioners are not having a culture of seeking information and the CoP and their own website are both demand-driven. This was confirmed by the AFAAS representative of MASA in Mozambique. She fears that materials on the CoP website are "far away" from public actors in Mozambique. She suggested to look into ways to make the PHM material available at country level. Different actors in Tanzania confirmed that they hardly use the website and many lost their passwords.

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