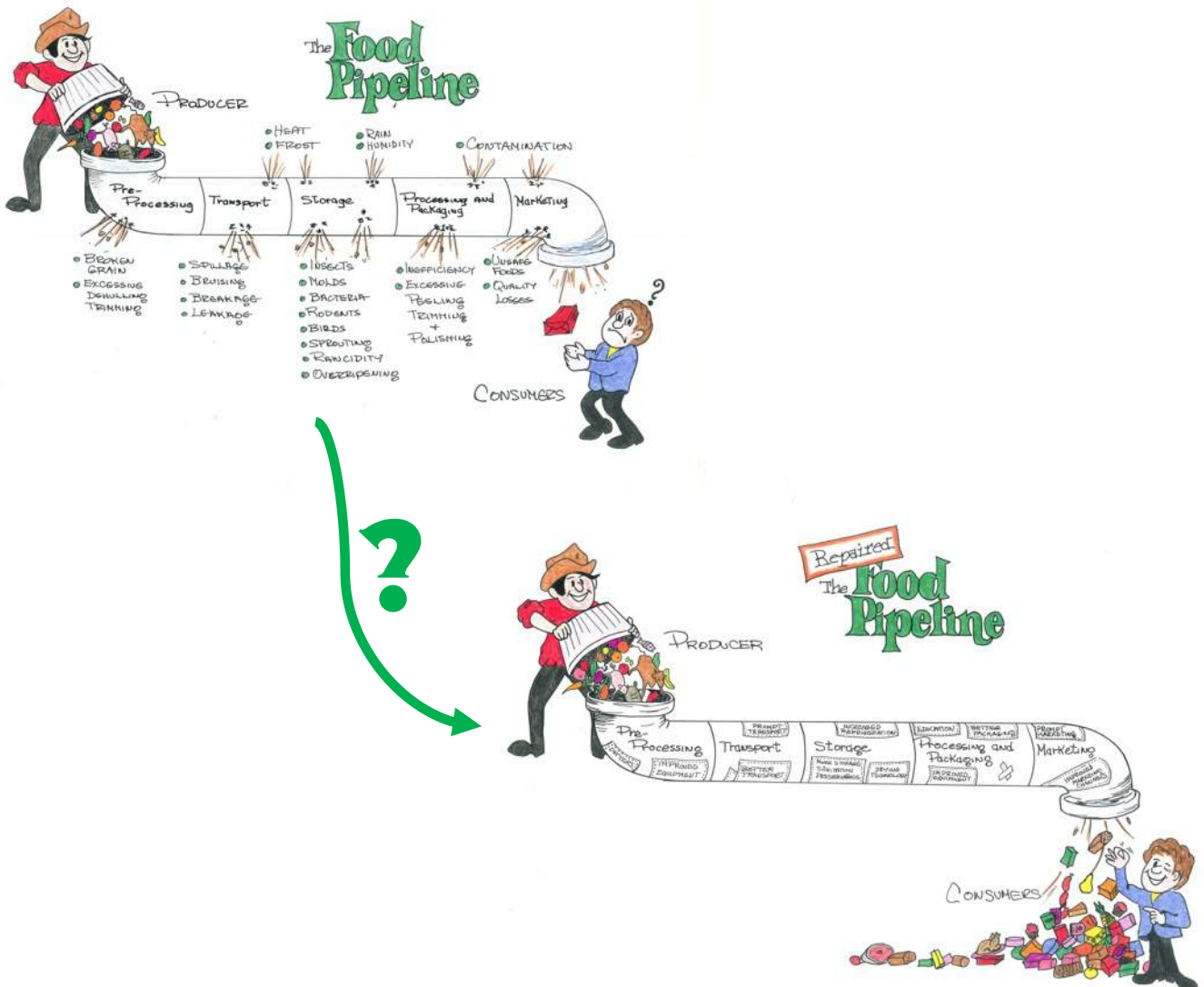


“Capitalization of Experience” (CAPEX) on the SDC Africa Postharvest Management Portfolio”

Study Report



Source: Bourne, 1977.

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 IlluDest Ltd
 January 30, 2020

Foreword

Both CAPEX teams would like to express their gratitude to all those who have made these CAPEX studies possible. It is not possible to name them all. But the team members would like to thank the implementing institution representatives in each visited country for their welcome. The programs officers who have been delegated to organise and participate to all meetings and the local workshops have invested a lot of time and energy for the success of the field visits. All these visits were very fruitful and discussions very open. The drivers should also be thanked for the long hours and, for several of them, their contribution as translator and cameraman among others.

Finally, both teams' members would like to thank all the stakeholders, farmers, processors, traders, research staff, etc. for their time, knowledge and patience to respond to our queries.

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 synthesizes the key conclusions related to the guiding questions. Both CAPEX documents served as basis for the learning workshop that took 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 all countries, there is a business case for metal silos for a specific clientele. Currently the adoption is slow, mainly 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-récoltes (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 développés 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 2^{ème} 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 ont servis de base pour l'atelier apprenant, atelier qui a eu 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-récoltes 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 inexistantes. 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 contribué 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 investi 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 visites, 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 contribué 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

ACR	Anna Crole-Rees
AFAAS	African Forum for Agricultural Advisory Services
AfDB	African Development Bank
AIS	Agriculture and Innovation System
APHILIS	African Postharvest Losses Information System
ASDSP	Agriculture Sector Development Support Program
ATVET	Agricultural Technical Vocational, Education and Training
AU	African Union
AW	Annet Witteveen
CAAPD	Comprehensive Africa Agriculture Development Programme
CAPEX	Capitalisation of Experience
CIMMYT	Centro Internacional de Maize y Trigo
CLP	Critical Loss Point
CoP	Community of Practice on Food Loss Reduction
DRC	Democratic Republic of Congo
EGSP	Effective Grain Storage for Sustainable Livelihood of African Farmers Project
ETHZ	Swiss Federal Institute of Technology Zurich
FANRPAN	Food, Agriculture and Natural Resources Policy Analysis Network
FAO	Food and Agriculture Agency of the United Nations
FLA	Food Loss Analysis
FLR	Food Loss Reduction
FSC	Food Supply Chain
FLW	Food Loss and Waste
FTC	Farmers Training Center
GDLI	Grain Distribution Logistical Infrastructure
GFLI	Global Food Loss Index
IFAD	International Fund for Agriculture Development
INERA	Institut de l'Environnement et Recherches Agricoles
ISRAT	Institut de Recherche en Sciences Appliquées et Technologies
IT	Internet Technologies
JdM	Julien de Meyer
GF	Georg Felber
GPFS	Global Programme Food Security
GPLP	Grain Postharvest Loss Prevention
KNOC	Post-Harvest Knowledge & Operations Centre (WFP)
MAAIF	Ministry of Agriculture, Animal Industries and Fisheries (Uganda)
MSD	Market Systems Development
NAIP	National Agriculture Investment Plan
NFP	National Focal Point
NGO	Non-Governmental Organisation
NPSC	National Project Steering Committee
P4P	Purchase for Progress (WFP program)
PBA	Programme-based approach
PICS	Purdue Improved Crop Storage (bags)
PHL	Post-Harvest Loss and waste
PHM	Post-Harvest Management
PO	Producers Organisation
PS-PASP	Politique Sectorielle sur le Production Agro-Sylvo Pastorale

RAS	Rural Advisory Services
RBA	Rome-based UN Agencies
SCP	Satellite Collection Points
SDC	Swiss Agency for Development and Cooperation
SDG	Sustainable Development Goals
SENAP	Southern Africa, East and North Africa, Occupied Palestinian Territory Division
SSA	Sub-Saharan Africa
VICOBA	Village Community Banking (Uganda)
WB	World Bank
WFP	World Food Program
WRS	Warehouse Receipt System
ZECC	Zero Energy Cooling Chambers
ZFLI	Zero Food Loss Initiative (WFP program)

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- Introduction

The Swiss Agency for Development and Cooperation (SDC) has been funding programs on postharvest management (PHM) in Sub-Saharan Africa (SSA) since 2008, following its successful POSTCOSECHA program in Central America that led to the adoption of metal silos for grain storage by more than 400'000 smallholder households. The Global Programme Food Security (GPFS) of SDC had launched a PHM umbrella program including several projects to complement the synergies within SDC in postharvest food loss reduction issues in SSA. Five programs were running under this umbrella, one of which ended in 2016.

GPFS decided to phase out post-harvest management as a core thematic focus by 2020/2021. Following this decision, GPFS formulated a phase out strategy that includes a “Capitalization of Experiences” (CAPEX) as a learning exercise to compile and to analyse the key insights, lessons learned, identified factors of success or failure of projects under the PHM umbrella in SSA. The CAPEX exercise will culminate in a learning event. This document outlines the methodology to conduct the Capex study.

This report aims at presenting the results of the CAPEX executed by Illudest with three of the five projects. Another CAPEX team led by Helvetas has studied the experiences of the two other projects. Both Capex teams have written a study. The next Chapter reminds about the objectives of the CAPEX studies and the expected outputs. Chapter 3 briefly presents the context, PHM initiatives in SSA and the SDC-funded ones. The methodology and implementation design are given in Chapter 4. They are similar for all five SDC-funded PHM projects, hence for both teams. Chapter 5 submits the results of the CAPEX experiences and their factors of the various assets by the Illudest team. Chapter 6 proposes responses to key questions formulated in the ToRs.

It has to be reminded that this present report is a draft of the report to be sent to all participants of the learning workshop in Arusha (22 October until the 25 October). In its final version, the Executive Summary, in English and in French, will be written for both CAPEX studies. The draft report is first sent to the CAPEX Core Group and then will be shared with the workshop participants on October 7 – two weeks prior to the meeting in Arusha. This report is one of the inputs in the discussion of the learning workshop. It will be complemented by the other study and, more importantly by the experiences of the workshop participants. The studies and the workshop discussions and findings will inform the final narrative report.

- Objectives and expected outputs

The overall CAPEX objective is to take stock of experiences of the five PHM programmes - this study covers three of the projects (see Table 2) to allow the adoption of the lessons learnt by SDC, Helvetas, stakeholders, government officials, policy makers and donors working in PHM or related topics, currently and in the future.

The objective of this mandate is to support SDC and HELVETAS in all stages of this comprehensive and far-reaching CAPEX exercise. Its specific objectives are:

- I. Get a practical, instructive overview of lessons learned on the approaches, strategies, methodologies used in the five projects 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 to enable them to take informed policy decisions on PHM.

During the inception phase, these specific objectives were fine-tuned. The communication on SDC experience and expertise in PHM should be directed to the Community of Practice on Food Loss Reduction hosted by FAO (CoP), the PHM stakeholders in Africa and the Swiss public. Furthermore, the CAPEX should not only define ways to improve approaches and future intervention strategies but also increase their accessibility to the CoP.

The expected outputs of the mandate are: an inception report, a concept report for the learning workshop, two CAPEX study reports, a learning workshop, and final narrative report and a CAPEX communication package.

3. Post-harvest losses in SSA

3.1. Context

Post-harvest loss (PHL) is now quite high in the development agenda. PHL are the measurable qualitative and quantitative food loss along the supply chain, starting from harvest until consumption or other end uses. Today it is estimated that 13,5% of the grain produced across SSA is lost postharvest. This is equivalent to US\$ 4 billion per year, or the annual caloric requirements of 48 million people (World Bank et al. 2011). Table 1 below presents the PHL losses in 6 Sub-Saharan countries where the SDC-funded PHM programs are operating.

There have been several approaches to PHM during the last decades, from quantitative losses at farm level to including qualitative losses along the whole value chains. According to Affognon *et al.* (2014), PHM innovation systems in the past did not explore value chains and concentrated on technical efficacy of technologies focusing mainly on storage improvement at farm level, leaving out the socio-economic aspects and other dynamics that link knowledge to practice. They recommended that future PHM research should regard the entire value chain and develop innovation packages that not only work in one segment but across it, based on clear identification of the loss hotspots and the socio-economic aspects. Furthermore, it is now acknowledged that PHM has not only high economic impacts, but it also affects financial prospects for farmers, nutrition, health and the environment.

PHM has also gained attention at policy level and support to reduction of PHL from national governments and donors have been present. In 2014, the Africa Union (AU) Malabo Declaration commits AU Members to reduce the current level of PHL by 50 percent. In 2017, practitioners representing various actors active in the reduction of PHM, including donors, governments, and UN Organisations met in Bellagio and issued a commitment to collaborate and scale up effective action (Helvetas, 2018). The latest high-level initiative is the Post-Harvest Losses Reduction and Agro-processing (PHAP) flagship funding by the African Development Bank (AfDB) launched at the end of 2017. African states as well are developing national strategies to reduce these losses, as demonstrated by actions such as the high level consultative workshop in Kampala in May 2019 to develop a comprehensive strategy and action plan for PHL reduction and the recent signing, in August 2019 by the Minister of Agriculture in Tanzania the country Postharvest Management Strategy.

However, the results of the inaugural review report on the implementation of the Malabo Declaration (AU, 2018) indicated that only Malawi, Mauritania, Rwanda, Togo and Uganda had collected adequate data on PHL. The other 42 Member States could not collect data to fulfil their reporting commitment. Lack of data does not allow to draw conclusion as to whether PHL has increased or decreased but it is a symptom of the difficulties to obtain accurate data to guide the implementation of strategic actions. The PHM context in SSA is very dynamic and FAO CoP provides the latest information on this changing environment.

3.2. PHM initiatives

3.2.1. SDC-funded programmes

Since 2008, the SDC has been implementing programs on postharvest management in SSA with a common goal “to increase food security of smallholder farmers in SSA through reduced postharvest losses at farm and community level”. An umbrella program was launched by the GPFS of the Global Cooperation Domain with the objective to replicate the great achievements of SDC in Central America (POSTCOSECHA Program) and to complement synergistically the engagement of the South Cooperation Domain (in particular East Africa Division) in postharvest food loss reduction issues in SSA.

Based on the successful POSTCOSECHA program in Central America that led to the adoption of the metal silo by more than 400'000 smallholder households, SDC started in 2008/2009 supporting a number of initiatives on postharvest management in SSA. The initiatives are implemented in several countries (Benin, Ethiopia, Mozambique, Uganda, DRC, Burkina Faso and Tanzania) and at regional level by different international and national partners and networks (FAO/IFAD/WFP, HELVETAS-Swiss-Intercooperation, FANRPAN, AFAAS, AGRIDEA).

The total support of SDC for postharvest food loss reduction programs and initiatives in SSA is around USD 25 million for the period 2012 to 2019. These postharvest food loss reduction programs focus on innovation and promotion of improved postharvest technologies and best practices for smallholder farmers, broad sharing of knowledge (e.g. through the FAO Community of Practice CoP) and addressing policy constraints related to postharvest food losses.

The five programs aim(ed) to achieve similar objectives and a similar thematic focus. They also use(d) similar and partly the same key approaches in their implementation, such as: Systemic Market Development (MSD), Policy dialogue and advocacy, Pluralistic Rural Advisory Services (RAS), Technology demonstration and dissemination, and Institutionalisation of PHM at national and regional levels. Furthermore, all five programs mainly focus(ed) on four major pillars:

1. Technology: applied research for development, demonstration and dissemination (scale up),
2. Markets linkages: business model development, financing, private sector engagement,
3. Policy: regional harmonisation, advocacy and institutionalisation / mainstreaming of PHM,
4. Capacity building: training, education and infrastructure.

The intervention strategy is presented in the Figure below.

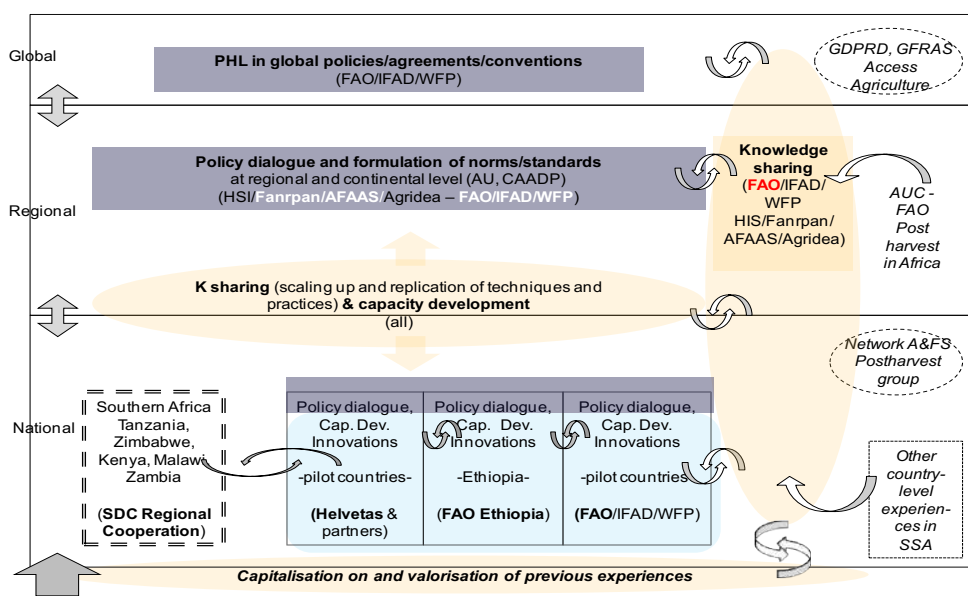


Figure 1: Postharvest management in Sub-Saharan Africa – intervention strategy GPFS
Source: entry proposal

The name, lead implementer, phases' dates, countries, crop included and budget of the SDC-funded PHM programs are presented in the table below. For information about the expected outcomes per programs, please refer to Annex 1.

SDC-funded programs	PHM-RBA	PHM-ETH	EGSP
Lead	FAO/WFP/IFAD	FAO	CIMMYT
Phase 1	1.10.2013 – 31.5.2017	1.09.12 – 31.08.17	1.07.08 – 31.03.11
Begin-end phase 2	1.6.2017 – 31.5.2020	1.9.2018 – 31.8.2022	1.6.2012- 15.03.2015
Countries	Uganda, Burkina Faso, DRC...	Ethiopia	Kenya, Malawi, Zambia, Zimbabwe
Crops (grains and pulses)	U: maize, beans, sunflower BF: cowpea, maize, sorghum DRC: maize, rice	Maize, wheat, haricot , beans, fava beans and chickpeas	Maize
Total budget	I: 2,97 mio li: 1,8 Total: 4,77 Mio	I: 3.3 Mio li: 2,95 Mio Total: 6.25 Mio	I: 645 K li: 7.3 Mio (orig. budget) Total: 8 Mio

Table 1: Synthesis information on the three SDC-funded PHM programs covered by this study

3.2.2. Other PHM initiatives

There are currently several PHM initiatives in SSA. The Africa Union (AU) is currently implementing an initiative to map existing PHL initiatives in the continent. The preliminary results were presented in Nairobi in 2018 (FAO. 2018). It is worthwhile noting that their mapping shows a majority of these initiatives (44%) located in 22 countries focusing on technologies and practices, where as 8% in 4 countries focus on Policy, and 6% in 3 countries focus on value chain development. The FAO CoP as well is attempting to catalogue the PHM initiatives in SSA. It is currently being updated (<http://www.fao.org/food-loss-reduction/resources/map/en/>, September 12th, 2019). A listing of selected initiatives is in the Annex 4

- The CAPEX studies

4.1. Methodology

Capitalisation is an iterative process allowing experience, successful or less successful, to be identified, valued, documented and, finally, disseminated. The final aim of a CAPEX is to transform individual and institutional experience and knowledge of key stakeholders into capital that can be used in future. It is participatory, inclusive and deliberative.

The proposed framework is described in detail in the inception report and is only briefly presented here. It aims to: i) List the assets being introduced into SDC-funded PHL programmes, ii) Characterise all assets¹ in the capitalisation process and iii) Then value them in their diverse context and as well explore the broad context of the SDC funded PHM innovation process in SSA. Key questions have been prepared to guide the characterisation of assets in their various dimensions. These are:

- 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 2008? Which one of these assets have been promoted or duplicated with SDC funding?
 - Which assets have contributed or have attempted but failed to contribute to the shift in focus defined by the 2018 Bellagio statement: from reducing Post Harvest losses in quantity only to focusing as well on food quality, from focusing on post-harvest loss reduction in storage to a more holistic approach to PHM from field to fork, from the promotion of technology to a market system development approach and from single actor, single sector led technology promotion to a multi-sectorial and multi-actor led innovation.
- Key success factors and Constraints
 - What are the 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 reflexion that has guided the promotion of specific assets in PHM by Government, Sub-regional organisation, donors and others?
- Lessons learned: What was the role of SDC in supporting, accompanying, promoting, adapting the PHL solutions and their support strategy: openness to innovation, adaptation to changes?
- Sustainability and replicability
 - 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 existed, has the private sector been engaged and how?

The data collection is based on: a desk review, an online survey, field visits, including multi-actor workshops, and specific bilateral interviews.

¹ A list of terms and their definition is included as Annex 1 of the inception report. This is to ensure that all participants in this CAPEX have the same understanding.

4.2. Implementation design

There are two separate CAPEX teams working on the SDC-funded programs with the methodology described above: Julien de Meyer and Anna Crole-Rees from Illudest and Annet de Witteven and Georg Felder from Helvetas. The five programs have been allocated to these teams, as shown in the Table below.

Programmes	Lead implementer	Visited countries	CAPEX Study team
PHM in Sub-Saharan Africa (FAO/WFP/IFAD)	FAO	Burkina Faso, DRC, Uganda	Illudest
Effective Grain Storage for Sustainable Livelihoods of African Farmers (EGSP II)	CIMMYT	Kenya	Illudest
Reducing Food Losses through Improved PHM in Ethiopia	FAO	Ethiopia	Illudest
PHM in Sub-Saharan Africa	Helvetas	Benin, Mozambique	Helvetas
Grain Postharvest Loss Prevention (GPLP)	Helvetas	Tanzania	Helvetas

Table 2: PHM program participating in the CAPEX and responsibilities of the CAPEX teams.

The whole process, from the inception to the reporting phases, was facilitated by both teams, Illudest having the lead. A core group of experts has been invited to accompany the process facilitation and steering (for the composition: see inception report). The main activities were:

- **Desk review:** SDC has provided a “list of mandatory literature” about the five SDC-funded PHM projects. This was complemented by documents supplied by the projects themselves and by an online search about PHM in SSA. It should be noted that the CAPEX team was specifically informed during the briefing that the POSTCOSECHA program was not part of this CAPEX study. The desk review was a continuous process during the study.
- **Online survey:** its main objective is to better understand the context of PHM in SSA, test some hypothesis and assumptions developed during the desk review. The online survey used Survey Monkey and was sent to the members of the FAO CoP as well as others not on the list, from the networks of the CAPEX team members. It was launched on June 10th and closed on July 4th. There were 224 responses (178 responses in English and 46 in French) from 59 countries. 25% of the responses were from women. The results are inserted in the chapter 5 and Annex 3 for details.
- **Field visits:** The field visits happened between May 2019 and September 2019 (one visit happening after sending the draft report). A field visit guide was prepared for both teams, with a first briefing with the lead implementer in the country, a multi-stakeholder workshop and bilateral interviews in the capital and in the field. These were 5 days visits for the Illudest team and between 5 and 10 days for the Helvetas team. It is worthwhile mentioning that most of the field visits occurred several weeks before the next harvest, hence during the hunger period.
- **Bilateral interviews:** these occurred with key resource persons.
- **Learning workshop:** A learning multi-stakeholder workshop was held between October 21st and October 25th, 2019, Arusha, Tanzania. The aims were to: i) discuss and validate both the CAPEX studies, ii) further exchange and discuss about experiences and assets, iii) consolidate the learning among all participants and, iv) start the appropriation process. A first list of participants was suggested by the CAPEX teams. This list was then finalised by SDC. The latter includes delegations from visited countries, key resources persons, FAO CoP representatives, the core group and other PHM experts. Both teams moderated the whole workshop. They made use of tools and instruments from various approaches, such as

participation and learning, visual tools, change management, digital media, etc., with the aim to foster learning and inspiration.

- **Deliveries:** there are three outputs, namely i) this current CAPEX studies report that was prepared by the Illudest team. The main results of the Helvetas team is included in the summary of this report, in French and English, ii) a narrative report that aims at documenting the whole process and, iii) communication products.

- “Assets” used in SDC-PHM projects in SSA

A list of “assets” or innovation outputs has been made based on the literature review from SDC-funded PHM programs and from PHM documentation in general, including the FAO CoP, the various interviews, the online survey and the field visits. The list includes over 100 innovations that were identified in SDC funded PHM programs and outside these programs. This list was then reworked: similar innovations had different names in different regions or programs, etc. The final list presented in Annex 3 records all innovations that were found. They have been then grouped, the grouping being adapted from Kehl and Nano (2014).

This chapter describes assets of the SDC-funded programs in the PHM domain, the experiences with them and their strengths, opportunities, threats and constraints. The selection of the assets has been made based on the following criteria: i) the asset is being used in the programs’ implementation and/or has been discussed during the field visits or the interviews, ii) it is relevant to the key questions in the ToRs. A subset of assets were then selected and described. Each of asset description includes: brief presentation of the issue, the experience within projects, the results, comments about sustainability and replicability and, finally, their strengths, opportunities, weaknesses and threats. The basis for the information is the documentation review, own consultants’ expertise and field visits, including the workshops. The description of some assets not being mentioned in this Chapter or in the Annex 3 have been subject of a session during the learning workshop.

5.1. Innovative PHL assets and strategies package at farm level

The assets at farm level are differentiated by pre-storage, storage and post-storage.

Improved pre-storage activities

Harvest should be dried and cleaned (sorted) before storage, particularly in improved storage facilities. This reduces the risk of contamination by mycotoxins, the development of moulds, etc.

Experience and results

In all projects, innovations for drying and pre-storage have been introduced, often as a package. These innovations as: drying, improved drying on tarpaulin or plastic sheet, humidity analysis before storage with plastic or glass bottle and salt or hygrometer, threshing on a Tarpaulin or a plastic sheet, manual or mechanical and aflatoxin analysis, among others. During these last years, the issue of high level of aflatoxin has emerged in project management and moreover in grains and pulses trade very strongly, mostly due to export ban and due to public health concerns (Uganda, Ethiopia and Burkina Faso. In the Democratic Republic of Congo (DRC), on the other hand, aflatoxin was not a prominent concern for the producers interviewed. There have been some efforts at looking at ways to include this factor. As found out in Uganda, much cheaper tests exist and allow to test whether the level of aflatoxin is higher than a certain level or otherwise. The aflatoxin issue is particularly of relevance for P4P, as a formal key player in grains and pulses markets.

The field visits showed that several of these innovations were well in place. Humidity tests with the bottle seemed to be quite well known and used in all the visited areas. However, in some area, the inclusion of salt to test humidity was not explained, thus rendering this method unreliable. In Ethiopia, farmers training centre in Kebele have access to one hygrometer belonging to the extension services. In Kenya, a hygrometer has also been distributed to farmers' groups. These were imported and are quite easy to use and cheap (one USD). The use of tarpaulin is also acknowledged to be useful, simple and being re-usable during at least 3-4 campaigns. Furthermore, in case of rain, the tarpaulin can easily be folded and closed, hence protecting the grains from the rains. Their purchase does not seem to be an issue thanks to its low price. Some households use simple plastic sheets, hence showing that this innovation is well integrated. The farmers mainly mentioned the quality of grains for storage and less grains' loss reduction as a benefit of using this innovation.

Aflatoxin analysis is being done in some countries. In Burkina Faso, INERA developed Aflasafe, a product to be used by producers on their plots. This is being integrated in the project. Research results showed that the level of aflatoxin will increase in non-airtight storage, but can be controlled in airtight storage. Interestingly, improved seeds are not being mentioned in the projects, but were regularly mentioned during the local workshops by farmers.

The cleaning, drying and sorting is mainly done by women, even though men stated that they do help. This is particularly relevant as women are generally responsible for keeping an eye on stocks and for withdrawing grains and pulses for domestic uses.

Sustainability and replicability

The use of the bottle and salt is a simple and reliable method that is sustainable and perceived as very useful by the producers who received the training. Despite the growing urgency in tackling the aflatoxin issue, results are not sustainable yet (see below). Replicability should include: pursue the delivery of the portfolio of assets (humidity, improved drying, etc.), train men and women of the same household, link with household nutrition and markets requirements and opportunities, etc.

Strengths and opportunities	<ul style="list-style-type: none"> • Producers are aware of the need to store and sell grains at specific moisture content and welcome simple and reliable technologies. The bottle test seems very well known and used. The use of tarpaulin is also acknowledged to be useful and simple. It is also cheap and people buy it. Tarpaulin can be folded and “closed” when it rains, hence protecting the grains. • Many producers have adopted several of these innovations, even those who did not get access to improved storage.
Weaknesses and threats	<ul style="list-style-type: none"> • Some producers were disappointed with their pre-storage efforts, particularly those who did not get access to hermetic silos or bags after their training or those who used cheaper PICS counterfeit. • The responsibility of clearing, sorting and drying is generally allocated to women. The issue of who buys the PHT were not discussed, but could be of relevance. • Someone challenged the aflatoxin test due to moral reasons: “What should you do when a household stock is being found containing a high level of aflatoxin. Morally, you should replace it!”

Table 3: Characterisation of improved drying assets

Improved storage (hermetic silos and bags)

Silos

Producers store grain and pulses for food security and to be able to sell their produce at a time where market prices are higher. However, traditional methods of storage do not always provide adequate protection against insects, animals, humidity, mould or even thefts, resulting in considerable postharvest losses.

Experience and results

Storage improvement in the SDC-funded PHM projects was first mainly based on the dissemination of metal silos. It was a critical element. Airtight metal silos are incremental innovations for grains producers. It can be considered as radical for some artisans as its production implies new material and often, new clients. There was already quite a lot of experience with metal silos in Africa since the 40's (FAO. 2008) and particularly by FAO (FAO. 1994 and 2008). FAO introduced airtight silos in 1997 in nine countries, in Burkina Faso and Mozambique among others.

The silos in these SDC-funded projects are similar to those from earlier projects. The main innovations here are: i) the accompanying measures to the silos' introduction, such as PHM awareness raising and training before presenting the silo physically, ii) adding market-driven elements in all projects and iii) individual silos. Earlier experience showed that availability of extension officers or trained fumigator was very low (FAO. 2008 and personal communication in Uganda), expensive and sometimes not well executed, hence with health risks. Furthermore, according to people, "it changes the taste". In Kenya, research has been conducted on hermetic storage without phostoxin, with success. It demonstrated that metal silos are technically very effective and control insects for at least six months and furthermore, the use of insecticides is not recommended (De Groote et al. 2013). Another change was made: In Burkina Faso, the collective metal silos have been dismissed from the project to concentrate on household silos. This also follows the experience in Malawi where collective silos were not used as rural households preferred to have their stock in their home (FAO. 2008). In some cases, farmers have diversified the use of silos: stocking water, renting to others when their silos were empty, etc.

All projects first began with a "standardised" silo, generally of 500 kg. Several issues were raised. First, silos need to be kept inside because of exposure to sun and rain. Most silos did not fit the house doors. In some areas, the roof has been temporarily displaced to allow the silo to be installed in the house. In other cases, smaller silos were made available. There are now silos of various sizes: 100, 250, 500 and 1,000 kg. Artisans in Burkina Faso and Kenya now measure the house door and manufacture silos fitting exactly. This flexibility was made possible as the silo production is decentralised and made by local artisans, except in Uganda. In this country, there were difficulties to find enough competent artisans as it was in Mozambique before 2008 (FAO. 2008). The manufacturer in Uganda, Steel and Industries Ltd, produces a silo that is lighter than those produced by artisans, but also much more expensive. The sizes are also limited. Furthermore, as silo production is centralised in Kampala, some farmers have complained that they would like one, but cannot find it on the market. Others also decided against buying a metal silo due to the volume (cannot be installed some houses). This business model was not discussed during this CAPEX.

A research in Kenya shows that the best sellers are 1-ton silos that were purchased by producers who had surplus grain to sell to the market (Kimenju and De Groote. 2010). In Ethiopia, larger silos were also produced. In DRC, the quality of the silos produced was an issue as the metal sheet used were thin and non-galvanised and thus were rusting and tearing easily when filled with grains. A few

producers in DRC actually claimed to have lost more grains because they attempted to store it in the silos². A respondent to the online survey mentioned that the way to check if the silo is hermetically closed with a candle was developed by CIMMYT. The candle check is used extensively in the projects' areas and in Ethiopia. All producers mentioned that it was successful.

At farm level, and except in DRC³, all those who benefited from or bought one or more metal silos were proud of their acquired silos, and moreover, that they still had stocks before next harvest and that their grains were of good quality. Some even mentioned that they could "help" their community by selling high quality grains and pulses. Interestingly, it was found that farmers do not like to show their silo and stock to others, limiting the "copying model" for this technology. During the field visits that happened a few weeks before harvesting, all visited farmers who had a silo still had stocks and the visual quality of the grains and pulses was very good. This was not the case for those without improved storage. Since PHM awareness raising campaigns and silos demonstrations were first executed by NGOs and/or extension services, those having benefited or bought silos all still make use of the pre-storage requirements. This is generally done by women, even if men often mention that "they can do it" or "we help when needed". Women acknowledged that the metal silos freed them from having to stay on their compound to secure the stocks from thefts.

The fact that fumigation is not needed positively influenced adoption. Particularly women mentioned that "the taste of the grains remain the same". Due to high toxicity of the fumigation products, in countries such as Uganda, it is required that fumigation be executed by professional fumigators, who are always available at the right time. The reduction of the fumigation cost seemed secondary. Another positive factor quoted by women was the fact that "you can not keep your grain in traditional granaries outside the house, because of thieves". The adoption of the metal silos potentially allows producers to take advantage of fluctuating grain and pulses prices. Households who have adopted metal silos sell the largest amount after five months while the non-adopters sell most of their output right after harvest and then keep selling small amounts (De Groote and Gitonga. 2013). Reports of 67% price increase during the off-season have been reported for on SDC-funded PHM projects (Egessa et al. 2017). In Uganda, the 2018 harvest being good, prices were low at harvest time and much higher three months later... As someone mentioned: "producers woke up" and wanted silos. Research also confirmed that metal silos adopters store their maize longer and are food secure for at least a month longer than non-adopters (Gitonga et al. 2012).

Adoption rate of metal silos is complex to estimate. In the visited countries, the silos market did not seem to take up. In Ethiopia, artisans and extensionists were hopeful that orders for silos would increase, however no concrete evidence was found during the CAPEX visits. Data on adoption levels are scarce. In Uganda, a baseline survey showed that 0.2% of smallholders had metal silos (Omotilewa et al. 2018). In all countries with reduced or elimination of silos' subsidies, demand for silos has been decreasing drastically. Artisans mentioned some private urban individuals buying small silos for their relatives in rural areas. Some schools and churches and parishes have bought silos outside the project in all countries. They are cheaper counterfeits silos being sold on the market. This has damaged the image of the silos, particularly since it is so expensive. Kimenju and De Groote (2010) empirically showed that household size, literacy of the household head and land size increased the likelihood of adopting the metal silo technology in Kenya. Furthermore, households

² In DRC, producers use mosquito nets dip-treated with insecticide to cover their stored grains to protect against insects. This has obvious public health concerns as those nets are not protecting sleeping family members against malaria and as well could bring insecticide in contact with food.

³ In RDC, only a few metal silos were still operational at the time of the field visit at the end of September 2019, most had been discarded due to their poor quality.

with access to financial services (bank account and/or mobile money) were more likely to adopt metal silo. Distance to the nearest passable road reduced odds of adopting metal silo technology. Silos represent quite an investment for smallholders and require a long-term perspective as shown by Kimenju and De Groot (2010). They found that demand depends on harvest and grain price of a specific year, but also on harvest and prices in the mid-term perspectives. The later will influence the perception for repayment of the credit (if credit is available). Economic analysis shows that the largest silos (up to 1.8 tonnes) are economically attractive, while the smaller silos are sensitive to the interest rate and the investment period (Kimenju and De Groot. 2010). Walker et al. (2018) even argue that metal silo “seem unrealistic alternatives for most smallholder famers”. Walker et al. (2018) assert that despite metal silos having “very positive attributes due to its durability from an operational viewpoint”, “ these positives may not outweigh the high initial cost”. Currently, there are demands outside SDC-funded programs for metal silos. For example, USAID asked CIMMYT about silos for South Sudan. Various NGOs in Ethiopia are requesting trained artisans and extension services for metal silos for their program.

Silos’ prices have proved to be a critical issue for adoption. First, the metal silos were subsidised (see asset Subsidies) in order to enable a more rapid increase in demand and reach a critical mass. Efforts were invested for reducing silos’ costs and reduce buyers’ transaction costs. Artisans have almost all begin to build silos directly on-site. Metal sheets are easier and cheaper to transport than silos. There were also negative experiences with poorly negotiated prices for transport with no guarantee by farmers. The later often had to pay additional costs for artisans to travel on-site for re-welding the silos. This is one of the reasons why artisans now generally build silos on-site. In several countries, the programs have tried to convince the government to reduce or even eliminate the taxes on metal sheets, without success (see asset institutionalisation). An analysis showed that in Kenya 56% of the costs of metal silos were associated with government duties and Value-Added Tax (VAT). Financial institutions were contacted for financial services to the metal silos buyers (see asset financial services). Producers’ Organisations (PO) were also informed how farmers could repay them, the repayments then serving other farmers to access metal silos.

Trained artisans by the project not all pursued silos’ manufacturing. According to De Groot et al. (2015), the uptake of metal silo production as a business depend on previous training as a metalworker, ownership of a workshop, experience of technical work, level of income at the time of training and age. All artisans met mentioned their conviction of this new product, but also admitted being discouraged by the low demand outside projects. Interestingly, less than half of the trained artisans in Kenya owned a metal silo, despite most of them being also farmers (De Groot et al. 2015). Non-airtight silos also were mentioned to negatively influence the market. Being trained allowed artisans to increase their income (Ndegwa et al. 2015) and diversify their products’ portfolio. In Kenya, the margin was estimated to be between 16 and 25% of the selling price (installed onsite).

Plastic silos are more and more perceived as an airtight storage alternative. In DRC, because of the quality issue with the metal silos, most producers and extensionists interviewed see it as the only viable alternative. In Kenya, it was found that plastic silos were interesting for small-scale farmers, with less than 0.5 t grains or pulses. In Burkina Faso, there are now discussions between a potential manufacturer and the project for plastic silos.

In Ethiopia (FAO. 2017), it was found that cost-benefit analysis for the bags showed a positive profitability of 13.2 USD/yr to achieve 95% reduction of losses during storage. However, use of galvanized metal silo resulted in negative profitability for the same goal of loss reduction during storage. This is mainly associated with a high production cost of the storage structure (219.5

USD/metal silo for one-ton capacity) and the current low price of maize (169.8 USD/ton) in the national market.

Sustainability and replicability

The prospects of sustainability for the hermetic metal silos are currently mixed⁴. There are certainly positive factors. The seasonal price fluctuations of grains positively influence demand and are more and more perceived as a “wake up call” for silo by farmers. In some cases, price fluctuations represent higher income loss than PHL. The aims of increasing agricultural production in order to expand export, feed other regions (population growth, internal and external refugees, climate change, etc. and of transforming subsistence farming to commercial farming also favour demand. The upfront cost of the metal silos is an important negative factor. Furthermore, the lack of access to financial services and, in some cases, the lack of market access to grains may also disfavour the sustainability of metal silos’ market.

Strengths and opportunities	<ul style="list-style-type: none"> • The technology has been empirically proved as technically efficient: gas-tight (O₂ and CO₂), resistant to rodent attacks and insect pest like LGB, etc. Silos were also shown to reduce the ability of <i>Aspergillus flavus</i> to produce aflatoxin (Adler et al. 2000), even when opened regularly (Walker. 2018) • Socially and management wise, silos bring positive benefits to farmers, particularly to women: prevention from thefts, freeing time for women, shorter hunger period, requires less space than plastic bags for storage (particularly for large quantities). Potential benefits from grains selling are perceived, but not by all farmers. • With the growing issue of aflatoxin in most countries, there is a clear opportunity for such improved storage technology. • Linking research with the silo introduction allowed to determine adoption factors at farm level. • The decentralised and local production system allows the availability of various silo’ sizes. • Metal silos certainly got attention. Consequently, metal silos have sometimes been used for political purposes. Some cases of politicians offering silos free of charge have been reported. • Interest in metal and plastic silos remains high. In Kenya, a private company for plastic silos asked CIMMYT to them. There is currently a Danish technician working on improving the metal silos.
Weaknesses and threats	<ul style="list-style-type: none"> • Technical: easily damageable during transport. Requires good quality grains and pulses before storage, hence drying control and sorting before hand is a pre-requisite for success. Not “removable”. Risk of corrosion, particularly when stored grains are not dry enough. The release of grains or pulses out of silos has also been said to be slow, particularly when for selling large quantities. • Airtightness in counterfeit (and cheaper) silos not guaranteed • Artisans lack of revolving fund and stocking capital and/or space

PICS and hermetic bags

PICS bags were the first hermetic bags to appear on markets. They were introduced by Purdue University and disseminated by them since 2007 in SSA and Asia. Purdue University introduced them

⁴ Sustainability for plastic silos was not included, due to lack of time (and data).

with a clear business model including support to companies producing the PICS bags as well as the whole PICS bags' value chain, farmers' training, PICS bags retailers and extension and research capacity building. Later on, AgResults introduced a pay-for-results competition among PICS bags producers and sellers in Kenya, inducing competition and innovation. Radio was also used. There are now competitors in several countries.

Experience and results

It is important to note that PICS bags were not in the first SDC-funded PHM program descriptions. Most programs have now introduced, formally (Burkina Faso, Kenya and DRC) or informally, the PICS bags. In Ethiopia, CBA recommended that the project include also Super Grain Bag. For the PICS, it stated that they should be tested (Regassa. 2014). During the field visits there, only PICS bags were observed. In DRC, FAO was also attempting to source ZeroFly® storage bags as an alternative. Test research was not discussed. In Kenya, other bags than PICS were observed. Ndegwa et al. (2016) analysed that hermetic bags are profitable in Kenya, if stored for four months or longer and if they can be re-used for four seasons and more. Experience showed that industrials producing PICS request large orders or an existing distribution system, which is the case in Kenya with Bell Industries. In Uganda, an industrial contacted by Purdue renounced. In Burkina Faso, the current producer, FASOPLAST, works with orders from the RBA program. There are no producers of bags in DRC and PICS bags were imported from Tanzania by FAO, WFP is today as well trying to source bags to import. One importer was met in Uganda. She entered the market, but overestimated the demand, the sales window and the distribution channels. She suffered from the mobilised capital.

Dissemination of PICS bags has now reached over 5 million farmers in SSA. In most visited countries, sales have been exponential, except, it seems in DRC and Burkina Faso. In the later country, sales remain at around 150'000 bags per year and slightly increasing. In Kenya, the producing company has its own marketing channels and works with their local agro-dealers who are well in place.

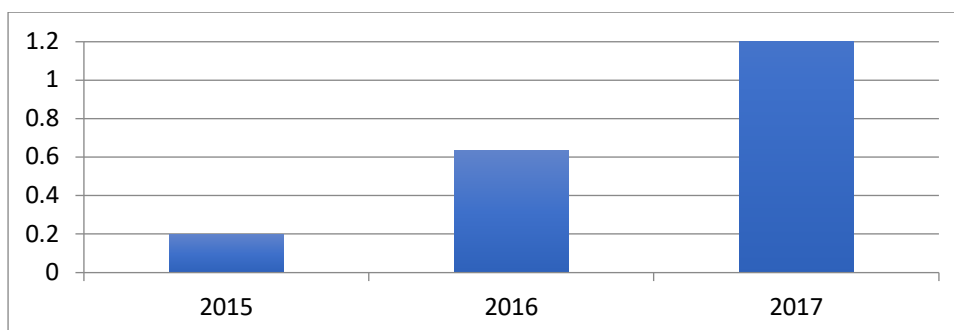


Figure 2: Annual PICS bags sales (million bags) of Bell Industries Ltd, Kenya. Source: Bell Industries Ltd (personal communication)

Sustainability and replicability

Within less than 10 years, the PICS bags are recognised by the governments and their sales are beginning to show an exponential curve (see Figure 2). Producers are paying the full price, except in some projects. The issue of who pays the bags within the household was not discussed. Interestingly, the “plastic” law (Ministry of Environment) in Burkina Faso has made an exception for the PICS bags, hence showing institutionalisation of this improved storage. In countries where there is no production, such as in Uganda, sustainability is dependent in business opportunities for importers.

Strengths and opportunities	<ul style="list-style-type: none"> • Cheap, easily transportable, more easily movable than silos, no need of pesticides, easily repaired (with tape), can be kept for 3 to 4 seasons,
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	<p>content easily monitored.</p> <ul style="list-style-type: none"> • Business model for PICS in place and sales have reached an exponential curve in most visited countries. There is still market potential. • The inclusion of PICS bags into the projects has diversified the hermetic storage solutions at farm level and induced a higher level of inclusiveness as many farmers are able and willing to pay for the PICS bags that are much cheaper than silos, metal or plastic. • Producers can potentially take advantage of price seasonal variability and differentiated prices for quality. • Recycling has already been thought through, for the plastic bags and the woven sack (Baributsa et al. 2015). • Inserted in the portfolio of improved storage, it offers alternative for farmers, particularly for those not willing or able to invest in silos.
Weaknesses and threats	<ul style="list-style-type: none"> • Farmers in specific areas have been complaining of rodent attacks, while other farmers have received metal silos. Ndegwa et al. (2015. Quoted by Walker et al. 2018) found that maize stored in PICS bags in clean stores is rarely affected by rats. • Sales of bags are highly seasonal (less than two months). The window sales period begins at harvest. Demand also depends on harvest level and hence, grain price. This implies specific production and marketing planning. For example, in Burkina Faso, the bags producer began too late (as not willing to stock) so that many smallholders got the bags too late. In Uganda, some producers perceived the PICS bags as a FAO technology as they could not find them on the market. • Movability: mixed experiences due to size and weight. Some reported bags breaking when moved. • Environmental impact of the plastic bags is not well assessed (the outside bag is generally recycled for cords). • PICS bags copied and replicated but quality is not consistent. • Price dependent on raw material price. In Ethiopia, SYS, the company manufacturing PICS bags mentioned an increase in the cost of plastic used to fabricate the inner and outer lining of the bags, they will increase the price of the bags to the producers. • The introduction of PICS bags requires the selection of enterprises that have the capacity and willingness to produce and/or buy quantities and to market them further.

5.2. Innovative PHM extension delivery strategies

Pluralistic Rural Advisory Services

Historically, public institutions have provided agricultural extension services. This system is limited by government budget and the knowledge of the extension agents. Under a pluralistic systems, different providers and types of agricultural and agribusiness advisory services, public and private, work together to provide extension services. Farmers receive advice from different sources and in different ways.

Experience and results

Projects' staff have contacted and regularly invited and involved the local RAS as well as local inputs sellers to events, training, meetings, etc. There were also efforts to include extension officers from Report CAPEX study, Illudest, January 2020

other NGOs. The results are mixed. There are positive results such as the financing the training of RAS officers by some counties in Kenya, hence including public RAS. In Ethiopia, the public extension system encourages and invites artisans and other input providers to provide embedded services. In Uganda and Burkina Faso, invited public extensionists rarely attend field days or visits due to financial issues (no money to pay for transport). In DRC, public extensionists attend field days and meeting with FAO..

The results of the inclusion of the private sector seem less successful. Producers and sellers of hermetic bags (PICS or other types) and probably tarpaulins and threshers sellers have developed and fully integrated chain with embedded services. For the PICS bags, this was clearly incorporated into the business plan at the beginning of the PICS project. How these PICS bags sellers are contributing to a pluralistic RAS is not known. During the field visits, there seems to have been less explicit measures to include grain and pulses processors or traders or artisans to contribute to a pluralistic RAS. In DRC very few agro dealers were present in remote areas and so including them was not always possible.

Sustainability and replicability

It is acknowledged that a pluralistic extension system including input traders and agribusinesses increases the sustainability of the system. Public extension should take the lead to this process. This will highly depend on the financial and human resources means. The participation of the private sector is not yet sustainable. A negative factor is the low coordination of the various value chains (VC). The replicability depends on the political context, the financial and human resource means of the various actors.

Strengths and opportunities	<ul style="list-style-type: none"> • Several have mentioned the opportunity to get exposed to new ideas, different approaches and needs • There are real opportunities with processors and traders, particularly when including the quality aspects of grains and pulses
Weaknesses and threats	<ul style="list-style-type: none"> • Requires strong leadership in leading the process and the activities • In several areas, public RAS is almost absent due to lack of HR and/or to financial resources to participate to events. Several rural communities had never seen a public extensionist (visited villages in Uganda and Kenya)! • Some admitted that the attendance of the private sector requires a well-defined business case • Requires harmonisation with other NGOs' aims

Extension communication products and tools

The aim is that producers are made aware of current and potential constraints in their production system and have access to information about a basket of possible solutions through effective communication with and from rural advisory services and other producers. Effective communication products and tools can influence the decisions of producers. However, information needs to be relevant, timely, accessible, context specific and understandable

Experience and results

Radio has been used quite extensively in all countries. Several videos also exist and have been diffused on the internet and on television channels, some in local languages. Leaflets, pamphlets as well as posters promoting technologies, often translated in local languages have been extensively used. Farmer-to-Farmer communication has been encouraged by the use of Farmers Field Schools (FFS). However, little use of mobile technologies or ICT was visible.

Most farmers were aware of PHM radio programs and had a poster and/or a pamphlet in their houses. The pamphlets on how to use silos translated in local language were common in farms. For example, in Ethiopia, these are glued on the silos. In Ethiopia, farmers explained that they learnt to identify common post-harvest constraints and devised or found out solutions during discussion with other producers in the FFS.

In DRC, two “Radios Communautaires” met during the CAPEX had been contracted by the project to deliver PHM messages. Listeners then provided feedback and asked questions, the extension officer (Inspecteur) being sometime live in the show. The producers and director of the radio expressed frustration with the project explaining that they had advertised silos and PICS bags, but listeners complained that they could not buy these products as they were not on the market and that the project did not distribute enough to cover all the producers in the region.

Sustainability and replicability

Sustainability will mainly depend on the RAS and county financial means, moreover to update and complement the PHL mapping data. The later was regularly a topic in the local CAPEX workshops as farmers were eager to have PHL numbers for the own areas. Communication products and tools must be context specific to be relevant. As such replicability is limited by availability of funding.

Strengths and opportunities	<ul style="list-style-type: none"> • The need and demand for agricultural information and extension are high. • A lot of communication products and tools are available for various audiences: policy makers, extensionists, farmers, etc. Many can be found on the FAO CoP. • Social media is successfully used by a county agricultural department in Burkina Faso.
Weaknesses and threats	<ul style="list-style-type: none"> • Most written and oral media firms require payments for their attendance and the writing of articles. • Women who generally are responsible for storage activities have on average a lower access to communication means such as radio, as reported by FAO. The communication media, especially public, rural or community radio, reflect inequalities based on gender (FAO, 2014a) • Radio program used to advertise the program and the technologies rather than sensitize and inform on PHM issues create expectations in the community that lead to frustration. • There is a strong culture of oral communication in SSA, compared to a more visual communication in say Europe. • The use of phone and/or ICT seemed to be scarce.

5.3 Quality improved storage and handling facility providers

Innovative solutions and relevant technologies need be brought to scale to ensure broad impact and allow more potential users to have access to the asset. However, the innovation characteristics and the relevance of the technology depend on its inherent quality and the knowledge to produce or deliver which sometimes becomes questionable without appropriate quality control. Competition for metal silos and PICS bags has emerged. Artisans and PICS bags producers and/or sellers perceive that lower quality storage facilities might impede their markets. Buyers might be discouraged to invest when the benefits are lower than expected. Certification is a mean to solve this, through private or public certification.

License and certification

Experience and results

The issue of quality control was included in all projects. Artisans selling metal silos through the project are required to be trained and accredited. The control is implicitly done by the government or the NGO, at the delivery of the silos at the buyer, and is a condition for the payment of the subsidy as in Burkina Faso and Kenya. In Ethiopia, artisans selling silos through the project are required to be trained and accredited. The issue for e.g. threshers was not dealt with during this CAPEX. There seems to be no quality control for the tarpaulins. The reason was probably that the most important thing is to protect grains and pulses from soil humidity and foreign matters. The quality of the plastic is less relevant and farmers explained that the plastic sheet should not have wholes. No licence or accreditation is required for their selling. For the PICS bags, the issue was mainly dealt by Purdue University. The license was given to Bell Industries in Kenya, to Fasoplast in Burkina Faso and SYS in Ethiopia. Bell Industries has a its own network of local agents, distributors and agrovets to sell their own products.

The certification of metal silos was dealt differently in the countries. In Ethiopia and Burkina Faso, the silos are certified on site by an agency of the government. In Burkina Faso, it is by the Institut de Recherche en Sciences Appliquées et Technologies (ISRAT). In Ethiopia, it is done by the public extension services. Only trained artisans who are accredited can produce and sell silos. Silos are “certified” by extension agents trained as silo certifier. In Uganda, silos are produced by a sole manufacturer. The certification issue was not discussed. In Kenya, during the project, the local NGO, the Catholic Diocese of Nakuru, sought approval from Kenya Agricultural Research Institute (KARI). Since the project has been terminated, it is not known if the system still remains. An association of silos artisans has been created aiming at introducing a brand. However, due to the very low demand for silos, the association lacks means to develop the brand as well as marketing. For the PICS bags, the situation is very different. The manufacturer gets a licence from Purdue University. EGSP had challenges with obtaining a food safety certificate from one of the proposed supplier of the hermetic bags. In Burkina Faso, It is worth mentioning that there is competition of companies licensed to sell. In Kenya, Bell Industries has an exclusive private partnership with the producer of PICS. It does seem to be disturbed by the counterfeit.

Sustainability and replicability

Sustainability level for the PICS bags certification is quite high. The upfront costs are covered by Purdue University. For the metal silos, sustainability depends on the system. In Ethiopia, senior extension officers could not see any issue with sustainability as accreditation of artisans is an element of the government PHM program and will continue to be supported. The costs are hence taken over by the government. In Burkina Faso, the sustainability factor clearly remains within the current system as someone from ISRAT, based in the capital, has to travel on site for certification. In Kenya, to the best of the CAPEX team’s knowledge, the certification sill exists. Currently, this control made by the government is free of charge. In Burkina Faso, it is a condition for the subsidy payment. Accreditation system by private sector or government is easily replicable. However control and enforcement of the accreditation, formal or not is not always replicable due to funding or access.

Strengths and opportunities	<ul style="list-style-type: none">• A certified system provides quality assurance and gives the farmers a guarantee that he/she is purchasing an effective hermetic storage device.• Certified artisans in Ethiopia are pleased with the system as they are sure to have a level field for their competition and their products cannot be replaced by cheaper ones, which might be defect.
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Weaknesses and threats	<ul style="list-style-type: none"> • Limited competition is not conducive to innovation. • The perception of quality by the buyers is critical for costly equipment, such as metal silo, particularly when bought at individual level. Low quality can seriously damage the market. • In Burkina Faso, FASOPLAST sees the license for PICS distribution to another company as threatening. Some say that attitude to market and risk is still similar to the time at when the company was a public, then semi-public enterprise. However, the company is now fully private and there is now a new director from abroad. • The issue of finding the relevant quality of metal sheets in some countries, as in Burkina Faso, has been regularly raised. Importing quality metal sheets increase the price of metal silos (import taxes, transport, etc.) and... the quality cannot be seen by the buyer.
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5.4. Cooperation mechanisms with the private sector

Cooperation mechanisms with the private sector include all mechanisms enabling the private sector to enter the PHM market and contribute to reduce PHL.

Business model

To trigger massive and large scale PHM strategies, hence distribution of improved PHM technologies, demand-driven and business model based approaches are critical as public resources will never be sufficient to reach all the smallholder households in the various countries. The introduction of a new technology, process or service requires a clear business model in order to get adopted by the future clients. Costs, risks and returns of producing, marketing, distributing the innovation or the innovation package relative to the motivations and incentives of potential adopters and other private actors in the VC (USAID. 2016).

Silos

Experience and results

The various programs have made use of similar business models for improved storage (see also Annex 4. Business models for improved storage). The table below examines elements of the business model for the metal silos.

Elements	Choices and experience
Supply of raw materials	<ul style="list-style-type: none"> • The projects all contacted metal sheets' producers or importers in order to link them with the artisans, at least in the beginning of the projects. • Quality of the metal sheets has been raised several times during the CAPEX visits. In Burkina Faso, one artisan claimed that the locals could not provide the right quality, indicating that he imported metal sheets himself. Raw material prices and, in some cases shipping costs, had to be negotiated by artisans with suppliers.
Manufacturing	<ul style="list-style-type: none"> • The projects all chose a decentralised production, by small-scale artisans, except in Uganda where a unique industrial firm is producing metal silos. In the latter, this choice was made after struggling with the quality work of the artisans in rural areas. • Artisans were selected and trained in each country. In Kenya, it was found that two thirds of the trained artisans were using their skills in producing

	silos (Ndegwa et al. 2015).
Transport of silos	<ul style="list-style-type: none"> • Transport of silos has been experienced as tricky. Silos are bulky and sensitive to damages, mostly due to the bad roads. Transport of silos is hence quite costly. Several projects began by transporting manufactured silos to the clients. Now, most artisans transport the metal sheets and build the silos at the client's sites. • Artisans are responsible for the transport of the silos or metal sheets and pay the transporter. The transport cost to the farm is sometime included in the subsidised price or otherwise. The transport price negotiation has been mentioned as an issue. In Ethiopia, it is free of charge, subsidised by the extension service.
Quality control	<ul style="list-style-type: none"> • The quality control system varies among projects (see also assets Certification and License / accreditation). In Burkina Faso, quality control is done by the central ISRAT in Ouagadougou and is required for the payment of the subsidy. In Kenya, it was done by the local implementing NGO. Since the termination of the project, artisans through their association are controlling the final product. In Ethiopia, the extension services certify the silos and will continue to do so.
Advertising and advising	<ul style="list-style-type: none"> • Artisans sell the silos to the client. • All potential silos' beneficiaries have been trained in PHM and silo handling by NGO before getting their silos. This element has been rightly taken from the lessons learnt of earlier projects. This training has been financed by the PHM projects. Artisans also had some training about PHM. Most say they also advise their clients about the use of their silos. They also mentioned that they have to do it for those clients who were not included in projects. • The targeting of beneficiaries / clients has been done by the NGOs on behalf of the projects. In Ethiopia, artisans and extension agents agreed that the business model for the silos had not taken in consideration the high cost of the metal sheets and so had to rethink the targeting for their clients. • In Burkina Faso and in Kenya, artisans mentioned their efforts to market silos, following a reduction in demand due to, respectively, the reduction of subsidies and termination of the project. Their success is mixed. Artisans mentioned the issues of covering large geographical areas, low transport mode and the cost and time of marketing.
Financing	<ul style="list-style-type: none"> • Metal sheets are bought and paid by the artisans. In some cases, they were start-up capital from projects. One artisan mentioned a credit from his bank to import the metal sheets. • Transport of the silos and/or metal sheets at clients' site is paid by the artisans. It is sometimes subsidised or, as is the case in Ethiopia, transported free of cost by the public extension service. • As several programs were aware of the silos' upfront costs and/ or had to reduce the silos' subsidies, financial institutions have been contacted with low success (see asset Financial services). They do not seem to have got business interest yet in offering specific services linked with PHM for the acquisition of metal silos and with metal silos production businesses.
Price setting	<ul style="list-style-type: none"> • The price setting has been a kind of negotiation between artisans and the projects, at least for those silos being given or sold at a subsidised price.

Sustainability and replicability

The current business case for metal silo is still weak and is not sustainable. It is now probably also true for the plastic silos. The main reasons are:

- Client/beneficiary targeting not sufficiently clear. Silos are expensive for small-scale farmers.
- Assets aiming at reducing transaction costs for producers as well as artisans, such as financial services, are scarce.

The assumption that the private sector would take over the marketing and its costs does not seem to hold for metal silos in the countries visited for this study. It seems that these costs were not included in the business plan, opposite to the PICS bags in Kenya for example. But even in Burkina Faso, the PICS bags producer seemed reluctant to invest before knowing the RBA-plan. Before replication, there would need a clear business model, showing a clear business case for the private sector to engage.

Strengths and opportunities	<ul style="list-style-type: none"> • The distribution of subsidies (see also asset Subsidies) is a great leverage for quality control of the metal silos. • The artisans had the opportunity to diversify their products. Most of them are truly convinced of the metal silos. • The silos makers association in Kenya did try to sell silos to grain traders and schools, with some success with schools (also see Box 1) • The introduction of a business model did allow some stakeholders to think more about the private sector.
Weaknesses and threats ¹¹	<ul style="list-style-type: none"> • Subsidies have seriously biased demand for metal silos. Several producers are now expecting these and hence, are not willing to pay for them (see also subsidies above). • The market targeting for the silos is not clear, during and after the programs. In some areas, relatively wealthy producers have benefited from the subsidised silos. Research studies have shown it larger silos are more profitable, but most of the small-scale farmers do not need larger silos. • The business model does not seem to take into account the quality aspect of grains and pulses storage. Most rural markets do not reward grains and pulses quality. In Uganda, an expert estimated that most metal silos were in urban areas as the pressure for quality products is higher than in rural areas. • Most artisans are small enterprises. They lack capital and storage space. No metal silo “package” was included: artisans offering help for getting a loan, transport, provide guarantee of repairs free of charge, teach customers about use and management, visit their customers to solve any management problems. • Advisory services for silos were done by the project. There was an assumption that the private sector would take over. Some local artisans have done some promotion and marketing, but did not invest explicitly. With low turnover (15-20 years) and low demand, incentives to invest in marketing will remain low. The exit strategy from advisory services and subsidies did not seem to be accompanied by training in and financial support for marketing to the artisans (and/or bags retailers). In Kenya, it was found that half of the trained artisans owned their own workshop, while the other half, were employees (Ndegwa et al. 2015). According to the same study, despite earning more, the artisans lack capital and demand.

	<p>As one resource person claimed: “it is not easy to take a silo to a market for demonstration, but a PICS bag yes! “</p> <ul style="list-style-type: none"> • Some local artisans have claimed that high quality metal sheets were not available domestically (BF) and that they needed to import them, implying a large financial base and high transport costs. • In Burkina Faso, with their POs, farmers are better organised than those in Uganda and Kenya. This has an influence on marketing costs. • Identifying and engaging with the right partners proved challenging and take time. • The business models did not link demand for improved storage outputs with the drivers for quality grains and pulses production, storage and trade.
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Financial services

Farmers, artisans and PICS producers and/or sellers as well as retailers all claim that they have liquidity shortages at critical times. Demand for storage facilities is very seasonal and increases dramatically just before harvest time. Metal silos are quite expensive, particularly compared to the PICS bags. Access to finance is mentioned as a bottleneck for adoption, mainly for the expensive assets, such as silos.

Experience and results

Research in Kenya demonstrated that households with access to credit were more likely to adopt silos (Kimenju and De Groot. 2010, Gitonga et al. 2015). RBA projects and the CIMMYT promoted saving and credit groups and engaged with private financial institutions. In the various countries, the level of savings compared to the price of metal silos proved to be very small. During the CAPEX field visits and workshops, other financial creative solutions, such as payment in grain, micro-credit, etc. were discussed. Micro-credit from the local saving banks might be an opportunity. Leasing was also discussed with artisans. It does exist in other countries, but artisans said that it might prove difficult (transport, storage of silo, moral issue in case of no payment and the silo is full, etc.). FAO Ethiopia in 2019 researched about ways to “unleash the role of incentive mechanisms to enhance the role of the private sector participation and investment in the metal silo value chain” of Ethiopia. They found that the preferred incentives are, among others: granting duty free privilege to galvanized sheet metal importers for metal silo use, free technical and entrepreneurial training on metal silo. Credit access with favourable terms and certification and labelling on chemical free grains to help them receive premium prices. In various countries, some artisans accept down payment to start the production of silos and to get the rest of the cost after the delivery of the silo. However, in Ethiopia, some artisans are requesting a collateral from the public extension system. Financial services for input suppliers have also been an issue. Artisans in South Achefer (Ethiopia) explained that they had borrowed money from a financial institution to purchase their stocks and had already repaid the loan. The results after these few years are not very strong on alternative financial solutions for the silos’ adopters.

Sustainability and replicability

In Ethiopia, the artisans were convinced that they could access credit to fill their orders closer to harvest time. In Burkina Faso, there is hope that a new bank, BAFS, will enter this market. Discussions are engaged. The replicability of this asset depends on the availability of funds or collaterals (in the case of loans).

Strengths and opportunities	<ul style="list-style-type: none"> • In Ethiopia, discussions are under way to develop a credit system. • In most countries, there have been efforts to induce the finance sector into
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	offering micro-credit. Success has been limited. In Burkina Faso, there is great hope with a new bank, BASF.
Weaknesses and threats	<ul style="list-style-type: none"> • The existence of subsidies and the uncertainty of duration and rate of the subsidy probably negatively influence incentives for farmers to seek credit and to invest the full price and for artisans to invest in marketing. It might had the same effect to financial institutions. • Several project staff admitted that financial institutions were not sufficiently included in the project.

Contract farming

Contract farming was generally not considered in the SDC-funded PHM projects. However, during the CAPEX local workshops, it was acknowledged that contract farming did exist in all countries and that it did push the grains and pulses quantity and the quality issues higher in the agenda of the implied stakeholders. One processor in Uganda explained that he had contract farming with his suppliers. He informs his suppliers of his quality and quantity requirements and how to reach them. He however did not “promote” metal silos explicitly, but will do now. Contract farming is described in Annex 3.

Grains and pulses market segmentation and premium prices

For the majority of small-scale producers, markets do not offer many opportunities for price differentiation. Markets, particularly rural markets, do not encourage efforts on quality. Market segmentation and/or premium prices (see Annex 3) were not part of the projects, except for P4P. The later clearly allowed highlighting the need to take the PHM quality issue into the whole PHM system. WFP only buys products that meet high quality. For example, in Uganda, it is Grade One East African Grain council Quality Standards⁵.

Advices from the private sector

Training and public rural extension, technical, financial and management services in the areas visited are seriously limited in terms of resources. This might remain during the next years. Enabling the private sector to engage and invest in promotion and advice in PHM strategies and technologies would considerably contribute to PHL reduction.

Experiences and results

As mentioned above, all projects have made quite some efforts to invite the private sector to become more active in the PHM projects and moreover in the PHM system. Inputs sellers, traders and processors were invited to events. Fintract (2016) reported distributor-led rural demonstration events in farming communities served the dual purpose of raising awareness among end users and enabled the distributor to rapidly identify hundreds of rural dealers who were interested in stocking the technology. Large traders in Uganda were met by research in order to understand their issue and motivate them to invest in PHM. During the field visits, silos opening ceremonies were mentioned as a powerful tool for training.

The results are, as several projects’ staff mentioned, a bit disappointing. Artisans met during the CAPEX visits all provided some kind of advice on the use of the metal silos in order to guarantee the quality of grains and pulses, but admitted that it was limited. During the CAPEX mission, the

⁵ Quality specifications for grade 1 maize : moisture content : 13,5%/m, pest damaged grain 1.0% m/m, broken grains 2.0%/m, rotten & diseased grains : 2%/m, immature /shrivelled : 1.0% m/m, discolored grains : 0.5%/m, foreign matter : 0.5% me/m, inorganic matter : 0.25%/m, filth : 0.1%/m , aflatoxin : maximum 10 ppb, fumigated free form live weevils.

inclusion of services to clients other than technical, such as support to access credit, etc. was discussed and well taken. Artisans could see that they would gain from it, but never thought of it, except for one, and never had access to e.g. financial training. The business model of PICS3 includes advices by the retailer. In Kenya, with Bell Industries’ network, it is also the case with its networks of retailers. In Burkina Faso, Fasoplast seems to expect the RBA program to do it. Some agricultural processors met during the field visits provide some advices, as in Uganda for specific quality of sunflowers (video). The processor began well before the program. Financial institutions seem to be absent of this picture except in some rare cases, e.g. artisans in Ethiopia who got a loan.

Sustainability and replicability

The provision of advices from the private about the use of PICS bags and metal/plastic silos as well as threshing machines is slowly taking place. Advices about grain quality from grain buyers are very rare. For actors driving demand of grains and pulses to engage in PHM advices, they need long-term relationships with their providers, hence to coordinate their VCs. This is not often the case now. To be replicable, there is a need to invest in VC coordination. In Burkina Faso, a VC project is currently being formulated.

Strengths and opportunities	<ul style="list-style-type: none"> • Particularly relevant in isolated areas due to the lack of RAS or other. However, buyers need a minimum of volume vs. demand. • Regarding aflatoxin, it is particularly relevant in countries where one crop is the main staple food as in Kenya with maize! In Uganda, the diet is more diversified.
Weaknesses and threats	<ul style="list-style-type: none"> • Most grains and pulses selling from farmers are spot transactions. This is a negative factor for retailers and buyers to invest. • The buyers need a certain volume and/or high added value use in order to be able to support the advice costs. Advices and extension require investment in staff skills, PHM competences and time. Furthermore, the atomised grains and pulses production and selling add to the costs. Large companies requiring high quality products often rely on local spot markets. Some have invested in coordinated VCs, which also take time. • Small independent retailers and traders often look for short-term business opportunities. • Many small to medium grain traders are not aware of the grains and pulses quality requirements. Hence, they store all the bought grain together. Sorting is mainly on crop and visual quality, rarely on aflatoxin level.

Table 4: Characterisation of advices from the private sector

Collective / community warehouses

Collective / community warehouses with the warehouse receipt system (WRS) were seen as a mean to improve the performance of agricultural marketing systems. It allows producers to delay sale of their harvest, thanks for the inventory credit. It reduces postharvest losses and producers can benefit from seasonal prices rise, particularly for staple crops. It hence enables producers to have access to more remunerative markets. It can also increase market negotiation power of the producers.

Experience and results

Based on prior experience in Burkina Faso, the RBA project moved away from collective storage. In Uganda, WFP engaged in Warehouse Receipt System (WRS) in the 2000s. The idea was to sell agricultural outputs to the Commodity Export Board. Individuals / farmers’ groups need to register with UCE electronically. According to Leung and Jenkins (2012), expanding collective warehouses in Report CAPEX study, Illudest, January 2020

Uganda would lead to an attractive return on about 12,6 million USD of investment. 40% of the net economic benefits would arise outside of both the warehousing and farmer stakeholders. WFP has high quality requirements for the products. The required quality specifications are of grade 1 and 2 for East Africa Grain Council. In DRC, IFAD will invest in collective warehouse with Producers Organisation under their PPAKIN program. The quality of individual storage has a direct influence on ability to sell. In 2013, the hermetic silos were introduced at individual level by the WFP. According to Kizito and Kato (2018), “older and remotely located smallholder famers and those with longer transport duration were more likely to use the SCP storage facilities, while farmers with poor market access in terms of high transport costs and those who face higher price uncertainties were less likely to store at the SCPs. Therefore, there was no elite capture and the investments were pro-poor ». « households that stored at SCP facilities had significantly higher incomes or sales than those that did not; therefore, investments in storage enhanced the wellbeing of the participants. (...) the results robustly show that farmers who used SCP storage facilities stored significantly more quantities of maize than their counterparts who did not use these facilities”.

In most countries, efforts into collective warrantage have failed despite experts assessing net economic benefits. The experience of WFP in Uganda has been assessed and proved that. It was mainly donors’ driven. As told during the field visit, when donor money dried up, the system did not take off. It was even called “WFP owned”. This is relevant as these are the satellite collection points, hence small-scale warehouse facilities, which were handed over to communities. WFP continues to work on it, but admits that the WRS remains challenging (WFP. 2014). In Burkina Faso, WFP admitted that it was not a success.

Sustainability and replicability

Sustainability of warehouse requires well-managed warehouses, private or collective. It can remain an alternative for those households having grains and pulses selling as an income source. Institutional and policy issues to support collective / community warehouses affect their replicability (FAO, 2010).

Strengths and opportunities	<ul style="list-style-type: none"> • During the field visit, knowledge holders in DRC for example, highlighted that commodity warehousing would allow POs to have greater volume and have increased negotiating power on the market, as well consolidated warehousing for commodities would allow local processing and packaging to take place under the same roof as storage reducing wastage, and allowing more value to be captured by the communities.
Weaknesses and threats	<ul style="list-style-type: none"> • The discussions during the field visits (including the workshops) highlighted the important issue of lack of trust within the crops VCs actors, also among producers⁶. This limits the adoption rate of community warehouses.

Table 5: Characterisation of warehouses

5.5 Capacity building (infrastructure)

⁶ A illustrative example from Kenya: during a group discussion in a village, a farmer with a silo proudly announced that he was helping the others, thanks to the silo, with grain selling and even donations. All the other participants were thankful, but then acknowledged that they had never seen a silo.

Academic education and research

According to WFP, 95% of research is being allocated to production and 5% to reducing losses during the last 30 years (Costa. 2014). Integrating research and academics into PHM could lead a change in enhancing PHM in research agendas.

Experience and results

The international research centre, CIMMYT, did extensive research enabling to empirically demonstrate many technical and socio-economic aspects linked to the silos and their adoption by households and artisans (see references throughout the text). The research intensively involved staff from local research centres and students as shown in the many publications. That proved profitable for all. Furthermore, local research institutions have integrated PHM into their programs. The NARO in Uganda was responsible for the baseline survey and several on-site trials. It was mentioned that the baseline made in 2017 triggered the government to have a PHM strategy.

At least in two of the visited countries, there is a specific academic curriculum on PHM (Ethiopia and Burkina Faso, since 2016/17). Several students have been choosing this option. More importantly, it has changed the PHM vision of academics who considered PHL on farmers' plots only. They have now integrated the VC vision of PHM.

Sustainability and replicability

In all countries, the engagement, credibility and leadership of specific individuals favoured sustainability of the investments made until now. As one person said "PHM is now part of my DNA". However, the end of the program and its finance will seriously reduce some of the interactions of research with other sectors, despite the creation of a real PHM dynamic. CIMMYT continued to have research and publications on this topic, even after the project's termination. The academic curriculum in both countries will remain. Advertising to students will have to be done. Sustainability also depends on: ability to find PHM professors, political willingness, resources (funding), etc.

Strengths and opportunities	<ul style="list-style-type: none">• In Kenya, local research institutions have taken over the PHM results by CIMMYT for their own activities.• PHM research also has mid and long term impacts, as the "next" generation of academics and researchers will have integrated PHM in their competencies and knowledge.
Weaknesses and threats	<ul style="list-style-type: none">• The research grant in Uganda was limited to one county. This was considered to be limiting.

FAO CoP

The FAO CoP website on food loss reduction was launched in 2014. The aim is to facilitate linkages and sharing information among stakeholders and related networks. It reached to 1500 people a month. E-learning modules are available. The expected outcome of the second phase was: "Knowledge of the magnitude and sources of food losses and the methodology for food loss analyses expanded and good practice options for reducing post-harvest losses compiled and disseminated through a reinforced and fully functioning Community of Practice (CoP) website." This outcome is based on "the set up of a global Community of Practice (CoP) to compile good practice options for PHM. These are documented and promoted through the CoP, which is to be positioned as the global reference centre for food losses. The CoP is animated and operated by an FAO program officer and nurtured by experts, practitioners and ideally policy makers interested in PHM issues. It is supported by an online platform hosted by the FAO that allows interactions between its members,

knowledge sharing and will function as a network. The CoP will be integrated into FAOs web-services framework to make the website and its content available beyond the project duration.”

Experience and results

The need of facilitating information sharing and discussions was expressed in several major national and international events (progress report, 2nd semester 2018). An online forum, with experts, to be carried out on the CoP platform is discussed. Through intensive promotion of the FAO CoP in various events and conferences, the number of registered members and number of monthly hits increased. It seems however that membership stagnates⁷. A progress report (2nd semester 2018) indicates that activities related to the online forum discussions have been delayed due to security issues, including logging and functionalities. The exit strategy, which has to be defined during the program, has been subject of various consultations and discussions. The latest available progress report indicates that the FAO CoP will probably be merged with IFP RI FLW Technical platform.

The FAO CoP truly looks for collecting and disseminating all existing PHM knowledge online. 65% of the respondents of the CAPEX online survey⁸ posted or downloaded something the CoP during the last 12 months (see Annex 2 Online Survey). 70% of the respondents rated the benefits of being a registered user of the COP as very or extremely useful. Only 10% of the respondents rated the benefits slightly or not useful. The current members are mainly from the public sector, 48%. The private sector represents 17,5%. Research (national and international) represents 40% of the CoP membership. It has to be noted that several key resources persons met during the field visits were not members or even aware of the FAO CoP.

Sustainability and results

Sustainability is mainly subject to the existence of other similar platforms and their development and to the FAO CoP financing strategy. The latter will be defined in the exit strategy that will be developed. Replicability does not apply.

Strengths and opportunities	<ul style="list-style-type: none"> • 24/7 availability • Excellent repository of publications, events • Currently free of charge • Several forum discussions
Weaknesses and threats	<ul style="list-style-type: none"> • Several respondents to the CAPEX online survey mentioned low facilitation level, hence low networking and interactions among stakeholders. Also low pro-active activities (eg. Only one webinar) • Low membership from the private sector: less than 20%. • Very irregular postings as demonstrated by the existing postings on the forum. • Not enough in French.

⁷ The CoP had over 600 registered members worldwide and had recorded an average of 1500 hits per month for a total of 11,500 visits up to December 2016. (Gianfelici and Totobesola, 2017). The progress report for the second semester of 2017 mentions 1,000 registered members and the second semester of 2018 quotes 1,200 members and 2,660 hits per months.

⁸ See also Annex 2. Online Survey for the description of the survey and its results.

5.6. Institutionalisation and policies

Institutionalisation is the establishment of any part of PHM concept and processes as a convention, a norm, a process or a topic in public and private institutions or even in a culture. Institutionalisation cuts across all assets.

Experience and results

In all country visited, stakeholders were quick to mention that PHM was not part of the discussions with farmers and policy makers before the PHM projects' begins. However, now PHM and PHL were regularly an important topic in discussions. And there has been some tangible success within the public sector. Post-harvest management has been included in the curriculum for extensionists attending Agriculture Technical and Vocational Training in Ethiopia and PHM focal points have been hired and posted at local level. At national level, a PHM taskforce and a PHM week have been created. However, the pluralistic nature of RAS remains an issue. More unexpectedly, the Ministry of Education in Uganda had an interest in linking PHM with education. An example is illustrated with an observation in Kenya (see Box 1 below). In most countries, PHM has been included in research.

The institutionalisation within the private sector has been generally less successful overall, despite some positive experiences. The latter generally happened where institutionalisation was foreseen in projects. One clear example is the VC of PICS bags. Many farmers have bought PICS bags outside the various projects. Another example is the fact that many women acquired tarpaulins, with or without SDC-funded PHM projects' awareness activities. In Kenya, artisans created an association to brand high quality metal silo and promote them. Other practical examples are the bags markets.

Sustainability and replicability

Once PHM has been recognised as a key component of RAS, it becomes and component of advisory systems and it remains sustainably at forefront with the same weight as improved practices for increased production. Replicability does not apply.

Strengths and opportunities	<ul style="list-style-type: none">• Defining PHM as a key component of RAS provides attention, effort and funding to the issue• A focal point and task force on PHM focuses the attention of innovation system actors and create an enabling environment for innovation
Weaknesses and threats	<ul style="list-style-type: none">• Poor infrastructure and means at RAS is a serious impeding factor.• In most countries, it was acknowledged that the gender issue remained and was a threat to inclusion in institutionalisation. In some countries, it was said that it was difficult to find women willing and/or able to work in isolated rural areas.

Policy dialogue and advocacy

In order to engage meaningfully in policy dialogue at macro-, meso, and micro- level, PHM needs to be considered a priority by policy makers, farmers' representatives and supply chain actors.

Experience and results

Institutionalisation of a PHM policy unit could be understood by the extent to which PHM data and information are routinely used to inform decision-making processes. Policy dialogue within RBA projects has mainly been executed by external consultants and RBA representatives. CIMMYT in Kenya also invested in these activities. In Uganda, the Ministry of Agriculture made several proposals

in the past. However, “the government has been slow as it said it has no money”. The tax issue was also included in the policy dialogue.

The redaction of the strategy and the implementation plan by recognised experts, often external, allowed reaching the projects’ results. There are also several examples of positive experiences. In Kenya, a county government paid the project NGO (Caritas) to train some artisans (at 3,000 ES/artisans).

The results of policy dialogue and advocacy for reducing or eliminating import (and/or VAT) taxes for PHM goods are mixed. For example, in Ethiopia, market prices of Super Grain Bags do not include import tariffs, the later being waived by the government as it was convinced of the PHM challenge (Regassa. 2014). In Uganda, Burkina Faso, Kenya taxes, particularly on metal sheets, were also discussed with governments, without results until now. Most governments responded that it is difficult to distinguish the use of these metal sheets in agriculture and otherwise. PICS bags, which are produced domestically in Kenya, are subject to a 16% VAT.

Uganda has now a strategy to reduce PHL in grains that was supported by a national multistakeholder workshop in May 2019. In Burkina Faso, the government already issued an exception for improved bags in its environmental law. The governments all seem convinced of this improved storage facility. In Uganda, linking the silo with nutrition of schoolchildren has raised strong interest from the Ministry of Education (see Box 1). In the various country visited, government officials and private service providers have admitted to the need of having an institutionalised platform to formally recognise PHM.

Sustainability and replicability

Sustainability will depend on various factors: i) ability of the government to invest and fundraise the amount required in their implementation plan (e.g. 10 millions US\$ for five years in Uganda), ii) decentralisation and devolution process and county financial means (tax income portfolio), iii) political willingness and iv) time!

Strengths and opportunities	<ul style="list-style-type: none"> • The joint RBA programs allowed one strong voice from the UN-agencies. FAO and WFP often went together to meet government officials as mentioned particularly in Uganda. • Aflatoxin has been integrated in the policy dialogue.
Weaknesses and threats	<ul style="list-style-type: none"> • In every country, it was mentioned that time is a real issue. Three years is not enough. In at least two RBA countries, several interviewed individuals showed concerns that the projects will end soon. Pressure on government will be reduced, if not disappear. Policy dialogue takes time, particularly with multi-level and multistakeholder consultations, particularly when aiming at ownership. Furthermore, Ministries often work in silo, while PHM requires interdisciplinarity (see also Box 1 below). • The PHM issue is not just an agricultural issue. It requires inter-ministerial dialogue, despite the often silo-wise work of the various ministries. Ministries of trade or commerce (export), health and education are also concerned with PHM. • Stakeholders from other sub-sectors (e.g. tubers, dairy products, etc.) have been complaining that they were excluded from this process (eg. Uganda) • Donors active in PHM do not have all the same strategy.

Box 1: Linking agriculture and education

One of the CAPEX consultants visited a school in Kenya, with an artisan. The school has bought two larger silos for their kitchen that cook meals for 400 children. The school director explained that she first got her supplies through public procurement. Parents had to pay for the children's meals, leaving some children without access to the meals. She then switched to the children's parents. They were to give a certain amount of cereals and pulses. It was a great success. The parents do not need to worry for the children's food.

The discussion continued with the director explaining that she had asked boys to help fill both the silos. The gender issue was discussed as well as the role of the parents. The conclusion was that:

- The parents and the children, both girls and boys, should help fill the silos,
- Lectures about nutrition could be given to the children. Opening ceremonies could also be organised with the presence of children.
- Open days could be organised with the presence of a nutritionist, an artisan, an agronomist, the children and the parents.

In Uganda, WFP had been through the idea. The Ministry of Education is convinced of the idea.

Source: authors.

Policy documents

PHM was not high on the policy agenda 10 years ago. National governments were more concerned about increasing production and less about PHL.

Experience and results

In all the countries visited, government officials and civil servants from the Ministry of agriculture at national level, provincial level and local level recognised the importance of PHL. Many recognise the catalysing effect of the SDC funded PHM projects. In all countries visited, there are visible results on drafting of PHM strategies (such as Uganda and Ethiopia) or endorsement and signing of a PHL reduction strategy such as in Tanzania. This interest at policy level was as well recognised in the Malabo declaration where reducing PHL by 50% is part of the commitments.

Sustainability and replicability

The strategies were often conceptualised, and the drafting was supported by the project or a consultant hired by the project. This might reduce ownership and hence its sustainability in the long term. The fundraising ability of the government versus the Ministry of Agriculture will also determine the future of the strategy. Strategies and policies to reduce PHL have been drafted in various countries. The policies are not duplicated as they need to be context specific, but the process was replicated with support from the project.

Strengths and opportunities	<ul style="list-style-type: none">• A strategy policy does not need to be endorsed by the cabinet (Uganda). The process is hence shorter. Amendments can also be made as a mid-term review is being planned.
Weaknesses and threats	<ul style="list-style-type: none">• A strategy policy is... not a law! It is less powerful than a law.• As Ministries often work in silo, the question remains of how the other Ministries will take the various policy documents.• In Uganda, the strategy was endorsed before the results dissemination to those who have been consulted in the various districts. This might reduce the chance of implementation and ownership.• Time is an issue. Three years were given for the policy phase. In one country, a donor mentioned that a new law in education had taken 15 years! Furthermore, UN procedures are quite long. In one country, it

	<p>seriously reduced time for consultations at district level as well as the number of districts included in the process.</p> <ul style="list-style-type: none"> • In all countries, there were concerns that the whole process might have been too quick for robust institutionalisation.
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5.7. Concepts and resources

The main concepts and resources used were the introduction of subsidies, temporary or otherwise, PHL mapping, business models for the improved storage and pre-storage equipment. Subsidies were seen as a mean to reduce investment costs to the new technologies, particularly for metal silos. Partial and total subsidies have been one of the pillars for introducing the improved silos, particularly the metal ones, to small-scale farmers. The assumption was that this would induce an increase willingness to pay from non-project beneficiaries, once a critical mass of adopters was being reached. Furthermore, it was also assumed that the private sector would take over the market. PHL mapping was to contribute to raise awareness about PHL, but also to identify the critical points.

Subsidies

Experience and results

Subsidies were used to reduce the entry barriers to producers and artisans. Different approaches for subsidies have been used: i) silos sellers (artisans or others) sold the silos at subsidised prices and got the full price from the implementing institutions once delivering was being controlled, ii) project financed fully (full subsidies) the silos to selected beneficiary farmers as a demonstration tool, iii) the extension services provide free transport of the silos to the buyers when these are farmers.

In Uganda, silos have been first fully subsidised. Then, due the donors' pressure, the level of subsidy has been reduced (from 100% to 0% in four years). This has seriously decreased silos' adoption. The same happened in Burkina Faso. For example, 867 silos have been sold in 2016, while only 333 in 2018 (WFP. Personal communication). The main reason was the change in subsidies. Farmers had then to pay themselves for the transport of silos too. In Uganda, project staff acknowledged that price communication should have included the fact that the silos were subsidised and inform beneficiaries about the real price. During the field visits, silo' prices given by beneficiaries were indeed very different. Silo's subsidies levels have also varied during projects. In Kenya, the PICS bags were first distributed free of charges in the project areas. In Ethiopia, the government fully subsidised the delivery of silos to producers being part of the project, in the second phase of the project, the extension services confirmed that they will continue to deliver the certified silos build by accredited artisans free of charge to the producers who will buy it. Some schools have received silos, while others have bought silos full price in several countries (see the experience of a school in Kenya in box 1).

The Bellagio statement on PHM (Helvetas, 2018) encourages the subsidization of activities aimed at creating demand – such as public awareness campaigns and sustained training opportunities – as opposed to a more isolated subsidization of products and technologies themselves. Subsidies certainly contributed to the adoption of the silos and the PICS bags. Uptake of silos has been slower after the reduction of subsidies level in various countries). Several farmers are now “waiting” to see...

There were grants and revolving funds for artisans, e.g. in Ethiopia. This was also used by FAO before the beginning of SDC-funded programs as well as payment in grains (FAO. 2008). Mainly sold metal

silos at a subsidised price or even free of charge. For PICS bags, there is a revolving fund allocated by the PICS3 project to cover for liquidity issues for a distributor in Kenya, outside SDC-programs.

Sustainability and replicability

Despite the fact that the government of Uganda willing to finance subsidies, it still has to look for funding. One suggestion was discussed during the CAPEX field visits: considering the metal silo to be considered a public good for small-scale producers. In Ethiopia, the extension system is subsidising the cost of transport for certified metal silos to farmers. Replicability of institutionalised subsidies depends on several factors: i) donors’ pressure: the usefulness of subsidies is regularly debated and ii) with devolution, counties might be responsible for taking over some subsidies. Counties do not have the same financial power.

Strengths and opportunities	<ul style="list-style-type: none"> • Tools such subsidies enable producers to see their investment costs being reduced. It increases financial and risk acceptability, hence adoption, particularly for high investment such as for silos. • The distribution of subsidies is a great leverage for quality control of the metal silos. • All those who received a silo totally or partially subsidised and those who paid full price are convinced of the silo. This does not however allow an assessment of the willingness to pay.
Weaknesses and threats	<ul style="list-style-type: none"> • Subsidies have introduced some kind of inequality, at least perceived inequality, among beneficiaries, as several non-beneficiaries did not understand the targeting⁹. • Subsidies levels have been different among the various countries of SDC-funded projects. They have also changed during the project implementation. When subsidies were being reduced, potential beneficiaries turned to other projects giving or subsidising the silos at a higher level or... wait further. • Price communication by some projects about silos implied some constraints for artisans, when the later told the real market price, not subsidised, to new potential buyers. • Increases administration costs: targeting, etc. • It is acknowledged that it did not motivate financial institutions to offer new services particularly since subsidy levels were varying. • There seemed to have been no specific conditions for the beneficiaries. In short, targeting is not clear for projects’ staff outsiders. A testing period for the subsidised facilities for example would have been an opportunity to include the beneficiaries in further dissemination and/or monitoring. • It was assumed that the private sector would take over. This has been highly dependent on the subsidies existence or otherwise at this stage and on the clarity about subsidies planning. • It was also mentioned that some artisans producing silos tried to increase its price when subsidised by the project.

⁹ The issue of economic and social characteristics of the targets groups for subsidies were not discussed in detail during the field visits, due to time constraints. No mention were made about net-surplus and net-deficit grains households. There is ample empirical evidence that this is likely to influence technology adoption by farm households.

PHL mapping

PHL has been subject of increased attention. However, there are still major gaps in data and methodology. When data are available, they are still often prone to uncertainties. Extensive research has been done and guidelines have been written.

Experience and results

The PHL mapping is quite intensive in terms of time and human resources so that only a few counties vs. districts could be included. The harmonisation and consolidation of the robust methodology has also been quite intensive, but proved useful. It also requires extensive communication of results to be effective. During the local CAPEX workshops, participants were eager to be informed about the PHL in their areas as well as elsewhere. The results and the summaries of the Food Loss Analyses (FLA) studies are available for all three RBA countries.

Sustainability and replicability

Updates of PHL mapping might be subject to the ability of the Ministry of Agriculture to fund it. It might be too expensive to be taken over at county or district level. Furthermore, a clear attribution of the task between the county representative of the Ministry and the extension has to be done. The methodology exists. The replication requires training of assessors and funding. There might be small adjustments of specific aspects for local conditions.

Strengths and opportunities	<ul style="list-style-type: none">• Results of the PHL mapping proved to be a powerful tool to create awareness for quantitative losses. The FLA reports were basis for the policy briefs.• The percentage of loss also includes loss due to low quality as in FAO (2014b).• As it is done along the whole VC, it also provides benchmark information for determining loss reduction interventions.
Weaknesses and threats	<ul style="list-style-type: none">• It is quite expensive in terms of time and resources, hence geographically limited.• There are several other PHL assessment methods other than the FAO one.

5.9. Project implementation approaches

Systemic and market-driven approaches

There has been a tendency in the past to focus at technology transfer models with the promotion of single technologies rather than looking at the PHM Innovation system as whole engaging with all actors from the private and the public sector. Individual and uncoordinated actions do not address PHL efficiently and effectively. The Bellagio statement (Helvetas, 2018) calls for increased coordination among PHM stakeholders and encourage the creation of a multi-institutional postharvest coordination facility that will promote joint strategies.

Experience and results

The use of the systemic and market-driven approach definitively enabled the projects to engage with the private sector as well as the public sector. It also highlighted the functions of the various stakeholders. The selection of partners has proved critical. The multi-stakeholder aspect was greatly appreciated as it “opens new opportunities”, increase trust building, but was clearly limited by finance. However, the experience of the various projects is mixed. According to project staff, including the stakeholders directly linked with the PHM technologies at farm level was much easier

than including actors of the whole PHM system. The PHM system¹⁰ is defined as including all stakeholders of postharvest. During the local CAPEX workshops, the whole VCs of grains and pulses were discussed. There seemed to be an information gap about relationships along the chain. The online survey confirmed that as it shows that the responders perceive the shift from technology promotion to market system development as the statement with the lowest results (see Annex 2. Online Survey). Market analysis and CBA have been done, however, the results were not always used. Considering the PICS and tarpaulin markets, it is acknowledged that the crowding-in has been reached. This is not the case for metal silos. Regarding threshing, this has not been discussed during the field visits.

The MSD approach was not formally used in the RBA and the CIMMYT projects, but elements of the market driven approach were included. The experience was mixed. Some projects had (the perception to have) to invest quite a lot to motivate the private sector to participate to the various events. Some were disappointed about it. Interestingly, it was mentioned that thanks to MSD, farmers “can be part of the market”. A governmental staff also stated that he was being pushed outside his comfort zone and gladly appreciated it. Another former project’s coordinator did recognise the added value of being exposed to new groups of market’s stakeholders as well as international individuals.

MSD approach clearly assumes that poor and marginalised people’s livelihood depends on markets. However, the markets on which the poor and marginalised people depend were lowly included in projects, namely the grains and pulses markets. The projects seem to have mainly focused on inputs markets (PICS bags, silos, threshers, etc.) and less on outputs markets (processing and trade services). It needs to recognise that it is the grains and pulses markets that indirectly drives demand for improved storage facilities, but not only. Research from CIMMYT did find that households adopting silos could wait longer to sell their grains (Kimenju and De Groote. 2010). The catalytic impact seems implicitly more focused on technology access than on market participation of the poor and marginalised farm households. The insertion of hermetic storage bags did allow to increase inclusiveness.

Generally, it was acknowledged that the desired changes did not all occurred. Interestingly, an “unexpected” driver for PHM changes emerged in some countries, namely schools. Some schools have received free metal silos, which the idea to other schools. An example of a school involving farmers for getting their grains is described in Box 1. In Uganda, the Ministry of Education is interested by this linkage agriculture - Education. The results of the online survey (see Annex 2. Online Survey) indicates that the lack of coordination within VC is a reason for increased or no change in PHL level for 38% of the respondents. However, better coordinated VCs are a factor for a decrease in PHM level for only 7% of the respondents.

Sustainability and replicability

As recognised by Coulter and Scheider (2004) in a former metal silo project and SDC-funded PHM project staff, there is a need for a long-term systemic approach. Current project’s length might not be sufficient, particularly since the output’s actors close to small-scale farmers were included with less success. To become sustainable, there is a need of strong leadership among the “change drivers” within the system, also after the end of the program, inclusion of the grains and pulses markets. Replication of the coordination mechanism is limited by willingness, HR capacity and

¹⁰ The definition of the expression of “PHM market system” was not found. The only definition that could be found is from Grolleaud (no date), namely “The post-harvest system encompasses a sequence of activities and operations that can be divided into two groups) technical activities: harvesting, field drying, threshing, cleaning, additional drying, storage, processing; and ii) economic activities: transporting, marketing, quality control, nutrition, extension, information and communication, administration and management. ».

funding. Some of the expected changes did not happen. The role of the driving force of the grains and pulses buyers as a factor for enabling poor and marginalised people access to markets has to be assessed. PHM MSD should only be replicated if the outputs markets are included.

<p>Strengths and opportunities</p>	<ul style="list-style-type: none"> • SDC-funded programs clearly introduced the concept of the private sector into programs. It has also pushed some implementers out of their comfort zone and it was appreciated. Some governments and NGOs staff have specified that, for example, being induced to deal with the private sector has been beneficial to them. • The systemic approach increases trust between the various stakeholders. Trust between the various stakeholders’ groups has been an important issue during several local CAPEX workshops, also among the producers. As trust is enhanced, increased coordination within the various VCs (storage facilities, agricultural equipment, grain) can take place. • These approaches can be drivers to induce a change at ministries’ level, often working in silos. • Aflatoxin is now a serious issue in all countries that was not foreseen at the beginning of the projects. Aflatoxin affects the grains and pulses storage and marketing, hence total income and income sources of smallholders. It is a negative opportunity for MSD!
<p>Weaknesses and threats</p>	<ul style="list-style-type: none"> • The system was defined as the market system for PHM improved technologies. The linkages with the whole grains and pulses VCs or system were not always acknowledged. • The implementation approach of the systemic approach did not seem to always include the aim of the agricultural transformation of the governments. PHL reduction and storage is not only a matter of improving subsistence, but also of commercialisation, also for the poorest. • The length of the program was considered by several as too short to induce all the required changes. Someone also commented that the CAPEX studies would have been different if executed 2-3 years later... • The monitoring system to follow up changes in outcomes in the system was not always adequate. • The experience was sometimes described as constrained by financial means, particularly for the public sector and by lack of time and/or interest by the private sector. • Entrepreneurial and management support seemed low at all levels and in most projects. Artisans mainly received technical training. • Analysis of risks and elaboration of business cases were weak • The market driven approach has been seriously biased by the subsidies and the various changes in their levels, increasing risks for stakeholders. • Some stakeholders were not all included and “not enough” motivated to offer specific PHM services (e.g. financial services for silo investment). • Food standard and norms are often unknown and almost absent in projects. This has implications for the quality aspects of PHM.

Joint-project RBA

FAO, WFP and IFAD responded together to the SDC call and promoted their complementarities, namely production for FAO, postharvest for WFP and finance for IFAD. FAO has the lead.

Experience and results

The current PHM RBA joint-project was clearly an incentive to work together. Most agreed that working together required some adjustments in terms of e.g. administration, strategies, etc. The administrative procedures have been an issue. It resulted in improved “flow” among the RBAs. In Burkina Faso, the former FAO Rep organised monthly tri-partite meetings. This has greatly eased the cooperation and information flows and was greatly appreciated. Many RBA staff mentioned the communication issue among the three RBA agencies.

All recognised that working together has been beneficial and helped to argue for their competitive advantage and to broaden their horizons and approaches. It also increases synergies. An example for given in Burkina Faso: insurance IFAD and green fund FAO. In Uganda, the FAO and WFP representatives decided to have one strong voice towards the government. WFP usually has short-term projects. For them particularly, the long-term project enabled them to have a longer term strategy.

Sustainability and replicability

The RBA are dependant on project funding. Unless another project includes this type of cooperation, it is not clear if the joint cooperation at this level will continue. However, in the near future, some level of cooperation will remain. The replicability depends on project opportunities.

Strengths and opportunities	<ul style="list-style-type: none">• Powerful when dealing with the government as “one voice”• During the visit in Burkina Faso, FAO and WFP raised the issue that their own communication staff must work more intensively together.• It has introduced a kind of competition among countries. All countries stated that they were some kind of Knowledge & Operations Centre (KNOC) and that they were training staff from other countries. In one country, it was also mentioned that another country was far better in external communication and that motivated them to invest more into this activity.• The RBA approach also allowed more efficient use of resources, particularly at higher level, mainly international, advocacy. This was less discussed during the field visits.
Weaknesses and threats	<ul style="list-style-type: none">• Internal communication issues were mentioned several times. WFP recognised during the visit that it should communicate better and more. In one country, it was mentioned that one RBA staff did not know about the second phase of the project. This might have affected the building up for the strategic phase.• In Burkina Faso, it was acknowledged that IFAD was not fully into implementation. The fact that the IFAD office in the capital is rather small, one person, is a serious factor.

Gender mainstreaming

It is acknowledged that gender is relevant when dealing with PHM, particularly at the lower end of the crops’ VCs. Gender mainstreaming in SDC-funded PHM programs is a requisite.

Experience and results

Postharvest bags have been distributed free in Kenya to the poor farmers, particularly to women and accompanied with extension services and training on how to use the bags appropriately. In Ethiopia, training provided in Farmers training Centre are now gender disaggregated, were men and

women are trained in different sessions. The extension officers explained that this allows for freer and more inclusive discussions.

Gender issues are common knowledge. Everyone is aware of the role of women in PHM. However, the leverage offered by the various PHM improved technologies and gender related services is not always fully grasped. Women were also trained in PHM, but their differentiated roles and its impact on adoption was not always be taken care of. In several countries, the difficulty of recruiting women in extension was highlighted, particularly for isolated areas. The Ex-ante analysis for the PHM project in Ethiopia does not address gender roles where as the latest baseline survey (May 2019) recognises the gender role in PHM activities.

It has to be noticed that the gender issue has been very well included for the organisation of the local CAPEX workshops and allowed discussions on this topic. However, most resources persons that were met during the field visits were male, except during workshops. 25% of the online survey respondents are women. In the fields, In Ethiopia, 10% of the farmers met where women.

During the field visits, it was observed that many women had the initiative to buy small PHM equipment, such as tarpaulins, bags, despite the fact that this was the responsibility of their spouse. In Uganda, discussions highlighted the gender role in PHM, but also some remaining issues. Women are generally responsible for drying, cleaning and storing. They also open the silos or bags every day to withdraw grains or pulses for the household meals. They seemed to show more pride in the grain quality than men. They hence represent an “entry door” for grains and pulses quality, hence nutrition and household health. Interestingly, it was also mentioned that women were also taking their “pay” from improved storage facilities, in form of grains and pulses for selling and/or as remuneration for their work on the farm. They are hence very much interested in improved pre- and storage facilities.

Sustainability and replicability

Sustainability of gender mainstreaming requires pursued efforts. It is not yet “in the DNA”. The limiting factor to replicability is understanding of the in-depth issues, willingness, capacity and funding.

Strengths and opportunities	<ul style="list-style-type: none"> • The introduction of PHM issues at farm level definitively highlighted the work being done by women. Furthermore, the quality of stored grains and pulses was subject to proudness from women. • In Ethiopia, gender role and the need to empower women is well recognised and extension curriculum has been designed to recognise gender role.
Weaknesses and threats	<ul style="list-style-type: none"> • Gender mainstreaming is sometimes limited to women activities. It reinforces and accentuates cultural gender roles where women carry most of the burden in PHM, hence it is blind or even negatively biased. • The gendered role allocation is usually known, but its impacts on PHM and systemic change less. As an example, women are responsible for cleaning, drying and storing, but men are responsible for equipment investments in grains and pulses production, storage and marketing.

6. Influencing factors and lessons learnt

6.1. Positive and negative factors influencing success in PHM mainstreaming

Swiss support to PHM is considered to have significantly raised awareness about PHM and put it higher in the agenda in all the PHM projects' countries and regionally. Going through the descriptions of results and experiences of the various assets used in the SDC-funded PHM projects, conclusions about enhancing and hindering factors to successful PHM mainstreaming can be drawn.

There are several external positive factors. It was observed and demonstrated empirically that the **seasonal price variation** positively contributes to the introduction of improved hermetic storage. It was regularly mentioned that producers "woke up" to improved PHM technologies when prices increase after harvest. The **existence of farmers' organisations** can reduce the transaction costs of extension and access to information and innovation. The governments' aim to **transform subsistence agriculture into commercial agriculture** is a positive factor. This aim facilitates the inclusion of the quality issue of PHM into the policy process as the quality issue is particularly relevant when traded for processing and export, particularly since the rising issue of **aflatoxin**.

Within the projects, the rightly identification and selection of **champions and leaders**, at individual and/or institutional level, positively influenced the PHM mainstreaming process. **SDC** is perceived as a coherent donor. Furthermore, its engagement in the programmatic approach and long-term projects (6 to 10 years) was clearly appreciated by the projects' partners. SDC also agreed, for example, to include research on hermetic storage facilities without phostoxin and hermetic bags in the projects. SDC has been a sponsor of the 1st all Africa Postharvest Congress (March 2017). The **projects' staff** was found to be highly committed and creative, also former staff. The **regional versus international events**, such as the Malabo Declaration, was a positive factor for inducing policy engagement.

The **political and economical** context may positively or negatively influences the perceived importance of and the opportunities for PHM activities and policies. While in some countries, PHM is clearly state-driven (Ethiopia), it is less the case elsewhere. Insecurity in Burkina Faso as well as the presence of refugees in Uganda put pressure in some counties vs. districts to push for an increase in production.

Discussions during the local CAPEX workshops clearly demonstrated low levels of **trust** among stakeholders' groups, also among producers, within the value chains. There are several examples. In Uganda, producers claimed that traders were selling them low quality inputs and giving them no incentives for quality. They all agreed there was a high level of distrust between traders and producers. In Burkina Faso, it was stated that processors had a low level of hygiene and no traceability. Gender issues also belong here. **Attitude towards entrepreneurship** and the tax policy affect perceived opportunities for business. Most markets transactions executed by small-scale farm households are spot transactions, hence a one-time event. **Value chains** of specifically grains and pulses, opposite to coffee and cotton for example, are lowly coordinated. This has clearly put some strains in reaching results with systemic and MSD approaches. Furthermore, **agricultural producers**, and particularly small-scale producers, are atomised, often not strongly organised and lowly IT-connected. They represent a highly heterogeneous population in terms of household objectives, risk management, income sources diversification strategies and agricultural potential among others. The **household economy and gender** allocation of tasks within PHM are currently an issue. The fact that men and women have different responsibilities was not always taken into account. Women might be more willing to invest than men, but depending on the negotiation process within households, they might not always succeed. The targeting choice, in some areas, of "marginalised farmers" seemed to have induced a focus on improving subsistence level and less on income sources. This is particularly relevant due to the different adoption factors of cereals-buyers and cereal-sellers households. At the

public sector, there are several factors. The regular staff change was regularly mentioned as being an issue, but it is a fact that cannot be changed, hence has to be taken into account in project formulation. The often-underfunded RAS is a clear constraining factor for engaging farmers and the various inputs and output actors, but also for shifting to a pluralistic RAS. Ministries also often work in silos. This hinders the much needed interdisciplinarity. **Public monitoring of PHL** is currently scarce and mainly relies on APHLIS. The data covers specific areas and specific years, the difficulty being at assessing PHL at each level in a continuous manner. These scarce results are confirmed by the results of the online survey. 46% of the responders perceive PHL to have increased during the last 10 years. There are mixed feelings about commercial agriculture and entrepreneurship support among **donors**. Some might also have the perception that there is a nexus between commercial agriculture and subsistence agriculture, with the inclusion of the poor.

The system's choice affects PHM mainstreaming. Several projects considered the **PHM system** as the one for improved technologies and practices instead of the one of grains and pulses. This had implications on the expected shift from quantitative PHL to quantitative and qualitative PHL, but also on the capacity for financial institutions for example to see new perspectives for services. It also had implications on the evaluation and monitoring system. Another aspect of project design, the **exit strategy**, seemed to be insufficiently considered. For example, the willingness and capacity of the private sector to overtake marketing and promotion activities, with or without advisory services was "implicit" and hence overstated. This is particularly true for the metal silos produced by the artisans and grains and pulses processors, traders and exporters. SDC showed less **flexibility** in various cases. Contract obligations between partners did not allow to include and to react sufficiently to the emerging aflatoxin issue. The **management of partnerships** in one case was also reported, internally and externally, as difficult. The online survey also revealed a rebuke from SDC to include some technical suggestion for the metal silo. A funding gap between both phases was also mentioned as well as late arrivals of RBA funding.

6.2. Lessons learnt

Based on the results above, important lessons learnt can be drawn for future programs. The main ones are given here.

1. Realising relevant changes in the **PHM system** takes time. It is not an option for short-term support. The PHM system is, as stated in the Bellagio Declaration, multi-stakeholder, multi-actor. The shift from quantitative PHM to quantitative and qualitative PHM requires the consideration of the value chains of grains and pulses in the system, hence to have a PHM system that includes the actors driving the grains and pulses markets and not only those for PH technologies and practices. The various stakeholders' groups are not interested in the quantitative losses of the other groups. However the qualitative losses matters to all. This calls for a shift in PHM solutions: not only for pre- and storage, but also for added value and procurement solutions. Another issue is the distribution of the value added of high quality grains, as there is no guarantee that traders may pass the benefits to farmers. Furthermore, a more explicit integration of the transformational aim of the government for a more commercial agriculture into a PHM project will also positively contribute to define more adapted systems. Finally, it must be reminded that the different stakeholders within the value chains of grains and pulses have different needs and objectives. This also includes the potential different strategies of cereal-selling vs. cereal-buying households. The household dynamics and members' bargaining power as well as the various need of the various members need to be considered when introducing new PHM technologies, methods and strategies. Furthermore, farm households are no more autarkic. Not only do they earn income (net income) with various diversified income sources, but they might also have

different risk management strategies, including selling crops or otherwise. This will impact their willingness to invest in expensive PHM strategies and technologies.

2. The existence of a **portfolio of solutions** at the various levels increases inclusiveness. The major example at farm level is the inclusion of hermetic bags next to hermetic silos. In Kenya, it was empirically demonstrated that the use of super grain[®] bags were profitable if the bags could be used for three subsequent storage seasons. Metal silos were profitable if capacity exceeded 0.5 tons, meaning that larger silos would be more cost-effective, but were unaffordable to many small-scale farmers due to high initial cost involved.
3. **Economic and business cases** are critical for the various relevant PHM stakeholders to enter the PHM “market”. These need to be explicitly formulated. Willingness to do some good is not sufficient to have a sustainable business. The entrepreneurs need to know about the costs, the risks and returns of producing, marketing, distributing the innovation or the innovation package relative to the motivations and incentives of potential adopters and other private actors in the value chain. Showing the positive impacts on their clients may also contribute. The same is also valid for the public sector.
4. **The subsidies** have to be used very cautiously. It is important to clearly communicate the real, non-subsidised, price of the subsidised technology to the farmers and the duration of the subsidies period. Furthermore, the direct costs, such as transport, have to be included to. The indirect costs, such as marketing costs, have to be taken into account at artisans and project levels (for the later, if a CBA is done and for exit strategy). The level of subsidies has to be coherent with projects from the public sector and/or other donors.
5. The above mentioned business case has to take into account the analysis of the potential clients. **Research** has shown the relevance of some household characteristics for adoption of improved PHM technologies, services and strategies. These have to be further examined to include a market analysis for the various improved technologies at farm level. The best approach to improve value chain coordination should also be assessed. Furthermore, there is a need to have more evidence of business and social PHM strategies aspects.
6. The **DSM approach**, with **multi-stakeholder and multi-actor tools**, is particularly relevant in the PHM context, moreover when the qualitative losses are to be included. Depending on the socio-economical and political context, it will require strong context knowledge, important facilitation skills and leadership.
7. The identification of and cooperation with individual and institutional leaders as well as champions also clearly enhance lasting effects within the PHM system.
8. The **PHL mapping** clearly is a strong positive factor for awareness creation, particularly at producers, extension and decision-makers’ levels. It clearly induced an increased willingness to change at farm level by expecting a lower hunger period and an increased income. At decision-makers’ level, it also created a sense of urgency to tackle the PHL issue. More dissemination towards artisans could have enabled them to use the results for marketing purposes. It remains however quite expensive.
9. The **FAO CoP** is a powerful tool for information dissemination, particularly to research and public sector. It requires more facilitation to enable stakeholders’ interactions and reaching the private sector.

7. Conclusions: key questions

The CAPEX ToRs mentioned specific key questions (see Inception report) that are now discussed.

7.1. Systemic change in PHM markets

The definition of PHM markets systems did not seem to be clearly or formally defined in the various programs. Implicitly, in most of them, the system as well as the market appeared to be defined for

inputs, hence improved PHM technologies and practices for smallholder farmers. The introduction of the PICS bags has been subject to a business model promoted and supported by another project. PICS bags have been included in all projects, together with the other pre-storage and storage improved facilities. In that sense, the system included most inputs.

There are several factors in favour of using the Grolleaud's (no date) definition, hence including inputs and outputs: i) the demand-driven for quality outputs for P4P, export and breweries among others, ii) the rising business and health issue of Aflatoxin in every country that has been visited, iii) the aim of several governments to transform subsistence agriculture into commercial agriculture and, iv) the Bellagio Declaration principle about including qualitative losses and not only quantitative losses. All those factors require expanding the **PHM system** (and/or market). Several efforts have been made to include output traders and processors, less for financial institutions. However, the results are few as found during the country visits and as acknowledged by several project staff met. A processor met during a workshop stated that he had close relationships with farmers and farmers' groups in order to advocate and buy high quality outputs. He however did not promote metal silos or inform producers about ways to buy them. The **P4P initiative** does link producers with buyers and requires high quality outputs. However, it is not clear yet how the buyers' networks (satellite market collection points) will remain after the initiative's end. It is evident that expanding the system to outputs is complex as there is several **value chains**: different grains and pulses. The CAPEX team could not find any evidence of the financial institutions offering (new) **financial and insurances services** linked with metal silos or other PHM technologies, processes or practices.

A **system change** has taken place for the cheaper (in absolute terms) improved pre-, post- and storage facilities at farm level for the PICS bags, except maybe in Burkina Faso, or other improved bags (also counterfeits) and for tarpaulins. Market for threshing equipment also seems to have improved, particularly for collective ownership and threshing services from the private sector. However, a real system change allowing poor and marginalised households to access to grains and pulses markets could not be observed, also due to time constraints.

The opportunities to trigger access, adoption and demand of improved pre-, post- and storage facilities among smallholders are the following:

- **Measuring and communicating** about losses clearly increases awareness and triggers the need for improvement at various levels: i) household: the perceived loss for subsistence and/or income. It may hence increase the willingness to pay; ii) RAS, policy-makers: moral and perceived loss for the development of agriculture, food security, health issues and export opportunities. Generally, traders and processors do not feel concerned of these quantitative losses happening before arriving to them. The awareness of quantitative and qualitative losses emerges when traders and processors refuse outputs' batches or when they cannot sell further.
- **Aflatoxin** is a negative opportunity... The control need of aflatoxin is now acknowledged in all country visited because of the health and economic dangers. Management strategies involve strategies along the whole value chain, from pre-harvest to consumption, which is similar to the PHM strategies. Aflatoxin control will definitively induce the private sector active in grains and pulses to invest value chain coordination and products' quality. Aflatoxin control will become a competitive advantage, and most probably a regulation.
- The transformational aim of several governments to **commercial agriculture**: this is a clear opportunity for using the MSD approach to the whole PHM system.

The constraints are:

- **Selling costs** of certain facilities, particularly of the metal silos: despite several economic analysis showing that improved technologies are profitable under certain conditions, silos market has not taken up. Using the number of sold facilities without subsidies as a proxy for the willingness to pay of the producers, it is high for PICS, but low for metal silos. Furthermore, the often not resolved issue of transport and marketing costs seem to have impeded market dynamics. Local artisans often do not have the capacity to invest in marketing campaign and further lack access to capital (e.g. to stock metal sheets or even silos). Even a PICS producer or distributor implicitly wanted to take advantage of the PHM extension plan for its sale campaign. This goes in hand with the lack of clear economic and business cases.
- **Targeting:** PHM is complex. Also at farm level, it requires several measures to be introduced. Research has found that wealthier and more educated households are more likely to adopt metal silos. Furthermore, larger silos are more profitable than small. This requires cautious targeting versus market analysis.
- Lack of market and low **market coordination** within the value chains for quality grains and pulses: the low inclusion of the drivers for grains and pulses demand seems to have seriously reduced opportunities for metal silos adoption.
- **Atomisation of producing households:** particularly relevant for artisans as there is a need to “cover” a large geographical area in order to sustain demand, but moreover for marketing efficiency for artisans. It is to be reminded that once a silo is sold to a farmer, the later will not remain a client, except for repairs and maybe a new silo in case of production increase. The association of silos makers, as in Kenya, is an alternative to spread marketing costs.
- The development of an inclusive and effective **pluralistic RAS** depends on effective demand, conducive policies and delivery capacity. The presence of a strong public extension system that provides and regulates strictly the services provided to producers could constrain the development of an effective RAS.
- **Climate change:** climate change was not often mentioned during the field visits. However, some individuals argued that climate change will affect PHM through increasing risks in the near future. The changing rain pattern might also affect pre- and storage conditions at harvest time.

Triggering the private sector engagement in PHM markets requires the ability to highlight the profitable and sustainable business opportunities. This was not sufficiently the case for specific assets at farm level. **PHL mapping** does not help much there. It might help the artisans and the hermetic bags to build up their marketing communication. It has to be reminded that quantitative losses at farm do not really bother commercial actors. It is a fact. This is particularly important for expensive technologies at farm level. Threshing equipment was known in all areas, which was less the case for hermetic “certified” silo. Threshing may be done at collective level or by the private sector. Storage, as it was found in the various projects, is an individual matter.

7.2. 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. Positive results have been reached in public institutions, particularly due to the high engagement of specific individuals willing to introduce PHM into the various curriculum. For example, there is now a specific **curriculum on PHM at university** level in Burkina Faso and in Ethiopia. In Ethiopia where extension services are well spread, there has been an uptake in PHM. In the other three countries, RAS are present, but scarce. The officers often do not have transport means. However, there are positive experiences such as in Kenya, where the county financed the training of extension officers by the local NGO.

In the private sector, some of those selling inputs and equipment do invest in services, such as use of the facilities vs. inputs. However, services such as buying **financial schemes** or specific PHM services are limited, except maybe for those selling bags, and moreover PICS bags. Processors and traders rarely offer such services. Furthermore, there seems to be a nexus between advices and marketing. One entrepreneur explicitly asked about the extension plan of the program.

7.3. Effective advocacy and shaping of PHM policies

The programs have made use of specific assets to enable policy makers to commit into PHM. The **PHL mapping** surely induced awareness and, moreover, increased the willingness to change policy. In some countries, it allowed the government to support the formulation process of PHM policy strategies or policies. However, the later were often drawn by **external consultants**, probably reducing the sense of ownership. The time issue might also have negatively influenced ownership as, in several countries, it was not possible to disseminate the results of the various consultations. The **joint-project**, such as the RBA projects, certainly allowed to increase the donors' voice on PHM matters in front of the government in general and the Agricultural Ministries in particular.

7.4. Knowledge management and dissemination (CoP)

The key questions on this topic relate to evaluation aspects such as relevance, effectiveness and sustainability of CoP. The large majority of those contacted by the CAPEX team acknowledged that tackling PHM is highly **relevant**. Some traders did not seem concerned by the quantitative loss at farm household, the main reason being that they were not aware of these losses. Concerning the relevance of FAO CoP, several proxies can be used to give an indication about its relevance. The online survey got a 26% response rate, which is quite high (only one reminder). 65% of the online respondents also downloaded or posted something on the CoP during the last 12 months. 70% of the respondents rated the benefits of being a registered user as very or extremely useful. 10% of the respondents rated the benefits slightly or not useful. During the field visits, the CAPEX team met individuals, even key PHM or PHM-project persons, who despite being highly engaged in PHM, did not know about the CoP. Some have been enthusiastic regarding the access to information. One person in Uganda specifically mentioned having downloaded several videos from CIMMYT and all their publications. Some people expressed concern that there are other similar and/or complementary platforms at the international and national levels. This could eclipse CoP in terms of perceived relevance regarding convening power, knowledge sharing and advocacy, and therefore its ability to attract new members. The PHM issue is complex. The inclusion of specific topics increases the complexity of keeping an overview over PHM and over the online CoP.

Despite its obvious relevance, the **effectiveness** of the CoP is not as clear. Despite the very small number of staff, several expected outputs have already been reached (e.g. one webinar). However, some survey respondents have highlighted the issue of the objective of the CoP as, according to them, the CoP is not really interactive tool for dialogue and discussions yet. The number of publications, videos and information on events are perceived as very useful and already quite important and of quality. It is not possible to assess whether the CoP has been / is being effective in raising the visibility within national policy and commitments *per se*. The indicator of improved capacity to address PHL reduction among policy makers, senior technical staff and rural advisors in pilot countries and at regional/global level has not been assessed.

The **sustainability** of the CoP is still uncertain. More than half of the survey respondents would agree to pay fees to use the CoP, conditioning some improvements. Rightly, the output 1.8 explicitly

states that an exit strategy for maintenance and funding has to be developed so that the CoP will be viable and maintained at the end of the 2nd phase.

8. References

Adler et al. 2000. Quoted by Tefera T, Kanampiu, F., De Groote H., Hellin J., Mugo S., Kimenju S., Beyene Y., Boddupalli P. M., Shiferaw B., Banziger M.. 2011. The metal silo: An effective grain storage technology for reducing post-harvest insect and pathogen losses in maize while improving smallholder farmers' food security in developing countries. *Crop Protection* 30 (2011). Pp. 240-245.

Affognon H., Mutungi Chr., Sanginga P. and Borgemeister Ch. 2015. Unpacking Postharvest Losses in Sub-Saharan Africa: A Meta-Analysis. *World Development*. Vol. 66, pp. 49-68. <https://idl-bnc-idrc.dspacedirect.org/bitstream/handle/10625/53220/IDL-53220.pdf> (May 1st, 2019)

Africa Union. 2018. Inaugural Biennial Review Report of the African Union Commission on the Implementation of the Malabo Declaration on Accelerated Agricultural Growth and Transformation for Shared prosperity and Improved Livelihoods. (<https://www.resakss.org/sites/default/files/BR%20English%20Draft%20Print.pdf>) (September 12, 2019)

Baributsa D., Baoua I., Djibo K. and Murdock L. 2015. Using and Recycling Purdue Improved Crop Storage (PICS) Bags. Purdue Extension, Purdue University. <https://extension.entm.purdue.edu/publications/E-264.pdf> (August 28th, 2019).

Bourne, M. 1977. Post Harvest Food Losses – The neglected dimension in increasing world Food supply.

Brix J. 2017. Exploring knowledge creation processes as a source of organizational learning: A longitudinal case study of a public innovation project. *Scandinavian Journal of Management*. Volume 33, Issue 2, June 2017, Pages 113-127.

CIMMYT. 2011. Effective Grain Storage for Better Livelihoods of African Farmers Project. Completion Report June 2008 to February 2011. Submitted to SDC. May 2011.

Costa S.J. 2014 . Reducing Food Losses in Sub-Saharan Africa. Improving Post-Harvest Management and Storage Technologies of Smallholder Farmers. An "Action Research" evaluation trial from Uganda and Burkina Faso. https://documents.wfp.org/stellent/groups/public/documents/special_initiatives/WFP265205.pdf (August 29, 2019)

Coulter J. and Schneider K. 2004. Feasibility Study of Post Harvest Project in Mozambique and Tanzania. For the Swiss Agency for Development and cooperation (SDC). June 2004.

Dart, Jess; Davies, Rick. 2003. "A Dialogical, Story-Based Evaluation Tool: The Most Significant Change Technique". *American Journal of Evaluation*. 24 (2): 137–155.

De Groote H. and Gitonga Z. 2013. EGSP Baselin Survey – Kenya. April 15, 2013.

De Groote H., Kimenju S.C., Likhayo P., Kanampiu F., Tefera T. and Hellin J. 2013. Effectiveness of hermetic systems in controlling maize storage pests in Kenya. *Journal of stored Products Research* 53 (2013) pp. 27-36.

Delgado L., Schuster M. and Torero M. 2017. The Reality of Food Losses: A New Measurement Methodology. IFPRI Discussion Paper 01686. December 2017.

Report CAPEX study, Illudest, January 2020

Deloitte. 2015. Reducing Food Loss Along African Agricultural Value Chains. Deloitte & Touche.

Egessa J, Olupot M. Deppeler A., Dischl R., Vodouhe S.,Cossa L. 2017. Experiences With Business Models and Dissemination Techniques for Sustainable Postharvest Management Among Smallholder Farmers. Conference proceedings. The 1st all africa post harvest congress & Exhibition.

FANRPAN. 2017a. Cost Benefit Analysis of Post-Harvest Management Innovations Benin Case Study. Pretoria. https://www.fanrpan.org/archive/documents/d02074/PHLM_CBA_Benin_Report-Sept_2017.pdf (July 10th, 2019)

FANRPAN.2017b. An Evaluation of Gender Roles, Relationships, and Social Equity in Post-harvest Management in Benin and Mozambique. Presented at the 1st ALL Africa Post Harvest Congress & Exhibition 28th-31th March 2017, Safari Park Hotel, Nairobi Kenya. http://www.fao.org/fileadmin/user_upload/food-loss-reduction/Nairobi_congress_/An_evaluation_of_gender_roles_relationships_and_social_equity_in_post-harvest_management_in_Benin_and_Mozambique_.pdf (September 13th, 2019)

FAO. 1994. African experience in the improvement of post-harvest techniques. Rome, Italy, 1994. <http://www.fao.org/3/w1544e/w1544e00.htm> (July 25th, 2019)

FAO.2010. FAO/World Bank workshop on reducing post-harvest losses in grain supply chains in Africa. Lessons learnt and practical guidelines compiled by FAO and the World Bank.

FAO. 2013. Good Practices at FAO: Experience Capitalization for continuous learning. External concept note.

FAO. 2014a. Guidelines for the production of gender responsive radio broadcasts. <http://www.fao.org/3/a-aq230e.pdf> (September 13, 2019)

FAO. 2014b. Food loss assessments: causes and solutions. Case studies in small-scale agriculture and fisheries subsectors. Kenya. Global initiative on food loss and waste reduction – save food. Working paper.

FAO. 2008. Household metal silos: key allies in FAO's fight against hunger. FAO AGST, 2008. http://www.fao.org/fileadmin/user_upload/ags/publications/silos_E_light.pdf (May 1st, 2019)

FAO. 2017. Postharvest loss assessment of maize, wheat, sortghum and haricot bean. A study conducted in fourteen selected woredas of Ethiopia under the project – GCP/ETH/084/SWI. June 2017

FAO. 2018. AU-FAO PHL Regional workshop report. FAO Project GCP/RAF/503/RRF. Support to African Union in the development of policies and strategies for country specific plans to reduce post-harvest losses. Workshop report. http://www.fao.org/fileadmin/user_upload/food-loss-reduction/AU-FAO_Regional_workshop_report.pdf (August 30th, 2019)

FAO. 2019. Enhancing private sector participant and investment in the metal silo value chain of Ethiopia. Unleashing the role of incentive mechanisms. Author: Kindie West.

FAO, IFAD and WFP. 2019. Food loss analysis: causes and solutions. The Republic of Uganda. Beans, maize and sunflower studies.

(<https://books.google.ch/books?id=WqqjDwAAQBAJ&pg=PA158&lpg=PA158&dq=sg2000+postharvest+uganda&source=bl&ots=2W9kF4xk32&sig=ACfU3U04dx09LBg-AIRsYV71Gk44W7ZTLA&hl=fr&sa=X&ved=2ahUKEwiXv9ait6vkAhUPJVAKHQIxDjMQ6AEwBXoECAkQAQ#v=onepage&q=sg2000%20postharvest%20uganda&f=false>)

Fintrac. 2016. Smallholder Grain Storage in Sub-Saharan Africa. A case study on hermetic storage technology commercialisation in Kenya. Fintract Topic Papers – Volume 3. February 2016. <https://www.fintrac.com/sites/default/files/2017-09/SmallholderGrainStorage.pdf> (July 25th, 2019).

Fischler M., Berlin R., Bokusheva R., Finger R., Marin Y., Pais F., Pavon K. and Pérez F. 2011. 5 year ex-post impact study: POSTCOSECHA programme Central America. SDC.

Gianfelici F, Totbesola-Barbier M. 2017. Community of Practice (CoP) on Food Loss Reduction: A Global and Dynamic Platform for Solutions Sharing. Conference proceedings. The 1st all africa post harvest congress & Exhibition.

Gitonga Z. M., De Groote H., Menale K. and Tefera T. 2012. Can metal silo technology offer solution to grain storage and food security problem in developing countries? An Impact evaluation from Kenya. Manuscript submitted to the International Association of Agricultural Economists conference. Brazil. 2012.

Gitonga Z.M., De Groote H. and Tefera T.. 2015. Metal silo grain storage technology and household food security in Kenya. Journal of Development and Agricultural Economics. Vol 7(6), pp. 222-230. June 2015.

Grolleaud M. No date. Post-harvest losses: discovering the full story. Overview of the phenomenon of losses during the post-harvest system. Publication made for the AGSI, FAO. <http://www.fao.org/3/ac301e/AC301e00.htm> (July 15th, 2019)

Helvetas Swiss Intercooperation. 2018. Bellagio Statement on Postharvest Management. <http://www.fao.org/save-food/news-and-multimedia/news/news-details/en/c/1114189/> accessed on 30 March 2019.

Heyi D., Legesse G., Belt J., Goris W. 2016. Agricultural Innovators in Ethiopia. Lessons from the Food Security and Rural Entrepreneurship Innovation Fund. AgriProFocus and ICCO Cooperation.

Kehl, F and Nano, D. 2014. Capitalization of Experiences. 20 years Swiss VET support to Albania. Results, traces and footprints – and suggestions for future engagement. KEK-CDC consultant on behalf of Swiss Cooperation Office Albania.

Kimenju S.C. and De Groote H. 2010. Economic Analysis of Alternative Maize Storage Technologies in Kenya. Contributed Paper presented at the Joint 3rd African Association of Agricultural Economists (AAAE) and 48th Agricultural Economists Association of South Africa (AEASA) Conference, Cape Town, South Africa, September 19-23, 2010.

Kizito A. M. and Kato E. 2018. Does linking farmers to markets work? Evidence from the world Food Programme's Purchase for Progress satellite collection points initiative in Uganda. African Journal of Agricultural and Resource Economics. Volume 13, Number 2, pp. 169-181. June 2018.

Leung L. and Jenkins G.P. 2012. A cost benefit analysis of maize production and marketing in Uganda. Development Discussion Paper: 2012-04. <https://pdfs.semanticscholar.org/e243/9489c221a113a058ba3153759d812553bc07.pdf> (September 3rd, 2019)

Ndegwa M.K., De Groote H., Gitonga Z.M. 2015. Evaluation of artisan training in metal silo construction for grain storage in Africa: Impact on uptake, entrepreneurship and income. International Journal of Educational Development.

Ndegwa M.K., De Groote H., Gitonga Z.M. and Bruce A. Y. 2016. Effectiveness and economics of hermetic bags for maize storage: results of a randomized controlled trial in Kenya. Crop Protection 90 (2016) pp. 17-26.

OECD. 2005. Oslo Manual. The measurement of scientific and technological activities. Proposed guidelines for collecting and interpreting technological innovation data. European Commission. Eurostat.

OECD. 2008. OECD Better aid—2008 survey on monitoring the Paris Declaration: making aid more effective by 2010, OECD, Paris, 2008 www.oecd.org/dataoecd/58/41/41202121.pdf (September 13th, 2019)

Omotilewa O.J., Ricker-Gilbert J., Ainembabazi J.H. and Shively G.E. 2018. Does improved storage technology promote moder input use and food security? Evidence from a randomized trial in Uganda. Journal of Development Economics. Volume 135. November 2018. Pp. 176-198. https://www.sciencedirect.com/science/article/pii/S030438781830926X?_rdoc=1&fmt=high&origin=gateway&docanchor=&md5=b8429449ccfc9c30159a5f9a592ffb#! (August 29th, 2019).

Osei, RD, Dzanku, FM, Osei-Akoto, I, Asante, F, Hodey, LS, Adu, PN, Adu-Ababio, K and Coulibaly, M, 2018. *Impact of voice reminders to reinforce harvest aggregation services training for farmers in Mali*, 3ie Impact Evaluation Report 90. New Delhi: International Initiative for Impact Evaluation (3ie). Available at: <https://doi.org/10.23846/TW4IE90>

Regassa S. 2014. Does it pay to invest in postharvest management? An ex-ante cost Benefit analysis of reducing maize storage losses in Darimu woreda, Ethiopia. 2014. SDC.

Rogers E.M. 1962. Diffusion of innovations. New York. Free Press of Glencoe.

UFAAS. 2017. Supporting inclusive agricultural extension in Uganda: incorporating issues of policy, climate change, gender & nutrition, and youth in Agriculture. Activities and case stories. Kampala.

USAID. 2016. Scaling up of hermetic bag technology (PICS) in Kenya. Review of successful scaling of agricultural technologies. November 16, 2016.

Walker S., Jaime R., Kagot V. and Probst C. 2018. Comparative effects of hermetic and traditional storage devices on maize grain: Mycotoxin development, insect infestation and grain quality. Journal of Sotred Products Research 77 (2018) 33-44.

WFP. 2014. Purchase for Progress – P4P Uganda. July 2014.

WFP. No date. Information for farmers. WFP Uganda. Agriculture and Market Support Purchase for Progress (P4p). https://documents.wfp.org/stellent/groups/public/documents/newsroom_/wfp230719.pdf (July 4th, 2019).

World Bank, NRI, FAO. 2011. Missing Food report.

9. Annexes

Annex 1: Outcomes of the SDC-funded PHM programs

SDC-funded programs	PHM-RBA	PHM-ETH	EGSP	PHM in SSA	GPLP
Outcome 1	Knowledge of the magnitude and sources of food losses and the methodology for food loss analyses expanded and good practice options for reducing post-harvest losses compiled and disseminated through a reinforced and fully functioning Community of Practice (CoP) website.	Reduced post harvest losses among women and men smallholder farmers, farmers groups and cooperatives by using improving postharvest technologies and practices.	Metal Silos as a postharvest saving methodology adopted where traditional ineffective methods are being used		
Outcome 2	Improved post-harvest management within the targeted value chains are benefitting smallholder farmers in countries through the dissemination of results of food loss analyses and the experience of pilot food loss interventions	Financial and market linkages options for supporting women and smallholder farmers and artisans to access postharvest handling technologies and storage of grains and pulses established and become operational	Formulation of SADC harmonised policies conducive for effective post harvest management.		
Outcome 3	Policy and regulatory frameworks (policy, standards) on reducing food losses in food supply chains are developed and validated at national and regional level	Policy dialogue on institutional structures on post harvest management conducted and supported.	Development partners, farmers representative organisations and private sector adopt post harvest bags as alternative technologies for the poor smallholder farmers		

Table 6: Synthesis information on the five SDC-funded PHM programs

Annex 2: The online survey

Methodology

Two versions of the survey were developed, an English and a French version, both surveys had a set of 38 questions. The survey was sent on June 10th, with a reminder on June 17th. The survey closed on July 4th, 2019.

Results

The online survey was sent to 870 people, to 850 registered users¹¹ of the CoP and 20 key experts outside the CoP. 224 responses were received (26% response rate). The average time spent from the responders to the survey was 39 minutes for the English version and 30 minutes for the French version.

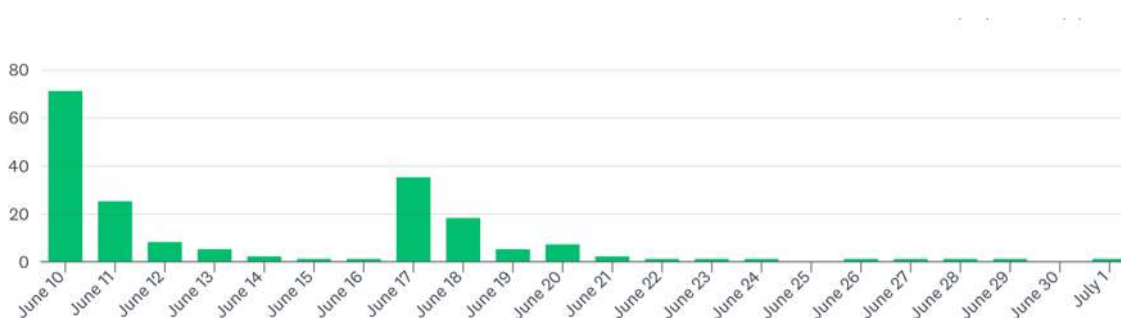


Figure 2: Responses volume by dates (English Survey)

Responders' characteristics

The characteristics included and valued were: sex, base country (where they are located), institutions and language. 80% of the respondents used the English version, while the others responded in French (see table below). The figure below indicates the number of responders from the various countries where they work.

¹¹ The survey was sent to all CoP members who had provided a valid e-mail address during their registration.

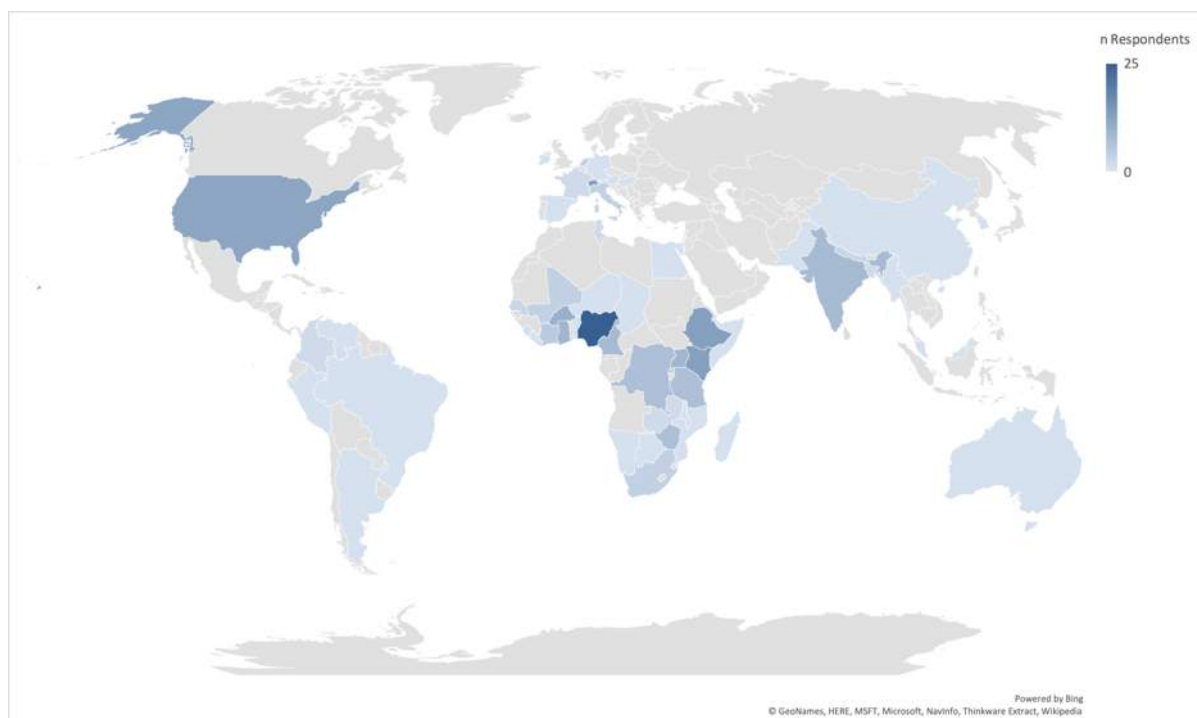


Figure 3: Map indicating the respondents' countries of origin to the online survey. The color-coding indicates the number of responses (Dark blue indicating the most respondent from a particular country).

The table below shows that women represent 25% of total responders. Public institutions make almost half of the responses, 48,5%, while the private sector counts for less than 20%: 17,5%, including 2% of farmers. Research institutions (national and international) make 40% of the responses.

	Total	English	French
Total sent	870 ¹²	n.a.	n.a.
Total responses	224	178	46
Language			
- French (%)	20.5% (46)	-	-
- English (%)	79.5% (178)	-	-
Country where responders are based			
- Africa (%)	68% (152)	62% (110)	91% (42)
- Europe (%)	14% (32)	16% (28)	9% (4)
- Asia (%) + Middle East	9% (20)	11% (20)	-
- America (LA, US + Canada) (%)	8.5% (19)	10% (18)	-
- Oceania (%)	0.5% (1)	1% (2)	-
Sex			
- Female (%)	25.5 % (57)	25% (45)	24% (11)
- Male (%)	72.5 % (162)	72% (128)	76% (35)
- No answer	2% (5)	3% (5)	

¹² The survey was sent to 850 registered users of the CoP as well as 20 external knowledge holders from Illudest networks.

Type of institutions	Female	Male	Total		
- National University	15.2% (7)	84.8% (39)	21% (46)	22% (39)	11% (5)
- Local or international NGO	23.1% (9)	76.9% (30)	17.8% (39)	17% (30)	14% (6)
- National Research institution	31.3% (10)	68.8% (22)	14.6% (32)	14% (25)	15% (7)
- Local or int. consultancy company	41.7% (10)	58.3% (14)	11% (24)	11% (20)	9% (4)
- Government (national, local)	22.7% (5)	77.3% (17)	10% (22)	8% (14)	15% (7)
- Bilat. and Multilat. Dev Partner	53.3% (8)	46.7% (7)	6.8% (15)	8% (14)	9% (4)
- International research institution					
- Other (Media, Clinic, etc..)	25% (2)	75.0% (6)	3.7% (8)	5% (9)	9% (4)
- Farm	28.6% (2)	71.4% (5)	3.2% (7)	4% (7)	2% (1)
- Farmers' Association	20% (1)	80% (4)	2.3% (5)	3% (5)	0%
- National Rural Advisory services	40% (2)	60% (3)	2.3% (5)	2% (4)	2% (1)
- Private commodity company	20% (1)	80% (4)	2.3% (5)	2% (4)	2% (1)
- Private input company	0%	100% (5)	2.3% (5)	2% (4)	3% (1)
- Private banking company	0%	100% (5)	2.3% (5)	1% (2)	9% (4)
	0%	100% (1)	0.5% (1)	1% (2)	0%

Table 7: Characteristics of respondents, by gender, language and type of institutions. Legend: n.a. non available

Perceptions of PHL decrease or otherwise

The online survey asked the respondents about their perceptions on post-harvest losses (PHL) in their country (ies) of interest and the reasons for the increase, decrease or status quo being observed since 2008. It is obvious that the result of this question might be different from empirical research' results.

46% of the respondents believe that post-harvest losses have increased since 2008, where as 28% believe they have remained unchanged and only 26% believe PHL have decreased. Considering only the countries where more than 1 respondent has answered, there was only one country, Rwanda, where all 4 respondents believed that PHL had decreased, whereas in Cameroon, Zimbabwe, Ivory Coast, Djibouti and Zambia, no respondents believed that PHL has decreased.

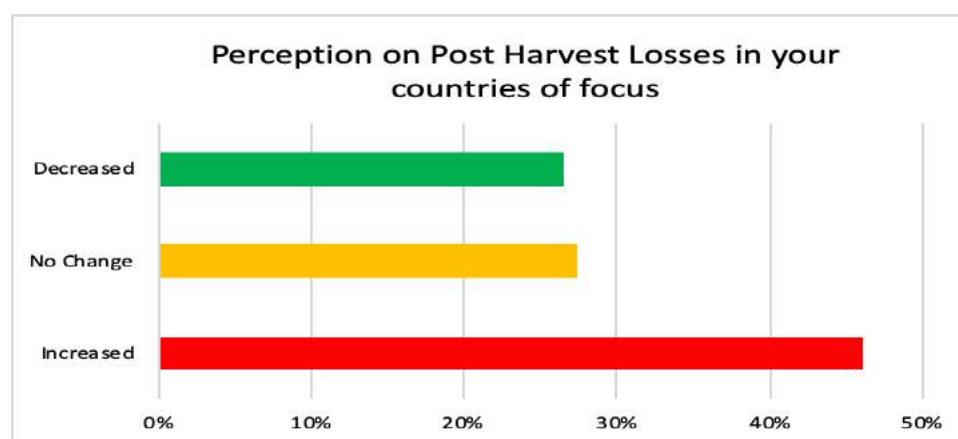


Figure 4: Perceptions on Post Harvest loss trends in Sub-Saharan Africa.

The table below presents the reason given by the respondents for observing and a perceived increasing or decreasing trend. Interestingly, we observe that the adoption of technologies for harvesting and handling is the most important reason for the decrease of PHL and the lack of adoption of this same technology is the reason for the increase or status quo in PHL. As well, awareness of PHM issues is a key for the decrease of PHL and is lack of awareness is a key constraint leading to increase or status-quo in PHL.

Reason for decrease of PHL (% respondents selected the answer)		Reason for increase or No Change in PHL	
Adoption of new technologies on farm for harvesting and handling	69%	Lack of adoption of new technologies on farm for harvesting and handling	58%
Increased awareness of PHM issues	65%	Lack of awareness of PHL issues	48%
Improved dissemination of technologies and good practices	60%	No dissemination of improved technologies and good practices	37%
Improved storage on farm	47%	Lack of Improved storage on farm	56%
Improved processing	31%	Lack of improved processing	41%
Improved consumers attitude	22%	Consumers attitude	11%
Improved Policies	20%	No appropriate policies	39%
Presence of Market drivers/incentives for change	20%	Lack of market drivers/incentives for change	31%
Improved road infrastructure	18%	Poor road infrastructure	41%
Quicker and better access to markets	18%	Lack of access to market	32%
Improved packaging for transportation	16%	Poor packaging for transportation	39%
Better coordination among supply chain actors	7%	Lack of coordination among supply chain actors	38%

Legend: The response rate is colour coded from the highest values (dark green) to the lowest value in red and sorted in decreasing order based on the respondent response rate for decrease in PHL.

Table 8: Reasons provided by the respondents about the evolution of PHL in their countries of interest

On those two points, some respondents made the following points: *“There is a heavy focus on a silver bullet technology “fix” for PHLs. The real underlying causes of PHL are often systemic and are therefore not susceptible to specific technical fixes. Most value chains have reverted to a “least-worst” situation where losses are accepted, unmeasured and unaddressed”* and *“There are plenty of farmers who take care of their plants during cultivation till harvest as a new born child. Suddenly they just drop their kids without understanding the importance of processing due to lack of money, technology and other factors”* finally paraphrasing a common answer among respondent, there is a perception that Farmers tend to accept post-harvest losses as a fact of life and so focus on increasing production factoring the losses that will happen post-harvest.

As well, the dissemination of technologies is rated high as a reason to observe a decrease in technology, it is not rated as high as a reason for the increase or no change in PHL. On the other hand, a lack of coordination between supply chain actor is rated higher as a reason for increase or no change in PHL.

Additional reasons provided of the increase in PHL include, security situation in some regions, no specific PHL in the curriculum of extension and frontline workers, poor or no enforcement of by-laws and implementation of policies due to lack of capacity or lack of will. Institutional set up with focus on warehouse receipt is not conducive to innovation and increase pests due to climate change.

Table 36 below presents the key areas of focus in all countries of interest, the three areas that collected more than 50% of the votes were new technologies, new accompanying services and improved quality of storage and processing at farm level.

Key area of focus to reduce PHL	
Developing new technologies for farmers	56.7%
introduction of new accompanying services to increase farmers’ access and adoption of improved storage products and strategy	56.2%
Improved quality of current improved storage and processing products at farm level	54.5%
New ways of delivering these new technologies to farmers	42.7%
Market / Wholesale connection	36.5%

Table 9: Key area of focus to reduce PHL.

When asked whether the efforts in these key areas of focus were successful, only 54% believed that these efforts had been successful in reducing PHL in their countries of interest.

Regarding the three major current PHL and waste bottlenecks a majority of the respondents (over 50%) believe that Improved PHL Technologies and Production (farm level: production, small scale transformation and storage) are the most important bottlenecks whereas the supply of varieties and good quality seed and advisory services are selected as the third bottleneck with over 30% respondents selecting these two options. Finally, 30% of the French speaker selected credit supply as well as a key bottleneck.

The world cloud below illustrates the answers to the open ended question regarding what was needed to remove the key bottlenecks identified above.



Figure 5: World Cloud based on English and French answers to the question: “What is needed to remove these three Major Bottlenecks”.

Main innovations in PHM

The Survey then asked: What were the main innovations in the field of PHM and waste during the last 10 years? 81% of the respondents selected innovations at storage level.

Main innovations in the field of PHL during the last 10 years?	
At storage level :	81%
At farm level prior to harvest:	69%
Harvesting and threshing:	66%
At government and policy level:	64%
At rural advisory level:	52%
At processing level:	50%
At financial institution level:	49%
At local market level:	48%
Globally, at the value chain level:	48%

Table 10: Percentage respondents selecting area where key innovations in PHL have been found in the last 10 years have been.

The set of four word-clouds below present the key responses for the 4 top innovation areas.



Figure 6: Word Cloud describing the words used to describe innovation in PHL in storage (top left), at farm level prior to harvest (top right), at harvesting and threshing (bottom right) and at policy and government level (bottom left).

The survey then asked what were the most promising innovations. The world cloud below represents the most common response to this question.



Figure 7: Word Cloud on the most promising innovation in the area of PHL.

Adoption factors

According to the respondents the top three factors influencing the innovation process on farm where that technologies developed respond to farmers demand (47%), the establishment of new partnerships between extension, credit institutions, artisans and/or commodity actors and measuring and increasing the awareness about losses.

What are the three main factors positively influencing PHL innovation on farm ?	
Responding to farmers demands	47%
New partnership between extension, credit institutions, artisans and/or commodity actors	45%
Measuring and increasing awareness about losses	45%
By including a technology market-driven strategy	39%
Taking in consideration gender in agricultural research and extension	37%
Increase of the economy of scale in improved storage technology	31%
Inclusion of a portfolio of technological solutions to farmers	26%
Technology subsidy	20%
Simplify the message by delivering one technology	19%
Reducing risk to farmers if they change practices	18%
Stable producers' prices	18%
Other factors ?	13%
New by-laws	5%

Table 11: Percentage of respondents selecting factors influencing PHL innovation on farm.

Bellagio Declaration principles

The survey then explored the respondents' perceptions in relation to the Bellagio Declaration principles. 50% or more respondents perceived that there was progress in three out of the four principles: 59% perceived that the PHL strategy in their country of interested focused on quantitative and qualitative food losses, 55% believed that there was a focus on management of Post-Harvest rather than a sole focus on reducing losses at storage level, and 65% believed that their PHM strategy relied on a Multi-sectorial and Multi-actor led approach. However, 58% of the respondents still perceived that the PHM strategy in their country of interest relied on technology promotion rather than on a development of a Market System.

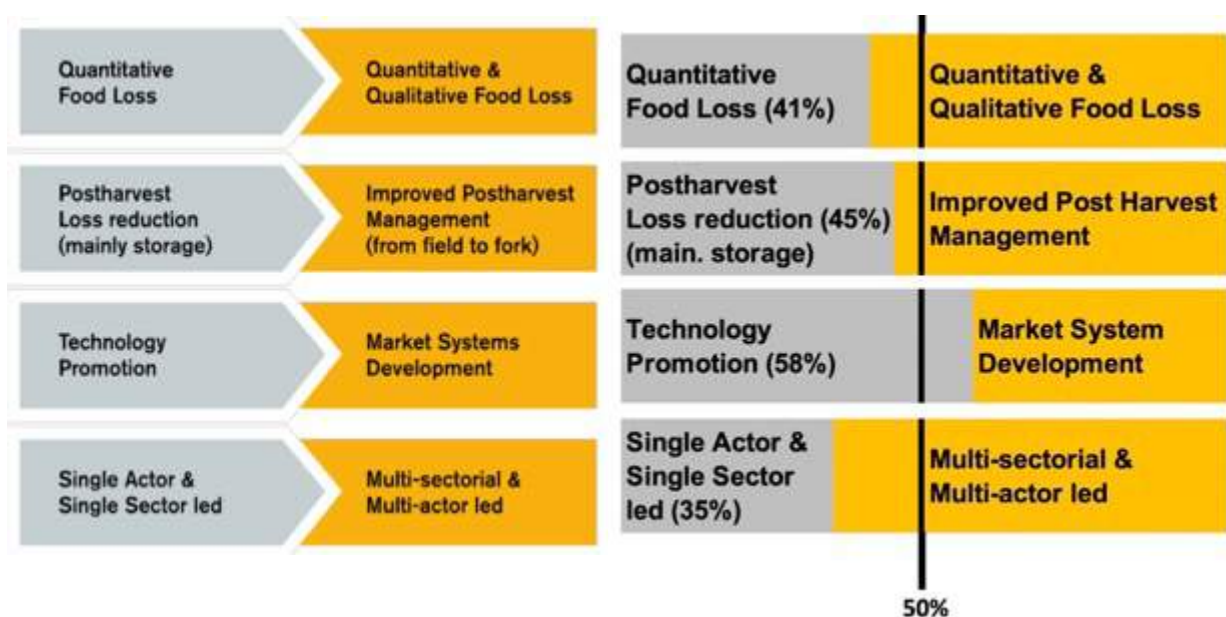


Figure 8: Principles of the Bellagio Declaration and perception of the current situation by the online survey respondents.

Own experiences

The online survey as well provided an opportunity for respondents to explain what the main experiences were and/or learning from the SDC funded PHM projects, the most relevant responses are listed below grouped by topic.

1. On local context: All wanted to transfer technology “tel quel” from Latin America to Africa without taking into account local conditions and without giving enough attention to the policy component working with government institution on technology development and adopting policies in the agricultural sector / Projects have been given up without trying to improve and to understand more why they have difficulties and why they do not work under the specific circumstances / Different approaches to PHL losses exist, solutions -at different levels addressing the complexity of the causes of losses (technical, economic, social, environmental) and strategies may have commonalities but need to take in account specific contexts in different countries /areas of interventions, which actors are present or missing or weak in the areas of interventions to ensure success of any model or support provided to reduce losses
2. On markets: Le Développement des marché permet de lutter efficacement contre les pertes post récoltes / Should have facilitated earlier meetings between different grain market stakeholders including government, maybe it is better to start with a grain market development programme and build in post harvest management technology / Approche système de marché est une bonne approche mais très intensive est il faut du temps
3. On awareness and communication: Opportunity to assess well PHM of selected grain crops in the country, Opportunity to learn traditional grain storage practices against storage pests, Identify critical loss points for selected grain crops / Good communication with experts & with farmers as well is important / Awareness creation to small holder farmers about PHL through use of local dance / In interacting with the project, I am now in position to use online media to train and share information on PHM with different stakeholders
4. On policy: Appui à l’élaboration de la première note d’orientation politique sur les aspects post récolte; Appui à l’élaboration et l’adoption des avant-projets des textes

règlementaires et normes relatives aux opérations post récolte, post-capture, post abattoirs et traitement des produits laitiers en République Démocratique du Congo, renforcement des capacités des petits producteurs et productrices sur les bonnes pratiques de réduction des pertes post récolte.

5. On coordination and networking: Linking, networking and coordination of the different actors / Coordination multi-acteurs des filières permet de traiter efficacement des questions de pertes post récolte. Good partnership in disseminating storage technologies via the program. Networking with Extension workers/agrodealers / I learned how important are the different levels of interventions to be put in place from farmers' engagement to government commitment and action. I tried to make the link between the global and the local level sharing the information from both ways / Il est important de travailler sur 3 niveaux (micro (paysans)-meso (org. paysan-nes)-macro(politique))
6. On technologies: New technologies. Utilisation de technologie adaptées parfois endogène permet de lutter contre les pertes post récolte. Introduction of new storage technologies to farmers and techniques about handling. The management & utilization of the technology to be promoted has to be supervised cautiously
7. On capacity building: Training, capacity building to Government extension workers to train farmers about the Importance of good PHM / Helped me desing my curriculum and inculcate my students on the importance of PHT
8. Other points not possible to group: Negative and unhealthy competition with other NGOS / En RDC, la rupture de continuité d'actions qui s'est observée en de 2017 à 2018, influence négativement sur l'appropriation de leçons apprises / Volonté d'atteindre les objectifs de tous les acteurs / Sérieux et pragmatisme de la DDC le succès au bout de l'effort

FAO CoP

In general the CoP as a repository for information was rated positively by a majority of its users: 65% of the respondents posted or downloaded something from the CoP in the last 12 month. 70% of the respondents rated the benefits of being a registered user of the COP as very or extremely useful, only 10% of the respondents rated the benefits slightly or not useful.

The survey then asked the respondents what were the main benefits in participating in the CoP, the world cloud below present the responses provided, the words in bigger fonts have been mentioned the most times in the responses received.

A total of 50 Respondents, including 10 women, were aware of a project or program on PHL funded by SDC. Out of these 50 respondents, 31 (including 6 women) knew a specific SDC funded project. Respondents from International research institutions, from bilateral and multilateral development partners and from private input companies (albeit this sample was very small) were the most aware of SDC funded project.

The 31 respondents who knew specific projects, 4 of them knew all 5 projects, 1 knew 4 projects, 5 knew 3 projects, 6 knew 1 projects, 13 knew of 1 project, out of this final group 1 respondents mentioned the SDC funded Agriculture Sector Development Support Program (ASDSP) and SDC project in Pakistan in 1990. One respondent mentioned that SDC funds as well studies on PHM conducted by the Swiss Federal Institute of Zurich (ETHZ) and the University of Zurich. Table 40 illustrates which projects were the most and least known to respondents.

Project name	Number of time selected
PHM in Sub-Saharan Africa (FAO/WFP/IFAD)	16
PHM in Sub-Saharan Africa (Helvetas, AFAAS and Agridea)	14
Reducing Food Losses through Improved PHM in Ethiopia	13
Grain Postharvest Loss Prevention (GPLP)	13
Effective Grain Storage for Sustainable Livelihoods of African Farmers (EGSP II)	8

Table 13: Number of times a specific SDC funded project was selected as known by a survey respondent.

Annex 3 Asset overview

Grouping / heading	Asset
Innovative PHM at farm level	<p>Pre-storage</p> <ul style="list-style-type: none"> Improved/adapted seeds Aflasafe¹³ and planting and harvesting timing Harvest time and/or humidity analysis (plastic or glass bottle, hygrometer, etc.) Aflatoxin crop analysis (rapid or extensive) Improved drying with yard, improved cribs, EasyDryM500¹⁴, solar dryer Low energy cooling Shattering, threshing equipment Packaging (and transport) <p>Storage</p> <ul style="list-style-type: none"> Traditional or improved individual storage facilities: gum Arabic coating, fumigation or insecticide powder, improved traditional granaries, wire crib Use of palletes to hold stored bagged grains Improved individual storage facilities options without pesticides: metal silos¹⁵, plastic silos, triple bags, PICS¹⁶, solar portable, AgroZ bag, Grain Pro brand bag¹⁷, SuperGrain bags¹⁸, ZeroFly bags¹⁹, Elite bags, GrainSafe™ bag²⁰, Improved collective storage facility (or stationary or mobile Grain Distribution Logistical Infrastructure (GDLI)) Sealed plastic tanks/buckets <p>Post-storage</p> <ul style="list-style-type: none"> Marketing channel analysis Market channels' segmentation Contract farming Premium for quality
Innovative PHM (extension) delivery strategies	<ul style="list-style-type: none"> Training curriculum on PHM strategies delivered at Farming Training Centres (FTC) Farmer Field Schools (FFS) on PHM Training before introducing improved storage facilities Silos and/or PICS bags opening ceremonies Pilot and demonstrations

¹³ Aflasafe was developed by IITA in Nigeria. It is a biological product. INERA cooperated with IITA to produce a local version, Aflasafe BF 01. It is distributed in Burkina Faso by Elephant Vert.

¹⁴ The EasyDry M500 is an open source technology, available for commercial adoption. It is a highly mobile, portable maize dryer targeted at servicing smallholder farmers. It lowers maize moisture from 20% to 13.5% in 3 hours, with the capacity to dry three 500 kg batches per day in one location. It has been piloted in Kenya, Tanzania and Rwanda.

¹⁵ Metallic silo existed before these programs (FAO. 1994). It is a key post-harvest technology in the fight against hunger and for food security. It is a simple structure that allows grains to be kept for long periods and prevents attack from pests such as rodents, insects and birds. If the grains have been properly dried (<14 percent moisture in the case of cereals and <10 percent in the case of pulses and oilseeds) and the household metal silo is kept under cover, there are no problems of moisture condensation in its inside. Household metal silos generally hold between 100 and 3 000 kilos. A household metal silo with a capacity of 1 000 kilos can conserve the grain needed to feed a family of five for one year. A small or medium farmer with more than one silo can store surpluses for off-season sale when prices are more attractive, thus increasing household income (FAO. 2008)

¹⁶ PICS bags have been developed by Purdue University. It has three layers: two liners fitted inside a woven sack. It is now being produced in various countries in SSA.

¹⁷ Produced by Grain Pro and imported into Kenya duty free. Made out of patented plastic technology. Needs to be placed inside another bag and on a pallet.

¹⁸ Commercialised by GrainPro Inc. These bags are made up of a single thick layer of high-density polypropylene with a thickness of about 78µm. They are used a liner along with normal woven polypropylene bags.

¹⁹ Product of Vestergaard, Switzerland.

²⁰ Produced by Grain Pro and imported into Kenya duty free. Made out of patented plastic technology and placed on a custom frame. Also called GrainPro Cocoon.

	<ul style="list-style-type: none"> • Awareness through loss assessment and visual PHL mapping • Pluralistic Rural Advisory Services (RAS) • Through schools – education: linking agriculture and education • Portfolio of improved storage facility (options) • Grants to training • Multistakeholder platform • NGO delivery • Use of media (magazines, radio, television in local languages) • Use of IT for dissemination and training • Socio-economic feasibility studies for solutions
Quality service providers	<ul style="list-style-type: none"> • Extension communication products and tools • Standard for PHM extension • Appraisal of the PHL • Promotion of technologies and good practices
Quality improved handling and storage facility providers	<ul style="list-style-type: none"> • License / accreditation • Certification of improved PHM facilities
Cooperation mechanisms with the private sector	<ul style="list-style-type: none"> • Partnership with buyers: premium prices for good quality products, direct sourcing, contract farming, central collection and marketing centres, warehouse receipts system, warrantage, improved packaging and transport, extension services, payment in grains, value chain coordination, revolving funds, Purchase for Progress (P4P), etc. • Partnership with improved storage facility providers for quality: after sale services, buying facilities, extension services, certification, accreditation, license, help to fill for credit, leasing, payment with grain, revolving funds, etc. • Partnership with finances providers for credit provisions, revolving funds, warehouse receipts system, merchandising credit model, extension services, etc. • Capacity training at key loss points • Introduction of competition award in the PHM market • Distributor-led rural demonstration events • IT tools: e.g. IT platform for storage management, data management IT tool to pilot agriculture and VC • Business models
Capacity building infrastructure	<ul style="list-style-type: none"> • Academic education and research • Private training providers • FAO CoP
Institutionalisation (into policy)	<ul style="list-style-type: none"> • Inter-ministerial task force approach • Institutionalisation of PHM in training and advisory services • By-laws and norms and standards, for example, standardisation of hermetic storage equipment • PHL data in national statistics • National multistakeholder PHM workshop • National plan and/or strategy, road map (including taxes and duties) • Inclusion of PHM in country strategy • Regional harmonisation • National PHM focal point • National government subsidies partially or fully local training and/or improved storage facilities • Policy-dialogue and advocacy • PHM policy briefs • TA for government

Concepts and resources	<ul style="list-style-type: none"> • Curriculum and training in diverse occupational profiles (extension, buyers, financial institutions, artisans, etc.) in forms of modules, courses, booklets (free or not), etc. • Subsidies • Grants and revolving funds • PHL mapping (FLA reports) • Business models • CBA • Voluntary guidelines • Conferences: international congress on PHL prevention and Africa-wide PHFL reduction congress and exhibition
Project implementation approaches	<ul style="list-style-type: none"> • Systemic approach to PHM • Market driven – MSD • Applied research • Value chain approach • Enterprise platform module • Joint-project approach (RBA) • Policy-dialogue and advocacy • Technology demonstration and dissemination • Institutionalisation of PHM at national and regional levels • Pluralistic Rural Advisory Services • Joint projects / programs • Results-based incentives or pull mechanisms • Pay-for-results approach • Joint development and review of communication materials • Working approach and culture • Focus on outcomes at level of farmers • Program steering committee • Inclusion of gender • Focus on outcomes at the level of female and male farmers • Programmatic approach²¹ (and - support from SDC) • Improved FAO FLW methodology and dissemination • SDC disbursement flexibility and review planning • Partnerships • Beneficiaries' targeting

Sources: authors.

²¹ Programme-based approaches (PBAs) are a way of engaging in development co-operation based on the principles of coordinated support for a locally-owned programme of development, such as a national development strategy, a sector programme, a thematic programme or a programme of a specific organisation. Programme-based approaches share the following features: i) leadership by the host country or organisation; ii) a single comprehensive programme and budget framework; iii) a formalised process for donor co-ordination and harmonisation of donor procedures for reporting, budgeting, financial management and procurement; iv) efforts to increase the use of local systems for programme design and implementation, financial management, monitoring and evaluation (OECD, 2008).

Annex 4: Selected PHM initiatives in SSA

Name (Implementer)	Years, budget	Country	Donors	Objective / goal
AgResults	2014-18 12 millions	Kenya	Consortium AUS, UKaid, USAID, Gates F, Canada, WB	a Pay-for-Results prize competition to motivate private sector competitors to develop, market, and sell on-farm storage (OFS) devices to smallholder farmers in the country's Rift Valley and Eastern Regions. Competing storage solution companies could become eligible for prizes by reaching an established sales threshold to promote purchases of improved devices among smallholder farmers. In this way, the project would reduce post-harvest loss and boost farmer incomes.
PICS 3 (Purdue)	2014-29	Burkina Faso, Ethiopia, Ghana, Malawi, Nigeria, Tanzania, and Uganda	Gates Foundation	Goal : to increase the use of hermetic storage technologies by 20% of grain (maize, sorghum, wheat, rice, peanut, common bean, etc.) stored on-farm in target countries. Objectives : (with ICT) <ul style="list-style-type: none"> • train farmers on proper use of hermetic technologies in at least 14,000 villages • Develop a sustainable supply chain to make PICS bag available to farmers • Build local research and extension capacity to sustain post-harvest loss reduction In addition to training,
Sassakawa Global 2000	?	Mali, Sudan, Tanzania, Malawi, Mozambique, Zambia, Ethiopia, Uganda, Nigeria, Mali, Guinea		Mission : to transform African extension advisory services to address food security among resource-poor farmers and provide greater economic benefit to commercially oriented smallholder farmers from agriculture value chains. Pillars : <ul style="list-style-type: none"> - Crop productivity - Postharvest & Agro-processing (Entreprise Development) : metal and plastic silos, PICS - PPP and market access for smallholder producers - Human Resource Development - Monitoring, evaluation, learning and sharing
AGRA	2016-19 2.155 millions	Mozambique Burkina Faso	IDRC	Support applied research to bring effective, field-tested innovations for reducing post-harvest loss of soybeans and cowpeas to thousands of smallholder farmers : PICS bags, threshers and processing technologies
APHLIS+ ?	2009-14 2016-19 3 millions	SSA SSA	EU Gates Foundation	Lead the design of an early warning system for grains contaminated with carcinogenic Aflatoxins, and insect and pest attacks which destroy harvested crops.
Ideas42	2016-...	Tanzania	Rockefeller F.	Study the behavioural challenges contributing to post-harvest loss among smallholder maize farmers and provide design solutions
Stemming Aflatoxin in Groundnut (NRI)	2014-17	Malawi and Zambia	EU	groundnuts

Source: authors.