IMPROVING FOOD SECURITY AND FACILITATING FARMER ADOPTION OF
IMPROVED TECHNOLOGIES: AN EVALUATION OF PEACE CORPS SENEGAL’S
MASTER FARMER PROGRAM

A Project Paper

Presented to the Faculty of the Graduate School
of Cornell University

In Partial Fulfillment of the Requirements for the Degree of
Master of Professional Studies in International Agriculture and Rural Development

by

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August 2013
CORNELL UNIVERSITY GRADUATE SCHOOL

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Degree: MPS

Title of Thesis/Dissertation:
Improving Food Security and Facilitating Farmer Adoption of Improved Technologies: An Evaluation of Peace Corps Senegal's Master Farmer Program

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ABSTRACT

In recent years, food insecurity has become a growing concern in the developing world, particularly in Africa. Because of this, various initiatives, such as the Feed the Future (FTF) initiative, have arisen that take a multi-faceted approach to improving food security. FTF uses innovation, research and development to improve agricultural productivity, link farmers to both local and regional markets, enhance nutrition, and construct safety nets. In order to do so, FTF engages with numerous organizations, such as the United States Agency for International Development (USAID) and Peace Corps (PC), and is focusing its activities in 19 countries around the world, one of which is Senegal.

In October 2009, an agreement between USAID/Senegal and PC Senegal went into effect, which provided PC Senegal with funds to start a food security program. One major aspect of the program is the development of demonstration and training sites throughout Senegal, called Master Farms. These farms are privately managed by Master Farmers, who act as local extension agents, demonstrating and promoting numerous improved field crop, gardening, and agroforestry techniques, while also emphasizing income generation and nutrition. The following study first explores the context in which the Master Farmer program was created, then describes the program and its current status, and then explains innovation diffusion theory. These are followed by a two-pronged analysis of the Master Farmer program: an examination of the program’s success at improving the food security of the Master Farmers, and an evaluation of the program’s effectiveness at facilitating the diffusion of the improved techniques demonstrated and promoted by Master Farmers to other farmers.

While the Master Farmer program is still in its early years, it is clear that the food security of the Master Farmers and their families is improving: they are achieving higher yields,
diversifying their crops and sources of income, expanding their household structures, expanding their animal husbandry activities, investing in agricultural machines or tools, and investing in wage laborers. In addition, the technologies demonstrated and promoted at Master Farms are being shared with others: Master Farmers have trained about 1,250 individuals in improved techniques. However, the success of the program is constrained by environmental and labor restrictions, relatively unfocused extension activities by Master Farmers, and differing perceptions of the improved technologies between PC Senegal and the potential adopters. Further research is needed to assess the long-term impact of the Master Farmer program and to evince whether this model of local demonstration and training sites maintained by local extension agents could be implemented throughout the developing world.
BIOGRAPHICAL SKETCH

Danielle Stoermer studied Biology and Environmental Studies at St. Olaf College in Northfield, MN, and received her Bachelor of Arts degree in 2008. That same year she started pursuing a Master of Professional Studies in International Agriculture and Rural Development at Cornell University as a Master’s International student through the joint program with the United States Peace Corps. After a year of graduate classes, she moved to Senegal where she served as a Peace Corps Volunteer in the Agriculture sector for nearly four years. Danielle’s professional interests focus on integrating agriculture, agroforestry, nutrition, and agribusiness to improve the food security of smallholder farmers and their families throughout the world.
ACKNOWLEDGEMENTS

I would like to thank Dr. Peter Hobbs for his extremely helpful advice, guidance and editorial feedback throughout the process. I would also like to thank Dr. Terry Tucker and Dr. Steve Kyle for their assistance throughout this process as well. I am grateful to all the staff members of Peace Corps Senegal, especially Mr. Famara Massaly, Mr. Youssoupha Boye, and Mr. Arfang Sadio, for sharing their extensive knowledge of Senegal and for their willingness to answer any question I ever had. I am also grateful to my fellow Peace Corps Senegal Volunteers for their readiness to help me survey farmers and provide feedback regarding the Master Farmer program. I would like to thank the Master Farmers, as well, for their eagerness to provide feedback and data regarding their farms at a moment’s notice. I am thankful for the people of Kaymor, Senegal, my friends back home, and my faith communities in Ithaca and Dakar for their support and encouragement throughout this whole process. Finally, I am indebted to my parents, my brother and sister-in-law, and my twin sister for their unwavering support and willingness to let me live so far away as I pursue my passion for improving the livelihoods of farmers in Senegal. Thank you.
# TABLE OF CONTENTS

Biographical Sketch iii  
Acknowledgements iv  
Table of Contents v  
List of Tables vii  
List of Figures viii  
List of Abbreviations x

1 Introduction 1

2 Food Security 4  
2.1 Food Security Basics 4  
2.2 Improving Global Food Security 5

3 Senegal: History and Environment 8  
3.1 La République du Sénégal 8  
3.2 Environment in Senegal 8  
3.3 Agriculture in Senegal 9

4 Feed the Future and Senegal 10  
4.1 Feed the Future 10  
4.2 Feed the Future in Senegal 11

5 The Master Farmer Program 17  
5.1 Objectives of the Master Farmer Program 17  
5.2 History of the Master Farmer Program 17  
5.3 Master Farmer Selection 20  
5.4 Developing Master Farmers 25

6 The Diffusion of Innovations 29  
6.1 Overview 29  
6.2 The Diffusion Process 29  
6.3 The Innovation-Decision Process 33  
6.4 The Rate of Adoption of an Innovation 41  
6.5 Criticisms of the Diffusion of Innovation Approach 48

7 Methods and Analysis 50  
7.1 Survey Methodology for Master Farmers 50  
7.2 Survey Methodology for Potential Adopters 52  
7.3 Observations and Informal Discussions 54

8 Results 57  
8.1 Improvements in Master Farmers’ Food Security 57  
8.1.1 Gardening Activities 57  
8.1.2 Field Crop Activities 59
LIST OF TABLES

5.1 Peace Corps Senegal’s Master Farmers, May 2013

6.1 Factors that Affect a Person’s Innovativeness

8.1 Garden Demonstration Yields (T/ha) for Master Farmer Ibou Sarr, Q2 FY2012

8.2 Total Inputs (CFA and hours) and Average Yield (kg/ha) for Field Crop Demonstrations in 2011

8.3 Financial Inputs (CFA) for Conservation Agriculture Demonstration with Maize, 2011

8.4 Labor Inputs (hrs) for Conservation Agriculture Demonstration with Maize, 2011

8.5 Financial Inputs (CFA) for Thinning Demonstration with Millet, 2011

8.6 Labor Inputs (hrs) for Thinning Demonstration with Millet, 2011

8.7 Financial Inputs (CFA) for Thinning Demonstration with Sorghum, 2011

8.8 Labor Inputs (hrs) for Thinning Demonstration with Sorghum, 2011

8.9 Financial Inputs (CFA) for Integrated Pest Management Demonstration with Cowpeas, 2011

8.10 Labor Inputs (hrs) for Integrated Pest Management Demonstration with Cowpeas, 2011

8.11 Financial Inputs (CFA) for System of Rice Intensification Demonstration with Rice, 2011

8.12 Labor Inputs (hrs) for System of Rice Intensification Demonstration, 2011

8.13 Yields (kg/ha) for Conservation Agriculture Demonstration with Maize, 2012

8.14 Yields (kg/ha) for Conservation Agriculture Demonstration with Millet, 2012

8.15 Yields (kg/ha) for Conservation Agriculture Demonstration with Sorghum, 2012

8.16 Yields (kg/ha) for Integrated Pest Management Demonstration with Cowpeas, 2012

8.17 Yields (kg/ha) for System of Rice Intensification Demonstration with Rice, 2012

8.18 Grafted Citrus Varieties at Master Farms

8.19 Grafted Mango Varieties at Master Farms

8.20 Production (kg) and Income (CFA) from Master Farms, FY2012

8.21 Attendees at Master Farmers’ Open Field Days, 2010-March 2013
LIST OF FIGURES

2.1 Maplecroft’s Food Security Index, 2012
2.2 Undernourishment in the Developing World, Number and Percent, 2012
2.3 Undernourishment, Poverty and Child Mortality in the Developing World, Percent, 2012
2.4 Worldwide Diet Diversification, 1990-92 and 2007-09
3.1 Senegalese Landscape
4.1 Agricultural Share of Government Expenditures in African Countries
5.1 Master Farmer Selection Criteria
5.2 Map of Peace Corps Senegal’s Master Farmers, May 2013
5.3 Process of Creating a Master Farm
5.4 Master Farmer 1-Hectare Field Demonstration Layout Guidelines
6.1 Standard S-Curve
6.2 Variation in Steepness of S-Curve for Different Innovations
6.3 Five Stages of the Innovation-Decision Process
6.4 Three Main Actors in Innovation Diffusion
6.5 Adopter Categories Based on Innovativeness
8.1 Front View and Side View of the Ripper
8.2 Process of Conservation Agriculture with the Ripper
8.3 Two Stations at Master Farmer Ibrahima Samake’s Open Field Day, March 2013
8.4 Nutrition Station at Master Farmer Ibrahima Samake’s Open Field Day, March 2013
8.5 Large Group Discussion at Master Farmer Ibrahima Samake’s Open Field Day, March 2013
8.6 Ease at Understanding Master Farmers
8.7 Perception of Type of Innovation-Decision
8.8 Reasons Why Innovation Provides Relative Advantage
8.9 Compatibility of Innovations with Respect to Socio-Cultural Values and Beliefs
8.10 Compatibility of Innovations with Respect to Current or Past Local Practices
8.11 Compatibility of Innovations with Respect to Perceived Needs
8.12 Effect of the Name of the Innovation
8.13 Difficulty in Understanding the Innovation
8.14 Perceived Difficulty in Implementing the Innovation
8.15 Perceived Difficulty in Maintaining the Innovation
8.16 Importance of the Ability to Adapt the Innovation
8.17 Perceived Difficulty in Experimenting With, Adjusting or Modifying the Innovation
8.18 Perceived Difficulty of Adapting the Innovation
8.19 Length of Trial Period to Satisfactorily Evaluate the Innovation
8.20 Observability of the Results of the Innovation
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tr>
<td>APCD</td>
<td>Associate Peace Corps Director</td>
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<tr>
<td>CA</td>
<td>Conservation Agriculture</td>
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<tr>
<td>CAADP</td>
<td>Comprehensive Africa Agriculture Development Programme</td>
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<tr>
<td>CDCS</td>
<td>Country Development Cooperation Strategy</td>
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<tr>
<td>CFA</td>
<td>West African CFA franc (XOF)</td>
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<tr>
<td>MCC</td>
<td>Millennium Challenge Corporation</td>
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<tr>
<td>NGO</td>
<td>Non-Governmental Organization</td>
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<td>PAPA</td>
<td>Participatory Agency Program Agreement</td>
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<tr>
<td>PC</td>
<td>Peace Corps</td>
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<tr>
<td>PCV</td>
<td>Peace Corps Volunteer</td>
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<tr>
<td>PTA</td>
<td>Programming and Training Assistant</td>
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<tr>
<td>SD</td>
<td>Standard Deviation</td>
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<tr>
<td>SRI</td>
<td>System of Rice Intensification</td>
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<tr>
<td>TOT</td>
<td>Training of Trainers</td>
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<tr>
<td>USAID</td>
<td>United States Agency for International Development</td>
</tr>
<tr>
<td>USD</td>
<td>United States Dollar</td>
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<tr>
<td>USDA</td>
<td>United States Department of Agriculture</td>
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<td>USG</td>
<td>United States Government</td>
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<td>WAFSP</td>
<td>West Africa Food Security Partnership</td>
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CHAPTER 1
INTRODUCTION

Despite the advances made from the so-called Green Revolution, much of the world, particularly those in Africa, still struggle to feed themselves and their families. There has been a growing emphasis on addressing this issue in the past several years, and from this have emerged countless development programs attempting to focus on various aspects of food security, such as improving agricultural research and extension services, increasing and diversifying agricultural production, improving access to seeds, fertilizers and other materials, linking farmers to markets, improving food storage and transformation methods, and improving nutrition. Most of these programs have achieved mixed results because of the complexities of improving food security, such as environmental constraints, cultural priorities, social configurations, government policies, internal conflict, and economic structures.

One program that is attempting to improve the food security of families throughout Senegal by taking an integrated and localized approach is the Master Farmer program. This program started in October 2009 and is part of Peace Corps (PC) Senegal’s larger food security program that is funded by the United States Agency for International Development (USAID)/Senegal. To date, 40 Master Farms throughout Senegal have been established. These farms act as local demonstration and training sites. They are privately managed by Master Farmers, who act as local extension agents, demonstrating and promoting numerous improved field crop, gardening, and agroforestry techniques, while also emphasizing income generation and nutrition. If successful, this program could act as a model for the design of integrated food security initiatives in developing countries around the world.
As a Peace Corps Volunteer (PCV) in Senegal from 2009-2013, I had the opportunity to participate in the Master Farmer program at different levels: I assisted with the selection and development of a Master Farmer in my village; I assisted with revising and developing new training materials for Master Farmers and PCVs who work with them; I provided guidance and advice to Master Farmers and PCVs; I participated in site visits to Master Farmers and in Open Field Days; and I assisted with regular data collection and analysis as well as program evaluations. I also developed and implemented a survey for farmers who attended Open Field Days in October 2011. The following report is an evaluation of the Master Farmer program and represents my analysis of the social, political, economic and environmental context in which the Master Farmer program was created, the design and operationalization of the program, the program’s impact on improving the food security of Master Farmers, the strengths and weaknesses of the technologies demonstrated and promoted in Master Farms, the program’s effectiveness at facilitating the diffusion of those technologies, and its potential for sustainability into the future.

The goal of this paper is to evaluate the effectiveness of PC Senegal’s Master Farmer program. In order to do this, this paper has two objectives. The first objective is to evaluate the change in food security of the Master Farmers to determine if their food security has improved since they joined the program. The second objective is to evaluate the adoption of the technologies demonstrated and promoted by the Master Farmers to determine if other farmers in their communities are adopting the technologies and, through this adoption, are seeing an improvement in their food security as well. Thus, this paper seeks to evaluate two hypotheses. First, since joining the Master Farmer program, the food security of the Master Farmers has improved. Second, the technologies demonstrated and promoted by the Master Farmers are
being adopted by other farmers in their communities and, through this adoption, the food security of these farmers is also improving.

Before evaluating the Master Farmer program, I will discuss a few different topics in order to provide context for this evaluation. First, I will describe what food security is, and then I will explore the history and environment of Senegal. Next, I will explain where the Feed the Future (FTF) initiative originated and what its objectives are in Senegal. Then I will provide a brief history of the Master Farmer program and how it is being implemented. Finally, I will discuss the process of innovation diffusion and how the Master Farmer program engages in it.
CHAPTER 2

FOOD SECURITY

2.1 Food Security Basics

Food Security exists when all members of a household have economic and physical access to enough nutritious and healthy food to satisfy their energy needs and to permit them to lead a healthy and active life. Food security is often described as being composed of three pillars and an underlying base. The first pillar to food security is availability. Availability is having sufficient quantities of food available in the marketplace or from production on a consistent basis. The second pillar is accessibility. Accessibility is having sufficient resources to obtain appropriate foods for a nutritious diet, such as the wherewithal to buy or otherwise obtain food. The third pillar is utilization. Utilization is consuming food based on knowledge of basic nutrition and sanitation, and having the ability to absorb and use the nutrients in the body. The underlying base is stability. Stability is having food available and accessible and having the ability to maintain sufficient nutrition consistently throughout the year; it is impacted by far-reaching environmental and sociopolitical factors, such as climate change, war or other conflicts, subsidies, and trade policies.

In 2012, 870 million people in the world did not have enough food to eat (FAO, WFP and IFAD 2012). About 27% of these undernourished people live in sub-Saharan Africa (FAO, WFP and IFAD 2012), where most of the countries with extreme food security risk are, according to Maplecroft’s index (see Figure 2.1).
Figure 2.1 The visual representation of the Maplecroft Food Security Index (FSI), which provides a quantitative assessment in 162 countries of the availability, stability and access to food supplies, as well as the nutritional outcomes that result from food insecurity. It is comprised of 18 key indicators, classified into four sub-indices: the current nutritional and health status of the population, the availability of food, stability, and access to food stocks. Four categories of risk have been identified based on the FSI value for each country: extreme risk (0.0-2.5), high risk (2.5-5.0), medium risk (5.0-7.5) and low risk (7.5-10.0).

Source: Maplecroft 2012

2.2 Improving Global Food Security

Addressing food insecurity has become a major focus in development in recent years, including an emphasis on increasing investments in agriculture as well as nutrition. The number of undernourished people in the world has fallen by 130 million since 1990, but progress slowed after 2008 (see Figures 2.2 and 2.3). The vast majority of hungry people – 98% to be exact – live in developing countries, where almost 15% of the population is undernourished.
Figure 2.2  The number (in millions) and percent of undernourished in the developing world. Source: FAO, WFP and IFAD 2012

Figure 2.3  Prevalence of undernourishment, poverty and child mortality in the developing world. Source: FAO, WFP and IFAD 2012
Diets have also been improving since 1990. As is evident in Figure 2.4, total caloric consumption has increased across all regions since 1990 and diets have also become more diversified.

![Contributions to total dietary energy supplies (kcal)](chart)

**Figure 2.4** Diets are becoming more diverse worldwide.  
Source: FAO 2012

While Asia and the Pacific have the largest share of the world’s hungry people (about 563 million), the trend continues to move downward. This is the case in every other region in the world, except sub-Saharan Africa, where the number of hungry people is on the rise (FAO, WFP and IFAD 2012).
3.1 La République du Sénégal

Senegal, officially the Republic of Senegal (La République du Sénégal), is a country in West Africa. It has a population of over 13 million people with several different ethnic groups: Wolof 43.3%, Pular 23.8%, Serer 14.7%, Jola 3.7%, Mandinka 3%, Soninke 1.1%, European and Lebanese 1%, and other 9.4%. French is the official language, but Wolof and Pulaar are spoken throughout Senegal. About 94% of the population is Muslim, 5% is Christian (mostly Roman Catholic), and the remaining 1% holds indigenous beliefs (CIA 2013).

3.2 Environment in Senegal

Senegal is tropical, with a hot and humid rainy season that lasts from May to November and has strong southeast winds. The dry season lasts from December to April and is dominated by hot, dry, harmattan wind. Temperatures often reach 40ºC throughout the country, and can get as hot as 54ºC in the region of Tambacounda, particularly along the eastern edge of Senegal on the border with Mali. Temperatures have increased by 0.9° Celsius since 1975. Average annual rainfall varies from as much as about 1,500 mm in southern Senegal to as little as about 350 mm in northern Senegal. Rainfall in Senegal has remained relatively constant in the past 20 years but is 15% below the 1920-1969 average (USGS 2012). The terrain in Senegal is generally low and rolling, with plains rising to foothills in the southeast. Senegal is 196,722 sq km in size – about the size of South Dakota – and is composed of arable land (19.57%), permanent crops (0.28%), and other (80.15%) (CIA 2013). The combined effects of low rainfall, high temperatures, wind and grazing typically lead to a desiccated landscape by the end of the dry season, as shown in Figure 3.1.
3.3 Agriculture in Senegal

Agriculture employs about 68% of the labor force and accounts for about 14% of the GDP. Most of the crops grown, such as millet, sorghum, maize, rice and peanuts, are rain-fed and are considerably affected by the variable rainfall, increasing temperatures and changing climate. The fragility of Senegal’s agriculture contributes to the country’s food security challenges. Already almost 50% of the population in Senegal lives below the poverty line, and under-nutrition is a moderate but persistent problem: about 16% of children under five suffer from stunting (FTF 2013b). These challenges will only be exacerbated as rapid population growth in Senegal is expected: Senegal’s population is projected to grow from 13 million today to somewhere between 29 and 37 million by 2050.
CHAPTER 4
FEED THE FUTURE AND SENEGAL

4.1 Feed the Future

As a result of the global food price crisis of 2007-2008 and the global economic crisis, the proportion and absolute number of hungry people worldwide jumped to historic levels – over 1 billion in 2009. In response to this, President Obama, at the G8 Summit in L’Aquila, Italy, in June 2009, pledged $3.5 billion over three years (FY2010 to FY2012) to a global hunger and food security initiative that would address hunger and poverty worldwide by investing in agricultural development. This U.S. commitment is just a portion of a global pledge of more than $20 billion made by the G20 countries and others. In May 2010, the Department of State officially launched the Obama Administration’s global hunger and food security initiative, called Feed the Future (FTF). The Department of State was initially the lead agency in developing the strategy for Feed the Future, though the U.S. Agency for International Development (USAID) is the primary agency responsible for coordinating its implementation (Ho and Hanrahan 2011).

Feed the Future is a multi-pronged approach, using innovation, research and development to improve agricultural productivity, link farmers to both local and regional markets, enhance nutrition, and construct safety nets. The goal of these investments is to increase the supply of food where it is needed and help vulnerable people endure price shocks better. FTF builds on the five principles for sustainable global food security that were first articulated at L’Aquila and then endorsed at the 2009 World Summit on Food Security in Rome: “supporting comprehensive strategies; investment through country-owned plans; improving stronger coordination among donors; leveraging effective multilateral institutions; and delivering on sustained and accountable commitments” (Ho and Hanrahan 2011).
The six foci areas of FTF are inclusive agriculture sector growth, gender integration, improved nutrition (particularly for women and children), private sector engagement, research and capacity building, and climate-smart development. Feed the Future is currently focusing activities in 19 countries in sub-Saharan Africa, Asia, and Latin America and the Caribbean. These countries were selected based on 5 criteria: level of need, opportunity for partnership, potential for agricultural growth, opportunity for regional synergy, and resource availability (FTF 2013a). Senegal is one of those 19 focus countries.

4.2 Feed the Future in Senegal

Even though Senegal is one of the most stable and promising countries in West Africa, it has experienced low economic growth rates in the past several years and only a small percentage of that growth can be attributed to agriculture (FTF 2013b). Some of the main reasons for this are poor infrastructure, limited operational strategy and implementation, longstanding underinvestment in agriculture, and an inhibiting policy environment exemplified by limited political will to undertake policy reform or improve the operating environment. However, starting in 2005, by the Government of Senegal increased investment in agriculture of more than 10% per year, which has created an enabling environment for progress in food security. Additionally, in 2009, Senegal set a long-term vision for agricultural development and elevated it as the primary driver of economic growth in its finalized Comprehensive Africa Agriculture Development Programme (CAADP) Investment Plan, the coordination of which is housed in the Office of the Prime Minister (FTF 2011).

CAADP was established at the assembly of the African union in July 2003 in Maputo, Mozambique, when African Heads of State and Government endorsed the “Maputo Declaration on Agriculture and Food Security in Africa”. Two of the main targets were to increase
agricultural productivity by 6% annually through 2015 and to allocate at least 10% of national budgetary resources to agriculture and rural development within five years. As is evident in Figure 4.1, Senegal is one of only seven countries covered by the data that have attained the 10% target in the most recent year for which information is available (2007 or 2008 in most cases) (FAO 2012).

Figure 4.1 Agricultural share of government expenditures in African countries.
Source: FAO 2012
In addition to low economic growth rates, Senegal is also plagued by moderate, chronic undernutrition where anemia as well as protein and micronutrient deficiencies are prevalent. Even though Senegal has one of the lowest undernutrition rates in West Africa, this condition continues to act as an underlying factor in Senegal’s high under-five and maternal mortality rates. Therefore, the Feed the Future initiative in Senegal integrates both agriculture and nutrition into its strategy (FTF 2011).

This multi-year strategy for implementing the Feed the Future initiative in Senegal covers FY2011-2015 and seeks to achieve the following Objective Statement that was developed by the USAID/Senegal Mission in alignment with the overarching goal of the Feed the Future initiative: “to sustainably reduce poverty and hunger, to improve equitable growth in the agricultural sector, and to improve nutritional status of the Senegalese people” (FTF 2011). The FTF strategy “is based on the development hypothesis that poverty and hunger can be sustainably reduced through transforming the national agriculture sector and nutritional status of the Senegalese population, especially women and children, through focused and scaled investment priorities” (FTF 2011). Thus, USAID/Senegal developed a Results Framework (see Figure 4.2), which demonstrates both how the FTF strategy intends to reach its objectives, as measured by Intermediate Results (IRs), and how the Mission’s larger Development Objective (DO) of increased, inclusive economic growth can also be achieved by the non-agriculture-specific efforts.
Through the implementation of this five-year strategy in Senegal, FTF aims to help an estimated 445,000 vulnerable Senegalese women, children and family members – mostly smallholder farmers – escape hunger and poverty. Services to improve nutrition and prevent stunting and child mortality will reach more than 188,000 children. Strategic policy engagement and institutional investments will help significant numbers of additional rural populations achieve improved income and nutritional status (FTF 2013b).

To meet its objectives, Feed the Future Senegal is making core investments in five interrelated areas:
1. Increased productivity and market linkages in key value chains. This investment works to improve the value chain of three staple grain value chains—rice, maize and millet—selected for their potential to achieve impact in reducing poverty and malnutrition. These activities aim to bring 50 percent more rice, 40 percent more maize, and 35 percent more millet to the local marketplace that meet local standards of quality to the benefit of many grain producers and consumers. The program will also work to improve Senegal’s sizable fisheries sector through policy and sustainable management reforms. Fisheries make a high-value economic and nutritional contribution in Senegal, but are a diminishing resource.

2. Scaled-up Essential Nutrition Actions (ENA). Essential Nutrition Actions (ENAs) include seven internationally acknowledged maternal and child health actions that improve nutrition and reduce maternal and child mortality. Feed the Future in Senegal will integrate nutrition activities into food-system economic activities, strengthening the link between increased food production, increased incomes, and increased consumption of quality and nutritious foods, particularly by women and children. Plus, ENAs will be promoted nationwide through capacity building of health facility personnel and increased access to Senegal’s health hut network.

3. Enhanced policy reform. Feed the Future policy reform efforts in Senegal focus on: enhancing the business environment; developing and testing new policies and management structures for the fisheries sector; and helping to move agricultural law toward implementation, including decreasing subsidies in the agricultural sector.

4. Improved rural infrastructure. To ensure long-term agricultural productivity, Feed the Future in Senegal will improve the infrastructure for post-harvest operations, including processing, storage and access to finance. In addition, investments are revitalizing up to five seed certification labs and seed conditioning facilities in order to increase the capacity of the seed system to address food insecurity.

5. Increased human resource capacity. Investments in human resource capacity will ensure access to and development of next-generation agriculture technologies in Senegal. The program will improve agriculture research capacity and associated higher-education institutions, strengthen human resource capacity across public and private sectors, and increase entrepreneurship and management capacities.

In addition to these five core areas, environmental sustainability and gender are integrated as cross-cutting issues in all programs and activities as guiding principles. In addition, Feed the Future in Senegal coordinates with many other agencies of the U.S. Government, along with other USAID initiatives such as the Global Climate Change initiative and the Global Health Initiative. […] Feed the Future is primarily focusing its rice activities in the Senegal River Valley, maize activities in the Southern Forest Zone, and fisheries activities in the Sine Saloum Delta. Augmenting this geographic focus is the Essential Nutrition Actions (ENA) program, which will be promoted nationwide through Senegal’s health hut network, seed lab development, and the related capacity building associated with each. (FTF 2013b)
USAID/Senegal’s Country Development Cooperation Strategy (CDCS) is an effort that is Whole-of-Government and incorporates an intricate collaborative plan, particularly with respect to FTF. In fact, in November 2010, USAID/Senegal hosted a Country Team retreat to create three development objectives for the CDCS as well as potential goal statements. In early 2011, the CDCS Results Framework was developed and included the FTF Results Framework. United States Government (USG) engagement and collaboration within the FTF context include the Department of State, Millennium Challenge Corporation (MCC), United States Department of Agriculture (USDA), Peace Corps (PC) and other USAID programs, among other programs.

Prior to this, however, PC Senegal had developed a proposal, called a Participatory Agency Program Agreement (PAPA), for USAID/Senegal for funding for food security activities. According to USAID/Senegal:

The Peace Corps provides rural technical assistance and expertise, as well as informal monitoring and evaluation. Volunteers currently work in private sector, agriculture and natural resource management, teaching, and health and nutrition, and can be further linked into the value chain programs via small project grants in such areas as training and technical assistance. Volunteers also act as observers measuring the impact of the policy reform efforts. Peace Corps recently assigned a liaison to USAID/Senegal’s agriculture programming. This relationship helps the USG reach the micro producers and processors that might otherwise be difficult to reach and will help spread project resources more efficiently. (FTF 2011)

The PAPA that PC Senegal had developed went into effect October 1, 2009. Through it, PC Senegal received 1.57 million USD from USAID/Senegal over the course of four years. In the proposal, PC Senegal committed to implementing numerous activities in order to improve the food security of smallholder farmers and others throughout Senegal. One of these main activities is the Master Farmer program.
CHAPTER 5
THE MASTER FARMER PROGRAM

5.1 Objectives of the Master Farmer Program

The Master Farmer program is an extension model developed by PC Senegal aimed at improving the food security of farmers and their families throughout Senegal. The program has four objectives:

1) To test, demonstrate, and adapt the best technologies that PC Senegal has to offer in the domains of field crops, gardening, agroforestry, income generation and nutrition;
2) To create local demonstration and training sites for farmers throughout Senegal;
3) To create local sources of seed and other planting materials throughout Senegal; and
4) To demonstrate that a one hectare farm can significantly improve a farmer’s food security.

5.2 History of the Master Farmer Program

The origins of the Master Farmer program can be traced back to the creation of PC Senegal’s Community Training Centers (CTCs) in 1995. The Centers were funded by USAID/Senegal’s Natural Resource Management Program and were established throughout Senegal, specifically in Thienaba (Thies), Passy (Fatick), Nioro (Kaolack), Missirah (Tambacounda), Salemata (Kedougou), and Dioucolon (Kolda). Owned by the government but operated and managed by PC Senegal and community leaders, these centers became educational hubs for the community by integrating improved techniques, information and skills from PC

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1 While income generation and nutrition were key components of the Master Farmer program from its inception, there was not as much emphasis placed on income generation and especially nutrition – compared to agriculture and agroforestry – early on in the implementation of the program.
Senegal’s four programs: Agriculture, Agroforestry, Health and Environmental Education (now just Health), and Small Enterprise Development (now, Community Economic Development).

Knowledge sharing and capacity building through demonstrations and trainings were the main goals of the CTC program. Each Center was managed by a 2nd or 3rd year PCV, who collaborated with other PCVs to implement demonstrations according to protocols developed by PC staff. Some Centers hosted interns, who assisted the volunteer in implementing the gardening and agroforestry demonstrations while being trained in the improved agricultural techniques being utilized. These interns then served as information resources for their communities.

In 1997, PC Senegal began expanding the area of CTC out-reach by including field crops in the planned demonstrations and introducing Open Field Days as a way to expose communities to new techniques, train participants and provide a forum for community information exchange. Volunteers in the area, along with their counterparts and one or two other farmers, typically participated in these Open Field Days. Agriculture PCVs in villages surrounding the Centers were then encouraged to work with some of their most innovative farmers to implement one or more of the techniques that had been demonstrated at the CTC. Once these demonstrations were in place, village-level Open Field Days were held. At this point, PC Senegal’s Agriculture program started to promote the idea of “pilot farmers,” whereby local farmers have demonstration plots to test out new techniques. The volunteers who spent time developing demonstrations with pilot farmers realized the meaning of capacity building: many of these pilot farmers hosted their own Open Field Days and shared the new techniques they learned through the implementation of their demonstrations with their surrounding communities.
As is the norm with development programs, the funding from USAID ended in 2000, after a five-year run. Peace Corps Senegal could not continue to support these Centers without USAID funding. After years of investment in the form of time, energy and finances, all the Centers (with the exception of the Kedougou CTC which now serves as the regional PC transit house) were returned to their communities and most of them quickly fell into disrepair. The demonstrations rapidly faded away and the other resources that were present at the Centers in the form of PCVs and interns were lost. However, the CTC experiment was not conducted in vain.

At the close of the agreement with USAID, an external, independent agency evaluated PC Senegal’s system of Community Training Centers. Based on their evaluation, they concluded that the trainings, Open Field Days and internships were the most successful components of the CTC program. They also concluded that one of the major obstructions to sustainability of the demonstrations in particular and the Centers in general were based on the fact that a PCV, rather than a community member, was in charge of developing the demonstrations and maintaining each site. These issues, combined with the regular turnover of the PCV working at the CTC, meant that there was little or no community-ownership of the site and institutional memory was quickly lost. Long-term sustainability is impossible to meet in a site that is community-owned but PCV-implemented. In fact, the lack of ownership and individual responsibility proved to be the CTC program’s greatest weakness. Without single ownership of space, there was no effective way to ensure the economic incentive required to make the training facility financially sustainable after the end of USAID funding.

However, there were many successful aspects of the CTC approach. Among them were the emphasis on hands-on, season-specific, locally-appropriate agriculture trainings; the level of community exposure gained through Open Field Days; the success of working closely with a few
innovative people who could then act as local community information resources; and the benefit of having regionally distributed training centers that could act as easily accessible locations for local communities to exchange agricultural information.

PC Senegal was not able to build on the conclusions of the CTC program until 2009, when PC Senegal developed the PAPA for USAID/Senegal that would provide them with funds for food security activities. PC Senegal carefully considered the lessons drawn from the CTC approach as they developed what eventually became the Master Farmer program. The extension strategy of the Master Farmer program is similar to other agriculture development programs, such as Farmer Field Schools. These schools are utilized by many different development organizations whereby a small group of farmers gather in the field with a technical facilitator to design and implement various improved techniques, and then evaluate and adapt the techniques over time and share them with other local farmers (SUSTAINET EA 2010).

The Master Farmer program is unique, though, in that it focuses extension resources and services by developing the knowledge, skills, and financial capacities of just one individual in a community and on a plot of land that he/she owns and operates. The Master Farmer program also allows PC Senegal to expand its extension outreach by developing these selected farmers’ capacities to become both educators and local sources of seed and other planting materials, while simultaneously enabling the emergence of an economically, socially and technically sustainable extension resource in the form of the locally owned and operated Master Farm.

5.3 Master Farmer Selection

Soon after the PAPA with USAID/Senegal went into effect on October 1, 2009, the first Master Farmers were selected. The selection process for Master Farmers is quite extensive and has become more rigorous as the program has progressed. A PCV who is working in the
farmer’s community initially nominates most potential Master Farmers. A few farmers have been nominated by PC Senegal staff who knew good candidates through the work of previous volunteers. In an effort to expand the Master Farmer program to areas of Senegal with few volunteers, PC Senegal staff members have asked partner organizations, namely Yaajeende and the Senegalese Agriculture Office, to nominate potential Master Farmers. A list of selection criteria (see Figure 5.1) was developed at the beginning of the program and is still used when selecting potential Master Farmers.

Figure 5.1 The Master Farmer selection criteria.

REQUIRED:
- **Communicative**: The Master Farmer must possess solid communication skills, as he/she must be able and willing to share knowledge, experience, and resources with the community. The farmer must also be enthusiastic about working as a trainer to extend agriculture/agro-forestry technologies and practices to the surrounding community.
- **Well-respected**: As the Master Farmer will be trained as a leader, he/she must therefore have already exhibited strong leadership tendencies. The farmer must be viewed as a capable and knowledgeable farmer whom the community deems an approachable resource and teacher.
- **Innovative/Experimental**: The Master Farmer needs to be open-minded since he/she will be expected to implement different and perhaps unfamiliar technologies in the field. Preferably, the farmer will have demonstrated such willingness with past (possibly small-scale) endeavors.
- **Successful**: The selected farmer must have established some degree of agricultural achievement, such as maintaining garden and field crops with decent yields and productivity.
- **Tenured**: The Master Farmer must own at least one hectare of land that he/she can devote to the project for the duration of at least five years.
- **Able-bodied**: As the Master Farmer will be a living example of how to establish a sustainable agricultural system, he/she must be physically capable of maintaining the demonstration site. Age is a factor, as the farmer must be young enough to invest future years and labor in the project but mature enough to be a respected adult within the community.
- **Mobile**: The Master Farmer must be able to attend trainings and demonstrations out-of-site without constraints due to familial and occupational duties.
- **Accessible**: Since the Master Farmer will be working closely with PCVs, his/her demo plot must be located in near proximity to a cluster of PCVs who preferably work in various sectors.

PREFERRED:
- **Experienced**: The Master Farmer should be familiar with the Peace Corps approach; previous collaboration with PCVs is desirable. It is also advantageous for the farmer to have relevant experience with a diverse range of crops.
- **Accessible**: As the Master Farmer’s plot will serve as a demonstration site, it should be readily accessible by surrounding communities. Reliable transport is a plus.
When a PCV wishes to nominate a potential Master Farmer, the PCV is asked to fill out a baseline survey for at least three potential Master Farmers in his or her community. This survey provides the volunteer and staff with a broad understanding of the farmer’s skills and experiences. Then a third year PCV or PC staff member, typically a member of the Agriculture or Agroforestry teams, travels to the community to interview the nominated farmers, visit their potential fields and discuss with community members about the program and nominees. Staff did not visit some of the first few Master Farmers who were selected before the selection was made. It is now standard policy that staff interviews all potential Master Farmers during field visits before a Master Farmer is selected, because of language and culture nuances that American volunteers sometimes are not able to use or pick up on during interviews.

Once the potential farmers have been visited, the staff member discusses with other staff members before a final selection is made and the chosen farmer is invited to PC Senegal’s Training Center in Thies for a training and orientation to the Master Farmer program. A farmer who is not selected to be a Master Farmer can sometimes blame the PCV who nominated him; this is another reason why several farmers are nominated from a community and a staff member interviews the candidates: the PCV who nominated the farmers can shift the decision for which farmer was selected from the PCV to a staff member. As of May 2012, PC Senegal had 40 Master Farmers (see Figure 5.2 and Table 5.1). They are spread out throughout every region of Senegal, except the region of Dakar, which has minimal agricultural production, and the regions of Ziguinchor and Sedhiou, which have been restricted to PCVs due to decades of civil unrest².

² “Certain areas in Senegal are restricted because there are credible reasons to believe that safety and security may be compromised to anyone traveling through those zones. The following is a list of restricted settlements and territories to which NO Peace Corps Volunteers are permitted to enter or travel without explicit permission in advance from the Country Director or Acting Country Director. Zones restricted for travel are: The region of Ziguinchor [and the region of Sedhiou […]” (Peace Corps Senegal 2013, p. 55).
The average age of all the Master Farmers is 60 years old. Two of the Master Farmers are female\(^3\).

Figure 5.2  Map of Peace Corps Senegal’s Master Farmers as of May 2013.  

Table 5.1  List of Peace Corps Senegal’s Master Farmers as of May 2013.  Group refers to date of first training: Group 1 was trained in March 2010; Group 2, June 2010; Group 3, March 2011; Group 4, May 2012; Group 5, December 2012; Group 6, March 2013.

\(^3\) PC Senegal has made a concerted effort to find women who fit the Master Farmer criteria, but it is very difficult to do so because the tradition and culture in Senegal is such that women generally do not own land.
<table>
<thead>
<tr>
<th>Group</th>
<th>Master Farmer</th>
<th>Site</th>
<th>Department</th>
<th>Region</th>
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<tbody>
<tr>
<td>1</td>
<td>Hassana Hedrick Diallo</td>
<td>Dindefello</td>
<td>Kedougou</td>
<td>Kedougou</td>
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<td>Faraba</td>
<td>Saraya</td>
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<td>Keur Lahine Lobe</td>
<td>Kaffrine</td>
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<tr>
<td>1</td>
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<td>Katakel</td>
<td>Kaffrine</td>
<td>Kaffrine</td>
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<tr>
<td>1</td>
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<td>Gouye Marie</td>
<td>Foundiougne</td>
<td>Fatick</td>
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<tr>
<td>1</td>
<td>Demba Balde</td>
<td>Goundaga</td>
<td>Velingara</td>
<td>Kolda</td>
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<tr>
<td>1</td>
<td>Toumani Diamanka</td>
<td>Saare Gagna</td>
<td>Kolda</td>
<td>Kolda</td>
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<tr>
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<td>Linguere</td>
<td>Louga</td>
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<td>Medina Ndjobene</td>
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<td>Saly Escale</td>
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<td>Tawa Fall</td>
<td>Thies</td>
<td>Thies</td>
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<td>Yacine Lakke</td>
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<td>Dar Salam</td>
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<td>Keur Bakary (Nguekoke)</td>
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<td>4</td>
<td>Hamadou Ly</td>
<td>Kanel</td>
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<td>5</td>
<td>Mamadou Gueye</td>
<td>Kalassane</td>
<td>St. Louis</td>
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<td>Taiba Wilanene</td>
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<td>Fatimata Samba Lo</td>
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<td>Demba Sabaly</td>
<td>Foulamory Demba</td>
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</table>
5.4 Developing Master Farmers

Soon after a new group of Master Farmers is selected, they and the PCVs with whom they work attend a four-day training at PC Senegal’s Training Center in Thies. During this training, the new Master Farmers and volunteers get an orientation to the program, which includes an overview of PC Senegal’s food security initiative, the goals and objectives of the Master Farmer program, and the current status of the program. They are also trained in the improved agriculture and agroforestry techniques which they are expected to demonstrate in their fields, such as composting, conservation farming, double digging, companion planting, integrated pest management, windbreaks, live fence, alley cropping and grafting. At the end of the training, the Master Farmers and a representative of PC Senegal sign the Master Farmer Contract (see Appendix A). However, before the Master Farmers sign their contracts, the contract is verbally reviewed since many Master Farmers are illiterate.

The contract specifies the main responsibilities of PC Senegal and of the Master Farmer. In short, PC Senegal is committing to providing the Master Farmer with technical and financial support for the implementation of the demonstration and training site and related extension activities. The Master Farmer is committing to carrying out the demonstrations and training activities, reporting yield, income and other data to PC Senegal, and attending required meetings and trainings. The contract is for four years and may be changed with a written amendment accepted by both parties.

Nearly all Master Farmers work with at least one PCV and sometimes two or more. Most volunteers who work with Master Farmers are in either the Agriculture sector or the Agroforestry sector, though several Health volunteers work closely with Master Farmers and some Community Economic Development (CED) volunteers are beginning to become more involved
with nearby Master Farmers. The vast majority of volunteers visit their Master Farmer once a week if not several times a week. As of May 2012, only six volunteers were living in the same compound as their Master Farmer, though many more live in the same village, most live within just a few kilometers of the Master Farmer, and everyone lives within 15 kilometers of their Master Farmer.

Volunteers typically act as liaisons between their Master Farmer and PC staff. However, there are occasions when Master Farmers and PC staff will communicate directly. When quarterly data is being collected, staff will often call Master Farmers directly since not all volunteers record all of the data that is collected quarterly. When some Master Farmers have technical questions, they sometimes call staff directly rather than their volunteer. Some Master Farmers also call staff directly if they have a concern regarding their volunteer, a question regarding the program, or interesting results regarding a demonstration.

The process of developing of a Master Farm is a long process, and, as Figure 5.3 shows, it first involves the establishment of the farm with the required infrastructure, then the development of demonstrations, and then the extension of the technologies being demonstrated. It often takes a year to get the main infrastructure installed: a chain-link fence around the 1-hectare farm, a small storage shed, a water tap or well, water basins, drip irrigation and tools, such as shovels, rakes, machetes, backpack sprayer, and pruning shears. During this time, some demonstrations can be started, especially during the rainy season such as field crop demonstrations, outplanting live fence trees and composting.
Figure 5.3  The process of creating a Master Farm is a long process: it first involves the establishment of the farm with the required infrastructure, then the development of demonstrations, and then the extension of the technologies being demonstrated. Source: Image created by Andrew Oberstadt

Once the entire infrastructure is installed, all appropriate field crop, gardening and agroforestry demonstrations can be developed in the field. Figure 5.4 is the field layout demonstration guide that was developed to help Master Farmers and their volunteers visualize the desired layout of the field. However, because of differences in shape of field, soil, slope, wind and other factors, no single Master Farm looks exactly like this model. In order to help Master Farmers and their PCVs set priorities for the farm, a set of yearly goals (see Appendix B) was developed. Since every Master Farmer is different in terms of skills and challenges, very few have actually been able to accomplish all of the yearly goals. However, there are a few exceptional Master Farmers who have surpassed the goals. Once several demonstrations have been developed, Master Farmers, with assistance from their volunteers, extend the technologies to others in their communities, through Open Field Days and other training events.
Figure 5.4 Master Farmer one-hectare field demonstration layout guidelines.
Source: Image created by Famara Massaly and edited by Andrew Oberstadt
CHAPTER 6
THE DIFFUSION OF INNOVATIONS

6.1 Overview

Diffusion of innovations is a theory that seeks to explain how, why, and at what rate new ideas and technology spread through a social system. According to Rogers, “diffusion is the process in which an innovation is communicated through certain channels over time among the members of a social system” (2003, p. 5). The diffusion of innovations manifests itself in different ways in various cultures and fields and is highly subjective to the type of adopters, the actions of the change agent(s), the perceived attributes of the innovation and the innovation-decision process. Of the research questions that have been addressed related to the diffusion of innovations, those that are most applicable to anyone seeking to increase the rate of diffusion of an innovation are (1) how earlier adopters differ from later adopters of an innovation, (2) how the perceived attributes of an innovation affects its rate of adoption, and (3) why the S-shaped diffusion curve “takes-off” at about 10-20% adoption.

6.2 The Diffusion Process

While the actual time frame for adoption of an innovation may vary from a few hours to centuries depending on the innovation, the diffusion process of a given innovation almost always follows a standard S-curve (see Figure 6.1). At some point, Time 0, the change agent shares the innovation with clients. In the beginning, only a few clients adopt the innovation, but gradually more and more adopt. When about 10-20% of the population in the system has adopted the innovation, there is a “take-off” period that marks the beginning of a period of rapid adoption of the innovation. This is followed by another period of gradual adoption as the remaining few clients who have not yet adopted the innovation adopt it. There is clearly not always necessarily
100% adoption of an innovation in a system. As is demonstrated in Figure 6.2, the steepness of the standard S-curve can vary greatly depending on several factors, namely the nature of the social system, communication channels, extent of change agent’s promotion efforts, the type of innovation-decision and the perceived attributes of innovations (Rogers 2003).

Figure 6.1 The percent of adoption of an innovation over time is generally represented as an S-shaped curve.
Source: Diagram created by Danielle Stoermer, adapted from Rogers 2003, p. 11

Figure 6.2 The steepness of the standard S-shaped curve for a given innovation can vary greatly depending on several factors.
Source: Diagram created by Danielle Stoermer, based on Rogers 2003, p. 11
As noted earlier, there are four main elements that influence the spread of a new idea: 
“(1) an innovation (2) is communicated through certain channels (3) over time (4) among the members of a social system” (Rogers 2003, p. 11). The first element in innovation diffusion is the innovation. An innovation is “an idea, practice, or object that is perceived as new by an individual or other unit of adoption” (Rogers 2003, p. 12). Innovation is a means of uncertainty reduction that is made possible by information about the cause-effect relationships on which the technology is based. The innovation-decision process is essentially an information-seeking and information-processing activity in which an individual is motivated to reduce uncertainty about the advantages and disadvantages of the innovation. Innovations typically have 2 components: a hardware aspect, consisting of the tool that embodies the technology as a material or physical object, and a software aspect, consisting of the information base for the tool. There are 5 main attributes of innovations: relative advantage, compatibility, complexity, trialability, and observability. Many inventions can be re-invented; re-invention is the degree to which an innovation is changed or modified by a user in the process of adoption and implementation.

The second element in the innovation diffusion process is communication channels. A communication channel is “the means by which messages get from one individual to another” (Rogers 2003, p. 18). Examples of types of communication channels are mass media channels and interpersonal channels. A basic principle of human communication is that the transfer of ideas occurs most frequently between two individuals who are similar, or homophilous. Homophily is the degree to which two or more individuals who interact are similar in certain attributes, such as beliefs, education, socioeconomic status, and the like. Heterophily, the opposite of homophily, is the degree to which two or more individuals who interact are different in certain attributes. While the nature of diffusion demands that at least some degree of
heterophily be present between two participants in the communication process, one of the most distinctive problems in the diffusion of innovations is that the participants are usually quite heterophilous and this difference frequently leads to ineffective communication as the two individuals do not speak the same language.

The third element in the innovation diffusion process is time. The time dimension is involved in diffusion in the innovation-decision process, in innovativeness and adopter categories, and in an innovation’s rate of adoption. The innovation-decision process is “the process through which an individual (or other decision-making unit) passes from first knowledge of an innovation, to the formation of an attitude toward the innovation, to a decision to adopt or reject, to implementation and use of the new idea, and to confirmation of this decision” (Rogers 2003, p. 20). The innovation-decision process can lead to adoption or rejection; both of these decisions can usually be reversed; for example, an adopter can later decide to discontinue using the innovation.

Not all members of a social system will choose to adopt an innovation at the same time; some are more innovative than others. Innovativeness is defined as the degree to which an individual or other unit of adoption is relatively earlier in adopting new ideas than the other members of a system. Members of a social system can be classified into five adopter categories based on their innovativeness: innovators, early adopters, early majority, late majority, and laggards. The rate of adoption is the relative speed with which an innovation is adopted by members of a social system.

The fourth element in innovation diffusion is the social system. A social system is defined as “a set of interrelated units that are engaged in joint problem solving to accomplish a common goal” (Rogers 2003, p. 23). Every social system has structure, which is the patterned
arrangement of the units in a system. Examples of such structure are social structure and communication structure. Social systems also have norms, which are the established behavior patterns for the members of a social system. Opinion leadership is the degree to which an individual is able to influence other individuals’ attitudes or overt behavior informally in a desired way with relative frequency. Opinion leaders are members of a social system in which they exert their influence. A change agent is an individual who influences clients’ innovation-decisions in a direction deemed desirable by a change agency. Change agents often use opinion leaders in a social system as their lieutenants in diffusion activities.

Consequences are the changes that occur to an individual or to a social system as a result of the adoption or rejection of an innovation. Change agents can often anticipate and predict an innovation’s form (the directly observable physical appearance of the innovation), and perhaps its function (the contribution of the idea to the way of life of the system’s members). But change agents are seldom able to predict an innovation’s meaning (the subjective perceptions of the innovation by the clients).

6.3 The Innovation-Decision Process

The innovation-decision process is “the process through which an individual (or other decision-making unit) passes from gaining initial knowledge of an innovation, to forming an attitude toward the innovation, to making a decision to adopt or reject, to implementation of the new idea, and to confirmation of this decision” (Rogers 2003, p. 168). This process is composed of a series of choices and actions over time through which an individual or a system evaluates the innovation and decides whether or not to incorporate it into ongoing practice. This behavior more-or-less consists of dealing with the uncertainty that is inherently involved in deciding about a new alternative to an idea that already exists. As shown in Figure 6.3, this process can be
separated into a series of five stages. It is the perceived newness of an innovation – and the uncertainty associated with this newness – that is a distinguishing aspect of innovation decision making compared to other types of decision making (Rogers 2003).

While there is no feedback loop shown in this process, it certainly exists. As an individual person, or other decision-making unit, experiments with the innovation or observes others implementing it, he can tweak the innovation and make changes to the innovation that may change some of the perceived characteristics of the innovation or other factors in the decision-making process, such as how the innovation is communicated. Such a feedback loop has the ability to impact the final decision of this individual – and of other individuals – to adopt or reject the innovation.

There are two factors that determine the type of a particular innovation-decision: 1) whether the decision is made freely and implemented voluntarily, and 2) who makes the decision. Based on these considerations, three types of innovation-decisions have been identified within innovation diffusion theory. An Optional Innovation-Decision is a decision made by an

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Figure 6.3 A model of the five stages of the innovation-decision process.
Source: Diagram created by Danielle Stoermer, based on Rogers 2003, p. 170
individual who is in some way distinguished from others in a social system. A Collective Innovation-Decision is a decision made collectively by all individuals of a social system. An Authority Innovation-Decision is a decision made for the entire social system by a few individuals in positions of influence or power. There is also a fourth type of innovation-decision that is a sequential combination of two or more of the first three types of decisions: such a Contingent Innovation-Decision involves making choices to adopt or reject that can be made only after a prior innovation-decision has been made.

There are three main actors involved in innovation diffusion: the change agency, the change agent, and the clients or potential adopters. The innovation is typically developed by the change agency, who then communicates it to the change agent, who then shares it with clients. Throughout this process, though, there is (in an ideal scenario anyway) continuous feedback from the clients to the change agent and from the change agent to the change agency, as well as potentially feedback from the clients directly to the change agency.

The change agency is the group or organization promoting an innovation. As is shown in Figure 6.4, the change agency in the Master Farmer program is Peace Corps Senegal, with support from USAID/Senegal through the Feed the Future initiative. The change agent is the individual working to convince potential adopters to adopt the innovation that the change agency is promoting. The changes agents in the Master Farmer program are the Master Farmers themselves, as well as the PC staff and volunteers who work with them to establish the demonstrations and promote the technologies. The clients or potential adopters are the individuals who are able to adopt the innovation promoted by the change agency and change agent. In the Master Farmer program, the clients are generally all Senegalese people, but especially Senegalese farmers (as defined in the broadest sense of the word).
Clients can be divided into several different categories based on how quickly they adopt an innovation, or based on their “innovativeness” (see Figure 6.5). These categories are partitioned by marking off standard deviations (SDs) from the average time of adoption. The area lying two SDs below the mean includes the first 2.5% of the clients to adopt an innovation; these clients are known as “innovators.” The next 13.5% to adopt are included in the area between two SDs below the mean and one SD below the mean; they are labeled “early adopters.” The next 34% of adopters are between the mean and one SD below the mean; they are called “early majority.” The next 34% are between the mean and one SD above the mean; they are the “late majority.” Finally, the last 16% of clients to adopt are in the area after one SD after the mean; these clients are known as “laggards” (Rogers 2003). This bell curve does not always include everyone in a social system: when there is incomplete adoption, those clients who did not adopt the innovation are not represented.
While innovativeness is the measure used to separate individuals into the five adopter categories, there are many other characteristics that are shared by individuals in a given category and that can then also be used to further segregate individuals into these 5 categories. Based on years of innovation diffusion research, diffusion scholars have come up with the most common characteristics of each adopter category.

Innovators are venturesome. They are on the fringe of their peer networks because of their obsession with new ideas. In order to support their venturesomeness, most innovators have control of substantial financial resources to absorb possible losses from unprofitable innovation, and they are also able to understand and apply complex technical knowledge in order to cope with a high degree of uncertainty about an innovation because of the small support system that they would have to help them when they adopt an innovation so early.
Early adopters, on the other hand, are a more integrated part of the local social system. They are highly respected individuals and also have the highest degree of opinion leadership in most systems. Early adopters often serve as a role model for many other members of a social system and typically help trigger the take-off period in the diffusion process. It is these early adopters – and particularly the opinion leaders among them – that change agents, such as Master Farmers, should target to speed up adoption rates.

Opinion leadership is “the degree to which an individual is able to influence other individuals’ attitudes or overt behavior informally in a desired way with relative frequency” (Rogers 2003, p. 27). This informal leadership is not a function of the individual’s formal position or status in the system; rather, opinion leadership is earned and maintained by the individuals’ technical competence, social accessibility, and conformity to the system’s norms. Opinion leaders exemplify and express their system’s structure because when a social system is oriented to change, the opinion leaders are more innovative, but when a system’s norms are opposed to change, the leaders’ behavior reflects this norm. Thus, through their conformity to the system’s norms, opinion leaders serve as a model for the innovation behavior of their followers. Since many systems have both innovative opinion leaders and leaders who oppose change, these influential leaders can lead in the spread of new ideas or lead an active opposition. Opinion leaders, compared to their followers, “(1) are more exposed to all forms of external communication and thus are somewhat more cosmopolite, (2) have somewhat higher socioeconomic status, and (3) are more innovative (although their degree of innovativeness depends, in part, on the systems’ norms)” (Rogers 2003, p. 27).

The most striking characteristic of opinion leaders is their unique and influential position within their system’s communication structure: they are at the center of interpersonal
communication networks. Such networks consist of interconnected individuals who are linked by patterned flows of information. Thus, an opinion leader’s interpersonal networks allow him to serve as a social model whose behavior, such as adopting an innovation, is imitated by many other members of the system. Since the respect an opinion leader holds is from his community, he can lose that respect and influential status. Opinion leaders can also be “worn out” by change agents who overuse them in diffusion activities, because opinion leaders can become to be perceived by their peers as too much like professional change agents, causing them to lose their credibility with their former followers.

After the early adopters come the early majority. The early majority are deliberate. They follow with deliberate willingness in adopting innovations but seldom lead. They make an important link in the diffusion process as they provide interconnectedness in the system’s interpersonal networks. Next come the late majority, who are skeptical. Before they adopt, the uncertainty about the innovation must be removed or at least significantly decreased and they must also feel an enormous sense of peer pressure.

The final group is the laggards, who are traditional. The past is the laggard’s point of reference; decisions are often made in terms of what has been done previously. They tend to be suspicious of innovations and change agents. While “laggards” may sound like it has a negative connotation, it does not. Resistance to innovations on the part of the laggards may be entirely rational from the laggards’ viewpoint; system-blame may more accurately describe the reality of their situation.

There are also some characteristics or factors that have been shown to be more of a continuum across the categories of adopters (see Table 6.1). These factors can be grouped into socio-economic, personality and communication factors. The socio-economic factors that affect
innovativeness are age, years of formation education, literacy, social status, degree of upward social mobility and size of unit. As all of those factors (except age) increase with a given client, the innovativeness for that client also increases. Age tends to not influence a client’s innovativeness.

The personality factors that affect innovativeness are degree of empathy, degree of dogmatism, ability to deal with abstractions, intelligence, attitude toward change, ability to deal with uncertainty and risk, fatalism, and aspirations. Empathy is the ability of an individual to project himself or herself into the role of another person. Dogmatism is the degree to which an individual has a relatively closed belief system, that is, a set of beliefs that are strongly held. Rationality is use of the most effective means to reach a given end. Fatalism is the degree to which an individual perceives a lack of ability to control his or her future. Similar to the socio-economic factors, as all of these factors increase (with the exception of degree of dogmatism and fatalism), the innovativeness also increases.

The communication factors that affect innovativeness are social participation, interpersonal networks, cosmopoliteness, contact with change agents, exposure to mass media, exposure to interpersonal communication channels, seek information about innovations, knowledge of innovations and degree of opinion leadership. Cosmopoliteness is the degree to which an individual is oriented outside a social system. As all of these factors increase for a given client, that client’s innovativeness will also increase.

Table 6.1 Socio-economic, personality and communication factors that affect a potential adopter’s innovativeness.
Source: Table created by Danielle Stoermer, based on Rogers 2003, p. 287-292

<table>
<thead>
<tr>
<th>Type of Factor</th>
<th>Factor</th>
<th>More Innovative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Socio-economic factors</td>
<td>Age</td>
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<tr>
<td></td>
<td>Years of formal education</td>
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<td>Literate</td>
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### 6.4 The Rate of Adoption of an Innovation

Rate of adoption is defined as “the relative speed with which an innovation is adopted by members of a social system” (Rogers 2003, p. 221). According to Rogers (2003), there are five main factors that account for most of the variance (about 49-87%) in the rate of adoption of innovations:

1. Nature of the social system (ex. its norms, degree of network interconnectedness)
2. Communication channels (ex. mass media, interpersonal)
3. Extent of change agent’s promotion efforts
4. Type of innovation-decision: optional, collective, or authority
5. Perceived attributes of innovations

<table>
<thead>
<tr>
<th>Personality factors</th>
<th>Social Status</th>
<th>Degree of upward social mobility</th>
<th>Size of unit (ex. field)</th>
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<tr>
<th>Personality factors</th>
<th>Degree of empathy</th>
<th>Degree of dogmatism</th>
<th>Ability to deal with abstractions</th>
<th>Rationality</th>
<th>Intelligence</th>
<th>Attitude toward change</th>
<th>Ability to deal with uncertainty/risk</th>
<th>Fatalism</th>
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<table>
<thead>
<tr>
<th>Communication factors</th>
<th>Social participation</th>
<th>Interpersonal networks</th>
<th>Cosmopolitaness</th>
<th>Contact with change agents</th>
<th>Exposure to mass media</th>
<th>Exposure to interpersonal communication channels</th>
<th>Seek information about innovations</th>
<th>Knowledge of innovations</th>
<th>Degree of opinion leadership</th>
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2. Communication channels (ex. mass media, interpersonal)
3. Extent of change agent’s promotion efforts
4. Type of innovation-decision: optional, collective, or authority
5. Perceived attributes of innovations
While these are distinct factors, they interact with an often multiplying effect. The nature of the social system can affect adoption rates by the society’s norms or degree of network interconnectedness. For example, in a society where tradition is greatly respected and valued, the rate of adoption of an innovation may be very slow. In a society that emphasizes individuality, though, the rate of adoption of that same innovation may be very rapid. Communication channels can also influence the rate of adoption because how one learns about an innovation can impact that person’s interest and ability to adopt the innovation. While mass media is an effective tool for disseminating information about a new innovation to a large audience, strong interpersonal communication channels (especially between an adopter and a potential adopter) greatly increase an innovation’s adoption rates.

Another factor that influences adoption rates is the extent of the change agent’s promotion efforts of the innovation. The change agent is an individual who influences clients’ innovation-decisions in a direction deemed desirable by a change agency. The main role of the change agent is to facilitate the flow of innovations from a change agency to an audience of clients. This main role can be broken down into a sequence of roles:

1. Develop a need for change on the part of clients
2. Establish an information exchange relationship
3. Diagnose problems
4. Create an intent to change in the client
5. Translate that intent into action
6. Stabilize adoption and prevent discontinuance
7. Achieve a terminal relationship with clients
A change agent’s relative success in securing the adoption of innovations by clients is positively related to the following factors:

- Extent of change agent’s effort in contacting clients
- Client orientation, rather than a change agency orientation
- Degree to which diffusion program is compatible with clients’ needs
- Change agent's empathy with clients
- Credibility in the clients’ eyes
- Extent to which change agent works through opinion leaders
- Increasing clients’ ability to evaluate innovations

The ability of a change agent to follow the sequence of change agent roles and to incorporate the factors above into the roles that he assumes throughout his innovation promotion efforts will greatly increase the adoption rate of the innovation that he is promoting. Change agents face two main problems. The first one is based on their social marginality – they are positioned between the change agency and the client system. The change agent is like a bridge between two differing systems, he/she is a marginal figure with one foot in each of two worlds. The second problem is associated with information overload. This is when excessive communication inputs cannot be processed and used (by an individual or a system), leading to breakdown.

Change agents can increase adoption rates and address differences among individuals within a social system through audience segmentation and targeting. Audience segmentation is “a strategy in which different communication channels or messages are used to reach each subaudience” (Rogers 2003, p. 292). By dividing a heterogenous mass audience into relatively homogenous audience segments, change agents are better able to target each subaudience.
Targeting is “the process of customizing the design and delivery of a communication program based on the characteristics of an intended audience” (Rogers 2003, p. 367). A targeting strategy can emphasize cultural sensitivity or other factors that may greatly influence an audience’s receptivity to an innovation.

Another factor that influences the adoption rate of an innovation is the type of innovation-decision: in other words, the way in which a decision is made about whether to adopt an innovation. As described earlier, there are three general types of innovation-decisions: optional, collective, or authority. Optional decisions are more common in fields such as agriculture and consumer behavior, whereas most innovation-decisions in most organizations, such as factories, schools, or government organizations, are collective or authority decisions.

The last major factor that influences the adoption rate of an innovation is the perceived attributes of the innovation. According to diffusion scholars, there are five main perceived attributes of innovations: relative advantage, compatibility, complexity, trialability, and observability. These five attributes typically explain a large percent of the variance in the rate of adoption of a given innovation – in fact, anywhere from about 49% to 87% (Rogers 2003). However, there are certainly other attributes that affect the rate of adoption of an innovation, and these other attributes may be more important than the five main attributes in certain situations.

Relative advantage is the degree to which an innovation is perceived as being better than the idea it supersedes. It is a ratio of the expected benefits and the costs of adopting an innovation. The nature of the innovation and the characteristics of the potential adopters determines which type(s) of relative advantage (ex. economic, social) are most important. For example, is the innovation more economically profitable? Does it convey social prestige? Is it less labor intensive? Does it provide faster results? Incentives are sometimes given to increase
the degree of relative advantage of an innovation. While incentives generally increase the rate of adoption of an innovation, they also have other, potentially-negative, effects.

Compatibility is the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters. An innovation can be compatible or incompatible with any or all of the following: sociocultural values and beliefs, previously introduced ideas, or client needs for the innovation. For example, even though environmentally and economically it appears that farmers should stop planting peanuts in Senegal (because of the pressure it puts on the soil and the reduced peanut prices in recent years), it is very difficult to get them to stop because of how ingrained peanuts are in their culture and diet. An innovation may be compatible (or incompatible) not only with deeply embedded cultural values but also with previously adopted ideas. For example, a farmer who has successfully adopted an improved variety of maize may quickly and successfully adopt an improved variety of millet, but a farmer used to spraying her vegetables regularly with a Neem oil solution may inadvertently kill them all when she is trying out a chemical pesticide by spraying them too frequently.

An innovation that meets a felt need is more likely to be adopted than one that does not. Change agents must seek to determine the needs of their clients and then to recommend innovations that fulfill these needs. Sometimes potential adopters may not recognize that they have a need for an innovation until they become aware of the new idea or its consequences. In these situations, change agents may seek to generate needs among their clients, but this must be done carefully or else the felt needs upon which a diffusion campaign is based may be a reflection only of the change agent’s needs, rather than those of clients.
There are numerous other factors that can affect the compatibility of an innovation: technology clustering, name of the innovation, positioning of the innovation, and indigenous knowledge systems. A technology cluster is when one or more distinguishable elements of a technology are perceived as being interrelated. In other words, it is when a group of innovations are not viewed individually but rather as an interrelated bundle of new ideas. Conservation agriculture is an example of this: a farmer could, for example, use a strip tillage system with a combination of both organic and synthetic fertilizers, as well as mulch in-between rows, use an improved variety of maize seed and thin to one stalk. While any of these five innovations may be adopted independently of the rest, they are most effective when all five are adopted together. Tracer studies\(^4\) have shown that a major technological advance in several fields, including agriculture, require not just one innovation but a cluster of innovations – often as many as a dozen (Rogers 2003).

Another factor that can affect compatibility is the name of the innovation. A variety of cowpea that Master Farmers extend is a great example of this: it is called *melakh*, which means “lightning” in Wolof, because it reaches maturity very quickly (50-55 days after planting). While the name of an innovation may not greatly affect its adoption rate, it is important to consider the name of an innovation, especially if it is being promoted in a culture or region different from where it was developed or in several different cultures.

The positioning of an innovation involves the basic assumption that an individual will behave toward a new idea in a similar manner to the way the individual behaves toward other ideas that are perceived as similar to the new idea. It is important to find the ideal niche for an

\(^4\) Tracer studies are retrospective studies that attempt to reconstruct the sequence of main events and decisions in the innovation-development process. The sources of data for these studies are usually personal interviews with key investigators and other participants, research publications, and archival records of research grants, patents and change agency records (Roger 2003).
innovation relative to perceptions of existing ideas in the same category. This ideal niche is determined by the new idea’s perceived position relative to (1) previous ideas and (2) the characteristics of the new idea that make it similar to, and different from, existing ideas.

Indigenous knowledge systems can also affect the compatibility of an innovation. This is based on the notion that a new idea is perceived in relationship to existing practices that are already familiar to the individual. Change agents often commit the “empty vessels fallacy” by assuming that potential adopters are blank slates who lack any relevant experience with which to associate the new idea. The solution for this fallacy is for change agents to understand clients’ prior experiences with the practice that the innovation will replace.

Complexity is the degree to which an innovation is perceived as relatively difficult to understand and use. The complexity of an innovation, as perceived by members of a social system, is negatively related to its rate of adoption. This factor is important in agricultural extension because some improved agricultural technologies are relatively complex compared to traditional techniques. It is important to note that where change agents perceive the innovation to fit on the complexity-simplicity continuum is irrelevant – what is important is where potential adopters perceive the innovation to fit. It is also important for change agents to determine if the location of the innovation on the continuum changes for different people. It is usually safe to say that early adopters, who typically have more formal education and are better able to deal with abstractions and uncertainty, would put the innovation closer to “simple” on the continuum than later adopters. However, that is not always the case.

Trialability is the degree to which an innovation may be experimented with on a limited basis. Innovations that can be tried out for a while are more rapidly adopted than innovations that cannot be tried out. Thus, it is important for change agents to know the degree to which the
innovation can be experimented. Change agents also need to know the length the trial period needs to be to satisfactorily evaluate the effectiveness of the innovation. Related to this is the extent to which the innovation can be re-invented, customized or adapted to the adopter’s conditions. Relatively earlier adopters of an innovation typically perceive trialability as more important than do later adopters because later adopters have usually used earlier adopters as their trial. Master Farmers, through their demonstrations, can significantly reduce or eliminate other farmers’ need for a trial period, thereby speeding up the rate of adoption of the innovations demonstrated at the Master Farm.

Observability is the degree to which the results of an innovation are visible to others. The more observable an innovation is perceived to be by potential adopters, the higher its rate of adoption. An innovation has 2 components: (1) a hardware aspect that consists of the tool that embodies the technology in the form of a material or physical object and (2) a software aspect that consists of the information base for the tool. The software component of an innovation is not as easy to observe, so innovations in which the software aspect is dominant possess less observability, and, therefore, usually have a relatively slower rate of adoption.

6.5 Criticisms of the Diffusion of Innovation Approach

While Rogers’ (2003) diffusion of innovations approach has been widely utilized and cited, there are some criticisms of it that should be considered. First, a large portion of the evidence for the diffusion of innovations gathered by Rogers comes from agricultural methods and medical practice. Thus it can be difficult to apply some aspects of the theory to all innovations. However, for the purposes of this paper, this criticism is irrelevant since the innovations under consideration are agricultural innovations.
Second, innovations are not static and there is often continuous development for new iterations in order to attract new or maintain old adopters all along the standard S-curve. Thus, it may be better to view the S-curve as made up of a series of bell curves of different sections of a population as they adopt different versions of a standard innovation. This criticism is applicable to this paper in that Master Farmers are constantly tweaking small aspects of the technologies they are promoting, and other community members also sometimes adapt the technologies to fit their specific context. Thus, it is important to consider the full range of different iterations that could all fall within the category of one specific technology when examining the rate of adoption of that technology.

Finally, the diffusion of innovation approach typically considers the communication process to be a one-way flow of information: the change agency communicates an innovation to the change agent who then has a goal to persuade the client or potential adopter to adopt the innovation. In this scenario there is little to no dialogue back from the client to the change agent and then to the change agency as well. In some cases this works and is the most effective way to achieve a high rate of adoption. However, other cases, such as the Mater Farmer program, require a more participatory approach. Thus, there is time and space for such necessary dialogue and feedback built into the Master Farmer program. I emphasized this earlier when I introduced this topic, and it should be clear from the two-way arrows in Figure 6.4. Thus, while there are legitimate criticisms of the diffusion of innovation approach presented in Rogers (2003), it is still a useful tool for analyzing the effectiveness of the Master Farmer program, which is the main goal of this paper.
CHAPTER 7

METHODS AND ANALYSIS

As mentioned earlier, this paper seeks to evaluate two hypotheses. First, since joining the Master Farmer program, the food security of the Master Farmers has improved. Second, the technologies demonstrated and promoted by the Master Farmers are being adopted by other farmers in their communities and, through this adoption, the food security of these farmers is also improving.

In order to test the first hypothesis, regular surveys were conducted with Master Farmers to gather data related to their food security to elucidate any change in their food security since they joined the program. In order to test the second hypothesis, data was gathered from Master Farmers and PCVs regarding Master Farmer extension activities to evaluate their promotion activities and the extent to which other farmers have been exposed to the technologies demonstrated in Master Farms. A survey was also conducted of farmers who attended one of several Open Field Days in October 2011 to understand their perceptions of the Master Farmers themselves and of the technologies demonstrated and promoted by Master Farmers.

7.1 Survey Methodology for Master Farmers

It is difficult to directly measure the food security situation of a farmer and his/her family. Therefore, various proxies were used to measure the change in food security of Master Farmers and their families since joining the program. Such proxies include the following: increase in yields; diversification of crops and sources of income; expansion of household structures; expansion of animal husbandry activities; investment in (more) agricultural machines or tools; and investment in (more) wage laborers.
This data was gathered quarterly through phone calls to Master Farmers. Since joining the program, each Master Farmer was called by PC staff on a quarterly basis to gather data regarding his/her activities. The data gathered involves all activities by the Master Farmer: the demonstrations he/she has in the farm, yield data, income data, and any other relevant information. During these phone conversations, PC staff asked questions such as:

- “What kind of demonstrations have you had in your farm during the past 3 months?”
- “What was the yield from those demonstrations?”
- “Did you sell what you harvested or did your family eat it?”
- “If you sold what you harvested, how much money did you make?”

Not every Master Farmer had activities to report on each quarter, nor did every Master Farmer record or remember the yields that he or she obtained for every demonstration. Demonstrations that did not end up resulting in a harvest were sometimes not reported by Master Farmers. Some Master Farmers have very poor cell phone reception or a cell phone that does not work properly. When this is the case, PC staff called the volunteer who works closely with that Master Farmer to gather the information. This data was compiled into quarterly reports that PC Senegal submits to USAID/Senegal per the agreement. Most of this data has been reproduced in this paper.

In order to evaluate the diffusion of the technologies demonstrated and promoted by Master Farmers, data regarding extension activities led by Master Farmers, such as Open Field Days or other training activities, was also gathered during these quarterly phone calls by PC staff as well as through reports submitted by PCVs. Such data includes dates of Open Field Days and other training events, topics covered, and number of attendees (disaggregated by gender). Most of this data has been compiled and reproduced in this paper.
7.2 Survey Methodology for Potential Adopters

Master Farmer Demba Balde and PCV Allyson Junker developed a survey of farmers who had attended a training they held at the Master Farm in Goundaga (Kolda) to gather their opinion of the training and to evaluate the effectiveness of the training (see Appendix C). The first training they held was in December 2011. About a month after this training, they surveyed 19 of the 25 farmers who had attended. They held another training in March 2012, and one month after this training they interviewed nine farmers who had attended this training. Most of this data has been compiled and reproduced in this paper.

I developed a survey for farmers in the communities surrounding Master Farmers in order to gather their opinions and perceptions regarding the Master Farmers and the technologies demonstrated and promoted by the Master Farmers (see Appendix D). The survey was given exemption by Cornell University’s Institutional Review Board (see Appendix E). The survey was originally developed in English and then translated into French and several local languages (Wolof, Fulakunda, and Mandinka) by PC staff and PC Language and Culture Facilitators. The surveys were conducted in October 2011 during nine Open Field Days hosted by the following Master Farmers: Fatou Wilane, Ibou Sarr, Ousmane Willame, Ibrahima Samake, Amadou Gano, Souleymane Traore, and Dembo Tigana. As shown in Figure 7.1, these Master Farmers are spread out throughout the southern half of Senegal.\(^5\)

\(^5\) At the time of the survey, there were no Master Farmers north of the Thies region.
PC staff and volunteers conducted the interviews. At each Open Field Day, they selected 10 farmers from among the group who attended the event to interview using the following criteria: the farmers selected had been attentive during the Open Field Day, the farmers selected were from a variety of villages surrounding the Master Farm (including the village the Master Farmer lives in), and two of the ten farmers selected were female. Sometimes interviewers ran out of time and were not able to interview all ten potential adopters at the Master Farm.
The interviews were conducted at the end of Open Field Day. PC staff who conducted interviews did the interviews one-on-one, as did most volunteers. Some volunteers, however, did the interviews in pairs (i.e., two volunteers per one farmer). The interviewer and farmer sat in a place away from the rest of the Open Field Day attendees during the interview. Before starting the interview, each interviewer read the farmer the consent form in French (if the farmer understood French) or in a local language, and then the farmer was asked to print and sign his/her name (see Appendix F). If the farmer was illiterate, the interviewer was instructed to print the farmer’s name for him/her, and the farmer was asked to make some sort of mark on the paper as a signature. A total of 65 interviews were conducted, but only 59 unique farmers were interviewed because six of the farmers were interviewed twice regarding their perceptions of two different technologies.

After all of the interviews had been conducted, I gathered all of the paper surveys. Then I created an identical survey through Survey Monkey, an online survey tool (http://www.surveymonkey.com/) and entered in the survey data there. Simple percentages were calculated in Survey Monkey for numerous questions; these percentages are displayed as bar graphs in the Chapter 8.

7.3 Observations and Informal Discussions

I was among the first group of PCVs to start implementing the Master Farmer program in late 2009. I spent a substantial amount of time during the following three and a half years observing the implementation of the program – during Master Farmer trainings, at Open Field Days, and during site visits to Master Farms. I also spent a considerable amount of time discussing the program with other PCVs, PC staff, Master Farmers, their fellow community
members and other development practitioners or extension agents. Thus, some of the comments and recommendations presented in this paper stem from those observations and conversations.

PC Senegal’s Associate Peace Corps Director for Agriculture, Famara Massaly, and I estimated the financial and labor inputs for the field crop demonstrations during the 2011 rainy season (see Table 8.2). The price of some inputs, namely organic soil amendments (i.e., manure), mulching material, and animal and machine for weeding, were averaged after calling several Master Farmers to determine the average prices of such materials in their communities. For example, a charette cart full of manure is usually about 100 kg and costs about 2,000 CFA (about 4 USD). Thus, since the conservation agriculture plots need 40 kg of manure, it cost 800 CFA for that input.

The costs for other inputs were calculated based on the standard price for those inputs throughout the country. The price for a 10L sprayer in Senegal is typically about 25,000 CFA (about 50 USD) and they usually last about three years, though that can vary significantly depending on the frequency of use, quality of maintenance and storage location. Thus, the cost of pesticide application was amortized, taking into consideration that price and time frame. The cost of a 50 kg sack of NPK is typically about 12,000 CFA (about 24 USD), as is the cost of a 50 kg sack of Urea. Thus, since 3 kg of each were needed for each conservation agriculture demonstration that called for synthetic fertilizer, it cost 720 CFA for that input.

The amount of time it takes for different activities related to the demonstrations were also averaged after asking several Master Farmers how long it took them to carry out those tasks. Average yields obtained from Master Farmers for each crop were used to calculate the amount of time for harvesting, threshing and winnowing. Since no Master Farmer had a successful yield
from the thinning to 5 at 15 days demonstration for sorghum, the yield for that plot was estimated to be 95% of the best yield from the same thinning millet demonstration plot.
CHAPTER 8

RESULTS

The results of the surveys support the two hypotheses of this paper. First, since joining the Master Farmer program, the food security of the Master Farmers has improved. Second, the technologies demonstrated and promoted by the Master Farmers are being adopted by other farmers in their communities and, through this adoption, the food security of these farmers is also improving.

8.1 Improvements in Master Farmers’ Food Security

Through their gardening, field crop, and agroforestry activities, Master Farmers have seen improvements in their food security since joining the program, though to varying extents. These improvements are evident through increases in yield, diversifications of crops and sources of income, expansions of household structures, expansions of animal husbandry activities, investments in (more) agricultural machines or tools, and investments in (more) wage laborers.

8.1.1 Gardening Activities

Since joining the Master Farmer program in March 2011, Master Farmer Ibou Sarr has implemented numerous demonstrations, particularly garden demonstrations. For example, during Q2 of FY12, Sarr successfully designed and implemented several garden demonstration plots. These demonstrations include comparisons of tomato and eggplant performance under double digging versus single digging and green pepper performance under mulching with different materials (see Table 8.1). All demonstration plots received the following organic soil amendments: manure, ash, Neem leaves and charcoal. The yield data that Sarr collected throughout this quarter show a higher yield for tomato and eggplant plots that were double dug.
Sarr also evaluated the effectiveness of different kinds of mulching material (peanut shells versus weeds, straw and grass) for green peppers. Beds mulched by peanuts shells out-yielded those mulched with weeds, straw and grass. In addition to these side-by-side demonstrations, Sarr demonstrated these and other improved techniques: peanut shell mulch with cucumbers and with onions, lettuce intercropped with tomatoes, onions intercropped with tomatoes, and *jaxatu* (or bitter tomato) in zai holes with mulch of weeds and grass. Sarr’s food security improved because of these demonstrations: he sold most of the produce, earning almost 70,000 CFA (about 140 USD), and he and his family consumed the rest (see Table 20). Thus, through his Master Farm activities, Sarr increased his income and diversified his family’s diet to include more vegetables, which is a food commonly lacking in Senegalese diets.

Table 8.1  Garden demonstration yields (T/ha) for Master Farmer Ibou Sarr, Q2 FY2012.

<table>
<thead>
<tr>
<th>Tomato, Mongal variety</th>
<th>Eggplant, Black Beauty variety</th>
<th>Green Pepper, Goliath variety</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double digging</td>
<td>Single digging</td>
<td>Double digging</td>
</tr>
<tr>
<td>50.5 T/ha</td>
<td>33.19 T/ha</td>
<td>28.4 T/ha</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cucumber</th>
<th>Onion</th>
<th>Tomato with lettuce</th>
<th>Tomato with onion</th>
<th><em>Jaxatu</em> (Bitter Tomato)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peanut shell mulch</td>
<td>Single digging, mulch with peanut shells</td>
<td>Single digging, no mulch</td>
<td>Single digging, no mulch</td>
<td>Zai holes, weeds/ grass mulch</td>
</tr>
<tr>
<td>7 T/ha</td>
<td>7 T/ha</td>
<td>7.1 T/ha</td>
<td>11.4 T/ha</td>
<td>2.6 T/ha</td>
</tr>
</tbody>
</table>
8.1.2 Field Crop Activities

During the 2011 rainy season, Master Farmers throughout Senegal implemented several field crop demonstrations in their Master Farms (see Appendix G for a link to the specific protocol):

- Response of maize to conservation agriculture (CA) with organic amendments only and with organic and synthetic amendments.
- Response of millet to thinning differences in timing and number of plants left after thinning;
- Response of sorghum to thinning differences in timing and number of plants left after thinning.
- Response of cowpeas to different pest (particularly thrip) management techniques (yellow sticky traps, Neem oil, Decis and nothing).
- Response of improved variety of rice, Nerica 6, to two different spacings (25 cm x 35 cm and 30 cm x 35 cm) when cultivated under SRI (System of Rice Intensification) and to traditional spacing with the traditional cultivation technique.

Table 8.2 has the average yield for each demonstration. This table also has the total financial and total labor inputs for these demonstrations. Inputs, particularly financial and labor inputs, can be a major limiting factor to technique adoption. Thus, estimates were made regarding the amount of money (in CFA) and amount of time (in hours) that were spent on preparing, maintaining and harvesting each demonstration plot during the 2011 rainy season for corn, millet, sorghum, cowpeas and rice (see Tables 8.3-8.12).

Table 8.2  Total inputs (in CFA and hours) and average yield (kg/ha) for all field crop demonstrations in 2011.

<table>
<thead>
<tr>
<th>Crop</th>
<th>Demonstration</th>
<th>Total Financial Inputs (CFA)</th>
<th>Total Labor Inputs (hrs)</th>
<th>Average Yield (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>Traditional w/ Organic</td>
<td>1,020</td>
<td>7.40</td>
<td>631</td>
</tr>
<tr>
<td></td>
<td>CA w/ Organic</td>
<td>2,960</td>
<td>17.74</td>
<td>1,090</td>
</tr>
<tr>
<td></td>
<td>Traditional w/ Organic &amp; NPK/Urea</td>
<td>2,460</td>
<td>8.36</td>
<td>1,103</td>
</tr>
</tbody>
</table>
In 2011, the conservation agriculture (CA) demonstration with maize used zai holes, rather than the ripper, which was used in 2012. The estimated financial and labor inputs for the different plots are listed in Tables 8.3 and 8.4. The mulching material was estimated to cost 2,000 CFA (about 4 USD) per CA demonstration plot. Some Master Farmers bought bags of peanut shells, which they used as mulching material, but most Master Farmers gathered the needed material themselves. Digging the zai holes for the CA plots constituted over 80% of the production labor inputs for those plots. But the labor inputs for weeding (by hand and with a machine) the CA plots were considerably less than the labor inputs for weeding the traditional plots – about 20% lower. However, the labor inputs for production for CA plots were still about three times higher than the traditional plots.

The extra labor inputs required for CA plots are reflected to an extent in the yields for those plots. The average yield for the maize CA plots with organic amendments was 73% higher than the average yield for the traditional plots with organic amendments (see Table 8.2). Similarly, the average yield for the CA plots with organic and synthetic amendments was 74%
higher than the average yield for the traditional plots with both amendments. Thus, the extra labor invested into CA plots resulted in an increased yield for those plots, but not nearly as large as the difference in the extra amount of work.

Table 8.3 Financial inputs (in CFA) for the conservation agriculture (CA) demonstration with maize from 2011.

<table>
<thead>
<tr>
<th>Financial Inputs (CFA)</th>
<th>Traditional w/ Organic</th>
<th>CA w/ Organic</th>
<th>Traditional w/ Organic &amp; NPK/Urea</th>
<th>CA w/ Organic &amp; NPK/Urea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seed</td>
<td>160</td>
<td>160</td>
<td>160</td>
<td>160</td>
</tr>
<tr>
<td>Organic soil amendments</td>
<td>800</td>
<td>800</td>
<td>800</td>
<td>800</td>
</tr>
<tr>
<td>NPK</td>
<td>-</td>
<td>-</td>
<td>720</td>
<td>720</td>
</tr>
<tr>
<td>Urea</td>
<td>-</td>
<td>-</td>
<td>720</td>
<td>720</td>
</tr>
<tr>
<td>Mulching material</td>
<td>-</td>
<td>2,000</td>
<td>-</td>
<td>2,000</td>
</tr>
<tr>
<td>Pesticide</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Water</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Animal &amp; machine for weeding</td>
<td>60</td>
<td>-</td>
<td>60</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total (CFA)</strong></td>
<td><strong>1,020</strong></td>
<td><strong>2,960</strong></td>
<td><strong>2,460</strong></td>
<td><strong>4,400</strong></td>
</tr>
</tbody>
</table>

Table 8.4 Labor inputs (in hours) for the conservation agriculture (CA) demonstration with maize from 2011.

<table>
<thead>
<tr>
<th>Labor Inputs (hr)</th>
<th>Traditional w/ Organic</th>
<th>CA w/ Organic</th>
<th>Traditional w/ Organic &amp; NPK/Urea</th>
<th>CA w/ Organic &amp; NPK/Urea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clearing the land</td>
<td>0.167</td>
<td>0.167</td>
<td>0.167</td>
<td>0.167</td>
</tr>
<tr>
<td>Digging holes</td>
<td>-</td>
<td>12.000</td>
<td>-</td>
<td>12.000</td>
</tr>
<tr>
<td>Organic fertilizer application</td>
<td>0.500</td>
<td>0.750</td>
<td>0.500</td>
<td>0.750</td>
</tr>
<tr>
<td>NPK application</td>
<td>-</td>
<td>-</td>
<td>0.167</td>
<td>0.167</td>
</tr>
<tr>
<td>Urea application</td>
<td>-</td>
<td>-</td>
<td>0.667</td>
<td>0.667</td>
</tr>
<tr>
<td>Mulching</td>
<td>-</td>
<td>0.500</td>
<td>-</td>
<td>0.500</td>
</tr>
<tr>
<td>Thinning</td>
<td>0.333</td>
<td>0.333</td>
<td>0.333</td>
<td>0.333</td>
</tr>
<tr>
<td>Weeding (hand)</td>
<td>2.560</td>
<td>0.667</td>
<td>2.560</td>
<td>0.667</td>
</tr>
<tr>
<td>Weeding (machine)</td>
<td>0.640</td>
<td>-</td>
<td>0.640</td>
<td>-</td>
</tr>
<tr>
<td>Pesticide application</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Production Subtotal (hrs)</strong></td>
<td><strong>4.200</strong></td>
<td><strong>14.417</strong></td>
<td><strong>5.033</strong></td>
<td><strong>15.250</strong></td>
</tr>
<tr>
<td>Harvesting</td>
<td>0.164</td>
<td>0.283</td>
<td>0.287</td>
<td>0.500</td>
</tr>
<tr>
<td>Threshing</td>
<td>2.753</td>
<td>2.753</td>
<td>2.753</td>
<td>4.800</td>
</tr>
<tr>
<td>Winnowing</td>
<td>0.287</td>
<td>0.287</td>
<td>0.287</td>
<td>0.500</td>
</tr>
</tbody>
</table>
The demonstration for millet in 2011 was a thinning demonstration. As is evident from Tables 8.5 and 8.6, the estimated financial and labor inputs for all the plots were the same. The difference between the plots is the timing of the thinning and the number of plants that are left after thinning. However, this timing can be important based upon the other demands on labor at that time, which is one reason why thinning is sometimes delayed to 30 days after planting, rather than done at 15 days after planting, which is the best time physiologically in order to achieve higher yields. The average yield for the plots demonstrating thinning to one at 15 days were only 5% higher than the average yield for the plots demonstrating thinning to three at 15 days (see Table 8.2). But the average yield for this latter plot was almost 50% higher than the average yield for the plots demonstrating thinning to three at 30 days. This suggests that the timing of the thinning is more important than the number of plants that are left after thinning.

Table 8.5  Financial inputs (in CFA) for the thinning demonstration with millet in 2011.

<table>
<thead>
<tr>
<th>Financial Inputs (CFA)</th>
<th>Thin to 1 at 15 days</th>
<th>Thin to 3 at 15 days</th>
<th>Thin to 3 at 30 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seed</td>
<td>40</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Organic soil amendments</td>
<td>800</td>
<td>800</td>
<td>800</td>
</tr>
<tr>
<td>NPK*</td>
<td>720</td>
<td>720</td>
<td>720</td>
</tr>
<tr>
<td>Urea*</td>
<td>720</td>
<td>720</td>
<td>720</td>
</tr>
<tr>
<td>Mulching material</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Pesticide</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Water</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Animal &amp; machine for weeding</td>
<td>60</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td><strong>Total (CFA)</strong></td>
<td><strong>2,340</strong></td>
<td><strong>2,340</strong></td>
<td><strong>2,340</strong></td>
</tr>
</tbody>
</table>

*NPK/Urea were optional

Table 8.6  Labor inputs (in hours) for the thinning demonstration with millet in 2011.

<table>
<thead>
<tr>
<th>Labor Inputs (hr)</th>
<th>Millet</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The demonstration for sorghum in 2011 was also a thinning demonstration. Like with millet, the financial and labor inputs for all the plots were the same (see Tables 8.7 and 8.8). Also like millet, the timing of the thinning appears to have a considerable effect on yield: the average yield for the plots demonstrating thinning to three at 15 days was over 65% higher than the average yield for the plots demonstrating thinning to three at 30 days (see Table 8.2). The effect of the number of plants left after thinning could not be examined because the plots demonstrating thinning to five at 15 days were not successful in 2011.

Table 8.7 Financial inputs (in CFA) for the thinning demonstration with sorghum in 2011.

<table>
<thead>
<tr>
<th>Financial Inputs (CFA)</th>
<th>Sorghum</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Thin to 3 at 15 days</td>
<td>Thin to 5 at 15 days</td>
<td>Thin to 3 at 30 days</td>
</tr>
<tr>
<td>Seed (CFA)</td>
<td>80</td>
<td>80</td>
<td>80</td>
</tr>
<tr>
<td>Organic soil amendments (CFA)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>NPK (CFA)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Urea (CFA)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Mulching material (CFA) - - -
Pesticide (CFA) - - -
Water (CFA) N/A N/A N/A
Animal & machine for weeding (CFA) 60 60 60
Total (CFA) 140 140 140

Table 8.8 Labor inputs (in hours) for the thinning demonstration with sorghum in 2011.

<table>
<thead>
<tr>
<th>Labor Inputs (hr)</th>
<th>Thin to 3 at 15 days</th>
<th>Thin to 5 at 15 days</th>
<th>Thin to 3 at 30 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clearing the land</td>
<td>0.167</td>
<td>0.167</td>
<td>0.167</td>
</tr>
<tr>
<td>Digging holes</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Organic fertilizer application</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>NPK application</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Urea application</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Mulching</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Thinning</td>
<td>0.500</td>
<td>0.500</td>
<td>0.500</td>
</tr>
<tr>
<td>Weeding (hand)</td>
<td>2.560</td>
<td>2.560</td>
<td>2.560</td>
</tr>
<tr>
<td>Weeding (machine)</td>
<td>0.640</td>
<td>0.640</td>
<td>0.640</td>
</tr>
<tr>
<td>Pesticide application</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Production Subtotal (hrs)</td>
<td>3.867</td>
<td>3.867</td>
<td>3.867</td>
</tr>
<tr>
<td>Harvesting</td>
<td>0.250</td>
<td>0.136*</td>
<td>0.238</td>
</tr>
<tr>
<td>Threshing</td>
<td>0.500</td>
<td>0.272*</td>
<td>0.475</td>
</tr>
<tr>
<td>Winnowing</td>
<td>0.500</td>
<td>0.272*</td>
<td>0.475</td>
</tr>
<tr>
<td>Processing Subtotal (hrs)</td>
<td>1.250</td>
<td>0.681</td>
<td>1.188</td>
</tr>
<tr>
<td>Total (hrs)</td>
<td>5.117</td>
<td>4.547</td>
<td>5.054</td>
</tr>
</tbody>
</table>

* Sorghum yield estimated from millet demonstration (yield from the similar thinning demonstration is 95% of best yield)

The cowpea demonstration was examining the effectiveness of various pest control techniques on thrips. The financial inputs were higher for the plot that used the chemical pesticide Decis because it costs twice as much as the Neem oil and yellow sticky traps. However, the Decis plot had lower labor inputs for production because it required half as much time for spraying compared to Neem and a third less time for application compared to the yellow sticky traps. The average yield for the plot with Decis was 58% higher than the average yield for the control plot (which had the next highest yield) (see Table 8.2). This suggests that, not
considering the potential human and environmental health consequences of using a chemical pesticide, the extra cost for Decis may be worthwhile, since it leads to a higher yield and requires less labor.

However, the 2012 data complicate the story a little (see Table 8.16). The average yield for the plots with Dimethoate (the chemical pesticide used instead of Decis) was only 29% higher than the next highest average yield, which was for the Neem plots. The average yield for the Neem plots was also about 30% higher than the average yield for the next highest average yield, which was for the yellow sticky traps plots. Finally, the average yield for the yellow sticky traps plots was 40% higher than the average yield for the control plots. This suggests that, while the chemical pesticide (either Decis or Dimethoate) requires fewer labor inputs and leads to a higher yield, the increase in the yield may not be as significant as originally thought. The organic pest management options, spraying with Neem oil solution or installing yellow sticky traps, may be considered satisfactory because even though they require some labor inputs, they lead to yields that are still above the national average, they require less financial input, and they cause no harm to humans or the environment like chemical pesticides do.

Table 8.9 Financial inputs (in CFA) for the integrated pest management demonstration with cowpeas in 2011.

<table>
<thead>
<tr>
<th>Financial Inputs (CFA)</th>
<th>Sprayed w/ Nothing</th>
<th>Sprayed w/ Decis</th>
<th>Sprayed w/ Neem</th>
<th>Yellow Sticky Traps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seed (CFA)</td>
<td>240</td>
<td>240</td>
<td>240</td>
<td>240</td>
</tr>
<tr>
<td>Organic soil amendments (CFA)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>NPK (CFA)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Urea (CFA)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Mulching material (CFA)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Pesticide (CFA)</td>
<td>-</td>
<td>500</td>
<td>250</td>
<td>250</td>
</tr>
<tr>
<td>Water (CFA)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Animal &amp; machine for weeding (CFA)</td>
<td>60</td>
<td>60</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td><strong>Total (CFA)</strong></td>
<td><strong>300</strong></td>
<td><strong>800</strong></td>
<td><strong>550</strong></td>
<td><strong>550</strong></td>
</tr>
</tbody>
</table>
Table 8.10  Labor inputs (in hours) for the integrated pest management demonstration with cowpeas in 2011.

<table>
<thead>
<tr>
<th>Labor Inputs (hr)</th>
<th>Sprayed w/ Nothing</th>
<th>Sprayed w/ Decis</th>
<th>Sprayed w/ Neem</th>
<th>Yellow Sticky Traps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clearing the land</td>
<td>0.167</td>
<td>0.167</td>
<td>0.167</td>
<td>0.167</td>
</tr>
<tr>
<td>Digging holes</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Organic fertilizer application</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>NPK application</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Urea application</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Mulching</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Thinning</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Weeding (hand)</td>
<td>2.560</td>
<td>2.560</td>
<td>2.560</td>
<td>2.560</td>
</tr>
<tr>
<td>Weeding (machine)</td>
<td>0.640</td>
<td>0.640</td>
<td>0.640</td>
<td>0.640</td>
</tr>
<tr>
<td>Pesticide application</td>
<td>0.833</td>
<td>1.667</td>
<td>2.500</td>
<td>2.560</td>
</tr>
<tr>
<td>Production Subtotal (hrs)</td>
<td>3.367</td>
<td>4.200</td>
<td>5.033</td>
<td>5.867</td>
</tr>
<tr>
<td>Harvesting</td>
<td>0.576</td>
<td>3.000</td>
<td>1.560</td>
<td>1.901</td>
</tr>
<tr>
<td>Threshing</td>
<td>0.096</td>
<td>0.500</td>
<td>0.260</td>
<td>0.317</td>
</tr>
<tr>
<td>Winnowing</td>
<td>0.096</td>
<td>0.500</td>
<td>0.260</td>
<td>0.317</td>
</tr>
<tr>
<td>Processing Subtotal (hrs)</td>
<td>0.768</td>
<td>4.000</td>
<td>2.079</td>
<td>2.534</td>
</tr>
<tr>
<td>Total (hrs)</td>
<td>4.135</td>
<td>8.200</td>
<td>7.113</td>
<td>8.401</td>
</tr>
</tbody>
</table>

The rice demonstration was examining the effectiveness of the System of Rice Intensification (SRI) with different spacings compared to the traditional rice growing technique. Only one Master Farmer (Dembo Tigana) had a successful SRI demonstration in 2011. The estimated financial and labor inputs for the different plots are listed in Tables 8.11 and 8.12. SRI required about one tenth the amount of seed that the traditional technique in Senegal required, meaning the financial input for seed for SRI was 10% of the financial input for seed for the traditional technique. However, more labor was needed for SRI because thinning is an important aspect of SRI, though it is not commonly practiced with the traditional technique.
This means that the labor inputs for production for the SRI plots were about 16% higher than the traditional technique plot.

The yield for the SRI plot with 25x35cm spacing was 50% higher than the yield for the SRI plot with 30x35cm spacing (see Table 8.2). The yield for this latter plot was 20% higher than the yield for the traditional technique. The differences were not so drastic in 2012 (see Table 8.17). The average yield for the SRI plots with 25x35cm spacing was 10% higher than the average yield for the SRI plot with 30x35cm spacing. Similarly, the average yield for these latter plots was 12% higher than the average yield for plots with the traditional technique. These results suggest that, despite the increases in labor, SRI may be worthwhile because it requires fewer seed inputs and leads to increased yields.

Table 8.11 Financial inputs (in CFA) for the System of Rice Intensification (SRI) demonstration with rice in 2011.

<table>
<thead>
<tr>
<th>Financial Inputs (CFA)</th>
<th>Rice</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SRI 25 cm x 35 cm</td>
</tr>
<tr>
<td>Seed (CFA)</td>
<td>40</td>
</tr>
<tr>
<td>Organic soil amendments (CFA)</td>
<td>-</td>
</tr>
<tr>
<td>NPK (CFA)</td>
<td>359</td>
</tr>
<tr>
<td>Urea (CFA)</td>
<td>359</td>
</tr>
<tr>
<td>Mulching material (CFA)</td>
<td>-</td>
</tr>
<tr>
<td>Pesticide (CFA)</td>
<td>-</td>
</tr>
<tr>
<td>Water (CFA)</td>
<td>N/A</td>
</tr>
<tr>
<td>Animal &amp; machine for weeding (CFA)</td>
<td>30</td>
</tr>
<tr>
<td><strong>Total (CFA)</strong></td>
<td><strong>788</strong></td>
</tr>
</tbody>
</table>

Table 8.12 Labor inputs (in hours) for the System of Rice Intensification (SRI) demonstration in 2011.

<table>
<thead>
<tr>
<th>Labor Inputs (hr)</th>
<th>Rice</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SRI 25 cm x 35 cm</td>
</tr>
<tr>
<td>Clearing the land</td>
<td>0.083</td>
</tr>
<tr>
<td>Digging holes</td>
<td>-</td>
</tr>
<tr>
<td>Organic fertilizer application</td>
<td>-</td>
</tr>
</tbody>
</table>
During the 2012 rainy season, Master Farmers implemented conservation agriculture demonstrations with three different crops: maize, millet and sorghum. They also implemented the same cowpea and rice demonstrations as in 2011, though a different pesticide (Dimethoate) was used in the cowpea demonstration (see Appendix G for a link to the specific protocol). Similar to 2011, only a portion of the Master Farmers successfully implemented and maintained these demonstrations during the 2012 rainy season. Numerous factors affected the success of these demonstrations: poor or inconsistent rainfall, pest problems, insufficient labor (due to illness or other factors), incorrect understanding of the protocol and poor data collection.

Six Master Farmers successfully implemented and maintained the conservation agriculture demonstration with maize, while seven Master Farmers and four Master Farmers implemented and maintained the conservation agriculture demonstration for millet and sorghum, respectively. The conservation agriculture technique that the Master Farmers used involved the use of a machine called a ripper (see Figure 8.1). As is shown in Figure 8.2, the ripper is pulled behind an animal and strip tills trenches in the soil that are about 10-15 cm deep and 15-20 cm
wide. Not all Master Farmers have draft animals that are strong enough to pull a ripper, so those Master Farmers dug zai holes for this demonstration.

![Figure 8.1 The ripper: a) front view and b) side view.](image)

Source: Danielle Stoermer

A “fourth generation” ripper has been developed, with a hopper to apply soil amendments while strip tilling. See Appendix H for photos of this ripper, which is being tested by Master Farmers and other farmers during the 2013 rainy season.
Figure 8.2 These series of photos describe the process of conservation agriculture with the ripper. The ripper is pulled behind an animal to till trenches in the soil that are about 10-15 cm deep and 15-20 m wide. These trenches are then filled in with organic amendments, such as compost or manure and wood ash, and/or with synthetic fertilizer. Some of the remaining soil is placed on top of the soil amendments, and then the farmer waits for the proper time to plant in the trench.
Source: Daniel Schlupp

Maize plots with two synthetic fertilizers, one containing nitrogen, phosphorus, and potassium, commonly called NPK, and the other one with Urea, had much higher yields than those plots without NPK and Urea (see Table 8.13). Millet plots (see Table 8.14) and sorghum plots (see Table 8.15) with NPK and Urea also produced higher yields than the plots without NPK and Urea, though not nearly to the extent of maize.

Table 8.13 Master Farmer yield data (kg/ha) for the conservation agriculture demonstration with maize in 2012.

<table>
<thead>
<tr>
<th>Maize Conservation Agriculture Demonstration</th>
<th>Yield (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>Master Farmer</td>
</tr>
<tr>
<td>----</td>
<td>----------------</td>
</tr>
<tr>
<td>1</td>
<td>Demba Balde</td>
</tr>
<tr>
<td>No</td>
<td>Master Farmer</td>
</tr>
<tr>
<td>----</td>
<td>---------------------</td>
</tr>
<tr>
<td>2</td>
<td>Moussa Diallo</td>
</tr>
<tr>
<td>3</td>
<td>Dembo Tigana</td>
</tr>
<tr>
<td>4</td>
<td>Ousmane Willane</td>
</tr>
<tr>
<td>5</td>
<td>Fatou Willane</td>
</tr>
<tr>
<td>6</td>
<td>Ibou Sarr</td>
</tr>
</tbody>
</table>

Average Yield (kg/ha) 3,460 1,712

Plots: 20m x 10m = 200m²

Note: The 2005-2011 nationwide average yield for maize is 1,400 kg/ha (World Bank 2011, Direction de l’Agriculture 2010).

Table 8.14 Master Farmer yield data (kg/ha) for the conservation agriculture demonstration with millet in 2012.

<table>
<thead>
<tr>
<th>Millet Conservation Agriculture Demonstration</th>
<th>Yield (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Master Farmer Site Region</td>
<td>With NPK &amp; Urea</td>
</tr>
<tr>
<td>1 Fatou Willane Katakell Kaffrine</td>
<td>1,500</td>
</tr>
<tr>
<td>2 Moussa Diallo Pakour Kolda</td>
<td>1,350</td>
</tr>
<tr>
<td>3 Ibou Sarr Ndiomdy Fatick</td>
<td>960</td>
</tr>
<tr>
<td>4 Demba Balde Goundaga Kolda</td>
<td>750</td>
</tr>
<tr>
<td>5 Ousmane Willane Keur Lahine Lobe Kaffrine</td>
<td>1,600</td>
</tr>
<tr>
<td>6 Amadou Gano Thioewal Lao Kolda</td>
<td>1,600</td>
</tr>
<tr>
<td>7 Omar Topp Saly Escale Kaffrine</td>
<td>2,000</td>
</tr>
</tbody>
</table>

Average Yield (kg/ha) 1,232 765

Plots: 20m x 10m = 200m²

Note: The 2005-2011 nationwide average yield for millet is 700 kg/ha (World Bank 2011, Direction de l’Agriculture 2010).

Table 8.15 Master Farmer yield data (kg/ha) for the conservation agriculture demonstration with sorghum in 2012.

<table>
<thead>
<tr>
<th>Sorghum Conservation Agriculture Demonstration</th>
<th>Yield (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Master Farmer Site Region</td>
<td>With NPK &amp; Urea</td>
</tr>
<tr>
<td>1 Fatou Willane Katakell Kaffrine</td>
<td>2,000</td>
</tr>
<tr>
<td>2 Ibou Sarr Ndiomdy Fatick</td>
<td>1,650</td>
</tr>
<tr>
<td>3 Demba Balde Goundaga Kolda</td>
<td>1,150</td>
</tr>
<tr>
<td>4 Ousmane Willane Keur Lahine Lobe Kaffrine</td>
<td>1,500</td>
</tr>
</tbody>
</table>

Average Yield (kg/ha) 1,575 1,113

Plots: 20m x 10m = 200m²

7 The nationwide average yields for maize, millet and sorghum were calculated from yearly averages from 2005-2011 (World Bank 2011) and from 2009-2010 (Direction de l’Agriculture 2010).
Note: The 2006-2011 nationwide average yield for sorghum is 800 kg/ha (World Bank 2011, Direction de l’Agriculture 2010).

The maize plots without NPK and Urea still had a yield that was, on average, more than the nationwide average yield for maize. This suggests that this type of conservation agriculture has the potential to increase farmers’ yields without the use of NPK or Urea. This is important because many farmers in Senegal cannot or do not use such synthetic fertilizers because they are too expensive, are unavailable in the market when it is needed, or are ineffective due to improper application (ex. broadcasting the NPK) or being leached or washed away from inconsistent or excessively heavy rainfalls soon after application. When NPK and Urea can be purchased, their impact is magnified with this type of conservation agriculture: the NPK and Urea are concentrated in the trenches tilled by the ripper, where the soil is typically damper, where the roots of the young plants can easily access them, and where they are prevented from being washed away.

Most Master Farmers saved what they produced to feed their families or for seed the following year, though a couple Master Farmers did sell some of their harvest for a small income (see Table 8.20). Master Farmer Ousmane Willane implemented a similar conservation agriculture technique in a one-hectare maize field during the 2011 rainy season and achieved a 226% increase in his maize yield, which improved Willane’s food security.

Ten Master Farmers successfully implemented the integrated pest management demonstration with cowpeas in 2012 (see Table 8.16). One farmer, Mamadou Minte, substituted Neem leaf solution for the Neem oil solution. The chemical pesticide, Dimethoate, out-performed every other pest management technique for every Master Farmer. However, the organic techniques still resulted in a higher yield, on average, compared to the national average yield for cowpeas, which is 400 kg/ha (Direction de l’Agriculture 2010).
Table 8.16 Master Farmer yield data (kg/ha) for the integrated pest management demonstration with cowpeas in 2012.

<table>
<thead>
<tr>
<th>Cowpea Integrated Pest Management (IPM) Demonstration</th>
<th>Yield (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>Master Farmer</td>
</tr>
<tr>
<td>----</td>
<td>---------------</td>
</tr>
<tr>
<td>1</td>
<td>Demba Balde</td>
</tr>
<tr>
<td>2</td>
<td>Moussa Diallo</td>
</tr>
<tr>
<td>3</td>
<td>Mamadou Minte</td>
</tr>
<tr>
<td>4</td>
<td>Cheikh Dieng*</td>
</tr>
<tr>
<td>5</td>
<td>Djiby Malaw Ndiaye</td>
</tr>
<tr>
<td>6</td>
<td>Fatou Willane</td>
</tr>
<tr>
<td>7</td>
<td>Omar Topp</td>
</tr>
<tr>
<td>8</td>
<td>Boubou Ndiaye</td>
</tr>
<tr>
<td>9</td>
<td>Cheikh Gaye</td>
</tr>
<tr>
<td>10</td>
<td>Ibo Sarr</td>
</tr>
</tbody>
</table>

Average Yield (kg/ha)

<table>
<thead>
<tr>
<th></th>
<th>Dimethoate</th>
<th>Neem oil</th>
<th>Yellow sticky traps</th>
<th>Control</th>
<th>Neem leaves</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1,043</td>
<td>806</td>
<td>621</td>
<td>445</td>
<td>950</td>
</tr>
</tbody>
</table>

Plots: 20m x 10m = 200m²
*Cheikh Dieng plots are 200m² for Dimethoate, 170m² for Neem oil and Yellow trap and 136m² for the control.

Note: The 2009-2010 nationwide average yield for cowpeas is 400 kg/ha (Direction de l’Agriculture 2010).

Only three Master Farmers successfully implemented and maintained rice demonstrations in 2012 (see Table 8.17). Many Master Farmers cannot grow rice in their Master Farms because of sandy soil, which does not support rice growth. For those who did have demonstrations, the SRI plots produced higher yields, on average, compared to the traditional technique of direct seeding with a machine seeder. Master Farmer Fatou Willane experienced low plant density in her SRI plots due to a poor transplant survival rate, which impacted her yields.

Table 8.17 Master Farmer yield data (kg/ha) for the System of Rice Intensification (SRI) demonstration with rice in 2012.

<table>
<thead>
<tr>
<th>System of Rice Intensification (SRI) Demonstration</th>
<th>Yield (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>Master Farmer</td>
</tr>
<tr>
<td>----</td>
<td>---------------</td>
</tr>
<tr>
<td>1</td>
<td>Amadou Gano</td>
</tr>
<tr>
<td>2</td>
<td>Dembo Tigana</td>
</tr>
<tr>
<td>3</td>
<td>Fatou Willane</td>
</tr>
</tbody>
</table>
Average Yield (kg/ha) | 1,053 | 1,179 | 1,302
---|---|---|---
Plots: 15m x 6.5m = 97.5 m²
Note: The 2005-2011 nationwide average yield for rainfed\(^8\) rice is 700 kg/ha (World Bank 2011).

8.1.3 Agroforestry Activities

An important component of the Master Farmer program is the establishment of a wide variety of grafted mango and citrus trees at each Master Farm to act as a local gene pool for these varieties. These improved varieties originate from all over the world, though the scions used for grafting the trees for the Master Farmers were taken from trees within Senegal and The Gambia. Prior to the start of the Master Farmer program, these varieties could typically be found only in select locations in Senegal, such as Dakar or Ziguinchor, and never were all of these varieties in one location. They were also usually sold as small samplings for about 5,000 CFA (about 10 USD). In other words, these improved varieties of mango and citrus trees were in a location and at a price well out of the reach of most smallholder farmers in Senegal.

Prior to distribution of these trees to Master Farms, the scions were collected and grafted onto local rootstock at PC Senegal’s Training Center in Thies by PC Senegal’s Agroforestry team. Tables 8.18 and 8.19 list all 17 improved varieties of mangoes and 25 improved varieties of citrus that were grafted at the Training Center between 2010 and 2012, as well as the three kinds of rootstock used to graft citrus trees. Due to agroecological differences throughout Senegal, each Master Farmer has received, on average, 12 different improved varieties of mangoes and 16 different improved varieties of citrus trees that are best adapted for their area.

Between fiscal years 2011 and 2012, 276 mangoes and 368 citrus trees were outplanted at Master Farmers’ sites to start or complete the set of varieties that each site should have. The

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\(^8\) Direction de l’Agriculture 2010 does not differentiate between rainfed and irrigated rice, so their average (2,800 kg/ha) was not included in the calculation for this nationwide average.
average survival rate of these outplantings was 95% for citrus and 71% for mangoes. Each Master Farmer, usually with the help of PC staff and a volunteer, transplanted the trees he or she received in the Master Farm’s designated orchard area.

Table 8.18  Citrus varieties that have been grafted onto rootstock at PC Senegal’s Training Center in Thies for distribution to Master Farmers.

<table>
<thead>
<tr>
<th>No</th>
<th>Orange</th>
<th>Mandarin</th>
<th>Grapefruit</th>
<th>Hybrid</th>
<th>Lemon &amp; Lime</th>
<th>Rootstock</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Japanese</td>
<td>Osecola</td>
<td>Ruby Star</td>
<td>Tangelo Orlando</td>
<td>Lime Tahiti</td>
<td>Bigaradier</td>
</tr>
<tr>
<td>2</td>
<td>Carmelle</td>
<td>Fremont</td>
<td>Shambard</td>
<td>Tangelo Nova</td>
<td>Citron Eureka</td>
<td>Volka</td>
</tr>
<tr>
<td>3</td>
<td>Hamlin</td>
<td>Clémentine</td>
<td>Thomson</td>
<td>Tangor Ortanique</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Blida</td>
<td></td>
<td>Red Blush</td>
<td>Tangor Temple</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Punka</td>
<td></td>
<td>Super Star</td>
<td>Murkott</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Page</td>
<td></td>
<td></td>
<td>Beauty</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Carvala</td>
<td></td>
<td></td>
<td>Fairchild</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Fortune</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 8.19  Mango varieties that have been grafted onto rootstock at PC Senegal’s Training Center in Thies for distribution to Master Farmers.

<table>
<thead>
<tr>
<th>No</th>
<th>Early Season</th>
<th>Mid-Season</th>
<th>Late Season</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Early Gold</td>
<td>Amelie</td>
<td>Keitt</td>
</tr>
<tr>
<td>2</td>
<td>Divine</td>
<td>Hadden</td>
<td>Kent</td>
</tr>
<tr>
<td>3</td>
<td>Hative de Passy</td>
<td>Tommy Atkins</td>
<td>Brooks</td>
</tr>
<tr>
<td>4</td>
<td>Pêche</td>
<td>Irwin</td>
<td>Valencia</td>
</tr>
<tr>
<td>5</td>
<td>July (Early-Mid)</td>
<td>Smith (Mid-Late)</td>
<td>Palmer</td>
</tr>
<tr>
<td>6</td>
<td>Zill (Early-Mid)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Bouko diéhal (Early-Mid)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

All Master Farmers have been trained on tree nursery establishment, grafting and pruning. Since acquiring these skills, they have started their own tree nurseries with fruit trees as well as other trees, such as thorny trees for a live fence, trees for a windbreak, or trees for alley cropping. Some have started grafting their own fruit trees and many are selling the trees they produce in their nurseries. They typically sell the non-grafted fruit trees for 500 CFA (about 1
USD) and the grafted mango or citrus trees for 1,000 to 1,500 CFA (2-3 USD) each. Many Master Farmers also give trees away for free.

Through gardening, field crop, and agroforestry activities on their farms, Master Farmers produced a wide range of vegetables, cereals, legumes and trees during FY2012, which their families consumed, they sold for additional income, or they gave away for free. Income data was collected in December 2012 for six Master Farmers who had kept good records of production and income and was compiled into Table 8.20. The income for these six Master Farmers ranged from 115,000 CFA (about 230 USD) to almost 585,000 CFA (about 1,170 USD) for all activities within the Master Farm during FY2012.

Table 8.20 Production (kg) and income (CFA) generated for several Master Farmers from Master Farm activities during FY2012.

<table>
<thead>
<tr>
<th>Master Farmer</th>
<th>Crop</th>
<th>Variety</th>
<th>Demonstration</th>
<th>Yield (kg)</th>
<th>Income (CFA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ibrahima Samake</td>
<td>Cowpea</td>
<td>Yacine</td>
<td></td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>Ibrahima Samake</td>
<td>Cowpea</td>
<td>Melakh</td>
<td></td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Ibrahima Samake</td>
<td>Peanut</td>
<td></td>
<td></td>
<td></td>
<td>30,000</td>
</tr>
<tr>
<td>Ibrahima Samake</td>
<td>Banana trees</td>
<td></td>
<td></td>
<td>10,000</td>
<td></td>
</tr>
<tr>
<td>Ibrahima Samake</td>
<td><em>Zizyphus</em> tree nursery</td>
<td></td>
<td></td>
<td>5,000</td>
<td></td>
</tr>
<tr>
<td>Ibrahima Samake</td>
<td>Mango tree nursery</td>
<td></td>
<td></td>
<td>35,000</td>
<td></td>
</tr>
<tr>
<td>Ibrahima Samake</td>
<td>Cassava</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ibrahima Samake</td>
<td>Millet, manure + NPK + Urea</td>
<td></td>
<td></td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>Ibrahima Samake</td>
<td>Millet, NPK + Urea</td>
<td></td>
<td></td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>Ibrahima Samake</td>
<td>Maize</td>
<td></td>
<td></td>
<td>250</td>
<td>30,000</td>
</tr>
<tr>
<td><strong>Ibrahima Samake</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>140,500</strong></td>
<td></td>
</tr>
<tr>
<td>Ousmane Diop</td>
<td>Hot pepper</td>
<td></td>
<td></td>
<td>58.75</td>
<td>117,500</td>
</tr>
<tr>
<td>Ousmane Diop</td>
<td>Okra</td>
<td></td>
<td></td>
<td>93</td>
<td>46,450</td>
</tr>
<tr>
<td>Ousmane Diop</td>
<td>Eggplant</td>
<td></td>
<td></td>
<td>46</td>
<td>13,750</td>
</tr>
<tr>
<td>Ousmane Diop</td>
<td>Bambara groundnut</td>
<td></td>
<td></td>
<td>171.7</td>
<td>42,925</td>
</tr>
<tr>
<td>Ousmane Diop</td>
<td>Turnip</td>
<td></td>
<td></td>
<td>9.3</td>
<td>2,800</td>
</tr>
<tr>
<td>Ousmane Diop</td>
<td>Cowpea, 1000 square meters</td>
<td></td>
<td></td>
<td>164</td>
<td>41,000</td>
</tr>
<tr>
<td>Ousmane Diop</td>
<td>Millet, manure + NPK + Urea</td>
<td></td>
<td></td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Ousmane Diop</td>
<td>Crop Type</td>
<td>Manure Type</td>
<td>Amount</td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------</td>
<td>-----------</td>
<td>-------------</td>
<td>--------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ousmane Diop</td>
<td>Millet</td>
<td>manure</td>
<td>50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ousmane Diop</td>
<td>Maize</td>
<td>manure + NPK + Urea</td>
<td>49</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ousmane Diop</td>
<td>Maize</td>
<td>manure</td>
<td>30</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ousmane Diop</strong></td>
<td></td>
<td></td>
<td><strong>584,800</strong>*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Breakdown by crop does not equal total, but total is accurate according to Diop*

<table>
<thead>
<tr>
<th>Ousmane Willane</th>
<th>Crop Type</th>
<th>Nursery Type</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ousmane Willane</td>
<td>Hot pepper</td>
<td>nursery</td>
<td>200,000</td>
</tr>
<tr>
<td>Ousmane Willane</td>
<td>Hot pepper</td>
<td></td>
<td>60,000</td>
</tr>
<tr>
<td>Ousmane Willane</td>
<td>Eggplant</td>
<td></td>
<td>25,000</td>
</tr>
<tr>
<td>Ousmane Willane</td>
<td>Thorny tree</td>
<td>nursery</td>
<td>750 trees [free]</td>
</tr>
<tr>
<td>Ousmane Willane</td>
<td>Cashew tree</td>
<td>nursery</td>
<td>75 trees [free]</td>
</tr>
<tr>
<td>Ousmane Willane</td>
<td>Mango tree</td>
<td>nursery, grafted</td>
<td>3 trees 4,500</td>
</tr>
<tr>
<td><strong>Ousmane Willane</strong></td>
<td></td>
<td></td>
<td><strong>289,500</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ibou Sarr</th>
<th>Crop Type</th>
<th>Nursery Type</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ibou Sarr</td>
<td><em>Jaxatu</em> (bitter tomato)</td>
<td>mulch, Zai holes</td>
<td>10 3,500</td>
</tr>
<tr>
<td>Ibou Sarr</td>
<td>Eggplant</td>
<td>double &amp; single digging, mulch</td>
<td>150 30,000</td>
</tr>
<tr>
<td>Ibou Sarr</td>
<td>Tomato</td>
<td>double &amp; single digging, mulch</td>
<td>160 20,000</td>
</tr>
<tr>
<td>Ibou Sarr</td>
<td>Green pepper</td>
<td>single, mulch (peanut shells)</td>
<td>15 7,500</td>
</tr>
<tr>
<td>Ibou Sarr</td>
<td>Cucumber</td>
<td>single, mulch (peanut shells)</td>
<td>7 2,750</td>
</tr>
<tr>
<td>Ibou Sarr</td>
<td>Lettuce</td>
<td>single, mulch (peanut shells)</td>
<td>450 4,500</td>
</tr>
<tr>
<td>Ibou Sarr</td>
<td>Okra</td>
<td>single, mulch (peanut shells)</td>
<td>2 700</td>
</tr>
<tr>
<td>Ibou Sarr</td>
<td>Carrot</td>
<td>companion planting with lettuce &amp; with eggplant</td>
<td>-</td>
</tr>
<tr>
<td>Ibou Sarr</td>
<td>Onion</td>
<td>single, mulch (peanut shells)</td>
<td>7 1,400</td>
</tr>
<tr>
<td>Ibou Sarr</td>
<td>Cassava</td>
<td></td>
<td>107 42,650</td>
</tr>
<tr>
<td>Ibou Sarr</td>
<td>Cowpea</td>
<td>IPM demo, sold 1 kg per demo</td>
<td>4 2,000</td>
</tr>
<tr>
<td><strong>Ibou Sarr</strong></td>
<td></td>
<td></td>
<td><strong>115,000</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dembo Tigana</th>
<th>Crop Type</th>
<th>IPM Type</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dembo Tigana</td>
<td>Cowpea</td>
<td>Dimethoate</td>
<td>36.4 [food for family]</td>
</tr>
<tr>
<td>Dembo Tigana</td>
<td>Cowpea</td>
<td>Neem</td>
<td>26.8 [food for family]</td>
</tr>
<tr>
<td>Dembo Tigana</td>
<td>Cowpea</td>
<td>nothing</td>
<td>16.9 [food for family]</td>
</tr>
<tr>
<td>Dembo Tigana</td>
<td>Rice</td>
<td>SRI: 30x35</td>
<td>16 [food for family]</td>
</tr>
</tbody>
</table>

77
8.1.4 Other Indicators of Food Security Improvement

The Master Farmers have all increased their gardening, field crop, and agroforestry activities since joining the program and these increases in yield and income data indicate that their food security is improving. There are other indicators that also suggest that the food security of the Master Farmers is improving, namely expansions of household structures, expansions of animal husbandry activities, investments in (more) agricultural machines or tools, and investments in (more) wage laborers. Since joining the program, Master Farmer Ousmane Willane has expanded his house by building another cement hut. He has also expanded his animal husbandry activities by investing in livestock, namely cows, horses, goats, chickens and ducks. Prior to joining the program, Willane always had to borrow agricultural machinery from
neighbors but he now owns his own agricultural machinery, such as an animal-drawn plow and seeder.

Other Master Farmers who have also invested in agricultural machinery since joining the program include Dembo Tigana, Samba Ly and Ibrahima Samake. Master Farmer Fatou Willane has also expanded her household structures since joining the program by adding on an additional cement building with two rooms, which is a significant achievement for a woman in Senegal. A couple Master Farmers, namely Dembo Tigana and Demba Balde, have also begun sending their children to school now that they have the ability to pay the school fees and buy pens, notebooks and other necessary school supplies. Some Master Farmers, such as Samba Ly and Ibrahima Samake, have also hired wage laborers to tend to some of the activities in their Master Farms. Thus, these proxies indicate that the food security of Master Farmers is improving. It also means that their food security will continue to improve, as they see a return on their investment in livestock and machinery as well as the education of their children.

8.2 Extension Activities by Master Farmers

8.2.1 Extension Activities to Local Community Members

One common way Master Farmers carry out their roles as extension agents and share their knowledge and experiences as well as train other community members in improved techniques is through Open Field Days. Open Field Days are an extension technique in which anywhere from 30 to 100 or more strategically selected community members are invited to the Master Farm for a day (see Appendix G for a link to the Open Field Day Guidelines shared with volunteers and Master Farmers). During this day, the Master Farmer gives a tour of his or her farm and explains the various technologies demonstrated there, such as improved field crop, vegetable and fruit tree varieties, conservation agriculture, live fencing, alley cropping, double
digging, mulching and integrated pest management. Depending on the number of guests, the Master Farmer may split the guests into several groups and make several tours of the farm so all the groups can see the technologies.

After the field visit, participants have the chance to ask questions of the Master Farmer or other agricultural extension agents (ex. PC staff, PCVs, government extension agents or extension agents associated with NGOs in the area), as well as share their own experiences and insights. Open Field Days are not only one of the tools Master Farmers use to share their knowledge and demonstrations with their communities but also one way in which community members can learn more about the Master Farmer program and establish a stronger relationship with the Master Farmer for further mentorship and knowledge exchange. As of May 2013, fourteen Master Farmers had hosted at least one Open Field Day at their Master Farm and ten of them had hosted two or more events (see Table 8.21). About 1,250 individuals⁹ had been trained at these Open Field Days.

Table 8.21 The number of men and women who attended Open Field Days hosted by Master Farmers from 2010 to May 2013.

<table>
<thead>
<tr>
<th>Date</th>
<th>Master Farmer</th>
<th>Site (Region)</th>
<th>Men</th>
<th>Women</th>
<th>Total</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>31-Mar-13</td>
<td>Omar Top</td>
<td>Sally Escale (Kaffrine)</td>
<td>11</td>
<td>28</td>
<td>39</td>
<td></td>
</tr>
<tr>
<td>25-Mar-13</td>
<td>Ibrahima Diakhate</td>
<td>Tawa Fall (Thies)</td>
<td>60</td>
<td>49</td>
<td>109</td>
<td></td>
</tr>
<tr>
<td>14-Mar-13</td>
<td>Ibrahima Samake</td>
<td>Gouye Marie (Fatick)</td>
<td>15*</td>
<td>45*</td>
<td>60*</td>
<td></td>
</tr>
<tr>
<td>18-Apr-13</td>
<td>Ibou Sarr</td>
<td>Ndiomdy (Fatick)</td>
<td>15*</td>
<td>50*</td>
<td>65*</td>
<td></td>
</tr>
<tr>
<td>29-Jan-13</td>
<td>Samba Ly</td>
<td>Karang (Fatick)</td>
<td>19</td>
<td>44</td>
<td>63</td>
<td></td>
</tr>
<tr>
<td>11-Oct-12</td>
<td>Fatou Willane</td>
<td>Katakel (Kaffrine)</td>
<td>38</td>
<td>15</td>
<td>53</td>
<td></td>
</tr>
</tbody>
</table>

⁹ The total number of attendees at Open Field Days is 1,647, but these are not all distinct individuals because numerous people have attended more than one Open Field Day hosted by a single Master Farmer. To get 1,250, I estimated that about half of the people attended the second Open Field Day that a Master Farmer held had also attended the first one, and that two-thirds of the people who attended the third Open Field Day that a Master Farmer held had also attended either the first or second one, which gives an estimate of about 1,250 people trained at Open Field Days.
<table>
<thead>
<tr>
<th>Date</th>
<th>Name</th>
<th>Village/Location</th>
<th>Age</th>
<th>Gender</th>
<th>PCV Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>8-Oct-12</td>
<td>Boubou Ndiaye</td>
<td>Weinde (Kaffrine)</td>
<td>27</td>
<td>13</td>
<td>2 PCVs</td>
</tr>
<tr>
<td>8-Oct-12</td>
<td>Omar Top</td>
<td>Sally Escale (Kaffrine)</td>
<td>36</td>
<td>13</td>
<td>49</td>
</tr>
<tr>
<td>8-Oct-12</td>
<td>Ousmane Diop</td>
<td>Medina Ndiobene (Kaolack)</td>
<td>42</td>
<td>42</td>
<td>84</td>
</tr>
<tr>
<td>8-Oct-12</td>
<td>Samba Ly</td>
<td>Karang (Fatick)</td>
<td>30*</td>
<td>40*</td>
<td>70*</td>
</tr>
<tr>
<td>7-Oct-12</td>
<td>Ibou Sarr</td>
<td>Ndiomdy (Fatick)</td>
<td>38*</td>
<td>32*</td>
<td>70*</td>
</tr>
<tr>
<td>6-Oct-12</td>
<td>Ousmane Willane</td>
<td>Keur Lahine Lobe (Kaffrine)</td>
<td>21</td>
<td>4</td>
<td>25</td>
</tr>
<tr>
<td>6-Oct-12</td>
<td>Ousmane Willane</td>
<td>Keur Lahine Lobe (Kaffrine)</td>
<td>33</td>
<td>5</td>
<td>38</td>
</tr>
<tr>
<td>4-Oct-12</td>
<td>Amadou Gano</td>
<td>Tiewol Lawol (Kolda)</td>
<td>35*</td>
<td>25*</td>
<td>60*</td>
</tr>
<tr>
<td>3-Oct-12</td>
<td>Dembo Tigana</td>
<td>Faraba (Kedougou)</td>
<td>40*</td>
<td>35*</td>
<td>75*</td>
</tr>
<tr>
<td>12-Oct-11</td>
<td>Ibrahima Diakhaté</td>
<td>Tawa Fall (Thies)</td>
<td>55</td>
<td>12</td>
<td>67</td>
</tr>
<tr>
<td>10-Oct-11</td>
<td>Fatou Willane</td>
<td>Katakel (Kaffrine)</td>
<td>28</td>
<td>19</td>
<td>47</td>
</tr>
<tr>
<td>10-Oct-11</td>
<td>Ibou Sarr</td>
<td>Ndiomdy (Fatick)</td>
<td>29</td>
<td>21</td>
<td>50</td>
</tr>
<tr>
<td>9-Oct-11</td>
<td>Ousmane Willane</td>
<td>Keur Lahine Lobe (Kaffrine)</td>
<td>33</td>
<td>5</td>
<td>38</td>
</tr>
<tr>
<td>8-Oct-11</td>
<td>Ibrahima Samake</td>
<td>Gouye Marie (Fatick)</td>
<td>61</td>
<td>3</td>
<td>64</td>
</tr>
<tr>
<td>7-Oct-11</td>
<td>Amadou Gano</td>
<td>Tiewol Lawol (Kolda)</td>
<td>50</td>
<td>22</td>
<td>72</td>
</tr>
<tr>
<td>6-Oct-11</td>
<td>Demba Balde</td>
<td>Goundaga (Kolda)</td>
<td>23</td>
<td>34</td>
<td>57</td>
</tr>
<tr>
<td>5-Oct-11</td>
<td>Souleymane Traore</td>
<td>Madjaly (Tambacounda)</td>
<td>61</td>
<td>22</td>
<td>83</td>
</tr>
<tr>
<td>4-Oct-11</td>
<td>Dembo Tigana</td>
<td>Faraba (Kedougou)</td>
<td>38</td>
<td>33</td>
<td>71</td>
</tr>
<tr>
<td>4-Oct-10</td>
<td>Dembo Tigana</td>
<td>Faraba (Kedougou)</td>
<td>52</td>
<td>17</td>
<td>69</td>
</tr>
<tr>
<td>24-Sep-10</td>
<td>Gorgui Aliou Mbdj</td>
<td>Kaymore (Kaolack)</td>
<td>60</td>
<td>15</td>
<td>75</td>
</tr>
<tr>
<td>23-Sep-10</td>
<td>Ousmane Willane</td>
<td>Keur Lahine Lobe (Kaffrine)</td>
<td>64</td>
<td>28</td>
<td>92</td>
</tr>
</tbody>
</table>

**TOTAL** | 981 | 666 | 1,647* |

*Estimated data because PCVs did not send the list of participants.
*See footnote on previous page.

Some Master Farmers, in collaboration with their volunteers and PC staff, have set up several stations during their Open Field Days in order to split the guests up into several small groups and train them in a variety of techniques. Master Farmer Ibrahima Samake and his volunteers hosted such an Open Field Day in March 2013. As can be seen in Figures 8.3-8.5, they had stations for several different improve technologies: composting, improved garden beds,
tree nursery establishment and outplanting, live fence maintenance, fruit tree pruning, Moringa and nutrition.

Figure 8.3 Two groups at different stations learning about composting (foreground) and live fencing (background) during the Open Field Day at Master Farmer Ibrahima Samake’s field, March 2013. 
Source: Danielle Stoermer
Figure 8.4 Health PTA Adji Thiaw discussing nutrition at one station during the Open Field Day at Master Farmer Ibrahima Samake’s field, March 2013.
Source: Danielle Stoermer
In addition to Open Field Days, numerous Master Farmers have hosted other training events to teach community members about specific techniques. Master Farmer Souleymane Traore led a two-day dry season gardening training, with assistance from Agriculture Program and Training Assistant (PTA) Arfang Sadio and volunteers Maria Gannett and Andrew Pochedly, in Madialy (Tambacounda) in January 2012. There were 44 individuals in attendance: 14 men, 22 women and 8 girls. A couple months later, in March 2012, Master Farmer Abdou Salam Ba, with assistance from Agroforestry PTA Cherif Djitte and PCV Peter Gill, led a training in Fas Toucouleur (Kaolack) for 23 farmers about live fencing. They discussed seed
collection, seed storage, and seed scarification and other seed treatments for live fencing tree species, as well as tree nursery establishment and maintenance. A few local farmers with live fencing knowledge also provided advice and recommendations from their personal experiences.

The training was based in the Master Farm, allowing visitors to see first-hand what an established live fence looks like.

Master Farmer Demba Balde and his volunteer, Allyson Junker, with assistance from Agriculture PTA Youssoupha Boye, held a garden market training in December 2011, for 25 women’s garden group members. They also invited a member of the local radio station, Radio Teewdu FM in Diaobe, to attend the training. They made a radio show about the training that aired several times during the following weeks. Other gardeners who did not attend the training were able to learn about what was covered during the training, and the women who did attend the training were able to listen and review the material that they learned during the training.

About a month after this training, Balde and Junker visited the gardens of the 25 women who participated in the gardening training they had hosted. They surveyed 19 of these women about the technologies they were applying in their gardens that year, the pests they had identified, who they work with in the garden and with whom they had shared the technologies presented in the training. All of the 19 women interviewed were using the suggested soil amendments, 14 had nurseries, 10 had planted beds, 10 were spraying weekly with Neem solution and/or other organic pesticides, 6 were companion planting, 5 were using proper spacing, one was using hexagonal spacing and none were mulching. Nearly all the women expressed interest in receiving more training on proper spacing and companion planting, as well as seed selection and conservation. All of the women using the Neem or hot pepper solutions reported that the solutions were effective at reducing damage from all of the different pest
attacks. In total, the participants had taught 120 other people, including 91 women, the techniques that they learned in the training.

Per the request of these and other women, Balde and Junker, again with assistance from Boye, held another training in March 2012 for several women’s garden group members. The representative from the radio station who had attended the previous training was not able to attend this training, but Balde and Junker recorded a radio emission on their own, which was broadcast on the Radio Teewdu FM station several times in the following weeks.

One month after this second training, Balde and Junker visited and interviewed nine of the women who attended the training (see Appendix C). Of these women, all of them were using at least three organic pest management techniques, namely sprinkling ash on leaves, spraying with a Neem solution and spraying with a hot pepper solution. All of them agreed that the Neem solution works well for a while after spraying. Five of the women were also using seeds that they had collected and saved themselves. Two of the participants were making and spraying papaya leaf solution, two women were practicing crop rotation and one woman was practicing companion planting.

Within just a month after the training, all of these nine women had also already each shown at least five people (family members, neighbors or other villagers) a technique they had learned during the training. In total, these nine women had taught 112 people, including 84 other women. Several of the women also said that the radio emission was very useful in refreshing their memories about what they learned at the training, especially since most attendees are illiterate and therefore unable to take notes during the training. Such a combination of training, mass media and follow-up is a very effective technique for innovation diffusion, especially for techniques that often involve some trial and error like agriculture.
Other Master Farmers, in collaboration with their volunteers, have used radio as an extension technique. Master Farmer Gorgui Aliou Mbojd hosted an Open Field Day in September 2010, and a couple different volunteers recorded what was explained and discussed. Then I edited what was recorded and turned it into a radio emission, which was broadcast several times over the following months at the community radio station, 96.4 FM Sine Saloum Radio Communautaire (a community radio station), in Kaolack, a nearby city. In September 2011, I attended several Master Farmers’ Open Field Days in the Kaolack, Kaffrine and Fatick regions. I recorded all of these events and combined key messages regarding the Master Farmer program and popular improved techniques into one radio show, which was also aired several times on the same radio station.

Even though several different teams of Master Farmers and volunteers have produced radio shows, it still accounts for a very small portion of the total number of teams of Master Farmers and volunteers so very few communities are reached through mass media, relative to the total number of communities that could be reached. For example, in the survey of 59 farmers who attended Open Field Days at several different Master Farms in October 2011, of the 58 who answered the question, only two farmers said they had heard of the innovation or innovations through mass media.

Master Farmers Ibou Sarr, Dembo Tigana, and Samba Ly, along with Agriculture PTA Arfang Sadio, attended a training of trainers (TOT) on SRI in Benin from September 10-13, 2012. This training was organized as part of the West Africa Food Security Partnership (WAFSP) with funding from USAID/West Africa. This TOT for French speakers taught participants the SRI technique and gave them a chance to see it in practice. The Master Farmers shared what they learned with other Master Farmers during the annual evaluation meeting and
training in December 2012. They also hosted trainings for members of their communities in May, June and July 2013.

Master Farmers also engage with local teachers and students. In April 2011, Master Farmer Cheikh Gaye, with assistance from teacher Adama Ndiaye and PC Volunteer Andrew Oberstadt, hosted a gardening and environment lesson for elementary school students from Sakagne’s Ecole Primaire. The program involved a farm tour, an introduction to vegetable gardening and an environment lesson. There were 20 children in attendance.

8.2.2 Extension Activities to Non-Local Individuals

Master Farmers reach out to and target audiences beyond just their peers in their communities. Master Farmers have hosted and trained several different audiences: PC Senegal volunteers, Gambian farmers, and PC staff and volunteers from across West Africa. Two groups of new agriculture and agroforestry volunteers (fall 2011 group and fall 2012 group) have visited Master Farmer Ibrahima Diakhate (near Thies) during their Pre- and In-Service Training to see the different technologies they were learning about in training. During the Agriculture Summits held in April 2011, August 2011, April 2012, August 2012, April 2013, and May 2013, these and other agriculture volunteers visited the Master Farmer closest to the site of the training in order to discuss and practice the gardening, field crop, and agroforestry technologies that were being demonstrated.

Master Farmers have also shared their knowledge and experiences with farmers from The Gambia and PC staff and volunteers from across West Africa. In February 2012, several PC The Gambia staff and volunteers, as well as a couple representatives from the NGO Future in Our Hands (FIOU) and several Gambian farmers associated with FIOU, attended a four-day training in Senegal about PC Senegal’s food security program, specifically the Master Farmer program.
During the training, they visited three Master Farmers in the Thies, Kaolack and Kaffrine regions. In May 2011, several other PC The Gambia staff and volunteers attended another four-day training in Senegal again about PC Senegal’s food security program, specifically the Master Farmer program. Several more PC The Gambia staff and volunteers who had not been at either of the first two trainings came to Senegal in February 2013 for a similar training. In September 2012, several PC staff and volunteers from Benin, Ghana, Guinea and Togo participated in a five-day training about the Master Farmer program, in order to be able to better understand the program and adapt it to their respective countries. During the training, they visited several Master Farmers in the Thies, Kaolack, Kaffrine and Fatick regions.

8.3 Potential Adopters’ Perceptions of Technologies at Master Farms

In October 2011, 59 farmers who attended Open Field Days at several different Master Farms were interviewed. In the survey, farmers were asked if they respected the Master Farmer. All 57 farmers who answered that question said yes, they do respect the Master Farmer. Farmers were also asked if they think the Master Farmer experiments and is innovative and if the Master Farmer is more willing than most to try new things. All of the farmers who answered these two questions, except one, said that they think the Master Farmer experiments, is innovative, and is more willing than most to try new things.

Farmers were also asked how quickly they are able to understand the Master Farmer when he/she explains an innovation. Over 40% of those who answered this question said that they understand the Master Farmer right away (i.e., no additional questions were required), and over 50% of those who answered said that only a couple clarifying questions were needed in order to understand the innovation (see Figure 8.6).
In this survey, farmers were asked how the decision to adopt an innovation is made: by an individual, collectively, or by an authority. Over 60% of the farmers who answered this question said that the decision to adopt the innovation is made by an individual, while 25% said that the decision is made collectively, and only 11% said that it is made by an authority (see Figure 8.7).

One farmer, who said that the decision to adopt the innovation is made individually, also said that the implementation of the innovation could be organized collectively. Another farmer
said that the decision to adopt the innovation would be made collectively – by he and his wives, who will be digging the zai holes (for conservation agriculture). A third farmer said that the decision to adopt an innovation would be made by an authority: her husband.

During this survey, the farmers who were interviewed were asked to identify at least one innovation that was demonstrated at the Master Farm. Many of them identified a few different innovations; seven farmers did not identify a specific innovation. One of the farmers who did not name a specific innovation said that some of the demonstrations are not effective but they might be interesting. In total, sixteen innovations were identified by these farmers (the number of farmers who identified this innovation is in parenthesis): conservation agriculture with zai holes with maize (29), integrated pest management with cowpeas (19), mulching (5), the System of Rice Intensification (SRI) (4), fruit tree orchards (4), live fencing (3), composting (3), thinning to one for millet (2), grafting (2), intercropping maize and cowpeas (2), an improved cassava variety (2), improved tree varieties (2), improved seed varieties (1), crop spacing (1), synthetic fertilizer use (1), and crop association for nematodes (1).

All of the farmers who answered the question regarding whether the innovation provides relative advantage agreed that the innovation does provide relative advantage, except one farmer. This farmer had identified the Neem solution as an organic pest management technique for cowpeas. She said later, when she was asked how compatible the innovation is with respect to perceived needs, that chemical pesticide works better and she is already using that. As shown in Figure 8.8, the farmers who thought that the innovation does provide relative advantage cited numerous reasons for this: the innovation leads to a higher yield (44), is economically profitable (36), conveys social prestige (15), is less labor intensive (19), provides faster results (18), or other (13).
Farmers said that the innovations were economically profitable for various reasons. One farmer said that the yellow sticky trap innovation is economically profitable because it is easy to find the materials needed to make the traps (namely yellow plastic sheets and oil) and the traps can easily be made without spending a lot of money. Another farmer said that the SRI technique is economically profitable because it cuts seed costs.\(^{10}\) One farmer said the conservation agriculture technique with zai holes is economically profitable because it will help his family have food and money. Similarly, another farmer said that trees are economically profitable because they produce fruit that family members can harvest to eat. One farmer said that mango orchards are economically profitable because mangoes can be eaten, sold and given away as a gift to visitors, which is an important aspect of Senegalese culture.

\(^{10}\) As discussed earlier, using SRI can reduce that amount of seed needed for planting the same area by as much as one tenth.
Many farmers also said that the innovation they named conveys social prestige. One farmer said that conservation agriculture with zai holes conveys social prestige because people will come to see your really nice field. Another farmer said that conservation agriculture with zai holes conveys social prestige because it brings you higher yields, which will increase your social prestige. Another farmer said that conservation agriculture conveys social prestige because it provides more food and money so if you have a guest you can buy them food and gifts.

Numerous farmers said that the innovation is less labor intensive. Some of those farmers said that conservation agriculture with zai holes is less labor intensive than traditional techniques because even though it takes more time in the beginning to dig holes and gather the organic soil amendments, it is less labor intensive when it comes to weeding because the mulch significantly reduces or eliminates the need to weed. Other farmers, however, said that conservation agriculture is actually more labor intensive. One farmer also said that the organic pest control techniques for cowpeas (namely Neem solution and yellow sticky traps) are also more labor intensive.

Several farmers said that the innovation provides faster results. Three farmers said that conservation agriculture with zai holes provides faster results because the maize plants grow faster than with traditional techniques and are ready to harvest earlier.

Finally, many farmers also mentioned other reasons for why the innovation provides relative advantage. One farmer said that mulch provides relative advantage because it means there will be less weeds. Another farmer said that using the Neem solution as an organic pest control technique for cowpeas is less dangerous because it uses no chemicals. Another farmer said that the Neem solution provides relative advantage because pests do not eat the beans.
Similarly another farmer said that the yellow sticky traps provide relative advantage because it protects well against pests. One farmer said that conservation agriculture provides relative advantage because it improves the soil. Another farmer said that conservation agriculture makes the soil stronger so the crop is less susceptible to pests. One farmer said that fruit tree orchards provide relative advantage because they produce edible fruit. Regarding live fencing, one farmer said that it provides free fencing and fencing is really important in his area. Similarly, another farmer said that live fencing provides relative advantage because trees last forever whereas chain-link fencing does not last very long (typically 3-5 years in Senegal).

Of the farmers who answered the question regarding the compatibility of the innovation with respect to socio-cultural values and beliefs, over 90% said that the innovation was compatible or very compatible with socio-cultural values and beliefs (see Figure 8.9). Less than 5% of the farmers said that the innovation was incompatible, and no one said it was very incompatible.

![Figure 8.9](image)

Figure 8.9 Chart indicating the compatibility of innovations at the Master Farm with respect to socio-cultural values and beliefs, according to the farmers who were interviewed.
The three farmers who said they think the innovation is incompatible with respect to socio-cultural values and beliefs gave explanations for why they think this. One farmer said that the new technique is incompatible because it is intensive, so it does not use much space, but people who do not farm a large area are not considered hard workers in their culture – they are, in fact, often considered lazy people. Similarly, another farmer said that it is a matter of a difference between small scale (new technique) versus large scale (traditional technique). The third farmer said that the technology is incompatible with respect to socio-cultural values and beliefs because it is not the same as past practices. But, he added, the technique is still good because it increases yield.

A few of the farmers who said that the innovations are compatible with respect to socio-cultural values and beliefs also gave explanations for why they think this, and they all had similar comments. One farmer said that it is compatible because their values and beliefs want people to have food, and the technique helps increase yield. Another farmer simply said that it is compatible because people will eat more. Similarly, another farmer said it is compatible because the technology helps them move forward and improve, which is something their culture and religion want. One farmer, who said that the technology is very compatible, gave one stipulation: but they need materials to do it.

One of the three farmers who said that the innovation is neither compatible nor incompatible with respect to socio-cultural values and beliefs said that the innovations have nothing to do with culture. Work in itself, he continued, brings one closer to one’s family. Another farmer said that culture has changed a lot. For example, what his father needs has changed a lot over time: earlier he did not need very much, but now his culture says that he needs a nice house, several wives, to pay for his children’s schooling and clothes and food, a
motorcycle or a car, to go to Dakar (the capital of Senegal) or Kaolack (the nearby regional capital), etc. It does not matter if the technique is compatible or not, he concludes, because things are changing and you just need to be able to keep up with those changes and support your family. Similarly, another farmer, who said the technique is compatible, said that the technique clearly works, so there is no reason not to do it.

These farmers were also asked to rank the compatibility of the innovation with respect to current or past local practices. Over 85% of the farmers who answered this question said that the innovation is compatible with respect to current or past local practices (see Figure 8.10).

Figure 8.10 Chart indicating the compatibility of innovations at the Master Farm with respect to current or past local practices, according to the farmers who were interviewed.

A few farmers, when referring to the conservation agriculture technique with zai holes, said that this technique is different from current techniques which use machines, but similar to past techniques that relied on cultivating the soil and planting by hand. Another two farmers said that the new conservation agriculture technique with zai holes is different from past techniques because it involves the addition of soil amendments, which were not needed in the past because
the soil was better. This need to change, according to one farmer, actually makes a technique’s compatibility with current or past techniques irrelevant because they do not have a choice: they need to change their farming practices, he said, if they wish to leave anything for their children. Other farmers echoed this comment when they said that even though the new techniques are incompatible with current or past ones, they are better because they result in a larger yield compared to traditional techniques.

Farmers were also asked to rank the compatibility of the innovation with respect to perceived needs. As is shown in Figure 8.11, over 95% of the farmers who answered this question said that the innovation is compatible or very compatible with respect to perceived needs.

When they commented on this question, the farmers identified several needs that the new technologies addressed: a need for a higher yield, a need for the technology to be applicable to a wide variety of crops or situations, a need to be able to do the technique with locally and readily

Figure 8.11 Chart indicating the compatibility of innovations at the Master Farm with respect to perceived needs, according to the farmers who were interviewed.
available material that is free, a need to be able to adapt the technology or combine it with other practices, and a need to intensify farming. Several farmers said that the new technology is compatible with respect to perceived needs because the new technique will increase yields so they will have more food and a higher income. Another farmer said the new technique of posting yellow sticky traps for pest control on cowpeas is useful because it can be applied to other crops, such as onion and cabbage.

Other farmers said that even though conservation agriculture with zai holes is labor intensive at first when digging the holes, it is better than other techniques because it does not require a machine – it can be done entirely by hand – and the other materials, such as manure, ash, and leaves, are locally and readily available and free. Since digging zai holes is very labor intensive, one farmer said that she would only be able to dig half of her field with zai holes. She said she would still plant the other half of her field, though, just with a machine instead of in zai holes. Another farmer said that conservation agriculture with zai holes is better because you can combine it with a traditional practice of penning cows up at night: you could pen the cows up on the field where zai holes will be dug to get extra manure there. One farmer said that families are getting bigger and land is still divided between the sons, so it is becoming more necessary to farm intensively and conservation agriculture with zai holes addresses this need. While these farmers listed specific needs that the innovation addresses, one farmer simply said that the new technology can give you what you need – whatever that may be.

The one farmer who said that the innovation is neither compatible nor incompatible with respect to perceived needs did not name a specific innovation that he was referring to, but did qualify his answer by saying that compatibility – or incompatibility – depends on the needs. The one farmer who said that the innovation is not compatible with respect to perceived needs was
referring to the new technique of spraying Neem solution as an organic pest control for cowpeas. She said that chemical pesticide works better and she is already using it.

In this survey, the farmers were asked if the innovation at the Master Farm is part of a technology cluster. Over 90% of the farmers who answered this question said that the technology is part of a technology cluster. Of those who said yes, over 90% again said that the innovations in the technology cluster are promoted together.

The farmers were also asked how the name of the innovation affected their opinion of the innovation. Just over 50% of the farmers who answered this question said that the name of the innovation has a positive or a strong positive effect on their opinion of the innovation, and the remaining farmers said the name of the innovation has no effect on their opinion of the innovation (see Figure 8.12).

![Figure 8.12 Chart indicating the effect of the name of the innovation on the farmer’s opinion of the innovation at the Master Farm, according to the farmers who were interviewed.](image)

When asked if they had a better name for the innovation, several farmers said yes and provided another name. Several of the new names were words or short phrases in a local
language that describe the technique, such as “all natural bug killer”, “dig holes”, “change seeds”, “the holes”, “rice circle”, “new farming technique that goes with digging” and “tree fence”. One farmer suggested her name, Kadja, as a better name for the innovation. Another farmer suggested the word in Wolof (a local language) that means “important”. Another suggested the word in Mandinka (another local language) that means well-decomposed manure, which is the closest word in Mandinka to the concept of compost. Other new names that farmers gave were words or short phrases in a local language that mean reducing work, making farming easier or taking it easy. One farmer explained her reasoning for choosing such a name: she said whether or not you have lots of strength, you can implement this technique (conservation agriculture with zai holes).

The farmers who were interviewed were asked how difficult the innovation is to understand and then how difficult it is to implement. Just over 70% of the farmers who answered the question regarding how difficult the innovation is to understand said that the innovation is easy or very easy to understand (see Figure 8.13). Similarly, almost 70% said that they think the innovation is easy or very easy to implement (see Figure 8.14).
Figure 8.13 Chart indicating the difficulty in understanding the innovation at the Master Farm, according to the farmers who were interviewed.

Figure 8.14 Chart indicating the perceived difficulty in implementing the innovation at the Master Farm, according to the farmers who were interviewed.

A couple of the farmers who said the innovation was easy to understand clarified their answer by saying that it was easy because the materials needed to implement the demonstration are locally and readily available and they are free. Another farmer said that it is not hard to know how to implement the innovation, but it is hard to actually implement it. A couple other farmers said that it is easy because they have seen the technique demonstrated. Other farmers disagreed, though: they said that even though they have seen the demonstration, they still think it is difficult to understand the technique because they did not actually see the Master Farmer demonstrating how to implement the technique. But, they said, if they had more training and possibly even the chance to practice the technique themselves, they might think the innovation was easier to understand. Similarly, another farmer said that the technique is neither difficult nor easy to implement because once she was taught how to implement it, she could. Two other farmers said
that the technique (grafting) takes practice, so once they practice they will be able to easily implement it. Another farmer said that the innovation is easy to implement because he is a farmer and he knows hand labor and how to farm in both the rainy and dry seasons.

A couple farmers said that the technique (conservation agriculture with zai holes) is hard to understand and implement because it is complicated and there is a lot you have to know in order to implement it. Similarly, a few farmers said that the techniques are difficult to understand because without prior experience, trying a new technique for the first time can be difficult. But, they said, if they had a chance to practice the technique, they would think it was easier to understand. Still another farmer said that the technique (conservation agriculture with zai holes) is difficult to implement because you first need to know how to implement it, and then you have to work hard to dig the holes. However, once that is done, it is easy to implement, said the farmer, because there is little weeding that will need to be done.

One farmer said that the technique (conservation agriculture with zai holes) is difficult to implement because you need to find and bring materials such as manure, ash, charcoal and leaves as well as dig the holes. It is also difficult, he continued, because it is hard to change the minds of people who have been farming for forever because they think they know how to farm. Similarly, another farmer said that the technique is difficult to implement because his community is conservative, implying that they are generally not interested in trying new things. Another farmer said that the technique (conservation agriculture with zai holes) is very difficult because it requires a lot of work and is slower than other techniques. Another farmer said that this technique is very easy – but only if you have enough people who can help you gather the needed materials, dig holes and plant. One farmer said that the technique is difficult to implement because understanding what the instructors say is difficult.
Farmers were also asked how difficult the innovation is to maintain over a length of time. As shown in Figure 8.15, exactly 70% of the farmers who answered this question said that the innovation is easy or very easy to maintain over a length of time.

![Figure 8.15 Chart indicating the perceived difficulty in maintaining the innovation at the Master Farm for a length of time, according to the farmers who were interviewed.](image)

One farmer said that it was easy to maintain the technique (conservation agriculture with zai holes) over a length of time because you just need to start early. Similarly, another farmer said this same technique is easy because once you have dug the holes, you just need to maintain things. Another farmer said that this technique is very easy because you can do it for a short time frame if you want, such as with vegetables. One more farmer said the technique is easy to maintain over a length of time because once you are convinced that it will work well, you are encouraged to do it and stick with it.

One farmer said that the technique (conservation agriculture with zai holes) is neither difficult nor easy to maintain over a length of time because if you are the only one who can do the work – i.e., if you do not have enough labor – then it will be difficult to do all the work that
the technique requires. Another farmer said that the innovations demonstrated at the Master Farm are neither difficult nor easy to maintain because it depends upon having and maintaining land: if one has enough land, then it will be easy, but having and keeping that land is often difficult. A third farmer said that the techniques (having fruit trees and a live fence) require regular watering, and that often means that one must have a well or other reliable water source, which can be difficult. Finally, another farmer said that the technique is neither difficult nor easy to maintain because he has not tried it yet: once he implements the technique, then he will know if it is difficult or easy to maintain.

One farmer said that the technique (spraying with Neem oil solution for pest control) is very difficult to maintain over a length of time because when it rains, you must repeat the process – i.e., you must reapply the Neem oil solution. Another farmer said that the technique (System of Rice Intensification, or SRI) is very difficult to maintain because it requires more preparation and longer maintenance than traditional techniques. Another farmer said that the technique (conservation agriculture with zai holes) is difficult to maintain because it requires that you prepare well in advance of the start if the rainy season: you must gather the necessary materials, dig the holes, incorporate the materials, etc. Another farmer simply said that the technique (conservation agriculture with zai holes) is difficult to maintain because it is a lot of work.

The farmers who were interviewed were asked how important it is that they are able to adapt the innovation. Over 65% of the farmers who answered this question said that it is important or very important to them that they are able to adapt the innovation (see Figure 8.16).
One farmer said that it is very important for her to be able to adapt the innovation because she does not have much money to buy different materials, such as synthetic fertilizer, so she needs to be able to adapt the innovation in such a way that it will not require much monetary input, which, she added, is possible with this technique (conservation agriculture with zai holes). Two other farmers said that it is important to be able to adapt the innovation because after trying the technique for a while, you may be able to find some changes to it that could make it better.

Just over 12% of the farmers who answered this question said that being able to adapt the innovation is unimportant or very unimportant. One farmer said that being able to adapt the innovation is unimportant if the adaptation is not going to increase yield.

When asked how difficult it is to experiment with, adjust or modify the innovation, almost 60% of the farmers who answered this question said that the innovation was easy or very easy to experiment with, adjust or modify, and just over 25% said that it was neither difficult nor easy (see Figure 8.17).
Figure 8.17 Chart indicating the perceived difficulty of experimenting with, adjusting or modifying the innovation at the Master Farm, according to the farmers who were interviewed.

One farmer said that he thinks it is unimportant if he can adapt the innovation because he believes that the innovation (conservation agriculture with zai holes) cannot be adapted. Similarly, one farmer said that it is neither difficult nor easy to modify the innovation because it is not important. Three other farmers said that it is neither difficult nor easy to modify the innovation because it is not necessary – they think there is no need to change the innovation (conservation agriculture with zai holes). Two farmers said that the innovation is difficult to modify because they do not know the technique. Another farmer said that it is very difficult to modify the innovation (grafting) because there is only one way that it works.

Farmers were also asked how difficult it is to adapt the innovation to their conditions. Of those who answered, over 65% said that the innovation is easy or very easy to adapt to their conditions (see Figure 8.18).
Just under 25% of the farmers said it was difficult to adapt the innovation to their conditions. Several of those farmers said that it was difficult because they do not have materials, such as a pump or organic material (for conservation agriculture, for example), or they do not have extra labor to help with implementing the technology.

When the farmers were asked how long the trial period needs to be to satisfactorily evaluate the effectiveness of the innovation, just over 60% of those who answered said that the trial period is six months or less, and another 10% said that the trial period is one year (see Figure 8.19).
Figure 8.19 Chart indicating how long the trial period needs to be to satisfactorily evaluate the innovation at the Master Farm, according to the farmers who were interviewed.

When farmers were asked how obvious the results of the innovation are, over 85% of those who answered that question said that the results are obvious or very obvious (see Figure 8.20).
Figure 8.20 Chart indicating how obvious the innovation at the Master Farm is, according to the farmers who were interviewed.
CHAPTER 9

DISCUSSION

In the three and a half years since the Master Farmer program started, the program has begun to see signs of success. The food security of the Master Farmers has improved, as demonstrated via increased yields, diversified production, investment in agricultural machinery, investment in livestock, expansion of household structures, and the hiring of day laborers. Master Farmers have shown about 1,250 farmers in their communities the demonstrations in their farms and taught them how to implement those improved techniques. However, despite these promising advancements, there are ways in which the program can be improved in order to better improve food security and increase adoption rates of improved technologies.

9.1 Improvements in Master Farmers’ Food Security

Through their gardening, field crop, and agroforestry activities, Master Farmers have experienced an improvement in their food security since joining the program, though to varying extents.

9.1.1 Gardening Activities

Compared to field crop and agroforestry activities, gardening activities acted as the largest source of income for Master Farmers and also provided the Master Farmers’ families with vegetables. The area available in each Master Farm for gardening is quite large: usually at least 3,000 square meters. Very few Master Farmers have thus far been able to maintain garden beds that cover most of this area, usually because of labor or water restrictions. By expanding their use of and continuing to refine labor- and water-saving techniques, Master Farmers will be able to expand their gardening activities and continue to improve their food security, provided they have markets for their extra production.
For example, many Master Farmers mulch their garden beds with weeds, straw, grass or peanut shells. Master Farmer Ibou Sarr experienced a higher yield of green peppers on the bed that was mulched with peanut shells compared to the bed that was mulched with weeds, straw and grass. It is unclear as to exactly why this occurred – perhaps the peanut shell mulch layer was thicker than the other mulch, or the peanut shells provided a denser soil cover, or perhaps the peanut shells decomposed more quickly and provided more organic matter for the soil, or the chemical composition of peanut shells provides a better balance of organic matter for the soil. Whatever the reason, many Master Farmers are now mulching with peanut shells and may be able to achieve higher yields by doing so.

Mulching is also important as a water-saving technique because this can save time, energy and money. Many Master Farmers have wells, and some of those wells are over 10 meters deep, so it takes significant amounts of time and energy to pull that water. Some Master Farmers, such as Gorgui Aliou Mbodj, use a donkey to pull water because it is too difficult to pull water by hand, even with two or three people, for long periods of time. While the Master Farmers who have a water tap save time by not having to pull water, they must pay for their water, and this can get very expensive, even if they are able to get a reduction in the price of water because it is for agricultural activities. Thus, it is important to continue to encourage Master Farmers to implement water-saving techniques such as mulching, since these techniques can continue to help Master Farmers reduce their water bill and thereby improve their food security.

Drip irrigation is another way Master Farmers have been able to reduce labor inputs on their farms. All Master Farmers have a drip irrigation system that covers anywhere from about 500 to 1,000 square meters (depending on if it is hooked up to a basin or a barrel and depending
on the Master Farmer’s field and preferences). This saves them a considerable amount of time because they no longer need to water those garden beds by hand, which is very time-consuming. Master Farmers can use the time that they save to, for example, invest in other income generating activities or gather more organic materials for the garden. Or, if the Master Farmer is paying for hired labor, he or she can spend less money paying the hired labor since the laborer(s) will need to work less.

The drip irrigation systems demonstrated at Master Farms are relatively simple systems, but they are still relatively expensive: about 220,000 CFA (about 440 USD) for an individual system (the price would decrease per system if items like drip tape are bought in bulk, like they are for the Master Farmers). The vast majority of smallholder farmers in Senegal would not be able to afford such a drip irrigation system, but there still are a fair number of slightly wealthier farmers who would be able to leverage the capital needed to invest in such a system. Since the Master Farmer program is attempting to demonstrate as many technologies as possible for as many different individuals as possible, it is understandable that the program would include a technology such as drip irrigation that may be applicable only for a relatively select group of people.

In addition, it is not just individuals who could purchase a drip irrigation system, groups could, too. In fact, it is not uncommon for women’s group gardens in Senegal to have a drip irrigation system. Granted, those systems are often in disrepair because they were given to the group with little instruction on care and maintenance and necessary parts were not locally available, so it broke down within a couple years of being installed. But it is in the realm of possibility that these women’s groups could work together to purchase a drip irrigation system for their garden. Drip irrigation has expanded relatively rapidly in the past 5-10 years in
Senegal, so knowledge of how to maintain them is spreading, as is the availability of spare parts. It is also becoming more common for smallholder farmers to be able to get small loans from banks. By getting a loan, farmers with little liquid capital could still have the opportunity to be able to invest in a drip irrigation system.

Another way some Master Farmers have addressed labor constraints is by investing in hand pumps to pull water from their wells. Early in the program, a few Master Farmers built hand pumps themselves, but none were particularly successful. After visiting a large farm near Sandiara (Thies) called the Beer-Sheba Project during a Master Farmer training in December 2012, three Master Farmers replicated the hand pump they saw at the farm and have since reduced the amount of time spent pulling water for watering their gardens and trees. A key to the success of these hand pumps is that they were quite simple and made out of locally available material, so Master Farmers were able to make it themselves and tweak it as necessary to fit their specific needs. This is a perfect example of how important self-motivation and innovativeness are to the success of the Master Farmer program, in terms of not only improving the food security of the Master Farmers but also helping other community members adopt improved technologies and thereby improve their food security as well.

As shown earlier, Sarr achieved a higher yield for tomato and eggplant plots that were double-dug compared to those that were only single-dug. Double-digging is a technique used to build up soil organic matter and improve soil quality. It involves removing the topsoil in the garden bed, adding soil amendments to the subsoil, then returning the topsoil and amending it, too. It requires significant time and material inputs upfront, but, if implemented properly, can reduce labor inputs over time and considerably improve soil quality. This technique is most effective if it is implemented with permanent garden beds and with conservation agriculture.
principles in mind. Since the soil in Senegal typically has very little topsoil and the subsoils are not necessarily rich in organic matter, it is necessary to build up that initial organic matter content and topsoil, through double-digging for example. However, once this is achieved, it is best to minimize soil disturbance. This is a key principle of conservation agriculture and contributes to improving soil health over time. The two other key principles of conservation agriculture – keep the soil covered and mix and rotate crops – should also be implemented on these permanent garden beds in order to achieve best results.

Most Master Farmers have implemented at least a few double-dug beds, if not numerous. They often complain about the amount of work and organic materials required in the beginning to double-dig garden beds. But once a garden bed is double-dug, it can – and should – remain a permanent garden bed that would require few soil amendments during subsequent planting cycles because of the quality and quantity of fertile soil in the bed. Additionally, if conservation agriculture principles are followed, soil organic matter will continue to increase over time and soil health will also continue to improve.

There are other techniques that Master Farmers could implement in order to continue to improve their food security, such as implementing off-season gardening activities. By planning gardening activities so that the vegetables are ready for sale when their price is the highest in the market, Master Farmers can gain the highest profits for their labors. Master Farmers could not only plan for off-season vegetable production but also plan for continuous production for vegetables that will be consumed by their family. They could also plan so that they will have enough of any given vegetable to be able to attain a good price for it in the market (since farmers can sometimes get a better price for their crop when they have a significant amount ready for sale at one time). But, in order to reduce spoilage, farmers could also space out their planting to
ensure relatively regular and continuous production of any given crop at any given moment in time.

Since many Master Farmers have severe pest problems, they could focus on growing vegetables that are less susceptible to pests, such as hot peppers. However, Master Farmers may be able to improve their food security more if they maintain a diverse garden. This will mean that the Master Farmer’s family will have a variety of vegetables to consume in addition to selling them in the market. A diverse garden can also help protect against pest problems, reinforcing their ability to maintain a diverse garden as well as reduce the costs and labor demands that pest management often require.

Some Master Farmers have been selling vegetable seedlings to their fellow community members. Master Farmer Ousmane Willane, for example, sold hot pepper seedlings from his vegetable nursery in 2012 and made 200,000 CFA (about 400 USD). This is a creative way to make use of extra seed that Master Farmers may have (from purchasing improved varieties of vegetables in large quantities). It is also a great way for Master Farmers to share improved varieties and a diversity of vegetables with other farmers. Since a vegetable nursery does not require a lot of time to make and maintain nor does it require a lot of space, it is a great way for other members in the Master Farmer’s family, particularly women, who are typically very busy, to also generate an income: they can have a very small plot of land at the Master Farm and create their own nursery for sale.

The ability of all of these gardening activities to succeed of course requires that there be a market for those vegetables and vegetable seedlings. Women can be seen selling vegetables and other goods in front of their compounds even in small villages, and the larger villages and towns have well established vegetable markets. Some Master Farmers have struggled with selling their
produce, for various reasons. Some Master Farmers have not engaged their wives or other women in the selling process, which can be detrimental because women are the primary vegetable sellers, particularly in more rural areas. Other Master Farmers may not know what the price is in other markets for the produce they are selling, so they sell the produce at the market they do know, regardless of if the price is good or not. Other Master Farmers may know which market has the best price at that moment, but may not be able to transport their produce there fast enough or well enough so the produce does not get beat up and spoils. These topics have been discussed at various Master Farmer trainings, and one goal of the Master Farmer-led and organized “Master Farmer Association” is to be able to help with information sharing and logistical challenges related to marketing what they grow in their farms.

9.1.2 Field Crop Activities

Field crop activities within the Master Farms themselves have not been large sources of income or grain because of the relatively small size of demonstration plots that Master Farmers have (anywhere from about 300 to 800 square meters per crop). However, by applying the techniques being demonstrated in the Master Farm to other fields, Master Farmers can achieve significant increases in yield – as demonstrated by Master Farmer Ousmane Willane’s 226% increase in maize yield in 2011.

Further refinement of protocol for the techniques promoted by Master Farmers will continue to help them increase their yields and improve their food security. For example, while the chemical pesticide, Dimethoate, out-performed every other pest management technique for every Master Farmer who had a successful cowpea demonstration during 2012, many Master Farmers understand the risks associated with using chemical pesticides and prefer to use organic techniques whenever possible. In addition, the organic techniques still resulted in a higher yield,
on average, compared to the national average yield for cowpeas, which is 400 kg/ha. More research is being conducted to better understand the most effective protocol for the density of yellow sticky traps and to continue to refine the protocol for spraying Neem oil and Neem leaf solutions. Such information will continue to help Master Farmers and other farmers use cheaper and safer methods to control pests and increase yields.

Zai holes were initially the technique promoted in association with conservation agriculture by Master Farmers. It led to increased yields, but required significant labor input in the early stages of implementation. Such intense upfront inputs can dramatically limit technology adoption, particularly when the input is labor, which is a major concern for most smallholder farmers. Through the feedback of Master Farmers and PCVs, and the observations of PC staff during the 2011 rainy season, the decision was made to shift the focus on implementing conservation agriculture with zai holes to implementing conservation agriculture with the ripper.

Zai holes were – and still are – promoted by some Master Farmers where agricultural machinery is very limited, such as in areas in the Kedougou and Kolda regions. It is also promoted by most Master Farmers as an improved gardening technique: instead of digging an entire garden bed, a farmer can dig a series of zai holes and plant his crops there. This is particularly effective for crops that spread out, such as watermelon, squash, zucchini and beans, or for crops that can get particularly large and/or can continue to produce fruit for numerous months, such as eggplant, hot and sweet peppers, and okra. Zai holes can also be maintained better as permanent planting locations with vegetables than with field crops because the zai holes would most likely have vegetables growing in them more or less all year round. If zai holes are
used for field crops, there is a stretch of about 8 months during which nothing would be planted in them and wind erosion could be eliminating any trace of the holes.11

The ripper was first developed by a USAID-funded project in Senegal called Wula Nafaa. They developed an initial model and tested it out with numerous farmers. Then, with feedback from them, they worked with local artisans to tweak it and improve it. This process for improving the ripper occurred twice before PC Senegal adopted the ripper for the Master Farmer program. The ripper is still being modified and improved upon – it is currently in its fourth iteration (see Appendix H), which may be tested by some Master Farmers during the 2013 rainy season. This conservation agriculture technique has many potential benefits: it is less labor intense compared to other conservation agriculture techniques, such as zai holes, it achieves the goals of minimal tillage, addition of concentrated soil amendments, and permanent soil coverage, and it allows for crop rotation. Thus, the implementation of such a technique has the potential to significantly increase field crop yields and improve food security.

Master Farmers first used the ripper during the 2012 rainy season. Master Farmers who had access to an animal and a machine for which to attach the ripper were expected to demonstrate the ripper as a conservation agriculture technique that rainy season. During that same rainy season, some Master Farmers used the ripper on fields outside of their Master Farms. Thus, they saw immediate value in the ripper before ever seeing the results of it. Once they had seen results of it, Master Farmers were even more interested in using it.

11 The zai hole technique was initially developed as a land reclamation technique for severely degraded land, so farmers would intentionally dig new zai holes every year, in an effort to gradually build up the soil fertility of the entire field. This is obviously incredibly labor intensive, which would make it a very difficult technique to promote in Senegal. In addition, most of the land on which farmers plant in Senegal is not so severely depleted of nutrients as to necessitate implementing zai holes this way anyway.
During the 2012 rainy season, the ripper led to yields for all three crops (maize, millet and sorghum) that were higher than nationwide averages, regardless of if only organic amendments were added to the demonstration plot or if both organic and synthetic amendments were added. This suggests that the ripper has the potential to increase the yields of both those farmers who are slightly wealthier and able to afford synthetic fertilizer and those farmers who are slightly poorer and unable to afford synthetic fertilizer. The majority of smallholder farmers in Senegal are in the latter group.

However, there are some constraints to adoption of conservation agriculture with the ripper. First of all, it requires the availability of an animal and a machine for which to attach the ripper. (This machine is necessary for the third generation ripper and earlier; the fourth generation requires no attachments as it is made with all necessary parts so it can be attached directly to a draft animal.) Many of the poorest farmers – those who would benefit the most from increased yields – do not own a draft animal nor do they own agricultural machinery. They either do all of their agricultural activities by hand, or they borrow or rent an animal and a machine from a neighbor when they need it. This means that if the poorest farmers wish to implement conservation agriculture, they either need to implement a technique that requires considerable upfront labor inputs, such as zai holes, or be dependent upon borrowing or renting an animal and the ripper from a neighbor – and that also requires that the neighbor had already seen value in the ripper and purchased it and was also willing to lend it to someone else.

Another constraint is that not just any draft animal is strong enough to pull the ripper. It takes time to strip till with the ripper and add the organic amendments and optional synthetic fertilizer to the trenches. Thus, most farmers want to till their soil before the first rains arrive, especially if they are going to plant millet in that field, because millet is often dry seeded (i.e., it
is seeded on bare soil before the first rain). At this time of the year, most soils in Senegal are very dry and compact, so it can be very difficult to till the soil to the depth that is needed for the ripper to be most effective (10-15 cm depth). This is why a strong draft animal is needed, such as an ox (or pair of oxen) or a horse. Donkeys are common draft animals in Senegal, but they are typically not strong enough to pull the ripper through dry, compacted soil. If a farmer is able to wait until after a couple decent rains, then the soil would be looser and any draft animal should be able to pull the ripper.

Some Master Farmers have been innovative in their use of the ripper: they have ripped trenches in their gardening area, filled those trenches with soil amendments (in the same fashion as they did with field crops), and then installed the drip irrigation lines on top of the trenches. This saves the farmers a substantial amount of time because they do not have to dig garden beds or zai holes by hand. If desired, Master Farmers can rip two trenches very close together in order to create a wider trench so that the area around each drip tape that can be planted with a crop can be maximized. By continuing to experiment with and adapt how they use the ripper, Master Farmers could continue to find unique ways to improve their agricultural practices and their food security.

The System of Rice Intensification (SRI) has proven to significantly increase yields throughout West Africa and the world, and it is another technology that is being modified and adapted to Senegal by Master Farmers. The three Master Farmers who attended the SRI TOT in Benin in September 2012, namely Ibou Sarr, Dembo Tigana, and Samba Ly, hosted trainings for members of their communities in May, June and July 2013. More Master Farmers will implement SRI demonstrations during the 2013 rainy season.
There are a couple different general ways in which farmers in Senegal traditionally grow rice: they typically transplant it into irrigated rice paddies (near the Senegal River or in seasonal rivers, for example) or they grow it as rainfed rice by direct seeding it with a machine on non-puddled (upland) soil. Since Master Farms are typically located on soil that is most conducive to growing upland, rainfed rice, Master Farmers promote SRI in that context. In this system, weeding is a major concern. The amount of time spent weeding for both SRI plots and the traditional plots demonstrated at Master Farms in 2011 (and again in 2012) was estimated to be the same (see Table 8.12). The distance between rows (35 cm) and within rows (25 cm or 30 cm) for the SRI plots allowed for machine seeding to occur in both directions, which cuts down on weeding time.

Thinning is an important additional input for SRI that is typically not present in traditional rice growing practices. In SRI, seedlings are thinned to one plant at a very early stage (typically about 10 days after planting). However, instead of thinning, seedlings could be transplanted at that same early stage. Master Farmers appear to prefer thinning to transplanting because thinning takes less time and, if certain precautions are not taken, the young seedlings can have a low survival rate when they are transplanted. Master Farmers should continue to experiment with SRI and adapt it to their individual situations.

9.1.3 Agroforestry Activities

Agroforestry activities have started contributing to improving the food security for Master Farmers. The sale of fruit tree saplings was the second largest source of income for Master Farmers. Many of these trees were not grafted saplings, and increasing the number of non-grafted fruit trees in the tree nursery is relatively easy for Master Farmers to do since it only requires that they gather more materials, namely manure, sand and seeds. The number of grafted
trees that Master Farmers have sold thus far has been severely limited due to the fact that their own grafted trees are only a year or two old and are thus too small to be producing branches that could be used as scions. Within the next few years as these grafted trees grow, Master Farmers will begin to have a steady supply of scions to graft onto rootstock of mango and citrus trees. Selling these grafted saplings could become a significant source of income for Master Farmers, even though they are being encouraged to keep the price at a level that is affordable for their fellow community members – typically about 1,000-1,500 CFA (about 2-3 USD) per sapling.

The grafted trees that have been outplanted in Master Farms have yet to produce fruit, but they will within 3-4 years after outplanting. This fruit will improve the food security of the Master Farmers by providing fruit for their families and acting as a source of income. Some Master Farmers have expressed interest in building solar dryers in order to dry fruit and vegetables for better preservation. There are numerous different models of solar dryers available in Senegal, so Master Farmers will be able to adapt these models to better fit their needs and interests. Drying fruits and vegetables grown in the Master Farm will provide them with another source of income and will provide them and their families with access to nutritious fruits and vegetables year-round. Drying will also reduce spoilage and losses. Thus, drying fruits and vegetables has the potential to both reduce risk and improve the food security of Master Farmers and their families.

Many Master Farmers have other, smaller fruit trees in their garden areas, such as papayas, guavas and bananas. Some of these trees have started producing fruit, which Master Farmers are taking home to their families. Expansion of the number and diversity of these trees, including an introduction of improved varieties, which has started among some Master Farmers but is not widespread, will serve to continue to improve the Master Farmers’ food security.
Many Master Farmers also have Moringa trees in their farms, as alley cropping and sometimes as live fence posts. Several Master Farmers also have Moringa intensive beds, which are garden beds where Moringa trees are planted at 10x10 cm spacing and trimmed regularly for high leaf production. Moringa leaves are incredibly nutritious and can provide children and adults alike with a wide variety of nutrients. The production of Moringa leaf powder is becoming more popular in Senegal, so if Master Farmers expand their Moringa activities, they could produce enough Moringa leaf powder for their families. If Master Farmers were interested in selling Moringa leaf powder, they would probably have to expand their production space outside of the Master Farm because Moringa leaf powder production requires considerable area and the Master Farm should have a variety of demonstrations rather than be monocropped in Moringa.

Most other agroforestry activities, such as live fences, windbreaks, and alley cropping, will not directly improve the food security of Master Farmers. However, they will do so indirectly – by improving the soil fertility, reducing wind and water erosion, protecting crops from pests (such as cows, goats and monkeys), and improving the microclimate of the farm. If Master Farmers continue to maintain and diversify their existing agroforestry activities, they will likely see a continued improvement in their yields and food security.

As with gardening and field crop activities, agroforestry technologies will need to be able to properly engage the market in order to significantly improve food security. There is relatively high demand for fruit, particularly local fruit, throughout Senegal. However, at peak production time for some fruits such as mangoes, a high percentage of the fruit spoils before it can be sold or consumed. This is one reason why some of the grafted varieties of mangoes have been introduced to Master Farms – they produce at different times of the year, thereby spreading out
production over the course of numerous months rather than concentrating production in just a couple months each year.

This issue of spoilage could become exacerbated in the future if, in several years, after orchards with trees from Master Farmers have become established and are producing fruit, then supply will be even higher and will likely surpass the demand. Some might say that this is a good thing since it might imply that fruit has so saturated the market that nearly everyone has access to it. This might not be the case, as it might still be sold at a price that is out of reach of some poorer families. As discussed earlier, food transformation activities, such as drying, canning or otherwise preserving, could help reduce losses and potentially allow for expanded markets because produce can be transported farther distances. All of these options have great potential for continuing to improve the food security of Master Farmers and their families.

9.2 Technology Diffusion Through Master Farmers

As discussed earlier, rate of adoption is defined as the relative speed at which an innovation is adopted by members of a social system (Rogers 2003). According to Rogers (2003), there are five main factors that influence the rate of adoption of innovations:

6. Nature of the social system (ex. its norms, degree of network interconnectedness)
7. Communication channels (ex. mass media, interpersonal)
8. Extent of change agent’s promotion efforts
9. Type of innovation-decision: optional, collective, or authority
10. Perceived attributes of innovations

While these are distinct factors, they often interact with a multiplying effect. Thus, there are several different ways in which the rate of adoption of an innovation could be increased. The Master Farmer program is structured in such a way as to facilitate relatively rapid rates of
adoption. Farmers who are well-respected members of their communities and are experienced with agriculture and/or agroforestry are selected as Master Farmers. They grew up in and continue to be permanent residents of the communities in which they work and, therefore, have a perfect understanding of the language and culture in which they work. Through formal Open Field Days and trainings and daily conversations with neighbors as well as through radio shows, they share new technologies and experiences through both formal and informal interpersonal communication channels as well as through mass media.

Master Farmers collaborate with PCVs to reach out to farmers throughout the surrounding communities and work with them to adopt the improved technologies. The program also acknowledges the existing agriculture knowledge of Master Farmers and builds upon it during trainings. Most of the technologies demonstrated in Master Farms can be adopted individually, though the few that usually require collective adoption, such as organic pest solutions in a community garden, are promoted by training everyone who would need to adopt the technology in order for the technology to be effective. The innovations promoted in Master Farms have been adjusted in order to improve their perceived attributes. Based on regular feedback from Master Farmers and PCVs as well as other community members, the innovations can also be modified and improved to better fit the different situations of farmers throughout Senegal.

9.2.1 Social System, Communication Channels and Master Farmer Promotion Efforts

The first three factors that affect an innovation’s rate of adoption, namely the nature of the social system, communication channels, and change agent’s promotion efforts, interact together quite a bit. The nature of a social system can influence the rate of adoption of an innovation. Senegalese culture values conformation and tradition. The rate of adoption for
innovations is often slower in such cultures compared to other cultures that value individualism more, because an innovative individual is typically looked down upon. However, adoption rates can be faster in such a culture if key community or religious leaders adopt an innovation, because the rest of the community is likely to follow suit.

Even though Master Farmers are typically not the main leader in their community, such as the chief of the village (though a few are), they are well-respected members of their communities. In the survey of 59 farmers who attended Open Field Days at several different Master Farms in October 2011, farmers were asked if they respected the Master Farmer. All 57 farmers who answered that question said yes, they do respect the Master Farmer. When they respect the Master Farmer, community members are more likely to listen to their knowledge and experiences and potentially adopt the innovations.

How potential adopters view the change agent is very important and can affect the rate of adoption of an innovation. In the survey mentioned above, farmers were also asked if they think the Master Farmer experiments and is innovative and if the Master Farmer is more willing than most to try new things. All of the farmers who answered these two questions, except one, said that they think the Master Farmer experiments, is innovative, and is more willing than most to try new things. These answers reinforce the belief from Peace Corps that the Master Farmers can be effective change agents because of their interest in experimenting and being innovative. However, there are many other factors that can affect the effectiveness of a change agent.

The degree to which different communication channels are used can influence an innovation’s rate of adoption. Mass media, for example, can disseminate information to a very large audience very quickly, but it often lacks a personal touch and does not allow for any interaction such as question-and-answer. Interpersonal communication channels, on the other
hand, offer personalized conversations with trusted individuals and follow-up opportunities, but, unless an army of change agents are deployed, information will spread more slowly. This is why Master Farmers and their volunteers often employ both styles of communication in order to more effectively disseminate the information and new technologies. Using a combination of communication techniques is useful in all the different roles Master Farmers play as change agents, from developing a need for change on the part of the client, to creating an intent to change in the client, to translating that intent into action, and finally to stabilizing adoption and preventing discontinuance.

Even though several different teams of Master Farmers and volunteers have produced radio shows, it still accounts for a very small portion of the total number of teams of Master Farmers and PCVs so very few communities are reached through mass media, relative to the total number of communities that could be reached. For example, in the survey of 59 farmers who attended Open Field Days at several different Master Farms in October 2011, of the 58 who answered the question, only two farmers said they had heard of the innovation or innovations through mass media. Thus, there is still a lot of room for increasing the use of mass media in the Master Farmer program.

Radio is the main mass media channel that most smallholder farmers have access to and that Master Farmers and PCVs could realistically tap into. However, most farmers have portable cellular telephones, so they could be used to provide advice or share information from a distance. SMS systems for providing market data among other things are also becoming more prolific in the developing world, so, if a similar system became widespread throughout Senegal, Master Farmers could make use of that information for themselves as well as share it with fellow community members. Some Master Farmers, who speak a common language (which is most of
them), call each other relatively regularly to check in on each other and share experiences or concerns. This helps facilitate the spread of information across regions and, as networks strengthen and grow, could also help other farmers as they begin to adopt the improved techniques promoted by Master Farmers.

Mass media communication channels are relatively more important than interpersonal channels for earlier adopters than for later adopters, but interpersonal channels become more important than mass media for later adopters (Rogers 2003). This suggests that training events like Open Field Days are more effective for earlier adopters, whereas longer-term relationships, such as a series of trainings that involve follow-up visits, will aid later adopters more. In addition, interpersonal channels are more important for all adopter categories (except innovators) at the persuasion stage than at the knowledge stage (Rogers 2003). This suggests that training events like Open Field Days may be beneficial in sharing information with potential adopters, but follow-up from Master Farmers and volunteers is more important as these potential adopters make the decision to adopt the technology.

In the seventeen Open Field Days that fourteen different Master Farmers have hosted since the program started, about 1,250 individuals have learned about the improved technologies. Despite the sometimes relatively large group that makes up the visitors during an Open Field Day, Master Farmers are able to quite clearly explain the various technologies demonstrated in their farms. In the survey of 59 farmers who attended Open Field Days in October 2011, farmers were asked how quickly they are able to understand the Master Farmer when he/she explains an innovation. Over 40% of those who answered this question said that they understand the Master Farmer right away (i.e., no additional questions were required), and over 50% said that only a
couple clarifying questions were needed in order to understand the innovation. Thus, Master Farmers appear to be effectively communicating the new techniques to their targeted audiences.

The so-called innovativeness/needs paradox proposes that the individuals or other units in a system who most need the benefits of a new idea (such as the less educated and the less wealthy) are typically the last to adopt an innovation (Rogers 2003). In other words, the units in a system who adopt first typically need the benefits of the innovation the least. This paradoxical relationship between one’s innovativeness and one’s need for the benefits of an innovation works to widen the socioeconomic gaps between those with higher socioeconomic standing in a system and those with lower socioeconomic standing.

This paradox, however, need not occur. Change agents can pursue a segmentation strategy of “greatest resistance”. This is when communication efforts are focused on the sub-audiences who are lowest in socioeconomic status, who feel the least need for the innovation, and who would ordinarily be the last to adopt. By concentrating extension efforts on those in the lowest socioeconomic status, Master Farmers could become more effective change agents and actively work to reduce this paradox. If a Master Farmer was able to promote the technologies to more than just the lowest socioeconomic status, then the Master Farmer should make use of audience segmentation to identify relatively homogenous groups within a larger community, develop targeted messages for those groups, and then deliver those specialized messages to those groups.

Not surprisingly, networks are also important for continued diffusion of innovations. Those with more connections to others who had adopted an innovation already are more likely to adopt that innovation themselves (Rogers 2003). This suggests that Master Farmers should focus their efforts to convince a few people with very different networks, so that those early adopters
can serve as extensions of the Master Farmers in the other networks. Opinion leaders would be key individuals with broad networks that could help Master Farmers extend technologies.

9.2.2 Type of Innovation-Decision

Generally, innovations with individual adoption decisions will have a higher adoption rate earlier in their promotion than innovations with collective adoption decisions. However, innovations with collective adoption decisions may have a very quick take-off phase when groups, rather than individuals, adopt the innovation. One farmer, who said that the decision to adopt the innovation is made individually, also said that the implementation of the innovation could be organized collectively. Even if the decision to adopt is made individually, implementing the innovation collectively could reduce the chance of incorrectly implementing the innovation as well as reduce the chance of dis-adoption. Another farmer said that the decision to adopt the innovation would be made collectively – by he and his wives, who will be digging the zai holes (for conservation agriculture). This collective decision will require buy-in from everyone involved in the decision-making.

Innovations with authority adoption decisions can have rapid adoption rates if the authority figure oversees numerous people. A female farmer said that the decision to adopt an innovation would be made by an authority: her husband. This is not too surprising: in Senegal, a husband often decides what a wife is going to plant in her field, and wives often help their husbands in their fields (and he in her fields if machinery is required for seeding or weeding). Children are also involved in farming in Senegal, often carrying out simpler tasks such as weeding and harvesting. Thus, since a Senegalese man is allowed to have up to four wives and will typically have numerous children, convincing him to adopt a new technique may mean that many other people are also convinced by default. All of these comments suggest that ensuring
that training for new technologies takes into consideration cultural norms and involves all individuals who may be involved in deciding to adopt as well as actually implementing the technologies – including men and women, and even boys and girls – may increase the rate of adoption.

9.2.3 Perceived Attributes of an Innovation

A key factor influencing innovation diffusion is the perceived attributes of that innovation. As mentioned earlier, the five main perceived attributes of innovations are relative advantage, compatibility, complexity, trialability and observability. These five attributes account for about 49-87% of the variance in the rate of adoption of innovations. The survey that was conducted of 59 farmers who had attended at least one Master Farmer’s Open Field Day in October 2011 sought to evaluate the perceived attributes of the innovations demonstrated at these different Master Farms.

9.2.3.1 Relative Advantage

Relative advantage is the degree to which an innovation is perceived as being better than the idea it supersedes. It is a ratio of the expected benefits and the costs of adopting an innovation. All of the farmers who answered the question regarding whether the innovation provides relative advantage agreed that the innovation does provide relative advantage, except one farmer. This farmer had identified the Neem solution as an organic pest management technique for cowpeas. She said later, when she was asked how compatible the innovation is with respect to perceived needs, that chemical pesticide works better and she is already using that. This reflects a common problem associated with innovation adoption: the currently practiced technique maintains relative advantage over the new technique because of the amount of time and effort that must be spent to achieve a certain benefit.
The farmers who thought that the innovation does provide relative advantage cited numerous reasons for this: the innovation leads to a higher yield (44), is economically profitable (36), conveys social prestige (15), is less labor intensive (19), provides faster results (18), or other (13). One farmer said that mango orchards are economically profitable because mangoes can be eaten, sold and given away as a gift to visitors. Giving gifts to visitors is an important cultural activity, and having a well regarded fruit such as mangoes readily available to give to visitors is sought after by many farmers, especially farmers in areas where mangoes are not as readily available, such as the northern half of Senegal. Another farmer said that conservation agriculture conveys social prestige because it provides more food and money so if you have a guest you can buy them food and gifts. Again, this important cultural activity is evident. Emphasizing these culturally important benefits of the improved techniques demonstrated at Master Farms may increase adoption rates.

9.2.3.2 Compatibility

Compatibility is the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters. As mentioned earlier, an innovation can be compatible or incompatible with any or all of the following: sociocultural values and beliefs, previously introduced ideas, or client needs for the innovation. There are numerous other factors that can affect the compatibility of an innovation: technology clustering, name of the innovation, positioning of the innovation, and indigenous knowledge systems.

The explanations farmers gave for their selection suggest that while an innovation may sometimes be adopted faster if it is compatible with respect to socio-cultural values and beliefs, how to define and delineate those values and beliefs is difficult, so other more specific factors, such as an innovation’s ability to increase yield, may be a better indicator of rate of adoption.
This is evident in the explanations given by the three farmers who said that the innovation they named was incompatible with respect to socio-cultural values and beliefs: the new technique is different from and incompatible with past practices because it emphasizes intensification of agriculture rather than extensification. This does not, however, exclude these farmers from preferring the new technique – and adopting it. One of those farmers added that the technique is still good because it increases yield.

One farmer, who said that the technology is very compatible, gave one stipulation: but they need materials to do it. Needing materials to do a new technique can negatively impact it’s compatibility with socio-cultural values and beliefs as well as its relative advantage over traditional techniques. Most individual techniques promoted through the Master Farmer program do not require many materials – perhaps some manure, seeds, and a few tools – but most gardening and agroforestry techniques require two things that are sometimes very difficult for farmers to have: a fence of some kind and water. This is one reason why live fences are demonstrated in all Master Farms, as well as water-saving techniques such as mulching and drip irrigation systems.

While some farmers emphasized the connection between culture and the improved technologies, others seemed to think this connection was not as strong or as important. One farmer said that the innovations have nothing to do with culture. Another said that their culture is changing a lot and adopting an innovation may be one way to stay up to date with the changes in culture, but the important thing was to support your family no matter what (which is an aspect of Senegalese culture that appears very resistant to western influence and is therefore unlikely to change). Similarly, another farmer gives the impression that the effectiveness of a technique,
rather than its compatibility with socio-cultural values and beliefs, is most important: the technique clearly works, he said, so there is no reason not to do it.

Generally speaking, the more compatible a technique is with current or past practices, the faster the rate of adoption. This is because adopters may have experience that would help them in adopting the new technique or have a context in which to frame the new technique. However, for a new technique to be new, it must be different – even if slightly – from other techniques. It is often the extent of this difference that impacts the rate of adoption of a technique. For example, if current practices are no longer sustainable, then the distinct differences of a new technology compared to current practices could increase the rate of adoption of the new technology, provided potential adopters recognize the un-sustainability of their current practices. Also, if past practices are no longer possible, because of changes in soil quality for example, then a new technology that specifically addresses this change could have a higher rate of adoption – despite the fact that it might be relatively incompatible with past practices, again provided potential adopters recognize the need to change. This suggests that the new technologies would be adopted faster if Master Farmers put more emphasis on convincing other farmers that their current practices are not sustainable and investing in these new techniques is imperative.

Similarly, the more compatible a technique is with perceived needs, the faster the rate of adoption. Over 95% of farmers agreed that the innovation is compatible or very compatible with perceived needs. The one farmer who said that the innovation is neither compatible nor incompatible with respect to perceived needs did not name a specific innovation that he was referring to, but did qualify his answer by saying that compatibility – or incompatibility – depends on the needs. Since many techniques are demonstrated in Master Farms, and this farmer did not name a specific one to which he was referring, he may have been talking about all of the
techniques in general, and viewed some as compatible and some as incompatible with his perceived needs.

The one farmer who said that the innovation is not compatible with respect to perceived needs was referring to the new technique of spraying Neem solution as an organic pest control for cowpeas. She said that chemical pesticide works better and she is already using it. This same farmer had previously said that this new technique does not provide relative advantage, is compatible with respect to socio-cultural values and beliefs, is neither compatible nor incompatible with respect to current or past practices, and is difficult to understand, and the results of the demonstration with this new technique are not obvious. Thus, perhaps part of her unwillingness to accept this new technique is not necessarily due to a problem with the technique itself, but with a poor demonstration of the technique and a poor explanation of the technique’s benefits and of other techniques’ drawbacks, such as negative human and environmental health consequences from using chemical pesticides. Ensuring clear and thorough explanations of techniques, including actual demonstrations of how to implement them, may increase adoption rates.

Promoting inter-related innovations can often increase their rate of adoption, which is why many of the new technologies demonstrated on Master Farms are promoted together. Over 90% of the farmers surveyed in October 2011 said that the technology is part of a technology cluster, and over 90% of them also said that the innovations in the technology cluster are promoted together. This suggests that Master Farmers are effectively conveying the interconnections between various technologies. However, there is room for improvement. One farmer, who said that she did not think the innovations in the technology cluster are promoted together, said that during the Open Field Day she saw synthetic fertilizer being promoted in
combination with traditional techniques, but she did not see new techniques promoted in combination with other new techniques. This perception of the existence of a technology cluster but no promotion efforts related to the technology cluster could cause the rates of adoption for the techniques within the technology cluster to be lower than if they were promoted together as a cluster. Thus, Master Farmers should make more of an effort to promote similar technologies together.

The name of an innovation can also affect its rate of adoption, though it is not clear how much of an effect the names of the technologies demonstrated in Master Farms affects adoption rates. Just over half of the farmers surveyed in October 2011 said that the name of the innovation has a positive or a strong positive effect on their opinion of the innovation, and the remaining farmers said the name of the innovation has no effect on their opinion of the innovation. When Master Farmers are taught a new technology, they are taught the name of the technology in French. However, many of the Master Farmers do not understand French, and, even if they do, many of the farmers in their communities whom they will be teaching do not understand French. Therefore, they are also taught a word or short phrase in the local language(s) that they speak that acts as the name for the new technique. Some of the new techniques can be translated directly from their name in English into a local language, such as “double dig” and “live fence”. However, other techniques have names that do not usually have an equivalent in the local language, such as “mulch” or “companion planting” or “windbreak”. In such cases, short phrases were developed in the local languages to describe that technique, so Master Farmers were taught the name of the technique in French as well as the short phrase in a local language.
For example, mulch is typically referred to as *paillage* (which is “mulch” in French) or the phrase “dry grass/weeds/straw on top of the soil” in a local language. Similarly, windbreak is usually referred to in its French equivalent (*brise-vent*) or the phrase “a line of trees that protect against the wind” in a local language. The exact wording of a phrase in the local language used as the name for a technique changes a little from Master Farmer to Master Farmer, especially with the phrases that are particularly long. Using a phrase that describes what the technique is as a name for the technique may help Master Farmers remember how to do the technique. However, it does not give any suggestion as to what the outcome would be if a farmer adopted the technique nor does it elicit an emotional response, both of which often increase the rate of adoption.

When asked if they had a better name for the innovation, several farmers said yes and provided another name. Several of the new names were words or short phrases in a local language that describe the technique, such as “all natural bug killer”, “dig holes” and “rice circle”, while other names focused on the outcome of implementing the technique, such as reducing work, making farming easier or taking it easy. This suggests that some farmers think that a name for the new technique that describes the technique is an effective name for that technique, while other farmers think it might be more effective to have a name for the technique that means one of the intended results of implementing this technique: less work or an easier life. Thus, PC Senegal should examine the names that they have for the different techniques promoted by Master Farmers and consider developing new names for them.

### 9.2.3.3 Complexity

Complexity is the degree to which an innovation is perceived as relatively difficult to understand and use. The complexity of an innovation, as perceived by potential adopters, is
negatively related to its rate of adoption. Two of the farmers who said the innovation was easy to understand said that it was easy because the materials needed to implement the demonstration are locally and readily available and they are free. This suggests that techniques that involve materials that are not locally available or free, such as a new machine, would be more difficult to understand and, therefore, have a slower adoption rate.

In their explanations for why the techniques are or are not difficult to understand and implement, many farmers said that it would be easier for them to understand and implement if they had the opportunity to actually see the technique being implemented as well as even be able to practice implementing it themselves. These comments suggest that the rate of adoption of the techniques promoted at Master Farms can be increased if potential adopters get more hands-on training regarding the new techniques: it would be best if they could not only see how to implement the techniques but also get a chance to implement them themselves. This is how Master Farmers themselves are trained: they are given relatively brief explanations of various techniques in the classroom, and then have time for lots of practice implementing those demonstrations out in the field. When they return to their own farms, they also have regular visits from their volunteers who continue to provide help and feedback if they are struggling with implementing any given technique.

A similar model for other farmers would help these potential adopters feel more confident implementing the technique in the first place as well as help prevent them from dis-adopting the technique. Potential adopters could practice implementing the new techniques on a small scale at the Master Farm or in a community garden or other applicable space. This will typically help farmers view the technique as less complex, which will help motivate them to implement the technique on a larger scale or over a longer period of time.
9.2.3.4 Trialability

Trialability is the degree to which an innovation may be experimented with on a limited basis. Innovations that can be tried out for a while are more rapidly adopted than innovations that cannot be tested. Similarly, relatively earlier adopters of an innovation typically perceive trialability as more important than do later adopters because later adopters have usually used earlier adopters as their trial. Master Farmers, therefore, play a very important role: through their demonstrations, Master Farmers can significantly reduce or eliminate other farmers’ need for a trial period, thereby speeding up the rate of adoption of the technologies demonstrated at the Master Farm. One farmer, when answering another question (regarding compatibility with respect to perceived needs), acknowledged this important role: he said that you need to try something all the way to the end before you can see a true result. But, he continued, many people do not do that. Thus, having Master Farmers assume the role of trying out and testing new techniques may help other farmers adopt those techniques.

Adaptability is an important component to an innovation and usually becomes evident during the trial phase. A farmer’s perception of the importance of and the difficulty in adapting or experimenting with an innovation can influence the rate of adoption of an innovation. A couple farmers said that it is important to be able to adapt the innovation if, by adapting it, you can make it better. This suggests that an innovation that allows for very little adaptation will have a slower adoption rate than an innovation that has more flexibility for adaptation, because, among other reasons, making changes to improve such an innovation would be limited. If an innovation cannot be changed very much, the range of situations in which an innovation can be adopted (or adapted) will typically be reduced as will the gradual evolution of techniques based on systematic experimentation, chance occurrences or situational differences. Similarly, one
farmer said that being able to adapt the innovation is unimportant if the adaptation is not going to increase yield. So again there is an emphasis not on simply adapting the innovation to fit a specific context, but on actually changing the innovation so it is more effective.

One farmer said that he thinks it is unimportant if he can adapt the innovation because he believes that the innovation (conservation agriculture with zai holes) cannot be adapted. This suggests that if it is easier to adapt or experiment with an innovation, potential adopters may perceive this adaptability characteristic as more important. Similarly, one farmer said that it is neither difficult nor easy to modify the innovation because it is not important. Three other farmers said that it is neither difficult nor easy to modify the innovation because it is not necessary – they think there is no need to change the innovation (conservation agriculture with zai holes). Thus, the importance of and difficulty in modifying an innovation are linked – and making it easier to adapt an innovation will likely make adaptability more important and may increase the adoption rate.

Two farmers said that the innovation is difficult to modify because they do not know the technique. This suggests that a better understanding of a technique will help farmers be able to experiment with and modify an innovation. Another farmer said that it is very difficult to modify the innovation (grafting) because there is only one way that it works. For very specific techniques like grafting it is very difficult, if not impossible, to modify the innovation because of the mechanics behind how the technique works. However, there are several different ways to graft, such as tongue-and-groove grafting, chip budding, top grafting, and top working, and these different ways allow farmers to adapt grafting to different situations.

Not only is it important for farmers to be able to adapt an innovation in general, but they also need to be able to adapt the innovation to fit their specific situation. Several farmers said
that it is difficult to adapt the innovation to their conditions because they do not have materials, such as a sprayer (for pest management) or organic material (for conservation agriculture, for example), or they do not have extra labor to help with implementing the technology. This suggests that demonstrating or at least suggesting ways in which farmers can adapt a technology to reduce the need for extra materials or labor may help them be able to see how they could adapt that technology themselves to fit their own conditions.

The Senegalese school system focuses on memorization and regurgitation rather than critical thinking and analysis. Similarly, Senegalese culture emphasizes tradition, similarity and assimilation, and in some ways discourages creativity and experimentation. Thus, it has been a challenge to get Master Farmers to think critically themselves regarding techniques and how they might be able to change them so they fit their personal situation better. This would be a problem for potential adopters as well. Therefore, a range of demonstrations that involve slight changes and highlight the potential in the technology for adaptation to different conditions may increase the rate of adoption of that technology.

The length of the trial period – or the amount of time that it takes to adequately evaluate the effectiveness of an innovation – can also influence an innovation’s rate of adoption. An innovation with a shorter trial period will typically have a higher rate of adoption than an innovation with a longer trial period. Many agricultural technologies, such as companion planting, proper spacing and thinning, using an improved variety, and mulching, require one growing season in order to satisfactorily see the effectiveness of the technology. However, some technologies, such as a live fence, a windbreak, alley cropping, and grafting, require a few, if not several, years in order to see the effectiveness of the technology.
With some technologies, such as conservation agriculture, composting, utilization of synthetic fertilizer, and chemical or organic pest management practices, the effectiveness of the technology may be partially visible after one growing season, but the effectiveness may become more – or less – visible as time goes on. Conservation agriculture (with zai holes or the ripper) with organic soil amendments, for example, often leads to an increased yield after one growing season, but if a farmer continues to implement this technique for several years, he is likely to see a gradual but continuous increase in his yield. The use of synthetic fertilizer will also typically lead to an increased yield after one growing season, but after several years of using synthetic fertilizer (with minimal or no additional organic amendments) will eventually lead to reduced yields. Therefore, it is important for potential adopters to be aware of both short-term and long-term effects of a technology.

However, in situations where short-term survival is often more important than long-term goals – which is the case for most farmers in Senegal – innovations with short-term benefits are likely to be adopted at a faster rate, regardless of their long-term effects. Therefore, combining techniques that provide both short-term and long-term benefits will likely be adopted faster. For example, farmers could start out by implementing conservation agriculture with both organic amendments and synthetic fertilizer for the first year. Then, add even more organic amendments the second year and less synthetic fertilizer the second year. And so on until synthetic fertilizer is no longer used (nor needed) because the organic matter in the soil has been built up.

9.2.3.5 Observability

Observability is the degree to which the results of an innovation are visible to others. The more observable an innovation is perceived to be by potential adopters, the higher its rate of adoption. In the October 2011 survey, most farmers said that results of the techniques
demonstrated at Master Farms are quite obvious. The vast majority of the farmers were rating the observability of the innovation after just one growing season, though a few were rating the observability after two growing seasons. The farmers who said that results were not obvious were referring to techniques that take a few years to become established, such as a live fence and grafted fruit trees. If Master Farmers are able to get fellow community members to adopt some of the technologies with better observability, then they would probably be more willing to adopt other technologies that require a longer time frame before the results are apparent. Once farmers are “hooked” and buying into the general mentality of the improved techniques at Master Farms, they will most likely adopt the improved technologies more quickly.

9.2.4 Recommendations

Based on the results of these surveys of Master Farmers and potential adopters, as well as observations made during my almost four years working with the Master Farmer program, I have developed several recommendations for ways in which to improve the Master Farmer program.

9.2.4.1 Master Farmer Selection

There are several ways to improve Master Farmer selection. The process of identifying potential Master Farmers should be done more delicately and patiently. Since a volunteer’s counterpart and host family, as well as the chief of the village and other influential members in the community, generally assist the volunteer in identifying progressive farmers to act as work partners for the volunteer, the community could be more involved in assisting with the identification and selection of potential Master Farmers. Community members have helped many volunteers identify and select potential Master Farmers, but their assistance could be more activity sought after. It is imperative that the Master Farmer is a well-respected member of the
community, and involving several different community members in the selection process can help elucidate the reality of this characteristic.

In order to do this, direct assistance from such local community members could be requested from the volunteer (as it has in the past). Throughout this process, it is best to emphasize certain aspects about the Master Farmer program to the community, and downplay, or perhaps not even mention at first, other aspects. This will help PC Senegal find farmers who truly fit the Master Farmer criteria. For example, it is imperative that the Master Farmer be interested in trying new techniques, have significant experience farming (with field crops, gardening and/or fruit trees), and be interested in teaching others and sharing information and materials with the community. Thus, such characteristics should be emphasized when seeking assistance from a community regarding potential Master Farmers.

It is also imperative that the potential Master Farmer has about a one-hectare field that he or she owns and that can be devoted entirely to the program. Some Master Farmers have significantly less than a hectare worth of land that is available in one location to devote to the program, and this limits the number and variety of demonstrations that can take place at any one time in the farm.

The main aspect of the program that should be significantly downplayed during the selection process is the inputs that the Master Farmer will receive (upon selection), such as a chain-link fence, well or water tap, tools, storage shed, and seed and other planting materials. Not surprisingly, when such inputs are mentioned, the individuals providing assistance in finding potential Master Farmers often name themselves or family members. By emphasizing the characteristics of Master Farmers and downplaying the inputs the Master Farmer will receive during the process of finding and selecting Master Farmers, volunteers will be more likely to find
and select farmers who have the necessary characteristics, fit into the Master Farmer program better, and will be active demonstrators and extension agents, rather than farmers who are just looking for a handout.

In order to verify the comments made by influential individuals as well as potential Master Farmers themselves, volunteers should spend a significant amount of time (at least one year, but preferably a few years) working with the potential Master Farmer. Ideally, more than one volunteer, and preferably a male volunteer and a female volunteer, would work with the potential Master Farmer to confirm the potential Master Farmer’s ability to work with a variety of volunteers.

Finally, PC staff members should interview the potential Master Farmer and spend time in the community to verify the Master Farmer’s abilities and interests as well as his role and status in the community. Being Senegalese, staff members are typically better at understanding community dynamics and subtle cultural or language nuances that volunteers might not pick up on. This has become a standard policy in the Master Farmer program, and it is important that it continue.

9.2.4.2 Trainings for Master Farmers

The vast majority of the training for Master Farmers thus far has focused on building up their technical knowledge regarding the techniques that they demonstrate in their farms. Little emphasis has been put on teaching them how to promote these techniques and teach others to use them. This is something that needs to be rectified – if Master Farmers are to become successful change agents, they need to be taught how to teach others, how to follow-up with farmers who are interested in trying new techniques, and generally provide support to farmers implementing
new techniques. This is the only way in which the techniques in Master Farms will diffuse throughout communities at a rate faster than a snail’s pace.

Another way to improve trainings for Master Farmers is to incorporate more nutrition, agribusiness and food transformation topics in their trainings. Master Farmers have already received a little training on such topics, but they need more training on such topics in order to more fully and rapidly improve their food security as well as train other community members in such topics.

9.2.4.3 Technologies Demonstrated on Master Farms

The technologies demonstrated on Master Farms were originally chosen among an endless list of possible technologies because of their applicability to Senegalese farmers, their ability to increase yields at a relatively fast rate, their ability to dramatically improve food security again at a relatively fast rate, and their diversity in nature (i.e., including field crops, gardening and agroforestry). However, in terms of innovation diffusion and achieving the goal of improving the food security of farmers throughout Senegal, how the change agency (i.e., PC Senegal) views these technologies is just as important as how the potential adopters – farmers throughout Senegal – view the technologies and the Master Farmers themselves. Their perceptions were elucidated through interviews at several Open Field Days in October 2011, which have provided insights into how the technologies could be changed or how Master Farmers could adjust their promotion efforts in order to increase adoption rates.

There are a few ways the technologies could be improved upon in order to increase adoption rates: make better names for some of the technologies, combine technologies so that technologies with longer-term results are paired with technologies that have shorter-term results so farmers can see a quicker improvement in food security, and demonstrate a few different ways
in which farmers could implement a technique depending upon the resources that he or she has since not all farmers have the same resources.

Most of the technologies promoted at Master Farms do not have unique names for them – either the French word or phrase is used, or a phrase is created that describes the technology in a local language. Creating unique names for technologies that have cultural significance, for example, may increase their rates of adoption. For example, the name of a popular wrestler, such as Balla Gueye 2, could be used as the name for composting, because composting gives your soil strength. Or a completely made-up name could be used for a technology that could be associated with a jingle or other catchy song or poem that describes the technique and its benefits.

Senegalese culture is largely auditory, involving a lot of tales and other stories shared verbally for example, so providing technical information in a song or other memorable, verbal manner can be particularly effective, especially for illiterate farmers.

Like farmers in many other developing countries, Senegalese farmers are often more concerned about providing for their families in the short-term rather than investing in the long-term. This means that technologies that require several years of inputs before any output is received may have a very slow adoption rate because many farmers simply do not have the luxury to invest in long-term activities when they have numerous mouths to feed today. One way to work around this issue is to combine technologies that require a long timeframe in terms of investment before returns can be expected with technologies that have a quicker turnaround. Using a combination of synthetic fertilizer with organic amendments with conservation farming, as described earlier, is one way to do this.

Another way is to introduce fast-growing trees, such as Moringa or Leuceuna, as both a windbreak and live fence posts (associated with a dead fence of some kind), while incorporating
slower-growing thorny trees to complete the live fence. Like many are already doing, Master Farmers could plant shorter cycle fruit trees, such as papayas, guavas and bananas, in their gardens while they wait for their grafted mangoes and citrus to produce fruit. Also while they are waiting, they could take scions from their grafted trees, graft them onto saplings and then sell those saplings. Master Farmers could also grow vegetables that have a short timeline to harvest, are relatively easy to grow and have relatively few pest problems, such as lettuce and turnips. These activities could provide Master Farmers with some quick cash to pay water bills or other things while waiting for longer-cycle crops to be ready to harvest. These shorter-term activities by Master Farmers could also act as encouragement for other farmers to try them out, which would help them address their immediate concerns and provide them with the financial flexibility and personal confidence to try more longer-term techniques.

Since time and labor restrictions often keep farmers from being able to invest in longer-term activities, Master Farmers could demonstrate the technique of trimming back indeterminate vegetable plants as a way to free up time for investing in other activities while ensuring continuous production. Master Farmers could plant indeterminate crops like eggplant and hot and sweet peppers in a few double-dug beds or zai holes and then, once their production has slowed down, trim them back, re-amend the soil with a little compost or manure, and wait for them to reproduce again. This will help reduce time spent preparing new garden beds, waiting for vegetables to be ready to transplant from the nursery, and then transplanting the vegetables. The yield will decrease slightly with each trimming, but doing this will save Master Farmers time, energy and materials such as seed and will allow for relatively continuous production from a set of plants for well over a year.
The third way to generally improve the techniques demonstrated in Master Farms is to diversify the demonstrations so it is easy to see how other farmers can implement most of the techniques regardless of the resources they have available to them. For example, while there are specific knives designed for grafting, it is possible to graft with almost any knife (though the success rate may decrease), so Master Farmers could emphasize that during trainings. Similarly, while very few farmers can afford a drip irrigation system such as the one installed in Master Farms, some can and Master Farms are an excellent resource for them to see the effectiveness of such a system. But for those who cannot afford it, Master Farmers should continue demonstrating improved gardening techniques with more basic watering systems, such as using store-bought or home-made watering cans.

There are numerous farmers who have access to a draft animal and machines, so it is important for Master Farmers to continue demonstrating the use of machines such as the ripper. However, there are many other farmers, because of their gender, socioeconomic status, or soil type, who are not able to use the ripper on their land. Thus, it is similarly important for Master Farmers to also maintain demonstrations of conservation agriculture with zai holes, so farmers are still able to see the benefits of conservation agriculture. While many farmers are interested in starting an orchard, they often do not have access to a fence to protect an entire orchard. Thus it is important for Master Farmers to demonstrate individual tree protectors as an efficient and effective way to start an orchard.

9.2.4.4 Master Farmer Extension Activities

There are several ways in which Master Farmers can improve their extension activities in order to increase innovation diffusion and improve the food security of other farmers in their communities. The most basic way for Master Farmers to improve is to simply focus more on
extension. Fourteen Master Farmers have hosted at least one Open Field Day in the past three and a half years since the program started, and several of them have hosted more than one as well as some sort of additional training event. However, this represents only about half of the Master Farmers who have been in the program for at least a year. The main reason that these Master Farmers have not had an Open Field Day yet is because it is very difficult to implement all of the required demonstrations – and even more difficult to implement them so successfully that they are useful as teaching tools. It certainly makes sense for Master Farmers to focus on establishing their farms before they begin extension activities. However, it is very important to share the early stages of longer-term activities, such as a live fence, a windbreak, alley cropping, and grafted fruit trees, with community members as soon as possible – this will help them understand such technologies and, if they adopt it, it will help them from dis-adopting it because they will have seen all stages of implementation.

Many community members are skeptical of the technologies demonstrated in Master Farms because they think that it is possible to implement the technologies only if you have all the inputs that Master Farmers have (such as a chain-link fence, well or water tap, tools, etc.). Thus, it is often difficult for Master Farmers to get any sort of buy-in from farmers in the area. One way to do that is to focus initial extension efforts on techniques with quick and dramatic increases in yield and food security. This will draw farmers in and get them interested in the new techniques. Once that has happened, Master Farmers can begin to teach them about other techniques that might involve a longer-term commitment before seeing results.

Another way to improve Master Farmers’ extension activities is to incorporate more nutrition, agribusiness and food transformation information in their extension work. This would require more training for Master Farmers on such topics, which was mentioned earlier. If
farmers know more about the importance of a balanced diet (and especially of eating fruits and vegetables), they may be more likely to be interested in growing such crops and saving them for their family to consume rather than selling them (and buying more rice or oil with the money). If farmers know more about agribusiness, they will be better equipped to sell their produce, which, if they implement techniques demonstrated in Master Farms, will be even more important because they will like have more of a diversity of crops and higher yields. Finally, if farmers know more about food transformation, they will be better able to preserve their diverse crops – for family consumption and/or for sale.

Master Farmers can also improve their extension activities by focusing their extension efforts on specific individuals or groups. There is a “take-off” period that marks the beginning of a period of rapid adoption of the innovation when about 10-20% of the population in the system has adopted the innovation. These new adopters, part of the “early majority” adopter category, rely more heavily on social networks than the innovators or early adopters. These two factors suggest that Master Farmers should make an effort to make promotion connections with several farmers from as many different social networks in their community as possible, in order to reach the 10-20% adoption point as soon as possible. If a Master Farmer does not have the capacity to extend technologies to several different social networks, then he should choose a few and work closely with those networks. Once 10-20% adoption has been reached, and it appears that the early adopters have begun to successfully act as extension agents, the Master Farmer can move on to other social networks.

Master Farmers may not have many choices for which social network(s) to which they can extend technologies. However, they should have a choice of which individuals to whom they extend technologies, and, according to diffusion theory, Master Farmers would be most
successful as change agents if they searched out individuals with the characteristics of opinion leaders and focused their extension activities on them. As discussed earlier, opinion leaders typically are more cosmopolite, have a higher socio-economic status, are more innovative, are very influential individuals in a society and are at the center of interpersonal communication networks. Thus, Master Farmers should focus their extension efforts on opinion leaders because these individuals will most likely not only have the interest and ability to adopt the improved technologies themselves, but also have the connections and leadership to extend those technologies to many others within that social network. After all, “the heart of the diffusion process consists of interpersonal network exchanges and social modeling by those individuals who have already adopted an innovation to those individuals who are influenced to follow their lead” (Rogers 2003, p. 35).

9.2.5 Conclusions

It is evident that the food security of the Master Farmers has improved since they joined the program, though to varying extents. This is remarkable considering the relatively short time frame in which this has occurred: in about three years for the Master Farmers who have been in the program the longest, and in just one to two years for most other Master Farmers. It is also noteworthy considering that food security improvements based upon agriculture depend upon seasons and growing cycles, which require time.

What is less evident is the extent of innovation diffusion that is occurring because of the Master Farmer program. Master Farmers have hosted 26 Open Field Days and numerous other training events, so that about 1,250 individuals have been exposed to the technologies demonstrated at Master Farms. However, very little data has been collected regarding how many of these individuals are adopting or adapting the technologies demonstrated and promoted by
Master Farmers. Therefore, more research needs to be conducted to determine the extent of innovation diffusion due to Master Farms.

Based on the research presented in this paper, specific improvements have been recommended in order to improve the Master Farmer program and make it more effective at diffusing technologies and improving food security. However, given the results so far, the Master Farmer program is definitely on the right track and the food security of Master Farmers and other farmers across Senegal is improving. And as the improved techniques demonstrated and promoted by Master Farmers continue to spread, improvements in food security should also continue to reach more and more communities throughout Senegal.
Lettre d’Agreement entre le Corps de la Paix Américain et

Paysan pilote ____________________________,

[Pronom et Nom]

__________________________________________, ______________________

[Voisin] [Région]

Partnership Agreement between the American Peace Corps and

Master Farmer ____________________________,

[Name]

__________________________________________, ______________________

[Site name] [Region]
Entre les soussignés

Le Corps de la Paix Américain de Dakar représenté par M. Famara Massaly, son Directeur Adjoint,

The American Peace Corps in Dakar represented by Famara Massaly, Associate Director,

D'une part,

Et,

_________________________ producteur agricole, demeurant dans le village de _____________________, région de _______________________, dénommé « Paysan pilote »

____________________________, farmer, resident of the village of _________________________ in the ______________________ region, named “Master Farmer”

D’autre part,

IL EST CONVENU ET ARRETE CE QUI SUIT

ARTICLE PREMIER : ODBET DU CONTRAT

Dans le cadre du programme de Sécurité alimentaire (Food Security) du Corps de la Paix qui vise avec l’appui des Volontaires Américains basés dans les villages, à améliorer la production, la transformation et la consommation des produits agricoles à travers l’augmentation mais surtout la diversification de la production, il est prévu de mettre en place des -centres de démonstration et de formation dans chaque département.

The Peace Corps Food Security Program aims to support Americans Volunteers based in villages to improve production, processing and consumption of agricultural products. This will be done by increasing and the diversifying production. In the planned demonstration sites, technologies for increasing and diversifying production will be demonstrated and trainings will be held.

Les centres d’une superficie de 0.5-1 ha sont des lieux de production agricole et agroforestière, de formation de producteurs et de volontaires, et de démonstration et d’expérimentation de nouvelles technologies par les volontaires et le paysan pilote. Ils appartiennent aux producteurs impliqués dans le programme qui sont les propriétaires exclusifs de toute la production issue de ces fermes. Le Corps de la Paix appuie le paysan pilote dans l’installation, l’équipement de ces fermes, la mise en œuvre des technologies et la formation. A terme le centre de formation et de démonstration des technologies sera un site de diffusion de semences et plants pour les besoins de la production locale.

These sites will have an area of 0.5-1 hectares. They are to be places of agricultural and agro-forestry production, places of training for farmers and volunteers, and places of demonstration & experimentation for new technologies by volunteers and the master farmer. These sites will be the exclusive property of the master farmers as well as all the resulting production. The Peace Corps will support the farmer in designing these sites, setting up farm equipment, implementing technologies and providing training. These training and demonstrations sites will ultimately be a local source of seeds and materials for agricultural and agroforestry production.

ARTICLE 2 : ENGAGEMENT DU CORPS DE LA PAIX

Le Corps de la Paix s’engage, dans le cadre du présent contrat, à :

The Peace Corps is committed, under the present agreement, to:

§ Collaborer étroitement avec le paysan pilote, par le biais de son staff et des volontaires établis dans la zone d’intervention, pour l’implantation du centre de démonstration et de formation et pour la mise en œuvre des technologies pour une durée minimale de quatre années;

Work closely with the master farmer, through its staff and volunteers based in the targeted area, to set up the demonstration site and provide training for the implementation of technologies for a minimum of four years;

§ Se concerter avec le paysan pilote avant la mise en place d’une culture ou d’une technologie dans la ferme. Pour se faire, les volontaires et le paysan pilote établiront pour chaque trimestre un programme d’activités ;

Collaborate with the master farmer to plan the implementation of a crop or technology in the farm. To do this, volunteers and the master farmer will establish a quarterly activity programs;

§ Mettre à la disposition du paysan pilote, en fonction des réalités locales, tout le matériel nécessaire à l’implantation du centre de démonstration et de formation et à la mise en œuvre des technologies ;

Supply to the master farmer, according to the local situation, all the equipment necessary for the implementation of the demonstration site, training and implementation of technologies ;

§ Creuser, si nécessaire et économiquement et techniquement faisable, un puits pour une bonne irrigation des spéculations mises en place ;

Dig a well for irrigation purposes, if necessary and economically and technically feasible ;

§ Mettre en place, en cas de besoin, un système d’irrigation approprié pour servir de démonstration mais aussi entretenir certaines spéculations mises en place ;

Establish, if necessary, an irrigation system suited to serve as a demonstration and also to support other demonstrations;

§ Appuyer le paysan pilote dans la protection de la ferme - par le biais d’un grillage (0.5-1 ha selon le contexte local) ;

Help master farmers enclose and protect their farm with a wire fence (0.5-1 ha depending on local circumstances) ;

§ Mettre en place une démonstration de haie vive tout au long du grillage ;

Establish for demonstration a live fence along side the fence ;

§ Former le paysan pilote et les personnes qui travaillent dans la ferme à la mise en place des cultures agricoles et des technologies agroforestières;

Train master farmer and others who work in the farm to the establishment agricultural and agroforestry technologies ;

§ Mettre à la disposition du paysan pilote tous les intrants nécessaires à l’implantation d’une culture ou d’une technologie dans le cas de son utilisation pour une démonstration ou à la formation des producteurs ;

Make available to farmers all materials for the establishment of a culture or technology if it is to be used for demonstration or training purposes;

§ Apporter toute l’assistance technique nécessaire au bon déroulement des travaux dans le cadre de ce programme ;

Provide any technical assistance necessary for the proper conduct of work under this program ;

§ Assister le paysan pilote dans la mise en place des démonstrations, l’entretien et le suivi des cultures ;

Assist the master farmer in the implementation of demonstrations, maintenance and monitoring of crops;
§ Faciliter l'organisation des journées portes ouvertes (en moyenne 4 par an) du centre de démonstration et de formation ;

Facilitate the organization of open field days (average 4 per year) at the demonstration site;

§ Faciliter la Connexion du paysan pilote avec tout paysan désireux de suivre une formation au sein du centre;

Facilitate the connection of the master farmer with any "intern" farmer wishing to be trained in the center;

§ Appuyer le paysan pilote à travers une intermédiation pour l'acquisition de matériel ou d'intrants agricoles et /ou agroforestières dans le cas de son utilisation personnelle ;

Support the farmers through mediation for the purchase of equipment and agricultural inputs and / or agroforestry in the case of personal use ;

§ Et, participer à une évaluation trimestrielle et annuelle des activités.

Participate in a quarterly and annual evaluation activities.

ARTICLE 3 : ENGAGEMENT DU PAYSAN PILOTE

Le Paysan pilote s'engage à :

The master farmer will:

§ Collaborer étroitement avec staff du Corps de la Paix et les volontaires établis dans la zone d'intervention pour l'implantation du centre de démonstration et de formation et la mise en œuvre des technologies pour une durée minimale de quatre années ;

Work closely with Peace Corps staff and volunteers in the area of intervention at the demonstration site and implement technologies for a minimum of four years ;

§ Mettre à la disposition du programme, une parcelle agricole (0.5-1 ha selon la disponibilité) avec tous les titres de propriété requis,

Make available to the program, an parcel of agricultural land (0.5-1 ha depending on availability) with all the required title;

§ Utiliser prioritairement tous les moyens reçus dans la mise en œuvre des démonstrations.
Toutefois les intrants seront exclusivement réservés à la mise en place des démonstrations;

Use all inputs received in the implementation of demonstrations. Furthermore, all inputs will be reserved exclusively to the establishment of demonstrations;

§ Bien entretenir et conserver le matériel et les intrants mis à sa disposition ;

Well maintain and conserve all material and inputs that are supplied ;

§ Fournir la main d’œuvre nécessaire à la mise en œuvre des démonstrations et leur suivi ;

Provide manpower needed to implement the demonstration and monitoring;

§ Entretenir toutes les spéculations agricoles et les technologies agroforestières mises en place dans le cadre de ce programme,

Maintain all demonstration agricultural and agroforestry technologies developed within the framework of this program;

§ Fournir toutes les informations relatives aux quantités récoltées, consommées ou vendues, aux revenus et à l’évolution des technologies mises en place ;
Provide all information relating to quantities harvested, consumed or sold, income and technological developments introduced ;

§ Accepter d’accueillir d’autres producteurs dans la ferme pour des journées portes ouvertes, des séances de formation ou des visites d’échange;
Accept to host “intern” master farmers during the farm open days, training sessions or on exchange visits;

§ Faire des présentations de technologies durant les journées portes ouvertes, des séances de formation ou des visites d’échange ;
Make technology presentations during the open days, training sessions and exchange visits ;

§ Former les producteurs qui sont intéressés par la mise en place d’une culture, du jardinage ou l’implantation d’une technologie agroforestière;
Train farmers interested in the establishment of farming methods, gardening or the establishment of an agroforestry technology;

§ Se concerter avec les Volontaires du Corps de la Paix avant la mise en place de toute spéculation pour son propre compte;
Consult with Peace Corps Volunteers before the establishment of the establishment of any crop for personal use;

§ Et, Participer aux réunions d’évaluation trimestrielles et annuelles des activités avec le Volontaire et les autres représentants du Corps de la Paix.
Attend quarterly meetings and annual evaluation activities with Volunteers and other representatives of the Peace Corps.

ARTICLE 4 : SUIVI ET EVALUATION

Le Corps de la Paix :

Un suivi régulier de toutes les cultures agricoles et technologies agroforestières mises en place dans la ferme se fera par les Volontaires du Corps de la Paix basé dans la zone. Ils seront appuyés dans par l’Assistant de programme, les Formateurs techniques, le Directeur Adjoint du Corps de la Paix et tout autre personnel technique relevant du Corps de la Paix.

Regular monitoring of all agricultural crops and agroforestry technologies on the demonstration site will be conducted by Peace Corps Volunteers in the area. These work will be supported by Program Assistants, Technical Trainers, the Associate Director of Peace Corps and other technical personnel of the Peace Corps.

Une auto-évaluation du programme se fera à la fin de chaque année. Le Corps de la Paix s’engage à produire un rapport d’activités trimestriel et annuel et un rapport final à la fin du programme.
A self-assessment program will be done at the end of each year. The Peace Corps will produce a report quarterly, an annual activities and a final report at the end of the program.

Une copie de chacun de ces documents sera transmise au paysan pilote.
A copy of each documents will be supplied to the master farmer.

Le Paysan pilote :

Un suivi des cultures agricoles et des technologies agroforestières se fera régulièrement par le paysan pilote.
Monitoring agricultural crops and agroforestry technologies will be done regularly by the master farmer.

Une auto-évaluation du programme se fera à la fin de chaque trimestre et de chaque année avec les représentants du Corps de la Paix.

A self-assessment program will be done the end of each quarter and each year with Peace Corps representatives.

**ARTICLE 5: FINANCEMENT**

Le Corps de la Paix s'engage à :

*The Peace Corps is committed to:*

1. Fournir tous les investissements et intrants nécessaires à l'implantation du centre de démonstration et de formation.

   *Supply all investments and inputs necessary for the implementation of the demonstration site.*

2. Prendre en charge les frais relatifs à l’organisation des journées portes ouvertes et des formations de courte durée.

   *Cover all costs related to the organization of open field days and short training courses.*

Le paysan pilote s’engage à:

*The master farmer is committed to:*

1. Mettre à la disposition du programme une parcelle agricole avec tous les papiers garantissant la propriété de celle-ci par ce dernier.

   *Supply to the program a parcel of agricultural lands and all the papers confirming master farmer's ownership.*

2. Prendre en charge la main d'œuvre nécessaire à la bonne exécution de ce programme.

   *Provide the manual labor and exertion necessary to the good execution of this program.*

3. Faciliter l’hébergement et la restauration des visiteurs.

   *Facilitate the lodging for all visitors.*

**ARTICLE 6: DUREE D'EXECUTION**

La durée du programme est de quatre (04) ans à compter de la date de signature du présent contrat.

*The program duration is four (04) years from the date of signature of this contract.*

Le contrat expire à la période indiquée sauf en cas de renouvellement d'un commun accord, constaté par écrit.

*The contract expires at the specified period unless renewed by mutual agreement in writing.*

**ARTICLE 7: MODIFICATION**

Toute modification apportée aux dispositions du présent contrat fera l'objet d'un avenant accepté par les deux parties.

*Any changes to the provisions of this contract will be an amendment accepted by both parties.*

**ARTICLE 8: REGLEMENT DES LITIGES**
Tout litige pouvant naître de l'exécution du présent contrat, sera réglé à l'amiable ou porté devant une commission paritaire de conciliation formée par les deux parties.

Any dispute arising from the execution of this contract shall be settled amicably or brought before a joint conciliation commission formed by the two parties.

ARTICLE 9: RESILIATION

Le présent contrat peut être résilié d'un commun accord:
This contract may be terminated by mutual agreement:
- en cas de force majeure,
  * In case of unforeseen events or acts of God
- en cas de non-respect des obligations par l'une des parties.
  * For non-compliance by either party.

La partie qui en prend l'initiative devra en informer par lettre motivée l'autre partie au moins un (1) mois à l'avance.

The initiating party should inform the other party by registered mail at least one (1) month in advance.

Si le paysan pilote prend unilatéralement la décision de rompre le contrat, il devra restituer au Corps de la Paix tout le matériel mis à sa disposition.

If the master farmer supports the decision to unilaterally break the contract, he will return to the Peace Corps all the equipment that was supplied.

ARTICLE 10 : ENTREE EN VIGUEUR

Le présent contrat entre en vigueur dés sa signature par les deux parties.

This Agreement shall enter into force upon signature by both parties.

Fait à ______________________, le _____ ___________________ ________

Signed in _________________, on ___________  _____, ________

Pour le Corps de la Paix
For Peace Corps

Pour le Paysan pilote
For the Master Farmer

Famara MASSALY

______________________________
APPENDIX B: Yearly Minimum Goals for Master Farmers

### Yearly (Minimum) Goals for Master Farmers

<table>
<thead>
<tr>
<th>Year</th>
<th>Field Crop Goals</th>
<th>Gardening Goals</th>
<th>Agroforestry Goals</th>
</tr>
</thead>
</table>
| 1    | - 3 out of 5 demos (ex., millet, thinning; sorghum, thinning; rice, SRI; cowpea IPM; corn, conservation farming) - Host an Open Field Day (if applicable) | - 1 variation of 2 of these 4 demos:  
  - IPM  
  - Soil amendment  
  - Mulching  
  - Companion planting  
  - MF's own demo  
  - Host an Open Field Day (if applicable) - Host interns whenever possible | - Live fence, 50%  
  - Alley cropping, 50%  
  - Windbreak, 100%  
  - Improved mango & citrus trees, 50% |
| 2    | - 3 out of 5 demos  
  - Seed storage demo (ex. phostoxin vs. neem vs. ash)  
  - Host an Open Field Day (if applicable)  
  - Host interns whenever possible | - 1 variation of all 4 of these 4 demos:  
  - IPM  
  - Soil amendment  
  - Mulching  
  - Companion planting  
  - MF's own demo  
  - Host an Open Field Day (if applicable)  
  - Host interns whenever possible | - Live fence, 100%  
  - Alley cropping, 100%  
  - Improved mango & citrus trees, 100%  
  - Other fruit trees: ex., papaya (25), guava (10), banana (5), sweetsop (2), soursop (2)  
  - Nursery with grafted *ziziphus*  
  - Nursery with variety of fruit trees, ex., mango, guava, papaya  
  - Prune live fence and replace trees that didn't survive  
  - Host interns whenever possible |
| 3    | - 4 out of 5 demos, plus MF's own demo  
  - Seed storage demo  
  - Produce, save and distribute high quality seed of improved varieties  
  - Host an Open Field Day (if applicable)  
  - Host interns whenever possible | - 1 variation of all 4 of these 4 demos:  
  - IPM  
  - Soil amendment  
  - Mulching  
  - Companion planting  
  - MF's own demo  
  - Host an Open Field Day (if applicable)  
  - Host interns whenever possible | - Nursery with variety of fruit trees and grafted *ziziphus*  
  - Maintenance of live fence, alley cropping, windbreak, and fruit trees  
  - Host interns whenever possible |
| 4    | - 4 out of 5 demos, plus MF's own demo  
  - Seed storage demo  
  - Produce, save and distribute high quality seed of improved varieties  
  - Host an Open Field Day (if applicable)  
  - Host interns whenever possible | - 1 variation of all 4 of these 4 demos:  
  - IPM  
  - Soil amendment  
  - Mulching  
  - Companion planting  
  - MF's own demo  
  - Host an Open Field Day (if applicable)  
  - Host interns whenever possible | - Nursery with variety of fruit trees and grafted trees, ex., *ziziphus*, mango, citrus  
  - Maintenance of live fence, alley cropping, windbreak, and fruit trees  
  - Host interns whenever possible |
| 5+   | Same as year 4   | Same as year 4   | Same as year 4    |

Throughout MF program implementation:
- Baseline survey when MF enters program; follow-up annual survey
- Data collection for demonstrations, income, etc.
- Monitoring and evaluation of demonstrations, activities, income, etc.
Enquête : Extermination des Nuisibles

1. Quelles sont les pestes dans le jardin ? Comment a-t-elle traite les attaques ?

<table>
<thead>
<tr>
<th>Insectes Nuisibles</th>
<th>Traitement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

2. Quelles techniques est-ce qu’elle a applique dans son jardin ?

<table>
<thead>
<tr>
<th>Technique</th>
<th>Oui/Non</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pepiniere couverte</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rotation des cultures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cultures associees</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pesticides Biologiques</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plaques jaunes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Irrigation reguliere</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3. Quelles techniques est-ce qu’elle n’a pas bien compris ? Qu’est-ce que c’est manque de la formation ?

4. D’où est-ce qu’elle a eu des semences ?


<table>
<thead>
<tr>
<th>Type de semence</th>
<th>Methode de Conservation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

6. Est-ce qu’il y a quelqu’un qui l’aide dans le jardin ?

7. A qui est-ce qu’elle a montré des techniques de jardinage ? Combien des femmes/hommes ?
Potential Adopter Survey

Interviewer Information

1. Name of the interviewer: __________________________________________
2. Village of the interviewer: ________________________________________
3. Region: _________________________________________________________
4. Language in which the interview is being conducted: __________________
5. How many interviews have you conducted in this village (including this one): __________ (example: if this is your first interview in this village, write “1”; if this is your third interview, write “3”)

Potential Adopter Demographics

6. Name of the potential adopter: ______________________________________
7. Village of the potential adopter: _____________________________________
8. Is the potential adopter a PCV’s pilot farmer?  Yes_____ No_____ [to be answered by the PCV in the village]
9. What is the potential adopter’s sex?
   1. Male
   2. Female
10. How old are you? _______ years
11. How many years did you spend in formal education (i.e., in the French school system)? _______ years (round to the nearest whole number)
12. Are you literate? Yes_____ No_____ 
13. If yes, in what language(s)? (circle all that apply)
   1. Arabic
   2. French
   3. Local language (ex. Wolof, Pulaar), specify ________________________________
14. [If the potential adopter is male:] How many wives do you have? _______ wives
15. How many children do you have? _______ children
16. How many people 13 or older do you support financially? ________ people supported financially

17. How many people younger than 13 do you support financially? (children < 13 years = 0.5 person) ________ people supported financially

   TOTAL people supported financially (i.e., Q#16 + Q#17): __________

18. What kind of house do you have?
   1. Hut – how many maintained? ______
   2. Battiment
   3. Other ________________________________

19. What is your household’s main source of income?
   1. Farming/gardening
   2. Animal husbandry (i.e., buys/sells/raises animals)
   3. Transport (car/truck/cart)
   4. Trade
   5. Civil service
   6. Family members working in the village (ex. as masons or boutique owners)
   7. Family members working elsewhere (ex. in Dakar or abroad)
   8. Other ________________________________

20. What is your main type of employment for yourself as an individual?
   1. Farming/gardening
   2. Animal husbandry (i.e., buys/sells/raises animals)
   3. Transport (car/truck/cart)
   4. Trade
   5. Civil service
   6. Family members working in the village (ex. as masons or boutique owners)
   7. Family members working elsewhere (ex. in Dakar or abroad)
   8. Other ________________________________

21. In what secondary income-generating activities do you engage? (circle all that apply)
   1. Farming/gardening
   2. Animal husbandry (i.e., buys/sells/raises animals)
   3. Transport (car/truck/cart)
   4. Trade
   5. Masonry
   6. Woodworking
   7. Tailoring
   8. Metalworking
   9. Baking
   10. Beekeeping/honey collecting
   11. Orchard management
   12. Fence making
   13. Teaching (secular/religious)
14. Other ________________________________

22. How many fields do you cultivate during the rainy season? ______ fields

23. What is the average size of your field(s)? ______ ha (round to nearest half ha)

24. How many hectares did you cultivate during the 2010 rainy season? ______ ha (round to the nearest half ha)

25. How many hectares are you cultivating during the 2011 rainy season? ______ ha (round to the nearest half ha)

26. How many hectares did you cultivate during the 2010-2011 dry season? ______ ha (round to the nearest quarter ha)

27. How many hectares will you cultivate during the 2011-2012 dry season? ______ ha (round to the nearest quarter ha)

28. How many family members do you have abroad? ______ family members

29. How many groups do you belong to? _____ groups

30. [If you belong to a group/groups:] What kind of group(s)?
   1. Farmer’s group
   2. Women’s group
   3. Community development group
   4. Savings group
   5. Work-related group (NOT farming related) (ex. teacher’s group)
   6. Religious group
   7. Other ___________________________________________

31. How many people do you know who have adopted one or more of the Master Farmer’s innovations? ______ people

32. Specify the average frequency (# times/month) that you carried out the following activities in the past year:

<table>
<thead>
<tr>
<th>Activity</th>
<th>0</th>
<th>1-5</th>
<th>6-10</th>
<th>11-15</th>
<th>16-20</th>
<th>21-25</th>
<th>26-31</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traveled &gt;10 km from home</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Listened to the radio</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Attended community meetings/gatherings</td>
<td></td>
<td></td>
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<tr>
<td>Saw the nearest</td>
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<td></td>
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</tr>
</tbody>
</table>
Perceived Attributes of Innovations and Master Farmers

All of these questions are looking for the opinion of the potential adopter, so you [the interviewer] can start each question with: “In your personal opinion…”

33. Does the innovation provide relative advantage (i.e., is the innovation better than the traditional practice)?  Yes_____ No_____  
34. If yes, why? The innovation... (circle all that apply)  
   1. Leads to a higher yield  
   2. Is economically profitable  
   3. Conveys social prestige  
   4. Is less labor intensive  
   5. Provides faster results  
   6. Other: __________________________________________________________________________

35. How compatible is the innovation with respect to socio-cultural values and beliefs?  
   1. Very compatible  
   2. Compatible  
   3. Neither compatible nor incompatible  
   4. Incompatible  
   5. Very incompatible  
36. If incompatible, why?  
   __________________________________________________________________________

37. How compatible is the innovation with respect to current or past local practices?  
   1. Very compatible  
   2. Compatible  
   3. Neither compatible nor incompatible  
   4. Incompatible  
   5. Very incompatible  
38. If incompatible, why?  
   __________________________________________________________________________

39. How compatible is the innovation with respect to perceived needs?  
   1. Very compatible
2. Compatible
3. Neither compatible nor incompatible
4. Incompatible
5. Very incompatible
40. If incompatible, why?

41. Is the innovation part of a technology cluster (i.e., are there other technologies that could be adopted in order to achieve better results for this innovation; examples of different technology clusters: promoting hexagonal spacing with companion planting and double digging, or promoting Zai holes/conservation farming and adding not just manure but also charcoal, ash and leaves)? Yes_____ No_____ 
42. If yes, are the innovations in the technology cluster promoted together? Yes_____ No_____ 

43. How has the name of the innovation affected your opinion of the innovation (i.e., what do you think of the name of the innovation)?
1. Strong positive effect
2. Positive effect
3. No effect
4. Negative effect
5. Strong negative effect
44. If there’s a negative effect, why?

45. Do you have a suggestion for a better name for the innovation?
1. Yes_____ better name: ________________________________(in local language/French & English)
2. No_____ 
46. How difficult is the innovation to understand? 
1. Very difficult
2. Difficult
3. Neither difficult nor easy
4. Easy
5. Very easy
47. If difficult, why?

48. How difficult is the innovation to implement? (Examples: Are there many steps involved? Does it require specific technical skills like grafting does?)
1. Very difficult
2. Difficult
3. Neither difficult nor easy
4. Easy
5. Very easy
49. If difficult, why?  ___________________________________________________________

50. How difficult is the innovation to maintain over a length of time?
   1. Very difficult
   2. Difficult
   3. Neither difficult nor easy
   4. Easy
   5. Very easy
51. If difficult, why?  ___________________________________________________________

52. How difficult is it to experiment with/adjust/modify the innovation?
   1. Very difficult
   2. Difficult
   3. Neither difficult nor easy
   4. Easy
   5. Very easy
53. If difficult, why?  ___________________________________________________________

54. How long does the trial period need to be to satisfactorily evaluate the effectiveness of the innovation?
   1. 1 month
   2. 3 months
   3. 6 months
   4. 9 months
   5. 1 year
   6. 1.5 years
   7. 2 years
   8. 3 years
   9. 4 years
  10. 5 years
  11. >5 years
55. How difficult is it to adapt the innovation to your conditions?
   1. Very difficult
   2. Difficult
   3. Neither difficult nor easy
   4. Easy
   5. Very easy
56. If difficult, why?  ___________________________________________________________

57. How important to you is it that you can adapt the innovation?
   1. Very important
   2. Important
   3. Neither important nor unimportant
4. Unimportant
5. Very unimportant

58. If unimportant, why?

______________________________________________________________________

59. How obvious are the results of the innovation?
   1. Very obvious
   2. Obvious
   3. Neither obvious nor not obvious
   4. Not Obvious
   5. Very not obvious

60. If not obvious, why?

______________________________________________________________________

61. How is the decision to adopt the innovation made?
   1. Made by an individual
   2. Made collectively
   3. Made by an authority

62. How has the innovation been communicated to you? (circle all that apply)
   1. Through mass media
   2. Through interpersonal communication channels
   3. Other, ________________________________________________________

63. How quickly are you able to understand the MF when he explains an innovation?
   1. Right away, no additional questions needed
   2. A couple clarifying questions need to be asked
   3. Several clarifying questions need to be asked
   4. Never am able to understand the MF

64. Do you respect the MF? Yes_____ No_____

65. Do you think the MF experiments and is innovative? Yes_____ No_____

66. Do you think the MF is more willing than most to try new things? Yes_____ No_____
APPENDIX E: Exemption by Cornell University’s Institutional Review Board

Institutional Review Board for Human Participants

Concurrence of Exemption

To: Danielle Stoerner
From: Matthew Aldridge, Senior IRB Administrator
Date: May 05, 2011
RE: Protocol ID#: 1105002210
Project(s): Master Farmer Food Security and Innovation Diffusion Surveys in Senegal

A member of the Office of Research Integrity and Assurance (ORIA) has reviewed the above-referenced project and found it to qualify for Exemption from IRB Review according to paragraph #2 of the Department of Health and Human Services Code of Federal Regulations 45 CFR 46.101(b).

This proposal has not been evaluated for scientific merit, except to weigh the risk to the human participants in relation to the potential benefits.

Please be aware of the following:

- Exemption from IRB review does not absolve the investigator from ensuring that the welfare of the research subjects is protected and that methods used and information provided to gain participant consent are appropriate to the activity. It is your responsibility as a researcher to familiarize yourself with and conduct the research in accordance with the ethical standards of the Belmont Report (http://ohsr.od.nih.gov/guidelines/belmont.html).
- You must notify the ORIA office of changes or amendments to the above-referenced protocol BEFORE their implementation.
- You are not required to submit progress reports or requests for continuing review/approval to ORIA, unless you modify your study protocol.

cc: Peter Hobbs
APPENDIX F: Master Farmer Evaluation Study Consent Form

Master Farmer Evaluation Study Consent Form

You are being asked to take part in an evaluation study of Peace Corps/Senegal’s USAID-funded Master Farmer program.

The purpose of this study is to evaluate how effective the Master Farmer program is at improving the food security of the Master Farmers and at sharing new technologies with other farmers.

If you agree to be part of this study, I will conduct an interview with you. The interview will include questions about your work and other activities, your family, and what you think about the technologies in the Master Farmer field. The interview will take about 30 minutes to complete.

I do not anticipate that you will experience any out of the ordinary risks by participating in this study.

There are no benefits to you by participating in this study besides know that, by participating, you are helping us improve the Master Farmer program.

You will receive no compensation for participating in this study.

Your answers will be confidential. In any sort of report we make public we will not include any information that will make it possible to identify you.

Taking part in this study is completely voluntary. You may skip any questions that you do not want to answer. If you decide not to take part or to skip some of the questions, it will not affect your current or future relationship with Peace Corps. If you decide to take part, you are free to withdraw at any time.

The researchers conducting this study are Danielle Stoermer, aka Ndeye Diaw, and Famara Massaly. Please ask any questions you have now. If you have questions later, you may contact Danielle at 77.330.48.63 or Massaly at 77.637.42.72.

You will be given a copy of this form to keep for your records.

Statement of Consent: I have read the above information, and have received answers to any questions I asked. I consent to take part in the study.

Your Signature ___________________________________ Date __________________________

Your Name (printed) ___________________________________ Date __________________________

Signature of person obtaining consent _______________________________ Date __________________________

Printed name of person obtaining consent _______________________________ Date __________________________
APPENDIX G: Master Farmer Resources on PC Senegal’s Website

Many more resources related to Peace Corps Senegal’s Master Farmer program can be found on PC Senegal’s website in the Master Farmer library:

http://www.pcsenegal.org/libraries/30-master-farmer

APPENDIX H: The Fourth Generation Ripper

Source: Susan Trainor
REFERENCES


