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FARMER-OWNED CLOUD DATABASE ENVIRONMENTS

IMPROVING THE USE OF DATA IN DECISION-MAKING
AND VALUE CHAIN DEVELOPMENT THROUGH FARMER-
MANAGED DATA TRACKING AND EVALUATION

APRIL 2015

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DISCLAIMER

The author's views expressed in this publication do not necessarily reflect the views of the United States Agency for International Development or the United States Government

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ACRONYMS

ANCAR	Agence Nationale de Conseil Agricole et Rural
ASPRODEB	Association Sénégalaise pour la Promotion du Développement à la Base
FEPROMAS	Fédération des Producteurs de Maïs du Saloum
FTF	Feed the Future
GB	Gigabyte
GIS	Global Information Systems
GPS	Global Positioning System
Ha	Hectare
ICT	Information Communication Technologies
M&E	Monitoring and Evaluation
PCE	<i>Projet Croissance Economique</i> or Economic Growth Project
SAED	Société Nationale d'Aménagement et d'Exploitation des Terres du Delta du Fleuve Sénégal et des Vallées du Fleuve Sénégal et de la Falémé
T	Tonne

PREFACE

This technical note is one of a series of short papers produced by USAID/Senegal's *Projet Croissance Economique* (PCE), or Economic Growth Project, implemented by Engility from 2009-2015¹. The purpose of the series is to share USAID/PCE experiences and lessons learned with implementing partners, USAID, and the broader development community. This paper is intended to serve as an informational tool for those wishing to replicate elements of this approach. As such, it is not an evaluation though it does present important program results and discussion on impacts.

The primary goal of USAID/PCE is to promote food security by linking small cereal farmers (rice, maize, and millet) to certified seed and commercial grain value chains to boost their productivity and diversify their incomes. USAID/PCE activities support certified seed production and distribution alongside structural investments in seed processing centers and certification labs; increased agricultural processing capacity; new market linkages between producers and the private sector for distribution, processing, and storage; introduction of new quality grading and packaging standards developed at the grassroots level to foster national and regional trade competitiveness; increased access for small farmers to agricultural insurance and tailored cashflow-based financing mechanisms; policy reform; and capacity building of Government, farmer organizations and financial sector actors relative to the functioning, monitoring and governance of cereal value chains including risk reduction and response strategies.

As USAID/PCE is an integrated program, a number of broad messages apply across the series of technical notes. One above all is that there truly is no "one-size fits all" approach to be transmitted. In fact, the USAID/PCE team invested significant time and effort into the development and iterative implementation of a set of models that were tailored in numerous distinct ways to meet varying needs along different FTF value chains in different regions of the country.

¹ Readers interested in accessing additional project reports and documentation should consult USAID's Development Experience Clearinghouse under project reference 685-I-00-06-00005-00 (<https://dec.usaid.gov/>)

INTRODUCTION

USAID/PCE (*Projet Croissance Economique* or Economic Growth Project) has employed a data collection system that, underpinned by the principle of producer responsibility, redefines traditional approaches to monitoring and evaluation (M&E) for interventions dealing with small farmers. The USAID/PCE data collection methodology engages farmers and field agents of partner networks as active members of a data collection/feedback loop, informing farmer network production planning activities in tandem with broader USAID/PCE programming. Producer networks are trained to collect data and to use it to better plan and manage their own activities while also integrating performance indicators to meet project-level data needs. They use a set of data management tools that was established and validated through a close participatory process between the USAID/PCE technical team and partner networks across different value chains. These tools incorporate various simple elements of computer software, information and communication technologies (ICTs), and cloud-based data sharing. The broader USAID/PCE approach embodies sustainability-focused systems that include implementing through partnerships with local producer associations, the private sector, and grassroots NGOs to achieve program targets. This approach demonstrates the power of efficiently aligning project and stakeholder incentives in order to leverage public and private investments to attain common goals with stronger impact. It also fosters locally tailored interventions and builds technical and organizational capacity of smallholders and rural actors while empowering and connecting local champions whose ownership of approaches will endure long beyond the project term.²

BACKGROUND

Before working with USAID/PCE, the majority of farmers and farmers' networks did not track their production activities. Only a few networks working in the Senegal River Valley with industrial rice mills documented, to a minimal extent, their credit, input supplies, and sales. USAID/PCE beneficiaries are mostly small farmers who are members of a diversity of farmer groups (called "networks"), which are the community-level owners of project implementation activities. USAID/PCE technical support to partner networks includes the establishment of demonstration sites, which are used by networks for trainings on best practices and for disseminating new technologies and seed varieties. USAID/PCE also supports networks through facilitating access to agricultural equipment and funding, and linking farmers to other downstream value chain actors, with a specific focus on grain processing industries. In the interest of strengthening small farmers' integration into cereal value chains across the country, it was critical to enable networks to efficiently manage their input needs, to monitor and evaluate their own performance, learn from experiences, and strengthen their credibility with other value chain actors, such as financial institutions, input suppliers, and technical partners. Therefore, emphasis was placed on building networks' capacity for documenting, monitoring, and evaluating their activities. This ultimately perpetuates a cycle of transparency, responsible ownership, and informed decision-making. This system also provides the USAID/PCE M&E team access to timely and reliable data to inform project-level performance indicators.

² See another note in this brief series on Farmer-Owned Extension Services for more details about this broader approach.

DESIGNING AND LAUNCHING FARMER-OWNED DATA MANAGEMENT SYSTEMS

Three core sets of information are tracked to support corresponding elements of USAID/PCE component activities. These include information on network membership, seasonal production planning, and agronomic monitoring of plots. Some networks also track additional data sets on output quality control results, and rainfall measurements. Database templates were developed in Microsoft Excel format to maintain simplicity and accessibility for users with little to no pre-existing skills in that area.

The approach design process began by an examination of the information needs of the project's partners (farmer networks) and the project itself (in terms of performance indicator tracking and annual planning). This examination also included an appreciation of the differing roles, responsibilities, and capabilities of the actors involved, as well as the physical and organizational distribution of technical and human resources that would be involved in data collection. USAID/PCE engaged other actors at various points various stages of the design, implementation, and refinement of the approach, such as consultants, technical associations (ASPRODEB or *Association Sénégalaise pour la Promotion du Développement à la Base*), and public agencies (SAED - *Société Nationale d'Aménagement et d'Exploitation des Terres du Delta du Fleuve Sénégal et des Vallées du Fleuve Sénégal et de la Falémé*, ANCAR – *Agence Nationale de Conseil Agricole et Rural*), among others. To launch the system, USAID/PCE led the facilitation of the technical design process and development of data collection tools, guides, and users manuals. The following are the core steps that were taken to validate and launch the approach:

Sensitizing partners: Monitoring and evaluation was a new concept and practice for rural farmers organizations, so raising awareness about the usefulness and importance of data tracking was a critical first step.

Development and validation of tailored tools: Database templates and different data collection tools (such as simple, clearly marked collection sheets) were developed by USAID/PCE according to the relevant information needs of partner networks. The tools were then tested in the different target value chains and adjusted according to feedback. Tailoring the data collection tools to the needs and skills of the users is seen as a key contributing factor to the high adoption rates of farmer networks. Examples of core data collections sheets are included in Annex 1.

- **Farmer's Notebook:** Satellite farmers receive a set of sheets, called the "Farmer's Notebook," which they use to regularly document the information generated by the implementation of their production activities. It is kept in a safe but accessible place so the facilitator can access the information even if the farmer isn't present. The Farmer's Notebook consists of three main parts: (i) An identification page for general information about the producer; (ii) An agronomic monitoring page to track farming activities and dates for each plot; (iii) A plot map with GPS geo-referenced data for the plot areas and perimeters.

- **Facilitator’s Notebook:** The Facilitator’s Notebook is more extensive than the Farmer’s Notebook, and includes: (i) A list of producers with their identification information, plot locations, organization affiliation, gender,³ phone number, and national identification card number; (ii) Attendance sheets from group training sessions and knowledge sharing, which are used to track training participation numbers; (iii) Plot identification sheets, used for documenting geo-referenced data, determining the area declared, and listing the various technologies applied to the plot; (iv) Planning sheets, which allow each producer to calculate and identify his/her exact input needs and to assess the amount of credit needed from the bank; (v) Rainfall monitoring forms for documenting rainfall data in the area; (vi) Agronomic tracking sheet to track dates of farming operations, quantities of inputs used, and to confirm that the farmer follows technical standards and requirements properly; (vii) Harvest tracking sheet, used to record production, sales, amounts kept for household consumption, etc.; (viii) Financial reference sheet (based on an average farm) used to assess profitability; (ix) Credit repayment tracking sheet; (x) Village identification sheet; (xi) Plot georeferencing sheet; (xii) List of sub-groups that are members of the Network; (xiii) Harvest quality control results tracking sheet.

Equipment and software provision: USAID/PCE provided a basic equipment package to enable partners to ensure the proper collection and processing of data. This consisted primarily of GPS devices and laptops with Microsoft Office installed. Database managers and some lead farmers also received laptops, and some even received solar notebooks to enable them to work despite the lack of electricity in their rural zones. For the networks using this portable equipment, data can be directly entered into the databases on-site. The following additional software was also provided:

- **Dropbox** was chosen as the cloud-based environment to secure and share data between network database managers and the USAID/PCE M&E team. The 2GB initial free storage allocation to new members proved more than sufficient for the needs of small farmer groups.
- **Mapsource:** Global Positioning System (GPS) coordinates are used by partners to measure and geo-tag farm plot areas. The Mapsource software is used to transfer GPS data to the computer and illustrate, measure, and label the plot. Knowing the exact area of their plot is a critical information tool for farmers, as it allows them to calculate their exact seed and fertilizer needs, as well as to calculate their yields more reliably.



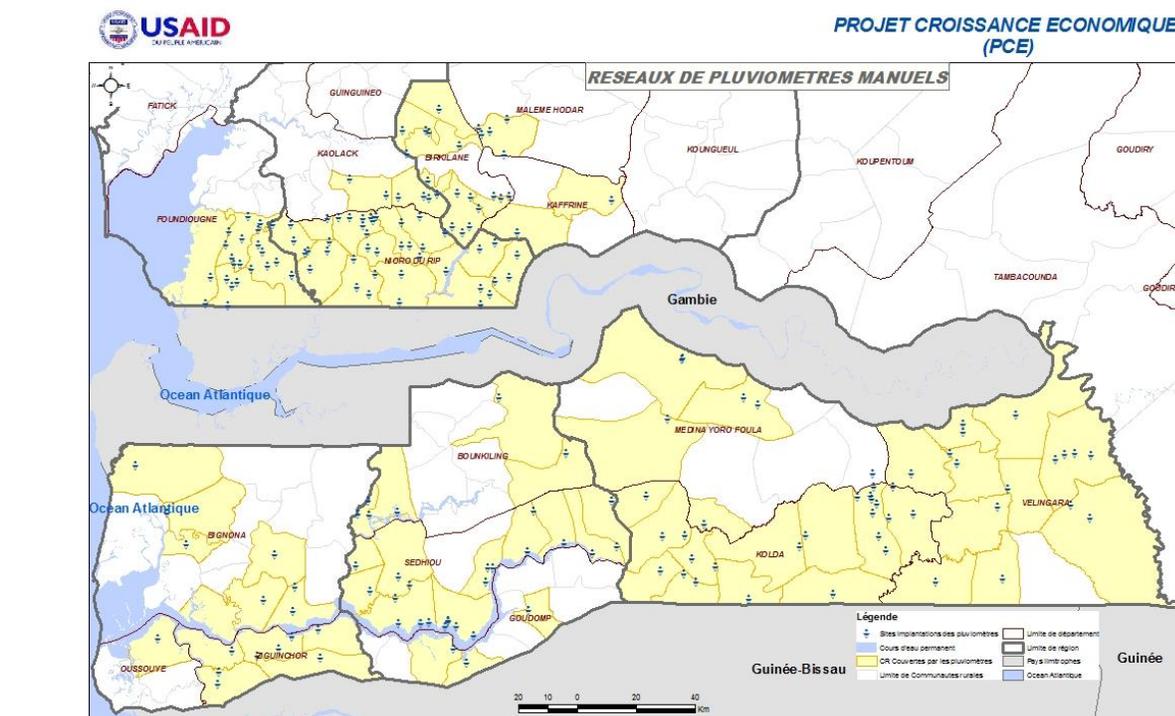
A facilitator records GPS coordinates to calculate a farmer’s plot area.

³ While this variable may seem simple, it has proven a powerful tool for advocating for women’s empowerment and inclusion in program activities. Tracking women’s participation, access to productive inputs, land areas, and productivity results has created a platform for making the economic case for women’s equitable inclusion in agriculture. Gender disaggregated data is reviewed in farmer debriefings and farmers discuss reasons between differences in yield profiles (e.g. women have less access to productive resources or trainings) and farmer groups have collectively chosen to set more ambitious targets to increase women’s inclusion in subsequent season activities.

- **Quantum GIS** is a free, open-source geographic information system (GIS) with a user-friendly interface. Networks use the software program to map their operations, including production areas, member distribution, and demonstration sites for different technologies.

Additional equipment and software packages are incorporated into the data collection system for different networks, according to their data tracking needs each year. These correspond to the evolution of their seasonal program objectives.

- **Quality Control Traceability:** Irrigated rice, maize, and millet networks are increasingly adopting quality control standards that are specific to each value chain. USAID/PCE developed these standards with value chain actors to provide a uniform and dependable quality product across production zones, and has gradually rolled out the incorporation of trainings and equipment support to partner networks.⁴ In addition to provision of and training on the use of probes, scales, humidity meters, mini rice mills, and palettes, the quality control package includes the creation of a traceability database which involves data collection and tracking templates and associated trainings.
- **Rainfall tracking:** Since 2013, USAID/PCE has supported the installation of a network of 217 manual rain gauges across 83 rural communities to improve availability and reliability of rainfall data recorded in rainfed value chain production areas (upland rice, maize, and millet). Each of the participating networks appoints a rain gauge manager, who is trained on installation, maintenance, interpretation of gauge readings, and analysis of rainfall data. A User’s Guide for rain gauges and a standardized rainfall data collection sheet was also developed and provided to rain gauge managers. Rain gauge managers receive a small amount of cell phone credit each month to send daily gauge readings via standard SMS messaging to the USAID/PCE M&E team, who aggregates data and produces monthly maps of the results (see Annex 2 for examples). The map below shows the distribution of rain gauges across the USAID/PCE rainfed zones.



⁴ See the note in this series on Quality Control Standards for Cereal Value Chains for more details

- **Handheld data collection:** The introduction of the CommCare application,⁵ an ICT-supported M&E system, represents the next phase of the cloud-based data management system approach. It was piloted with two partner networks in the Kaolack region – the Thiaré Association (for millet) in 2013, and FEPROMAS (*Fédération des Producteurs de Maïs du Saloum*) (for maize) in 2014 – and provides a platform for rapid collection, transmission, and consolidation of data. Network facilitators received basic Android smartphones capable of using the CommCare application, which is used to collect and store data and automatically update a cloud-based database as soon as the phone is connected to the internet. The cloud-based environment is also accessible via any Internet-ready device for storing or retrieving information. Dimagi, the company that developed CommCare, was contracted by USAID/PCE to provide trainings for facilitators and database managers and to produce an illustrated User’s Guide for the new ICT-based application.



A database manager inputs seasonal production data for a network farmer using the CommCare application.

Capacity building: Training sessions were organized and facilitated by the USAID/PCE team for network facilitators and database managers on the use of data collection tools, GPS, and mapping software such as Mapsource and Quantum GIS. In addition, networks are provided with relevant user’s guides and training manuals. As part of the iterative implementation, additional trainings are held early each season to share and validate tools, methods, and database models. Database managers are trained and supported in the development of a Data Analysis Plan, which outlines the structure of deliverable reports and indicates the types of data required for each component as per the seasonal partnership contract with USAID/PCE. As needed, the project hires part-time field support consultants to help better manage and leverage their data tracking and to prepare for seasonal debrief workshops.



A network-created low-cost training video on the quality control process shows equipment used to measure and document quality testing processes.

Monitoring and Evaluation of the Data Management System: The development and refinement of the data management tools was an ongoing process throughout USAID/PCE implementation. The system was adjusted each year, based on evaluations that were systematically conducted at the end of each season, to ensure that the information needs of partner networks and USAID/PCE were met.

⁵ www.dimagi.com/tostan/GIS

THE APPROACH IN ACTION

A cost-share partnership and contract with specific performance objectives is signed with each partner network at the start of each crop season. Throughout the year, farmer networks are responsible for the core management and implementation of the data systems, and USAID/PCE provides training for networks' database managers at the beginning of each season on using collection tools, software programs, database management and analysis. At the end of the season, working sessions are held with network data managers and the USAID/PCE technical team to review and verify the completeness of data while validating the analysis of key results.

The individual network database management implementation team is almost identical to the same team that drives the training and technical extension services for each network.⁶ These actors and their responsibilities are described below:

The Database Manager is responsible for collecting data, consolidating data collected by the facilitators, verification of data quality, data analysis, sharing results with USAID/PCE, and preparing figures for the seasonal debriefing meetings. Because there is a higher baseline skill set required for this role, USAID/PCE worked with partner networks to develop a job description template and to recruit for the role in a professional way (including CV evaluation, interviewing skills, etc.).

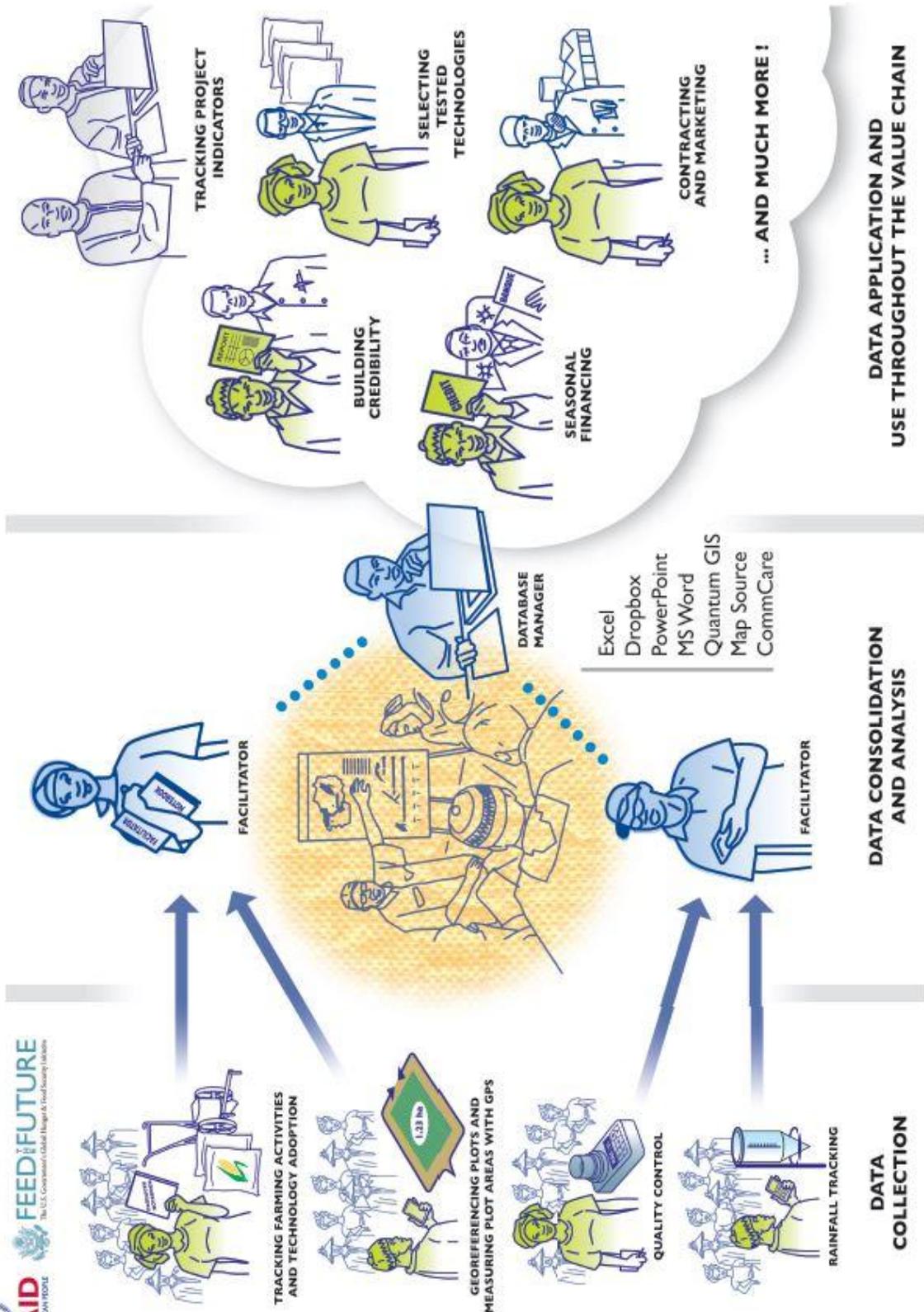
The Facilitator is responsible for collecting data at the farm level using a set of data collection sheets and providing these to the database manager. S/he also geo-references and measures plot areas with the GPS device.

The Lead Farmer plays an important role in showcasing and training on best practices and technologies promoted across each network. S/he is also responsible for ensuring the adoption of technologies by the satellite farmers s/he oversees. In some instances, the lead farmer assists the facilitator in collecting data from the satellite farmers.

The Satellite Farmer is the first level of data collection in the system, as the data collected concerns his/her farming activities.

The diagram on the next page shows the data collection and utilization process in action. To the left are representations of the various data collection activities, including those described above. The network facilitators and database managers are seen in the center, where the former are collecting information with the data collection tools (paper-based or CommCare) and the latter is organizing, analyzing, or transmitting the data to the cloud-based environment. To the right, the multiple uses for the data are pictured, which are described below.

⁶ See the note in this series on Farmer Owned Extension Services for more details.



RESULTS AND LESSONS LEARNED

USAID/PCE has worked to develop an extensive network of databases that collect data on and inform subsequent steps of program activities. As described above, the management and decision-making support tools that were developed, tested, and validated with partner networks are used for different tracking uses, are scalable, and have proven to be adaptable for different needs. The table below shows the extent of farmers tracked by the USAID/PCE project databases over the course of project implementation.

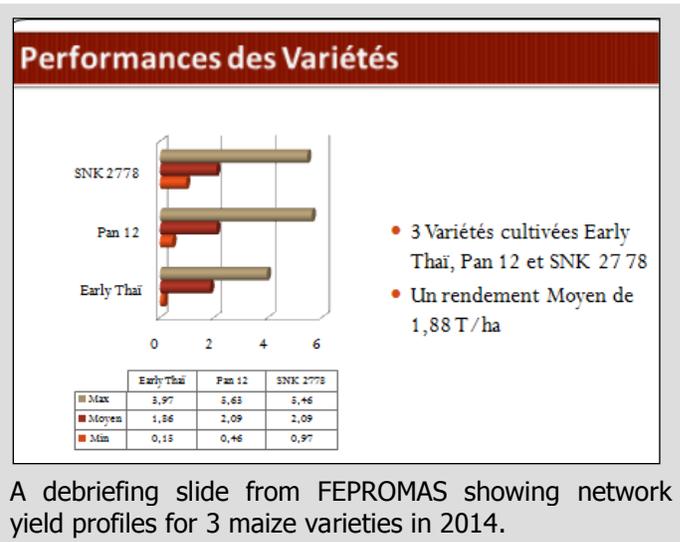
Farmer Tracking Systems 2012-2014						
Value Chain	2012		2013		2014	
	Farmers	% F	Farmers	% F	Farmers	% F
Irrigated Rice	3,314	17%	2,048	8%	10,830	24%
Rainfed Rice	7,201	54%	10,64	52%	16,320	58%
Maize	1,893	6%	5,606	8%	7,962	10%
Millet	1,689	13%	2,528	22%	2,650	22%
Total	14,097		20,822		37,762	

The rich collection of data allows for deriving accurate information on numerous aspects of farmer activities which can be aggregated from the farmer plot level to household, farming group, community, zone, or regional level as needed. Most prominent are:

- Geographical coverage of project interventions
- Local rainfall levels and effects on crop performance
- Network demographic profiles
- Land use/ areas sown
- Use of fertilizer
- Yield profiles
- Trends in network membership numbers
- Women’s engagement in network activities
- Adoption rates of agricultural best practices and technologies
- Performance of introduced technologies
- Funding obtained and repayment rates and types (e.g. cash or in-kind)

A number of farmer networks’ objectives are met through the implementation of the farmer-owned database approach:

- Calculating network-level input and financing needs for seasonal planning:** Farmer networks offer their member base – often thousands of small producers – a number of services, including facilitating access to inputs (seeds and fertilizer) as a bulk purchase. This is often paid through bank or supplier credit that is also negotiated collectively. Network leaders therefore need key information on the members and their plans concerning areas to plant and seed varieties selected, in order to properly calculate the combined input needs and to negotiate with financial institutions for credit disbursement in time for the season. Understanding the precise location of farmers’ plots also facilitates logistics planning for distribution of inputs.
- Identifying new practices and technologies that best improve performance:** Project interventions have largely focused on the promotion of new technologies and management practices that are accompanied by support tools. Tracking the adoption rates and associated results of these different technologies allows producers to learn from their own experiences and to continuously improve their practices and professionalism.
- Estimating yields and productivity pre-harvest to prepare for sales and marketing:** Monitoring crop production activities per farmer provides the necessary data for networks to generate a reliable seasonal production estimate and get a head start on preparing post-harvest sales activities. Over time, the databases and seasonal debrief analyses will also lend themselves to intra-annual comparison and tracking of medium- to long-term production and sales trends.
- Managing partnerships (with input suppliers, banks, and USAID/PCE):** With the tracked data, trends, and reports generated from the databases, producers increase their ability to engage with partners and communicate their results clearly and with authority, ultimately enhancing their credibility with respect to partners.
- Evaluating and responding to results and lessons learned from each season:** The utilization of monitoring tools enable networks to conduct seasonal debrief workshops with their members, in which they take stock of the season’s results and react to lessons learned while planning for the next season. The site-level management and tracking of data also enhances data access for farmers’ decision making in critical seasonal timeframes. This system has also significantly improved the availability and reliability of rainfall data and has enabled farmers to better determine appropriate timing for agricultural activities such as planting, tillage, weeding, fertilizer application, and crop disease treatment. Furthermore, the availability of rainfall data for project intervention zones enables USAID/PCE technical staff and national technical specialists to better understand crop performance dynamics and to explain these to partners in capacity building activities. As also mentioned above, tracking and analyzing gender-disaggregated



data on seasonal results has provided a platform for making the business case for gender inclusion and equality in agricultural production and for setting more ambitious targets for including women in subsequent seasons' activities.

- **Tracking quality to ensure traceability and increase credibility:** The standardized reporting and analysis of quality measurements ensure product traceability and quality maintenance. The numerous instruments and tools that have been provided to farmers (such as standardized data collection forms and database model templates) help them document and track their quality control results. The use of these tools has infused value chain development activities with reliable data on yields and product quality, which has proved invaluable for demonstrating – to all value chain actors – the benefits of adopting new practices. As such this data has also been an essential asset for other components of USAID/PCE's work such as contract farming and seed certification.



The Database Manager for the irrigated rice GIE Abdoul Aziz Sy Dabakh presents the results analysis at the end-of-season farmer debriefing.

- **Informing project performance indicators:** The farmer networks' databases are regularly audited by the USAID/PCE M&E team, who ensure quality control and strict adherence to data collection and management protocols. The databases are then used by the project to inform indicator tracking and project-level decision making. USAID/PCE's M&E team also conducts Data Quality Assessments to provide deeper targeted support and capacity building for partner networks.
- **Paving the way for a monitoring and governance system for value chains:** Eventually, the system can be extended beyond farmers' networks and linked with the various statistical information systems used across the agricultural sector to inform policies and sectoral programs.

The USAID/PCE experience developing and supporting farmer-owned, cloud-based data management systems has brought to light a number of lessons to inform future development programming, most notably:

Demand-driven interventions have proven to be the most appropriate for promoting a high and fast adoption rate of new technologies and practices by small producers. However, a proactive approach is also needed to introduce new practices that push farmers beyond their comfort zone – for example, moving beyond simple Excel spreadsheets to trainings on data analytics using pivot tables, or the introduction of CommCare and cartography applications for enhancing data collection and visualization capacities.

Simple and appropriate technology packages as the point of entry are key for facilitating the training and adoption process. The initial package should also be presented as a solution to farmers' current challenges or a tool to fill an existing gap they have articulated or identified themselves. By combining simple and appropriate technology packages with a system that cycles feedback and responds to results and stakeholder feedback, the USAID/PCE approach has proven to be quickly and efficiently scalable. Thanks to this iterative process, many of the data tracking teams supported by USAID/PCE since the start of the program are now at advanced computer processing and IT skill levels.

Creating opportunities for interaction and exchange within and across value chain networks through seasonal debriefing workshops contributes significantly to enhancing group dynamics and the professionalism of small farmers. Furthermore, **building skills for visual representation of data analysis results** has proven to be a powerful tool to motivate farmers' performance through comparative analyses with their peers. Diagrams have proven more impactful as analysis tools as they are easier to understand and more effective than tables, especially for supporting group discussions on comparative yield profiles.

Partnership with established institutions at the local and national levels remains of paramount importance as an overarching enabling environment for sustainability and efficiency. The internal systemization of data collection and management capabilities for farmers groups is feasible in the short term, but further long-term support is needed to ensure the effective integration of network databases into the value chain governance system, as well as an exhaustive exploitation and in-depth analysis of data over the long term. Moving forward, it will be important to involve more permanent local and national institutions in the process to ensure a broader impact and greater sustainability.

ANNEXES

1. EXAMPLE DATA COLLECTION SHEETS
2. EXAMPLE OF RAINFALL TRACKING MAP

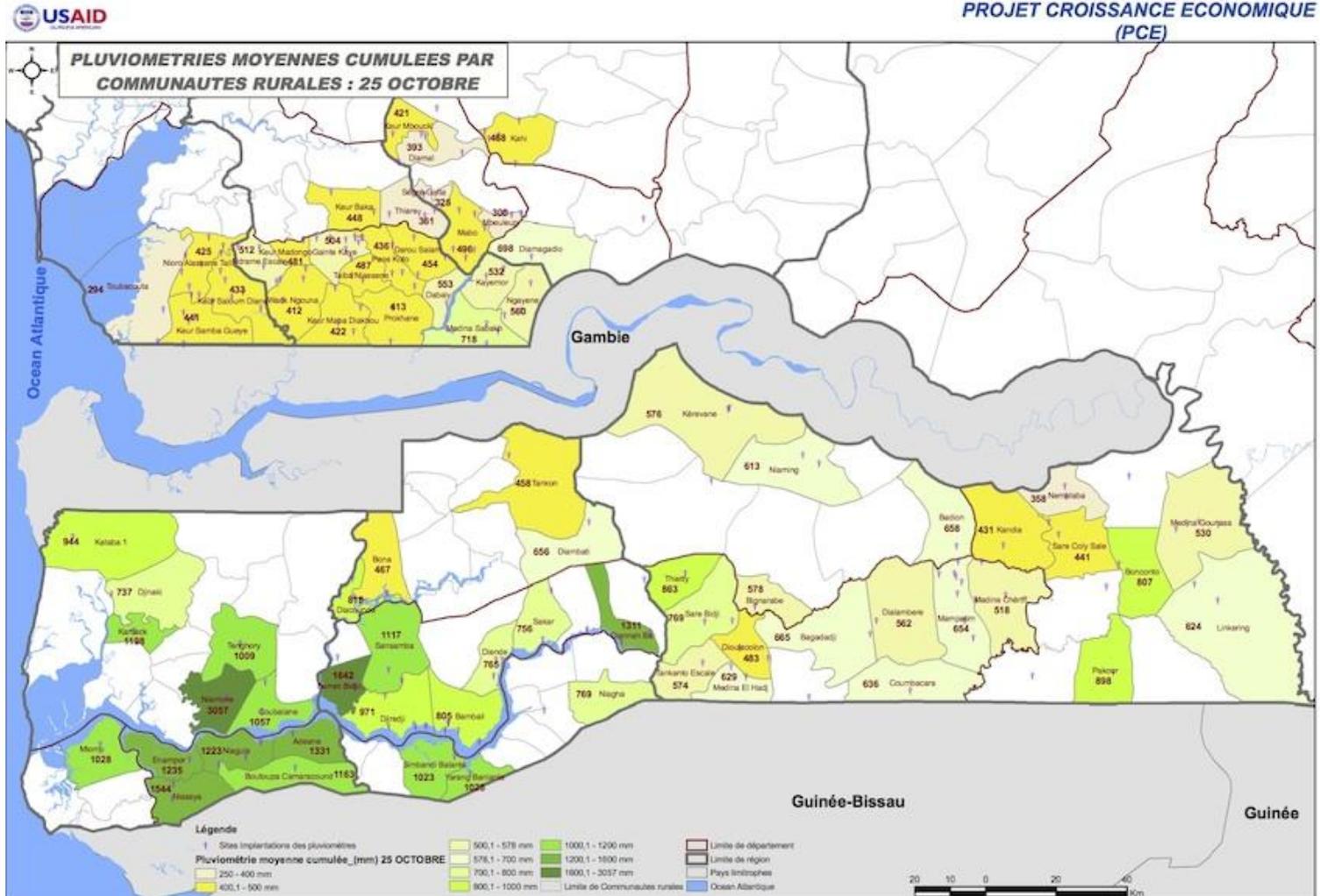
ANNEX I: EXAMPLE DATA COLLECTION SHEETS

FARMER TRACKING SHEET FROM FACILITATOR NOTEBOOK

FICHE IDENTIFICATION DU PRODUCTEUR									
CODE :		VILLAGE :			RESEAU :				
PRENOM & NOM :		GROUPE OU PERSONNE DE REFERENCE CREDIT :							
DEPARTEMENT :		REGION :			COMMUNAUTE RURALE :				
STATUT :				STRUCTURE FINANCIERE :					
GENRE :			N°CNI:						
TELEPHONE:				TAILLE DU MENAGE :					
FORMATIONS RECUES DANS LE CADRE DES PROGRAMMES DU RESEAU:									
Fiche Suivi Parcelle Producteur									
Producteur					Parcelle				
Code					Dénomination de la Parcelle		CODE :		
Prénom & Nom					Superficie déclarée		Hectare		
Statut Producteur					Superficie vérifiée (GPS)		Hectare		
Année d'implication					Statut Parcelle				
Campagne					Variétés de semences		Composite		Hybride
Technologies Introduites	Testeur d'humidité		GPS	Egrenage	Agréage Qualité				
	Semences		Sacs standards		Conservation farming		Précédent cultural		
Intrants Reçus					Applications Réelles				
Désignations		Quantité	Valeur		Opérations		Période	Observations	
Semences					Type de travail du sol :			Artisanal	Mécanique
NPK					Semis			_____ ha	_____ Kg
Urée					Buttage				
Fumure Organique					NPK				
sacs neufs					Urée				
Herbicide					Main d'œuvre Hors familiale				
Récolte					Commercialisation				
Période					Désignations		Quantité	Valeur	
Surface (ha)					Auto-consommation				
Production (T)					Remboursemen crédit				
Rendement (T/ha)					Ventes réseaux				
					Ventes hors réseaux				

ANNEX II: EXAMPLE OF RAINFALL TRACKING MAP

AVERAGE RAINFALL IN RURAL COMMUNITIES, OCTOBER 2014



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