

IMPACT ASSESSMENT PLAN

Republic of Senegal

Projet d'Appui aux Filières Agricoles (PAFA)

Authors:

Markus Olapade
Alessandra Garbero



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Introduction

In 2008, the Executive Board of IFAD approved the Agricultural Value Chains Support Project (PAFA: *Projet d'Appui aux Filières Agricoles* in French), which took effect on February 5, 2010. Actual project implementation started in 2011. The project completion date was on March 31, 2016, and its financial closure on September 30, 2016. PAFA is co-financed by IFAD, the State of Senegal, contributions from beneficiaries, and the Global Environment Fund (GEF).

The main focus of PAFA is to foster rural development and poverty reduction. Through the activities implemented during the course of PAFA, project beneficiaries are expected to experience an increase in their revenue from agricultural production through increased access to markets, improved coordination between the actors in the agricultural value-chains, and greater access to infrastructures.

The objective of this document is to outline the ex-post impact assessment plan of the selected PAFA activities. The proposed impact assessment for this project is relevant to the implementing institution at the regional, national, and international levels, and for the greater public interested in rural development policy. Impact assessments of agricultural projects are important for both accountability and learning about policies' effectiveness, as they help generate lessons learned for future project design and implementation. This ex-post impact assessment of PAFA is part of IFAD10 Impact Assessment Agenda.

The project consists of five components: (1) agricultural diversification and access to local markets, (2) development and structuring of regional value chains in Senegal's groundnut producing regions (French: "bassin arachidier"), (3) national coordination, knowledge management and project management, (4) climate change adaptation, and (5) support services for rural finance.

The impact assessment will focus on *sub-projects* (SPAM: *Sous-projet d'accès aux marchés* in French) submitted by producer organizations (POs) and funded by PAFA under its component 1. SPAM is the main direct support for smallholder farmers under PAFA. The approach is innovative as the comprehensive support that farmers receive from the outset, is structured such that they are empowered during the course of the project (for at least three years in each SPAM). Access to inputs, technical advice and linkages to markets are all put in place by the project. Financing these with a regressive subsidy enables farmers to gradually stem the costs for production themselves using the increased yields and gains from better marketed outputs.

Once approved for funding, POs received comprehensive support for their agricultural activities, allowing farmers to buy certified seeds, fertilizer, and agricultural material. Farmers also received technical support and information on best farming practices during the three years of the SPAM support. To finance this support, PAFA applied a system of subsidies diminishing over time. In the first year, PAFA support is provided with a 80% subsidy. The remaining 20% percent of the costs of the support can be provided by the beneficiary farmers through in-kind payments coming from their harvest. In the second year the subsidy decreases to 60%, to 40 in the third year and to zero afterwards. Within each SPAM, PAFA facilitated contractual arrangements between the PO and a market operator, fixing quantity and quality to be delivered as well as the price at which the market operator acquires the

output produced by the PO. In addition, PAFA supported selected POs in the adoption of a poultry farming model, solar powered water pumps, drip irrigation systems, and other targeted and locally required support.

This general SPAM model aims at (a) allowing smallholder farmers to access markets and receive remunerative prices for their produce, (b) granting smallholder farmers access to quality inputs required for their respective farming activities, (c) granting supply of standard quality produce and agreed upon quantities to the market operators, (d) improving autonomy of the POs in their provision with agricultural inputs, and (e) increasing capital intensity and savings capacity of smallholder farms and their households.

While not the focus of the impact assessment, infrastructural development funded under component 2 and 4, will be controlled for in the empirical analyses and, to the extent possible, it will be assessed whether access to improved infrastructures in project areas creates heterogeneous impacts. In other words, is there a differential impact of component 1 if the access to improved infrastructure is provided concurrently? The information PAFA's M&E system collected allows to know precisely what interventions a beneficiary PO received. However, disentangling the causal effects produced by component 2 activities will not be possible in the quantitative assessment. The strategic activities that were conducted under this component also included: (1) increasing seed production capacities in the four different value chains (mil/sorgo, niébé, sesame and bissap), diffusion of market prices, (3) diffusion of weather information, (4) intermediation and other activities that benefitted the entire value chain, and were not necessarily constrained to PAFA beneficiaries.

Component 3, which comprised to some extent of meso-level activities, will be excluded from the assessment. Component 3, which was exclusively funded by GEF, aimed at fostering climate change adaptation and mitigation. The main activities consisted of sensitization activities, installation of regional committees and reinforcement of technical capacities. In selected locations, particularly in the Fatick region, sites were identified where construction of water basins was necessary for climatic reasons and feasible for geological reasons.

Under component 5, access to microfinance was supported. The start of this component predated PAFA, and was added on to it in October 2013. Its scope is over-regional in character. The impact assessment will take into consideration the influence of the microfinance component on PAFA beneficiaries, especially in the sesame value chain, which benefitted pre-dominantly from increased access to finance, but will not aim at identifying its specific impact.

The key outcome indicators of interest in this impact assessment relate closely to the strategic objectives (SOs) of IFAD: increased agricultural production (SO1), strengthened linkages between smallholder farmers and agricultural markets (SO2), and greater environmental sustainability and climate resilience (SO3).

Theory of change and main impact assessment questions

The aim of the theory of change analysis in the impact assessment at hand is to assess whether the mechanism put in place by PAFA achieves the intended objectives at each step of the causal chain. The underlying hypothesis is that farmers lack access to inputs, lack access to commercial markets and conduct their farming activities with inefficient means. Due to these constraints farmers lead insecure lives with little prospect of independently increasing productivity, access to markets and food insecurity.

The major PAFA support, i.e. training, the financial subsidy to finance input acquisition and the support to create commercial contracts with market operators aims at solving these obstacles. Ultimately, so it is assumed, PAFA support will allow higher yields, as well as a higher share of commercially marketed output. These results in turn should allow higher farm incomes as well as higher resilience of farm households towards unexpected events. PAFAs targeting approach, that is granting higher scores at the SPAM approval stage to POs that resemble young and female members is to ascertain that these groups benefit more-than-average from PAFAs support. Elaborating, in further detail, the different steps in this causal chain, as well as providing qualitative and empirical evidence to prove its validity is the main objective of this impact assessment.

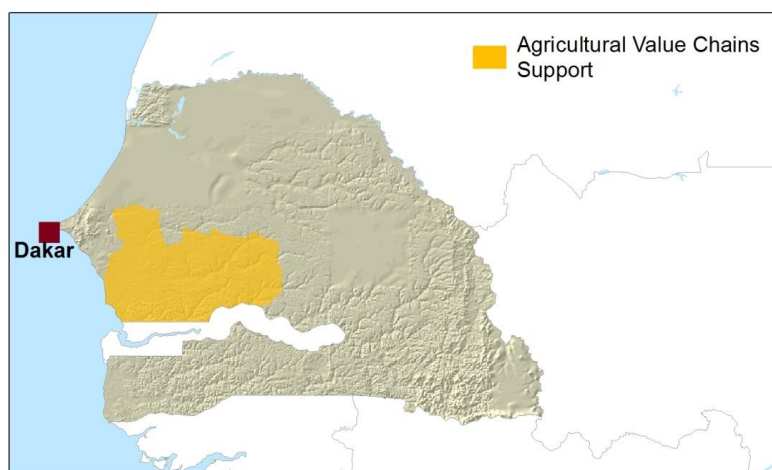
In the presence of a struggling groundnut industry at the inception of PAFA, its objectives were aimed at supporting the development of alternative crop cultivation to increase food security in the project regions. These regions were particularly hard hit by the decline of revenues from groundnut production. The project identified existing food crops where production was mostly subsistent, and formal commercialization not yet well-structured, as the main targeted crops for the project activities. These crops include sorghum, sesame, beans (niébé), bissap, aviculture, maize, and home gardening in general. Eventually, rice production was also included.

Two main support mechanisms were developed under PAFA. The first support mechanism, SPAM, provided technical assistance and agricultural inputs to farmer organizations through a declining subsidy (80% in year 1, 60% in year 2 and 40% in year 3), and strengthened the linkages between POs and buyers of agricultural produce. The second mechanism provided financial and organizational support to develop and organize actors along the value-chain, and supported solutions to problems and constraints that these actors identified. This mechanism relied heavily on the CNIF (Cadre National Interprofessionnel Filière), multi-professional interest groups that formed around the respective agricultural product. The CNIF combine actors from different professions related to particular value chains. These groups identify obstacles to the development of the value chain, propose solutions and are, at times, also part of the solutions. For example, it is the CNIF that manages the distribution of barcodes that were acquired to allow marketing of PO output in supermarkets. The CNIF, to give a second example, also manage a platform that provides weather information via cell phones to farmers. The CNIF also play the role of mediator and arbiter in case of conflict between different actors in the value chain.

The theory of change presented in the following focuses exclusively on the activities funded by PAFA under component 1, that is the market access sub-component, SPAM. Through

this instrument, PAFA targeted small-scale family farms in the four project regions: Kaolack, Kaffrine, Diourbel and Fatick, as shown in Figure 1. The aim at the outset of the project was to reach 32,000 households through the agricultural and livestock projects. Specific sub-groups that were targeted included, women, young people (18-30 years old) and vulnerable households with little or no landholding, poor soil quality, and lack of labor force.

Figure 1: PAFA intervention areas



Source: PAFA (2017)

The underlying concept of PAFAs SPAM program was to allow producer organizations to apply for the support in the production of millet/sorghum, niébé beans, bissap, sesame, village aviculture, maize, or rice. Farmers could thus choose the value chain in which they wanted to be supported.

Regardless of the value chain this support consisted , in general, of the following¹:

- Access to high quality production inputs such as certified seeds, fertilizer, pesticides, storage material and farming equipment.
- Technical consultation provided by so-called family-farm consultants who are local resource persons endogenous to the context (i.e. the local person).
- Access to farming equipment
- Access to innovative agricultural technologies, such as new crop varieties with shortened maturity cycles to increase climate change resilience of the producers, new planting techniques, soil enrichment practices using phosphor and the association of pisciculture (fish farming) to gardening.

Further under component 1, PAFA provided support to set up village-level aviculture/poultry production. To this end, the POs received animals as well as infrastructure required (such as aviaries) for breeding and technical advice.

¹ The support is actually homogenous across the different cultures: millet/sorghum, niébé beans, bissap, sesame, village aviculture, maize, or rice. Variation occurs according to necessity and feasibility of irrigation systems and the poultry farming.

In addition to the production-focused support, PAFA recognized that increases in yield and agricultural production alone would not achieve the ultimate objective of increasing livelihood security and incomes of family farmers unless the product is well-packaged and professionally commercialized with, optimally so, value added to the raw product. To achieve commercialization of the PO production, PAFA supported the creation of contractual linkages between beneficiary POs and market operators (MO) that purchase and commercialize the PO output. To improve storage and packaging, storage locales were constructed and centers put in place where POs can acquire high-quality packaging material to maintain the freshness and the quality of the agricultural produce after harvest.

To foster the financial sustainability of the project, and to prevent POs from depending on PAFA's support in the long term, a declining subsidy system financed the provision of the SPAM support. Over the course of three years, the share of the costs that the beneficiary POs have to cover by themselves increases each year. In year one of the SPAM, the PO pays 20%, in year two 40%, and in year three 80%. The beneficiary POs pay these shares in-kind from their increased production and increased marketed output.

Beneficiary selection for the SPAM followed a demand-based approach supporting small-scale agricultural producers associated in Producer Organizations (POs). PAFA conducted dissemination sessions during which project content and application process were presented to potential beneficiaries. Farmers then organized and submitted applications selecting themselves the kind of support they requested. Support was structured along different value chains and could either cover production of millet/sorghum, niébé beans, bissap, sesame, village aviculture, maize, or rice.

According to discussions held with the project team in during the scoping mission in March 2017, the following stylized process was applied during the selection of the beneficiary POs:

- PAFA conducted information sessions in the targeted localities, and disseminated information about the planned project activities via radio broadcasts.
- POs filled in the pre-qualification forms (see Appendix 1). The pre-qualification forms list characteristics of the PO as well as names and characteristics of the most vulnerable PO members.
- POs submitted pre-qualification forms to PAFA.
- PAFA verified completeness of the information provided.
- PAFA conducted verification missions to verify the correctness of the information provided.
- The pre-qualification forms were anonymized and submitted to a selection committee, the Regional Approval Committee (RAC).
- The RAC reviewed the anonymized forms, and evaluated them by applying the criteria and weighting mechanism defined by PAFA.
- The RAC selected the highest scoring project proposals. The number of projects that were approved depended on the funding available.
- The RAC submitted a selection report to PAFA listing the results of the scoring exercise and the projects selected for funding.

This selection process led to a total of 316 sub-projects (PAFA, 2017) that were supported during the PAFA implementation period.

In Figure 2, we present a stylized theory of change laying out the mechanism through which PAFA attempts to achieve the expected changes in the lives of the beneficiary farmers. The impact assessment will analyze, in a first step, whether the planned interventions have taken place and, to the extent this is possible in the context of an ex-post set-up, what quality of services was provided.

While PAFA's monitoring data on productivity and yields gives suggestive evidence that the implementation process was adequate, the impact assessment has to turn to the inputs and activities, presented in the first column of Figure 2, to verify whether these were correctly provided. It is thus of fundamental interest to enquire whether POs received the support packages they requested under SPAM which services and inputs POs received explicitly, whether the timing of the provision was appropriate, whether the quality, e.g. of seeds, was adequate, etc. Further, we will ask whether the family consultants were sufficiently available and sufficiently competent to introduce farmers to novel farming methods and techniques and to address issues farmers faced in the application of these methods and techniques. The question on what training the family consultants received might also figure in this initial stage of the evaluation. A mix of quantitative data, qualitative data and PAFA's administrative records will be exploited to elaborate how satisfied farmers were with the support they received.

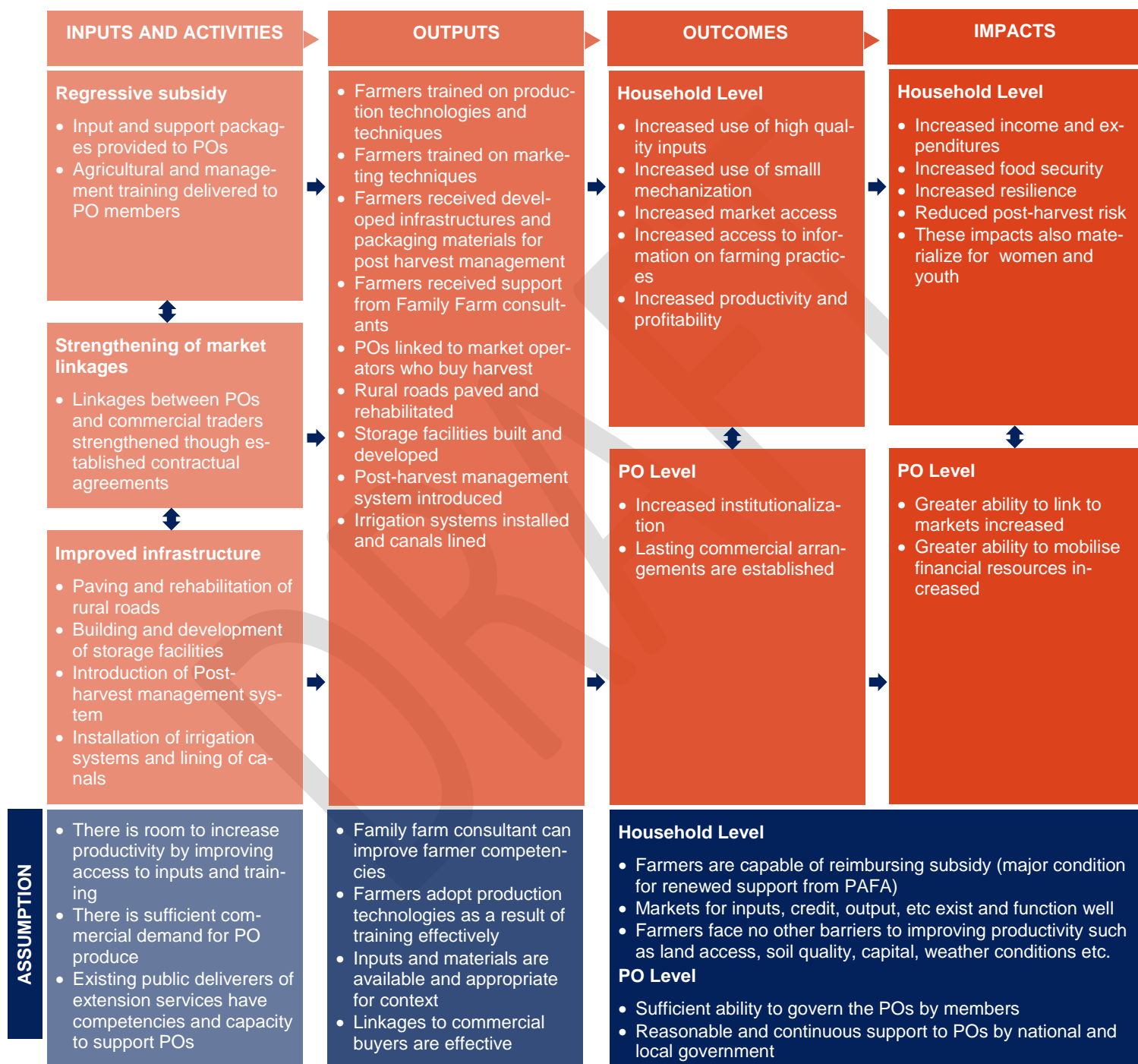
The next level that will be in the focus of the impact assessment is the output level, meaning the direct consequences of farmers' inclusion to a SPAM. We will assess how many POs were treated, how many farmers benefitted directly from the SPAM, how many farmers received particular training sessions. How many family farm consultants were hired and how many farmers each consultant supported? We will further enquire how many infrastructure project, how many chicken farms and packaging stores were put in place. This information is readily available in PAFA monitoring reports. We may complement the data on infrastructure projects funded by PAFA with geo-referenced data to assess the distance, and thereby exposure of the farmers to these outputs.

The third part of our analysis will focus on the direct outcomes created by PAFA support through the SPAM. Major outcomes of interest include whether usage of high quality inputs increased significantly compared to non-PAFA beneficiaries, whether the level of farming mechanization increased, whether market access and access to market information increased. Most importantly, did PAFA beneficiaries observe improvements in yields compared to POs that were not supported. Did shares of marketed harvest increase? Did the quality of the produced harvest improve and are farmers more capable to constantly produce a certain level of quality? For those who received special measures, for example, irrigation projects, road access or chicken farming, we will measure and take into account this particular form of support in the empirical analysis, in order to compare whether outcomes differ along these lines.

Ultimately, we will also test whether effects on the income and consumption expenditure of the farm households, on their food security and on their resilience to withstand income shocks can already be observed. A further hypothesis could be that while income can be

affected by the shock, household responses might aim at preserving consumption levels or at accumulating assets.

Figure 2: PAFA's theory of change



Analyzing the theory of change presented in Figure 2 allows us to derive and formulate the research questions that will be explored in this impact assessment.

- **Question 1:** Do households belonging to POs that received SPAM have higher agricultural productivity than households belonging to POs without SPAM support?
- **Question 2:** Do households belonging to POs that received SPAM have better access to agricultural information, e.g. related to weather conditions or market prices?
- **Question 3:** Do households belonging to POs that received SPAM make more use of mechanized tools in their work?
- **Question 4:** Do households belonging to POs that received SPAM make more use of high quality inputs?
- **Question 5:** Are households belonging to POs that received SPAM better connected to markets and traders than households in POs without SPAM support? Specifically, do we see that households in SPAM POs sell more of their crop and livestock outputs in the market relative to households in POs without SPAM, in relative and absolute terms?
- **Question 6:** Do households belonging to POs that received SPAM generate greater levels of income from crop and livestock production than households belonging to POs without SPAM support?
- **Question 7:** Do households belonging to POs that received SPAM have higher levels of per-capita food and non-food expenditures than households belonging to POs without SPAM support?
- **Question 8:** Are households belonging to POs that received SPAM more resilient to negative exogenous shocks than households in POs without SPAM support? Specifically, do they experience less frequent and less severe shocks, and are able to recover better from shocks than households in POs without SPAM support? In the presence of income shocks are households responding differently to income shocks (for instance crop loss) depending on the level of their asset ownership, and are their responses aimed at preserving consumption levels or at accumulating assets?
- **Question 9:** Do female SPAM beneficiaries have a higher degree of empowerment than female non-beneficiaries of SPAM?
- **Question 10:** Do young SPAM beneficiaries have increased agricultural production compared to non-beneficiaries of SPAM?

Question 1 assess whether a key outcome that one would expect if PAFAs theory of change materialized. That is, did access to PAFAs support and services allow farmers to increase the output they produce per cultivated hectare.

Further on the outcome level, questions 2-4 assess further the extent to which PAFAs theory of change holds by asking whether PAFA supported households have better access to agricultural information, use high quality inputs or mechanized tools more than households that did not benefit from PAFA support through the SPAM.

Question 5 also addresses the theory of change's outcome level by asking whether market access of PO members increased. The indicators of relevance here measure the extensive and the intensive margin. That is, whether farmers marketed any of their output and, if yes,

how much they marketed in total, or how large the share of their marketed output is as compared to their total produce.

Any answer to question 6 contributes to evaluating the theory of change at the impact level. This impact assessment does so, by estimating whether significant differences in income from agricultural activities exist between beneficiary and comparison farmers after controlling for observable, and optimally also for unobservable, differences.

Question 7 also assess the impact level. Indicators here are variables such as days spent without sufficient meals, etc.

To validate whether PAFAs intervention increased resilience, the center of focus of question 8, we will measure the behavior of farmers when shocks occur. This includes actual mitigation strategies that they implemented and, since it is not certain that each farmer faced a shock, mitigation strategies they would apply if struck by an disastrous hypothetical event today. The presence of savings or material assets will also be taken into account to assess resilience.

The analysis of effects on sub-groups like women and youth was at the heart of PAFAs strategy from the outset. Testing how these groups have been effected is at the heart of questions 9 and 10.

A number of analytical papers estimate the impact of market access interventions. Earlier literature emphasizes the role of the transaction cost barrier in preventing smallholder farmers from participating in formal marketing channels (de Janvry et al., 1991; Key et al., 2000). Thus, policies or interventions that may reduce the transaction costs facing farmers when marketing their crops may help improve farm revenues, and thus have a direct implication on welfare outcomes (Besley and Burgess, 2000; Chamberlin and Jayne, 2013). Previous studies have shown that agricultural projects specifically focused on strengthening the linkages between farms and markets help increasing farm productivity by increasing market participation opportunities of beneficiaries (Cavatassi et al., 2011; González-Flores et al., 2014).

In addition, Ambler et al., (2016) conducted an impact assessment in Senegal which evaluated the impact of a cash grant for farm management practices on agricultural production among small-scale farmers. Findings from this study indicate that beneficiaries have higher farm productivity and livestock asset accumulation. The analysis also extends to uncovering that the cash grant allows farmers to invest in farm inputs namely chemical fertilizers to increase crop yields.

Our study complements the existing literature by focusing on evaluating the market linkages, and therefore examining the complementary effects of interventions related to improving farm practices and market access. In addition, this IA adds to recent studies that investigate the impact of agricultural projects related to research and technology adoption (Emerick et al., 2016; Verkaart et al., 2017), and agricultural extension services (Davis et al., 2012; Kondylis et al., 2017). Interventions aimed at improving agricultural productivity, along with strengthening farmers linkages with markets, are largely effective as they allow farmers to take advantage of economies of scale and/or economies of scope when marketing their crops.

Impact assessment design

The proposed impact assessment design is aiming to establish causality in the context of the PAFA project implemented in four regions of Senegal during the period 2011-2016. In the absence of an ex-ante defined impact assessment strategy, we rely on the tools and methods available for ex-post impact evaluation. To identify what impact assessment strategy is most appropriate for the given context, we assessed the targeting mechanism of PAFA. One question of particular interest is thus whether beneficiary POs were selected based on a continuous ranking judging their eligibility. If so, the impact of the intervention under assessment can be identified by applying the regression discontinuity design (RDD) (Lee and Lemieux, 2010; Hempel and Fiala, 2011). The selection mechanism PAFA used to select SPAM beneficiary POs (see previous section) allows to apply the RDD approach to assess the impact of PAFA, and specifically the SPAM, on the beneficiaries of the project.

Using the pre-qualification forms that POs submitted to PAFA during the application process, we can thus assess the characteristics and scores of the sub-projects that received funding and identify sub-projects that had similar scoring, but did not receive funding². We exploit the plausibly exogenous cut-off point which determined whether a PO would receive PAFA activities or not. PAFA conducted verification missions to assess the validity of the information provided by the POs in the pre-qualification forms. We can thus assume that the information provided by the POs in the pre-qualification forms is reliable and that all POs evaluated by the RAC (Comité régional d'approbation) were eligible to receive funding. Among those not selected for funding we can find a valid comparison group. Thus, we compare the outcomes of the beneficiary households belonging to POs just above the cut-off line to receive PAFA (treatment group), and those of the households in the POs just below the cut-off line (control group). This identification strategy is similar to the one adopted by Crost et al. (2014) to exploit the exogenous variation in the assignment of a large-scale development program in the Philippines.

Two approaches are generally feasible: a fuzzy, or a sharp RDD design (Angrist and Pischke, 2009; Khandker et al., 2009). Whether we will apply a sharp or a fuzzy RDD remains to be determined based on how rigorously the cut-off was applied in the selection decision. In case that some POs received the funding whilst their score was below the cut-off set by the RAC, while other POs did not receive the funding whilst their score was above the cut-off, we will apply a fuzzy RDD design.

Either of the two approaches, fuzzy or sharp, will allow us to assess the local average treatment effect (LATE) at the cut-off (Angrist, 1990; Lee and Lemieux, 2010). In other words, we will be able to assess the effect of PAFA support through the SPAM for those POs that were just above the cut-off.

The success of an RDD design to identify the impact of PAFA depends on the number of observations below and above the cut-off. If the number of observations, in our case POs, around the cutoff is too low we might face problems as standard estimators rely on asymp-

² To date we only know about accepted POs, and we are not able to discern the number of selected and non-selected.

otic assumptions for valid statistical inference. If the sample size is too low asymptotic properties of the estimators might not hold.

In parallel to the RDD strategy (strategy 1), we propose to conduct an analysis based solely on cross-sectional data from the project region and communities in the adjacent regions (strategy 2). Here, the identification strategy will apply different types of matching estimators (parametric and non-parametric). As proposed by Heckman et al. (1998) matching estimators use observable characteristics of beneficiary and non-beneficiary households to create matches. The main underlying identification assumption is thus that any bias from self-selection is minimized once we control for observable characteristics. These estimators allow identification of Average Treatment Effects on the Treated (ATT) and Average Treatment Effects (ATE) (Angrist and Pischke, 2009).

Given the rich information we possess on the selection of beneficiaries, cross-sectional data will also allow us to explore instrumental variable estimation. Potential instruments, i.e. variables that are correlated to the selection decision, but are not correlated to the outcome variable (e.g. agricultural productivity), might include the distance between the PO locations and the location at which PAFA held initial information sessions. This requires us to collect accurate detailed geo-referenced information of all the POs (both project and non-project POs), and the locations where information sessions for PAFA took place at the project inception phase.

Contamination

Applying the RDD as the identification strategy to estimate the impact of PAFA assumes that POs were assigned to treatment and control groups according to a plausibly exogenous assignment rule around the cut-off point. That is, we assume that POs that were right above the cut-off point (and thus received SPAM) are similar to POs that were right below the cut-off point (and thus did not receive SPAM) before the start of PAFA-related interventions. We can therefore avoid any bias in our estimates coming from targeted selection at the stage of the beneficiary selection (selection bias). Other sources of bias might, however still persist, as for example the most motivated and best-organized POs are more likely to obtain information on the opportunity to apply for a SPAM, meaning there exists a selection into filling-in a SPAM pre-qualification form and submitting it. This bias cannot be addressed by the RDD, but would less likely pose problems in the propensity score matching and instrumental variables approach, simply due to the fact that the population we base our estimates is less restrictive in the latter two cases.

The regional nature of some of the interventions implemented under PAFA, creates serious doubts for whether a pure control group, that has not been exposed directly or indirectly can be identified within the project regions. To ward off this issue, we identified communities in the adjacent regions with similar geographic, climatic and socio-economic context and where farming and market conditions very similar. Comparison POs from these communities were not exposed to regional PAFA activities at all and thus represent a good approximation of the counterfactual for our PAFA POs.

Regarding comparison POs that we draw within the PAFA regions, the interventions implemented at the local level directly benefited only the selected POs. However, smallholder farmers that were ineligible, or eligible but not selected, might have been indirectly affected by PAFA. If these non-beneficiaries become part of the control group, it will be unlikely that

our impact estimates are unbiased and free from contamination effects. In other words, the stable unit treatment value assumption (SUTVA) would be violated.³

By elevating the level at which we measure our outcomes and analyse the impact of PAFA, we could control for these confounding effects. In addition to producer level impacts, we will also estimate the impact at the village level. As a result, any village that hosts a beneficiary PO will be considered treated and only villages without the presence of PAFA beneficiaries can be considered for the comparison group. Thus we will be able to estimate an intention-to-treat effect (ITT).

While concerns about contamination effects cast doubts about the unbiasedness of our estimates, one needs to consider what consequences these effects might potentially have. Before-and-after comparison of yields (kg/ha) of SPAM beneficiaries presented in PAFA (2017) show increases varying from 108 percentage points for Sorghum to 194 percentage points for Bissap. These are very large differences. Considering the intensive support that PAFA provided at all stages of the production process, the hypotheses that a large portion of these changes can be attributed to PAFA activities is justified. These large changes might in part be driven also by self-selection, that is, better organized POs entered the project. To the extent possible we will need to reduce this kind of bias by controlling for all relevant observable PO characteristics as, for example, education level of PO leaders, degree of remoteness of the PO, etc.

Further, it is justifiable to assume that non-beneficiaries are unlikely to realize similarly high results without the direct support of PAFA. If these assumptions hold, then contamination will certainly result in a downward bias of the effect estimates but it is unlikely that this bias will nullify the estimated effects.

Controlling for the presence of beneficiary POs in the village of residence, distance to beneficiary POs in neighboring villages, and inclusion of farm household from non-beneficiary communities inside and outside of the project regions might help to reduce the bias resulting from contamination. During qualitative interviews with the PAFA project staff, communities with no or little presence of SPAM funding have been identified and these could be oversampled in the sampling strategy.

Qualitative Investigation

To further complement the empirical analysis based on primary household data and the analysis of administrative data, we will conduct further qualitative interviews in particular with program managers and PAFA field workers to both validate the control sample (described in the next section) and assess the levels of input, activities and outputs. The main approaches here will be expert interviews (Key Informant Interviews, KII) and focus group discussions (FGDs). Experts in-depth interviews will try to ascertain that 1) the sample of villages chosen is appropriate for the upcoming quantitative data collection and 2) that PAFA targeting, provision of inputs, processes and outputs were delivered as planned. Relative to this last point, it will be explored what challenges implementation of the SPAM faced, potentially at different levels, and how these were mitigated. Potentially, shedding

³ In the household survey we might consider asking a self-perception question to farmers to control for this issue: e.g. to what extent PAFA gave any advantages to them, for instance.

light on these issues could contribute to understanding the effects that we will observe in the quantitative analysis.

Additionally focus groups discussions (FGDs) with PAFA and non-PAFA POs will be held separately in each region in selected villages through the help of the project management unit to get at expected and unintended impacts, as well possible contamination.

In addition, analysis of administrative data will basically contribute to drawing a clear picture of the inputs that were provided. Naturally, without these inputs, neither outputs nor impacts be expected.

Sampling and data collection

We propose to follow two concurrent impact assessment identification strategies both requiring primary data collection in the PAFA target region.

Data required for Strategy 1: The RDD strategy will use as a sampling framework the full list of POs deemed eligible for PAFA interventions by the RAC. Among those selected and rejected we will draw the study sample. This evaluation strategy heavily relies on the availability of the RAC reports and the SPAM scoring at the time of selection. This option is most likely not viable – given that we did not receive these lists by the PMU.

Data required for Strategy 2: As part of the second impact identification strategy, we will conduct a listing or enumeration exercise of POs in the PAFA targeted regions and POs located in communities in the adjacent regions. From this listing exercise we will be able to identify non-beneficiary POs with similar characteristics (main culture harvested, age since creation of the group, number of members, main crop, geographical location, formalization status, etc.) as the beneficiary POs. The list of POs that resemble the PAFA beneficiary POs will then serve as sampling frame for the comparison group.

In case that the RAC documents are available, we will draw non-beneficiary POs from both the list of rejected applicants and the list of non-beneficiary POs identified during the listing exercise. We denote the latter as *complementary non-beneficiary sample*. The main difference between the complementary non-beneficiary sample and the sample of rejected applicants, is that the latter deposited a funding request with PAFA, which might correlate with other relevant observable or unobservable characteristics.

In summary, there will be three main data collection steps:

1. A listing exercise of POs in PAFA targeted regions and POs located in communities in the adjacent regions.
2. A household level survey whose sample will be drawn from treatment and comparison POs members.
3. A PO survey in non-PAFA and PAFA POs on agricultural activities (agricultural practices followed in the PO and production). This survey will be conducted at the same time of the household survey. The PO leader will be interviewed. The PO survey will include a village level module to cross-validate reports from PAFA on project activities conducted in addition to

SPAM and to measure village level indicators that might determine our outcome and/or correlate with the treatment.

There is a total of 315 POs that benefitted from SPAMs. These are allocated across three generations, meaning they started in three different years of the project. In year 1, PAFA selected 36 POs, then 122 in year 2 and 157 in year 3. These are located across the four project regions: Kaolack, Kaffrine, Djourbel and Fatick and around 265 villages in 107 communities. The average number of members in PAFA beneficiary POs is 46 but ranges from 10 to 300 members.

This identification strategy faces the difficulty that official registries for agricultural POs cannot be accessed in the totality of the territory. Thus a sampling frame from which comparison POs can be drawn does not exist and needs to be created. We propose the following procedure to create the sampling frame.

1. With the support of and in collaboration with the PMU, we will examine the list of treatment communities (around 107 communities) and we will stratify such list into three groups (high, medium and low intensity communities). The high intensity group will include communities with more than 10 POs, the medium 2 to 10, and the low intensity group less than 2. From these three groups we will sample 35 communities in the high and medium intensity groups and 17 in the low intensity group. Another 18 communities will be sampled from a list of communities (to be provided by the PMU) with absolute no-PAFA interventions, the adjacent communities. In this way, we will have 71 communities in total, with 35 in the high to medium intensity groups (the treatment), and 36 in the low and no-PAFA communities (the control).
2. From the 35 treatment communes, and a random sample of villages will be drawn based on distribution of POs by villages and community, to determine 90 eligible PAFA supported POs that will be part of the listing exercise. (below).
3. From the control communes (36), we neither have the list of villages nor the list of POs that might be similar to PAFA supported ones. Hence we will take a random sample of villages (35) including chef lieu localities, from which we will have to sample at least 90 comparison POs (POs not supported by PAFA). If there are no POs, in the randomly selected villages, villages will have to be re-sampled. The listing exercise will take place in the final list of randomly selected villages (35) – to determine the characteristics of the 90 POs that will be part of the control sample. With the support of the survey firm and PMU – we will validate the obtained list of villages, prior to conducting the listing.
4. The listing exercise of all 180 POs (that is PAFA and non-PAFA POs) will collect information on the *number of members, the number of male and female members, the gender of the PO leader, the main crop and activities that the PO engages in, the year when the PO was created. This information is paramount to get at the observable characteristics of POs.*
5. Based on the data collected during the listing exercise, we will match non-PAFA and PAFA POs based on the characteristics listed above. We are hoping that the matching will discard, at the maximum, 20% of the observations in both treatment and control POs samples (hence having 75 treatment and 75 comparisons POs in total).

The matched PAFA and non-PAFA POs will constitute the study sample for which we will conduct the farm household and PO-level surveys. Within each study PO, PAFA and non-PAFA, we will draw respondents randomly from the list of members. These lists will have to be secured by the survey firm in collaboration with the PMU during the listing.

Preliminary Sample Size Calculations⁴

We conduct sample size calculations to determine the optimal number of observations required to identify the effects of the SPAM funding supported by PAFA. Our sample size calculations apply standard levels of power (90%) and varying minimum detectable effect sizes (between 0.1 and 0.2 SD). In addition to these parameters we require estimates of the mean and standard deviation of the main indicators of interest (before start of the intervention). Given that the SPAM was allocated at the PO level, we need to consider the number of clusters (POs) and the intracluster correlation coefficient (ICC).

To calculate these parameters, we require data that allow to cluster individuals by producer organization. Since this kind of data is not available, we have three options to obtain approximations of the required parameters. First, we may access 2011 individual-level data allowing us to estimate mean and standard deviation for the main parameter and approximate the ICC for POs by using the ICC calculated at village level, assuming that these are similar. The second option is to consider results from similar studies in similar contexts. The third option is to rely, to the extent possible, on data collected by PAFA.

We apply an adaptation of the third strategy. The average millet yield before implementation was 653kg/ha⁵. Since none of the documents provided by PAFA or DAPSA (Direction de l'Analyse, de la Prévision, et des Statistiques Agricoles) reports standard deviation we set it arbitrarily to half of the mean 326. For the ICC, we apply different values varying from 0.1 to 0.2.

With a baseline value of 653kg/ha, a 20% increase would equal an increase by 131kg/ha. Assuming an ICC of 0.15, and keeping the number of observations per village/PO to 15 farm households, we require, according to our calculations, a total of 1,810 observations with a minimum of 121 clusters (POs). To ward off issues that the common support requirement could pose, we increase the sample by 20%.

Table 1: Sample Size Calculation

Effect Size	ICC	Sample Size	Number of clusters	Sample Size +20%
Yields (kg/ha) Millet				

⁴ These sample size calculations are preliminary and will be refined based on accurate data on yields at the village level (mean, standard deviation and intra cluster correlation). A formal request for the data has been put forward to the Directorate for the Analysis of Agricultural Policy and Statistics.

⁵ Choosing millet production as the main value chain of interest could be justified as it is here where the largest number of sub-projects was financed (91) and consequently the largest number of direct beneficiaries was reached (6557). While other value chains, e.g. beans, bissap and maize could potentially be included as well, we refrain from considering the sesame value chain in this impact assessment as sesame farmers have benefitted disproportionately from access to microfinance through Component 5.

20%	0.20	1005	67	1206
20%	0.10	630	42	756
15%	0.20	1810	121	2160
15%	0.10	1155	77	1386
10%	0.20	4035	269	4842
10%	0.10	2550	170	3060

Since the changes in yields per hectare that we observe go far beyond the levels of MDE tested here, we adopt a sample with 2250 farm households in 150 villages/POs, distributed over the four PAFA implementation regions and bordering communities in neighboring regions.

As far as the PO survey is concerned we propose to conduct PO level interviews in the 150 POs across the 70 villages, identified in the final sample.

Key Indicators and Survey Instruments

We will have three main survey instruments: a listing exercise, a PO- and village level survey in sampled POs, a household-level survey.

An listing questionnaire that will aim at listing POs and their characteristics, along with geo-referencing their position, including institutional features as well as land allocation, production, and assets.

A farm household survey will be fielded as part of the household data collection. The modules are listed in Table 2.

A PO survey will interview PO leaders. This PO survey will inform on POs agricultural activities (agricultural practices followed in the PO and production). The PO leader will be interviewed. The PO survey will include a village level module that will cross-validate reports from PAFA on their activities. As this is essentially a value-chain project, the village survey will include a module on markets. Questions regarding markets locations, availability of markets, the number of traders and the types of goods and services available at the market, will be thus included.

Table 2: Farm Household Survey Modules

Module	Indicator
Demographic	
	Household composition
	Education
	Occupation
	Religion
	Ethnicity
	Time use
Income from other sources than agriculture	
	Wage income
	Enterprise or business income
	Pension income
	Remittance income
Asset	
	Housing characteristics
	Land ownership
	Durable assets
	Productive assets
	Livestock assets
Agriculture	
	Agricultural production
	Input use
	Labor use
	Agricultural marketing and processing
Vulnerability & Resilience	

	Exposure to shocks
	Frequency and severity of shocks
	Ability to recover from shocks
Consumption, food security, and nutrition	
	Food expenditures (weekly recall)
	Dietary diversity (24-hour and weekly recall)
	Food insecurity coping strategies (weekly recall)
	Non-food expenditures (monthly and yearly recall)
Access	
	Access to rural infrastructures
	Access to credit and savings
	Access to sources of information
	Access to assistance programs
	Access to rural infrastructures
	Access to social support and social capital

Table 3: Village/PO Survey Modules

Module	Indicator
Service availability	
	Availability of services
	Distance and travel time to service locations
	Means of transportation to service locations
	Rating of service quality
Agricultural organizations	
	Producer organizations (numbers, members, crops)
	Cooperatives (numbers, members, crops)
Road infrastructure	
	Availability of trunk roads
	Feeder roads
	Community roads and bridges
	Means of transportation to infrastructures
	Rating of infrastructure quality
	Main reason for poor infrastructures
Communal organization	
	Number of communal organizations
	Frequency of their meetings
	Number of members in these organizations (including women and youth)
Vulnerability & Resilience	
	Exposure to shocks
	Frequency and severity of shocks
	Ability to recover from shocks
Access to markets	

Presence of market in community
Distance to next market
Type of goods produced at market
Type of inputs and services available at markets
Frequency of market

Qualitative data

The proposed impact assessment relies mostly on a quantitative data collection. However it is recommended that key informants interviews with project management unit and village leaders are carried out in every project region to gain insights about implementation modalities and impact achieved at global and regional level. We recommend that this qualitative interviews are carried out prior to the listing exercise, to be able to better design the overall quantitative surveys strategy and validate the control sample.

Specifically the following is planned: one set of key informants interviews will be done with project management units and village leaders, to validate the listing strategy and the sample selection for the listing and the subsequent quantitative data collection.

In addition three focus group discussions (FGDs) will be done. One FGDs will be composed of experts (namely PMU, technical staff, providers and a selection of village leaders) to get at implementation and project specific features such as expected and unintended impact, as well as potential spillover and contamination effects. A second set of FGDs will be done with beneficiaries POs – in all regions. The last FGDs will be done in a selected village with non-beneficiaries POs in communities/villages in adjacent regions, randomly selected from the list of potential villages.

Supplementary data

Any impact assessment generally assesses whether inputs and outputs according to the theory of change were well delivered/produced. This is to ascertain to what extent the causal chain holds. The ex-post design we are applying to assess the impact of PAFA will rely heavily on M&E data to verify whether inputs and outputs were provided.

In the study area a listing exercise will be conducted allowing to obtain an idea of the presence of producer organizations. This will be essential in the case that the RAC documents are not made available by PAFA and, as a consequence the RDD approach will not be feasible. In this case, as discussed above the impact assessment will have to rely on a matching approach to identify the effects of PAFAs support. Drawing a sample of control POs will thus have to be done from the universe of existing POs, which we will identify during the listing exercise in communities/villages in neighboring regions.

During the listing exercise we will also collect GIS data allowing to obtain a clear idea of the exposure of POs and individual farmers to, e.g. infrastructure projects like rural roads. Be-

sides POs distance to the location at which PAFA held initial information sessions will be collected, distance to main road and to main market will be collected.

Possibly historical high-resolution remote sensing information such as the NDVI (Normalized Difference Vegetation Index) could be used to complement the identification strategy for this impact assessment, given that the PAFA interventions package provided irrigation systems to beneficiaries POs.

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Budget, deliverables and workplan

The estimated budget is composed by the various items namely: 1) qualitative investigations 2) quantitative surveys (household and village/PO surveys). Detail costs will be added upon completion of the mini-tender.

The deliverables are listed in table 4 along with the timeline.

Table 4: List of deliverables and timeline

Activity	
Data Collection	
Finalization of the impact evaluation strategy	June 2017
Drafting <u>preliminary</u> survey instruments, recruitment of survey firm	July 2017
Qualitative investigation: design and data collection	December 2017
Interviewer training and pre-test for the listing	February 2017
Data Collection for the enumeration or listing of POs	March 2017
Data cleaning and sampling for PO, household and community survey	May 2017
Preparation of CAPI data collection for PO, household and community survey (finalization of questionnaire and programming of CAPI application)	May 2017
Interviewer training and pre-test for PO, household and community survey	June 2017
Data Collection for PO, household and community survey	July/August 2017
Data analysis and report	
Data analysis	August/September 2018
Finalization of IA report	October 2018

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APPENDIX

1

PROJET D'APPUI AUX FILIERES AGRICOLES-EXTENSION CADRE D'APPROBATION DES SOUS PROJETS

A-Critères d'éligibilité

N° SP

Les critères d'éligibilité sont les critères obligatoires. Un SP qui ne répond à un des critères est éliminé d'office.

N°	Critères d'éligibilités des OP	Oui	Non
1	OP légalement reconnue ou disposée à /en voie de l'être pour l'inclusion des groupements vulnérables non formalisés		
2	OP ayant identifié un OM en vue d'un partenariat OP/OM		
3	OP résidentes et exerçant leurs activités dans la zone du projet depuis au moins deux ans		
4	OP dont les dirigeants ne sont pas poursuivis en justice pour détournement de deniers et biens publics, privés ou communautaires		

B-Critères d'évaluation du SOUS PROJET

	Critères	Barème	Note
1	Représentation des cibles (jeunes filles, garçons, femmes, hommes)	20	
2	Représentativité des personnes vivant avec un handicap (handicapés et personnes porteuses du VIH-SIDA)	15	
3	Représentativité des jeunes et femmes chefs de ménages	10	
4	Représentativité des ménages vulnérables à l'insécurité alimentaire : Nombre de ménages très vulnérables (11mois) ; Nombre de ménages moyennement vulnérables (7-10 mois) ; Nombre de ménages peu vulnérables (1-6 mois)	25	
5	Superficie moyenne exploitée par ménage Inférieur à 2 ha Entre 2 et 5 ha Supérieure à 5 ha	5	

6	Revenu annuel moyen par ménage <i>Inférieur à 135 000 F CFA</i> <i>Entre 135 000 F CFA et 250 000 F CFA</i> <i>Entre 250 000 F CFA et 450 000 F CFA</i> <i>Supérieure à 450 000 F CFA</i>	10	
7	Main d'œuvre disponible <i>Inférieur à 2 actifs</i> <i>Entre 2 et 5 actifs</i> <i>Supérieure à 5 actifs</i>	5	
8	Solvabilité de l'opérateur de marché (épargne, investissement)	10	
	Total	100	

Signatures

CRITERE 6 : Revenu annuel moyen par ménage en Francs CFA

Critères	Taux	Nombre de ménages	Note globale
1. Inf à 135 000 F CFA	100%	10	100
2. entre 135 et 250 000 F CFA	50%	6	30
3. entre 250 et 450 000 F CFA	25%	4	10
			140

Ex : Note = $140/20 = 7$ points sur 10

CRITERE 7: Main d'œuvre disponible

Critères	Taux	Nombre de ménages	Note globale
1. inf à 2 actifs	100%	10	100
2. entre 2 et 5 actifs	50%	6	30
3. plus de 5 actifs	25%	4	10
			140

Ex : Note = $140/20 = 7$ points sur 10

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International Fund for Agricultural Development


Via Paolo di Dono, 44 - 00142 Rome, Italy

Tel: +39 06 54591 - Fax: +39 06 5043463

Email: ifad@ifad.org

www.ifad.org

www.ruralpovertyportal.org

 ifad-un.blogspot.com

 www.facebook.com/ifad

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