**Impact Evaluation Design and Data Collection Plan for
the Alatona Irrigation Project, Mali**

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I. Overview

The MCC Compact in Mali, like the larger mission of MCC, seeks to reduce poverty through economic growth. This report proposes a design and data collection plan for rigorously evaluating one component of the Compact, the Alatona Irrigation Project (AIP).

The AIP project will create an additional 14,000 hectares of irrigated land in the Office du Niger (ON) zone. The project also hallmarks a number of innovations which represent a stark departure from current ON policy. Institutions and management processes will be improved relative comparable institutions in existing ON areas. One such example is land titles: all farmers in the Alatona will be given full land titles for their land, including rights to sell the land. This feature of the intervention will increase property rights and security for AIP farmers in contrast to the short or longer-run lease system currently used by the ON. Farmer organizations will also be encouraged and supported to to maximize local capacities. Additionally, water management and the collection of water fees will be administered through local farmer associations; whereas in existing ON areas, the ON is directly responsible for the collection of water fees. Financial systems in the area will also be developed. Finally, since AIP land is sold to beneficiaries, the land revenues may provide opportunities during and most likely after the Compact period for subsequent development of the zone.

This report presents a design and data collection strategy which has been informed by a detailed desk review of reports available from the MCC, a visit to Washington DC for meetings with key Washington-based staff on the MCC Mali team, and a two week mission in Mali where the IPA team: undertook qualitative interviews with villages in the Alatona and with villages in surrounding areas; and met with MCA-Mali team members, members of the MCC Resident Mission and key institutions such as the Office du Niger (ON). Using the information gathered in each these steps, the design and data collection plan has been updated from the initial proposal. However, we emphasize that the evaluation plan may need to be adjusted and altered once certain project plans are finalized, including: the construction schedule, the number of New Settler households across tranches, the timing between the call for application and lottery for New Settlers.

II. Impact Evaluation: Objective and Methodology

The key distinction between impact evaluation and other monitoring and evaluation techniques is that impact evaluation seeks to isolate the causal relationship between interventions and the welfare or well-being of beneficiaries. Given the objective of MCC to enhance economic growth, well-being will generally be captured by household consumption or income, at the individual, household or even a more aggregate level. Since there are many factors influencing households' consumption, income and well-being in a given year, including multiple projects within an MCC

Compact, often a simple before-and-after comparison can lead to a misleading or incorrect assessment of project impacts. The challenge of impact evaluation, therefore, is to identify suitable comparison groups to compare with beneficiaries. Randomization is considered the gold standard, since it is the best tool available to remove confounding observable and unobservable factors. However, randomization is not always feasible for a number of reasons, including political or ethical constraints, or because program design necessitates targeting to particular individuals or groups. When randomization is not possible, a number of techniques are available, including instrumental variables, differences-in-differences, propensity score matching and regression discontinuity. While it is outside the scope of this report to provide details on each of these techniques, we describe the methodologies as appropriate during the discussion of the evaluation plan. The proposed methodologies for the AIP evaluation are primarily randomization, though a lottery system, and propensity score matching (PSM). Finally, the design described in this report for a rigorous impact evaluation should be viewed as a compliment to other evaluation techniques which will be used by the MCA-Mali and MCC M&E teams. There are some aspects of the AIP which will not be evaluated through rigorous impact evaluation, such as the Niono-Goma road, but will be evaluated through other evaluation techniques.

III. Literature Review

Empirical evidence suggests that irrigation projects have positive impacts on agricultural production and the reduction of poverty for farmers (Goldman and Squire 1982; von Braun, Puetz, and Webb 1989; Freebairn 1995; Datt and Ravallion 1998; Rosegrant et al. 1998; Jayaraman and Lanjouw 1999; Lipton et al. 2003; Hussain and Hanjra 2004; Smith 2004; and Hussain 2007). In addition to direct benefits for farmers, the overall economic rate of return for projects has also increased over the past 30 years. Large scale irrigation projects which were initiated from 1970-74 in Sub-Saharan Africa had an average return of about 10%, but returns have increased to 30% for projects initiated between 1995-99, when costs are explicitly considered (World Bank 2007). However, only 4% of total cultivated area is under irrigation in Sub-Saharan Africa (World Bank 2007) and much of the empirical work cited is founded on research undertaken in India, China and other Asian countries[1].

In areas that do have large scale irrigation schemes, there are several important pathways by which irrigation has been documented to have impact. We follow broadly the classification of Hussain (2007) who categorizes the impacts of irrigation into micro-pathways, meso-pathways and macro pathways. Micro-pathways are the direct productivity-increasing effects on a household's physical and human capital. For example, increasing the productivity of land through irrigation raises agricultural production, thereby raising household income from marketed surpluses. Meso-pathways are the market participation pathways that irrigation opens to households to participate in input (development of agricultural labor markets, access to agricultural capital, fertilizer and seed markets) and commodity markets as well as knowledge/information markets. For example, access to irrigation increases demand for fertilizer

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[1] Much of this research also varies in attention to econometric problems generated by the endogeneity of irrigation decisions and poverty status. None of the papers cited use a randomized control trial (RCT) approach to evaluate the effectiveness of irrigation on poverty, primarily due complications with implementing an RCT in those settings.

and the income necessary to finance this investment in inputs. This creates a market that may not have previously existed. The increased spatial connectedness of input dealers with farmers not only increases access to fertilizer, but augments farmer knowledge through exchange and networking to other markets. Fundamentally, this increases knowledge exchanges and provides risk diversification opportunities for farmers. Macro-pathways are the long term mechanisms by which irrigation influences national economic growth; this stimulates positive externalities such as increased investment, food security and agricultural and non-agricultural sector diversification.

As mentioned above, much of the work on the impact of irrigation is Asia-specific. Of these studies, the difference in headcount poverty measures between households with irrigated and non-irrigated land ranges from 4%-35% for canal irrigation projects in India, Bangladesh, Indonesia and Pakistan (Hussain 2007). Fan and Hazell (2000) report an 11% difference in headcount poverty measures in India, while Ut et al. (2000) find a 42.7% difference in Vietnam. These differences are purely descriptive. In the African context, Van Den Berg and Ruben (2006) find that access to small-scale irrigation increases total household consumption in rural Tigay region, Ethiopian households by a factor of five. Dillon (2008) estimates the impact of small-scale irrigation on household consumption in Northern Mali to range from 694,921 - 776,748 FCFA using PSM and difference-in-differences PSM with a small panel of households over an 8 year period. Additional, rigorous work examining the impact of large-scale irrigation projects is needed.

While the overall objective of the AIP is to raise income and well-being for beneficiaries in the Alatona and beyond, there are a number of important innovations in the project design. One example is the provision of full land titles to Alatona farmers. Land tenure reform and management is an important component of the AIP project and moreover a salient feature in many MCC Compacts. Property rights have often been pointed to as a precondition of growth (Delong and Shleifer 1992; North 1998). Furthermore, there is evidence from a few studies in West Africa that secure ownership of land creates greater incentives for farmers to invest in their land, thereby raising productivity (Besley 1995; Goldstein and Udry 2005). Banerjee and Iyer (2005) show that the legacy of colonial land policies regarding land tenure influences present-day investment levels. In addition to providing knowledge to the wider development community and to MCC, isolating the impact of land tenure on agricultural productivity can help inform future Government of Mali (GoM) land policies in the ON zone.

The principal mechanisms through which property rights can influence investment and productivity, as identified in the economics literature, are: 1) fear of expropriation or loss of control over land in which farmers invested, 2) hindered access to credit, and 3) loss opportunities to gain from trade in improved land. Despite a few papers showing solid evidence on the role of property rights in augmenting productivity, many studies in this area "fail to find strong evidence of significant effects of property rights on investment" (Besley 1998, 361). The relationship between land tenure and increased productivity has not therefore been fully elaborated nor illustrated in a wide variety of contexts. Moreover, there has been even less work attempting to distinguish between the different mechanisms which might generate said relationship. Therefore, the objective of providing land titles in the AIP to boost productivity and investment in the Alatona should be formally tested if possible.

An additional important component of the AIP is providing extensive technical training and extension services to Alatona farmers. Farmers' ability and interest in adopting new technologies is an important step to develop the agricultural sector. In the context of the AIP, there will be multiple types of learning about new technologies. The PAPs will largely need to learn how to undertake irrigated rice cultivation on a fairly large scale, New Settlers will need to adapt their farming practices to new soil and a new way of managing water flow, and it is also expected that the larger farm size (5 and more hectares) will facilitate adoption of relatively new technologies for the zone such as mechanized tillers.

To address the obvious need for technical knowledge, the AIP will provide significant support in the form of extension services to the PAPs. In addition, all Alatona farmers will also learn by doing and engage in an informal learning process. For all of these reasons, we expect to see agricultural productivity rise over time. An additional resource for PAPs to learn about irrigated rice cultivation is the other farmers with whom they share a tertiary and secondary canal. There is evidence that "social learning" is important for promoting productivity growth (Conley and Udry 2007; Foster and Rosenzweig 1995; Bandeira and Rasul 2006). Social learning is simply the idea that farmers can learn about both new and previous innovations from their neighbors and friends. Understanding how farmers learn by doing and learn from those with whom they are socially connected can have important policy implications: harnessing this type of informal learning can complement formal extension services and improve the cost-effectiveness of such interventions. For example, targeting information to individuals within a community who can spread this information on behalf of the agency can dramatically reduce extension costs.

IV. Hypotheses and Design: Overall Impact

The AIP project will not only create an additional 14,000 hectares of land in the ON, it will implement a number of innovations in the way institutions and management processes function. The impact of providing irrigated land and the additional benefits created by the AIP will be jointly evaluated for both New Settlers and PAPs by estimating the overall impact of the project for each group separately.

- ▪ New Settlers

Hypothesis 1: The AIP will improve New Settler households' well-being by increasing agricultural productivity, agricultural incomes, and household consumption.

The lottery for New Settlers, in addition to being fair and transparent, provides an opportunity to study the impact of the project using Gold Standard methodology. The general strategy is simple: in the event that there are more qualified candidates than plots of land available, beneficiaries will be chosen randomly through a lottery. The beneficiary group then comprises of those who are randomly selected to purchase AIP land, while comparison households are those who applied and met the selection criteria but were randomly not selected. The comparison between these two groups of households will provide an unbiased estimate of the total project impacts on qualified new settlers, as measured by agricultural productivity, income, household consumption, etc. Note, however, that this will not provide an estimate of project impacts for a randomly selected

Malian, but only for Malians who have the observable characteristics required by the selection criteria.

A risk to any RCT is that a disproportionate number of individuals with certain observable characteristics are selected by chance. This may present a problem for the econometric analysis, especially if there is significant heterogeneity among the applicant pools. Our understanding is that the criteria to be used to evaluate applications are broadly: financial capacity, including agricultural equipment, cash, access to credit; limited access to irrigated land; household size; experience in irrigated agriculture; and formal training in agriculture. Many of these characteristics will be correlated with how productive a farmer will be in the Alatona. For example, financial capacity will likely affect program effectiveness, and thus farmers with higher initial resources may have higher productivity on AIP land. Therefore, individuals who qualify based on assets may not serve as a good comparison for farmers who qualify largely because they have limited access to irrigated land. We can minimize this risk by stratifying the randomization using observable characteristics. Given that the potential sample size is not large with only 900 parcels to be distributed to new settlers, we do not want to negatively affect statistical power with too much stratification. We therefore suggest stratifying on assets alone.

The project impact will then be evaluated as:
$$Y_i = \alpha + \beta T_i + X_i + \varepsilon_i$$

where Y is the outcome of interest, for example household-level income or per capita consumption levels, for household i. T is an indicator for whether an individual was randomly selected for treatment. X_i includes additional observable demographics at the individual and community level. If a stratified randomization is used, the observable characteristics used in the stratification will be included in X_i. While additional control variables are not needed due to the randomization, their inclusion can often improve precision.

The evaluation team will also use the baseline data in conjunction with the follow-up data to use a difference-in-differences approach. The use of baseline data will be important given that New Settlers will have had significant changes in household composition while the New Settler Comparison households will not have household composition changes attributable to the AIP.

While the impact evaluation team has not yet been informed of the final form of the lottery and the criteria which will be used to qualify candidates, we are aware of discussions to use a hybrid lottery system. In such a hybrid system, candidates with the highest number of points would directly qualify and only those "marginal" candidates would be selected through randomization. As long as the criteria used to attribute points to each candidate are clear, objective and quantifiable, a hybrid system can be used to generate a comparison group. However, it would decrease sample size, as only individuals who participated in the lottery can be used in the analysis, and it further decreases the external validity of the study. Therefore, a risk of this strategy is that there could be too few households selected by lottery. In this case, we will be forced to consider a weaker regression discontinuity approach. In order for regression discontinuity to be a successful alternative, the criteria used to allocate points would need to be clear, objective and quantifiable. A threshold number of points would be used to determine which households qualified for land. In this case, the treatment group would be comprised of

households who received just enough points to qualify, and the comparison households would be those who were close to the threshold but did not get land. Given that our expectation, and that of the M&E department of MCA-Mali, is that there were be a large number of applications for land, we are planning to use the randomization strategy for the evaluation of total project impacts among the New Settlers.[2]

Outcome Measures

Consistent with MCC's objectives, the critical measures of impact for this hypothesis are: agricultural income, non-agricultural income, and food and non-food consumption. An important consideration in the selection of these measures is timeframe. While New Settlers will all be experienced farmers, they will need to adapt to the new land. For example, water management practices may differ, underlying soil quality may differ and also, as has been explained to the impact evaluation team, yields may be lower initially as the soil begins to acquire nutrients cumulatively with fertilizer use. Therefore, it is essential that intermediate outcomes are selected which can both be measured with ease but also outcomes which we could reasonably expect to change within the timeframe of a couple of years. Household income, disaggregated into agricultural and non-agricultural, and consumption are excellent candidates for both reasons. As will be discussed in section V.2, we will also look at how these measures change over time if the collection of multiple rounds of follow-up data is possible.

Data Collection Needs

The essential implication of the lottery strategy for data collection is the need for a baseline distinct from the baseline which will be done December 2008 – March 2009. Since the call for applications will likely not be done until early 2010, it is not possible to interview the New Settlers and New Settlers Comparison households until the applications have been received. That is to say, they can not be included in the baseline survey of 2008/2009 as we do not know who they are or even which regions of the country they may come from.

We are operating under the assumption that many of the qualified New Settler applicants will come from the existing irrigated areas in the Office du Niger (ON). We feel this working assumption is reasonable given that one of the eligibility criteria used for qualification is experience with irrigated rice agriculture. However, given that there is small-scale irrigated rice agriculture in other areas of Mali, it is very possible that applicants will be living at the time of application in Bamako or in other areas along the river where there is rice cultivation. Therefore, this strategy requires a flexible data collection strategy. The collection of two separate baseline surveys is reflected in the budget in section VIII.

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[2] While we believe this to be a viable strategy for households applying for 5 or 10 hectare parcels, there may be significantly less demand for the 30+ hectare plots. However, given that there will be little time to evaluate farmers who receive land in tranche 3 since it will near the end of the Compact, we are not currently planning on evaluating rigorously the large commercial farms. If the timing allows and there is a viable lottery, we will revise this plan.

We will also need to have flexibility to undertake the baseline data collection of New Settlers in a very short time frame. Once applications have been received, we will need to undertake our survey. Given that there is as of yet no definite information as when the application process will begin, it is difficult to prepare a survey firm to undertake this work. This is therefore an issue which the Evaluation Team highlights as particularly time sensitive.

Implications for Implementation

Since the lottery has been proposed in order to ensure fairness and transparency in the process, its faithful implementation is necessary. Since the objective of this report is the elaboration of the impact evaluation strategy, we stress that is also important for the impact evaluation that the following aspects of the lottery are followed:

o   First and foremost, the randomization must be adhered to. Any change to the lottery process which is not anticipated and quantifiable will invalidate the use of the lottery as a technique for generating a valid treatment and comparison group.

o   The criteria used to determine eligibility should be clear, objective and quantifiable. If the criteria are subjective or loosely defined, this will create a problem for the lottery strategy and preclude the use of a regression discontinuity strategy.

o   Due to our need to conduct a baseline survey between the time when candidates apply for land and before New Settlers can re-locate, we request that there be good communication with the impact evaluation team and also, that the amount of time between the call for applications and the time New Settlers are authorized to move be maximized.

Limitations of Design

The principle limitation of the design using the lottery relates to external validity. The concept of external validity asks the question "Can we apply the results of the evaluation in locality *x* to another setting *y*?" Since the design relies on the lottery, the individuals used in the evaluation comprise, by construction, a select pool.

An additional concern is the number of households who will be selected by lottery and can be evaluated. This concern stems from the possibility that a hybrid randomization process will be utilized and concern over possible construction delays which would give little time for evaluation of New Settlers selected late in the Compact period. As details on how the lottery will be implemented develop, we may need to need to update the evaluation strategy. The information is essential, as the use of the lottery to evaluate the impacts on New Settlers is the strongest component of the entire evaluation design.

Finally, the total project impacts will most likely be an underestimate of total project impacts because there are some aspects of the AIP which will affect all farmers in the ON. For example, the Niono-Goma road will affect farmers throughout the cercle of Niono. Additionally, the work on the main canal should improve water availability throughout the zone. By using the baseline data in a difference-in-differences approach, we may be able to disentangle some of these

general benefits of the AIP from benefits more specific to Alatona residents. However, we expect that the estimate of total project impacts will be biased downward. Therefore, all reporting of project impacts will have this caveat clearly expressed.

  ▪ PAPs

Hypothesis 2: Overall impact: Access to irrigation will increase agricultural production in PAP villages.

Because PAP villages will be resettled, the package of inputs including irrigated plots, inputs, and access to credit will be packaged as the "treatment" intervention. Because none of these factors changes between PAP households, there is likely no credible evaluation strategy to isolate the effects of a single element of the treatment. However, the totality of the treatment should impact agricultural production by increasing the quality of land, in a number of dimensions, to which a farmer has access. This gain in quality through increased control of water access breaks the farmer's dependence on rainfall as the primary source of water supply to their crops.

Hypothesis 3: Distribution of the gains in agricultural income: Gains in agricultural income among PAP villages will be distributed among increases in consumption per capita, asset and livestock holdings, and input utilization.

We expect the gains in agricultural income to be large relative to the initial state of the PAP villages. These gains will not be entirely consumed and will depend heavily to whom they accrue within the household (see our hypotheses with respect to gender). However, the studies reviewed above clearly show reductions in poverty associated with access to irrigation. Consumption will likely increase, as some of the gains in agricultural production will be consumed within the household and a portion of income from this production will be used to purchase food. Some of the gains will be saved via either asset accumulation or livestock holdings, while the rest of the gains may be re-invested in the plots to further increase their productivity in the future.

Hypothesis 4: Access to irrigation will increase the demand for inputs (fertilizer and seed), agricultural capital, and household and hired agricultural labor.

With access to irrigation, complementary inputs such as seed and fertilizer which require stable water control become profitable investments for small farmers (Morris et al. 2007). Without sufficient rainfall, improved seed or fertilizer has low potential to increase the productivity of a plot. Thus, the cost of these inputs is not recovered at harvest. Extension advice to farmers which is consistent with soil research on the right "mix" of inputs has shown the best results. In experimental studies in Kenya, Duflo et al. (2008) illustrate that despite experimental farm estimates that illustrate high rates of return to fertilizer, the over-prescription of fertilizer to farmers can actually be unprofitable under normal field conditions.

The mix of these seed and fertilizer inputs is not only constrained by lack of irrigation and the appropriate mix of inputs, but also supply-side constraints. Since the AIP will provide many of these inputs for farmers in the first years of the intervention, these supply side constraints will

not limit farmers and may stimulate private input market development as farmers will be well aware of their benefits after the input subsidies from AIP are phased out. Increased participation in farmer's cooperatives may also assist farmers in organizing bulk fertilizer orders to reduce transportation and administrative costs of importing fertilizer.

In addition to fertilizer and seed inputs, the increased area to cultivate for AIP beneficiaries will increase demand for household and hired agricultural labor. Some of this demand for increased labor will be offset by the household's investment in labor-saving capital such as carts and mechanized tillers which will be made possible by increased access to credit and the titling of plots. However, some of the demand for labor will be offset by increasing the amount of time farmers spend in the field and increasing the amount of time other household members spend in agriculture. Dillon (2007) illustrates that there are large negative effects on child agricultural labor in response to negative production shocks in northern Mali. That is, when labor demand increased due to a crop loss shock, children's participation in the farm sector increased while their participation in other activities decreased. Because irrigation will increase the demand for labor, these substitution effects may also hold in the case of an increase in the irrigated land area of the household. However, demand for labor may also be met hiring seasonal agricultural laborers. This tradeoff depends on the income effects of increased agricultural production which may permit households to simultaneously purchase more hired labor and keep children in school. Since the AIP intervention also involves the construction of village schools, households may choose to invest in their children's human capital as opposed to using their agricultural labor. Fundamentally, the distribution of labor among household members and hired labor will be an empirical question to monitor in the evaluation of the AIP.

Outcome Measures

The overall impact of the project will be measured using agricultural production measures (kg of crop produced per hectare), a household consumption aggregate, and asset variables (durables and livestock holdings).

Data Collection Needs

To evaluate hypotheses 2-4, detailed data on the PAP households and an adequate comparison group is necessary. The construction of two comparison groups, one of which is similar to the PAP communities current rainfed millet cultivation system will permit the estimation via propensity score matching of the average treatment effects of the AIP. A comparison group of other irrigated households in the ON will permit estimation of the average treatment effect on the treated of access to irrigation to evaluate whether AIP farmers at the end of the intervention are as well off as farmers with access to irrigation.

To conduct the propensity score matching, it is necessary to collect information on all household and village characteristics that could plausibly explain adoption of irrigation and physical characteristics of the areas being compared to assure that agro-climactic differences are not driving the results as well. At the individual level, the relevant characteristics to be included in the propensity score matches include education, experience with irrigated farming, and age of the farmer. The relevant household characteristics include household size and composition and

initial asset levels. Village characteristics include access to markets, rainfall, soil quality, prevalence of farmer's cooperatives and access to infrastructure.

Limitations of Design

The use of propensity score matching will rely on the un-testable assumption that there are no unobservable differences between villages with PAPs and other communities in and around the ON. These differences could include political influence which may increase the allocation of public goods to ON villages as opposed to PAP villages, causing underestimation of the true benefits of the irrigation intervention. If unobserved factors influence the rate of adoption between the treatment and comparison groups, then this could bias the outcome indicators. While there is undoubtedly a bias to estimates that do not control for household unobservables, it is unclear how large this bias may be and in what types of evaluations, the role of unobservables is most likely to be largest (Diaz and Handa (2004), Smith and Todd (2005), Bertrand et al. (2006)). The impact evaluation team will also undertake a bounding exercise to provide a best estimate of whether unobservable factors may be driving the results (Altonji, Elder and Taber 2005).

V. Additional Hypotheses

1. Gender

Hypothesis 5: AIP will increase women's incomes in the AIP and potentially influence women's empowerment.

One objective of the AIP is to provide new economic opportunities to women. This is accomplished through the provision of women's gardens to all AIP households and by providing additional points to women to qualify for the lottery. The market gardens will be titled like the main agricultural land, but the title will be held through women's associations to ensure that women can maintain control over the land. All AIP beneficiaries will receive 0.5 hectare plots for women in each household to use for gardening, in addition to the 5+ hectare plots provided to the household in general.

Since the household will also benefit from the main farm land, we expect women's income and well-being to also be positively influenced by the total project impacts. The social infrastructure provided by the project may also lead to positive gains for women in absolute terms and also relative to men.[3] All these project components in addition to women's gardens and the organization of women into associations should lead to improvements in women's income. While we are unlikely to be able to separate the impact of the women's gardens or the organization of women's gardens into larger women's associations from the additional project benefits, we can explicitly measure the impact of the project for women.

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[3] For example, the availability of pumps in the village will particularly help women as the time saved from having to fetch water from far distances can then be used for other activities, including agriculture.

New Settlers

The design for evaluating women in New Settler households is similar to that described for measuring total project impacts, except that the outcomes measures of interest focus on women. The treatment group will be women in AIP households who gained land by winning the lottery, and the comparison group will be women in households who qualified for land in the AIP but randomly did not benefit due to the lottery.

PAPs

For PAP households, the evaluation of the effects on women of access to AIP interventions will be done by creating a comparison group of women in rain-fed millet cultivating households. The evaluation strategy will be similar to the construction of the propensity score matching methodology used to evaluate overall benefits of the AIP to PAP households. The outcome measures will be constructed to be gender-specific as described in the next section.

Outcome Measures

Since the questionnaire will be designed to measure both male and female agricultural and non-agricultural land, we will be able to observe changes in women's, relative to their male household members', changes in income. We are also considering a module on women's empowerment, which would focus primarily on women's ability to make financial decisions independently and move freely within and across villages without the accompaniment or permission of male family members.[4] There is evidence that women's income leads to larger benefits for children than comparable income received by men (Lundberg, Pollak and Wales 1994). Therefore, we will also look at measures of children's well-being, such as school attainment and expenses within the household which target towards children (children's clothing as an example), although we will be unable to argue whether changes in children's well-being are due to the project's focus on women or from the larger project benefits.

2. Learning about a New Technology

Hypothesis 6: the productivity of both New Settlers and PAPs will increase over time, possibly at different rates.

We expect the agricultural productivity of both New Settlers and PAPs to evolve over time. There are three main factors affecting the dynamics of productivity in the AIP. In particular:

1. Because of the resettlement process, both New Settlers and PAPs will have their livelihoods interrupted. Additionally, both groups will have to spend a considerable amount of time establishing basic functioning of their households under new circumstances. Therefore, we expect that both groups will have more time to spend cultivating their fields after the initial year of resettlement. New Settler households will have to move to a new village from a further distance than PAP villages, will

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[4] These measures may prove too subjective to measure well in a quantitative study.

know the land and climactic characteristics of the region less, and will have to spend time organizing themselves in a new village while attempting to cultivate in the first few years of the project. While all PAP households will also be affected by the resettlement process, there will be considerable variation in the extent of disruption. Some villages, such as N'Doukoula, will not be physically relocated. It is overall possible that PAP villages will be better organized within their own households and have reciprocal sources of labor on which to draw from other households in their village to better exploit irrigated parcels in the early phases of the project compared to New Settler households.

2. Farmers will also be learning by doing and learning formally through the extension services provided by the AIP. In this case, the PAPs have the most to learn, as they are less experienced in irrigated rice agriculture than the New Settlers. However, the New Settlers will also have to learn and experiment as they adjust to potentially different soil conditions and a new size of plot. New Settlers may also be farming land independently from their extended family for the first time and may therefore experience more responsibility in certain aspects of the farming process, especially in acquiring inputs and financial capital. All of these factors will create a need for learning, and therefore a likely increase in productivity, over time.

3. Agricultural productivity may change over time due to fertilizer use. Within the first couple of years, productivity may increase due to the benefits of residual fertilizer from year to year. However, we could observe soil degradation even within a short time frame depending on fertilizer usage rates which would have negative effects on agricultural yields.

We seek to document the dynamics of learning in the AIP using panel data on both PAPs and New Settlers and data on other ON households. The ON households will show how, on average, changes occur over time in older, more established areas of the ON. This will provide a way of descriptively comparing the learning and resettlement dynamics in the AIP to dynamics occurring in more established areas.

Data Collection Needs

In order to capture the dynamics of how agricultural productivity evolves over time, the evaluation team will need multiple rounds of data and measures of how productivity in existing areas on the ON is changing over time. This will therefore require panel data on PAPs, New Settlers, and farmers in already irrigated areas of the ON. The budget in section VIII proposes two follow-up rounds. However, the construction schedule may not provide sufficient time for multiple rounds prior to the conclusion of the Compact.

Hypothesis 7: Social learning in the AIP will complement formal extension services, leading to improved agricultural productivity.

In addition to formal extension services and learning by doing, another source of information for both the PAPs and New Settlers is their friends and neighbors.

Identifying social learning is difficult for two main reasons, as outlined by Conley and Udry (2007): first, it is often difficult to determine the set of people from whom a farmer can learn. Second, disentangling social learning from other correlated unobservable factors is challenging. For example, neighbors may behave like one another since they have common socio-cultural practices (or other types of shared preferences), are affected by similar shocks (such as pest infestation), or have more similar agro-climatic conditions than farmers who are more geographically distant.

The way the AIP will be implemented offers a significant opportunity to evaluate how important social learning is in the adoption of new technologies in Mali. Before explaining the empirical strategy, we first provide an overview of our understanding of how land allocation will be determined:

- New Settlers: The understanding of the impact evaluation team is that the lottery for New Settlers will determine not only who receives land but also which parcel of land a household will receive. This will provide random variation in the types of farmers who are sharing secondary and tertiary canals.

- PAPs: The Resettlement Action Plan (RAP) proposes a protocol to determine how land will be allocated to PAPs. The protocol seeks to balance the desire to let villagers choose their neighbors but also prevent prominent community members from taking advantage of their position (elite capture). This is particularly important since proximity to the secondary and main canals can affect access to water during times when water is not abundant. Therefore, the protocol allows villagers to put themselves into groups of 8, enough to cover a tertiary canal. The assignment of groups to tertiary canals and households to individual parcels within a tertiary is then randomized. Therefore, while there will not be exogenous variation in who shares a tertiary canal, there will be random variation who become neighbors by sharing a drain and also in proximity to other farmers on the secondary canal.

- In addition, there will be New Settlers with land in secondary canals occupied primarily by PAPs. This will be determined by two factors:

  1. *Selection of PAP villages to receive New Settlers.* The resettlement plan determines where villages are moved and which villages will be occupying which secondary and tertiary canals. There was an explicit attempt to keep villages together on secondary canals and use information on the historical relationships between villages to place friendly villages near one another. However, due to the geographic constraints of the area (some secondary canals are longer than others) and the size of each village prior to the project, there are some parcels open to New Settlers in a number of secondary canals.

  2. *Selection of New Settlers for PAP villages.* It is our understanding that New Settler households will be selected to join PAP villages largely by the lottery, with some criteria added (such as linguistic similarities) to maximize the likelihood that all villagers will be compatible in both village life and also in the functioning of the agricultural associations.

These two factors combined provide "plausibly exogenous" variation in which PAP villages receive New Settler households and which New Settler households are sent to reside in primarily PAP villages.

The exogenous variation in who becomes a given farmer's neighbor is the starting point for evaluating the hypothesis. We can address the difficulty with identifying social learning due to unobservable factors such as common preferences using the exogenous variation created by project implementation. However, neighbors may still have similar soil types or agricultural shocks. Therefore, we intend to measure indicators at baseline which will capture objective characteristics which should predict farmers' ability. The amount of experience a farmer has with irrigated rice agriculture, the types of agricultural capital they possess at baseline, their financial capacity for investment, and their baseline level of fertilizer use (largely for New Settlers) are all examples. We will then look at whether farmers who randomly have higher quality neighbors, as measured by having more experience or better agricultural capital, also show higher productivity. While many econometric specifications are possible in this setting, and the exact specification we will use will depend on exactly how the allocation of parcels to farmers is done, below is one example. This is simply a formalization of the intuition above:

$$Y_i = \alpha + \beta N_i + X_i + \varepsilon_i$$

where Y is the outcome of interest, for example agricultural productivity, for household i. N_i captures the quality of individual *i*'s neighbors. This may be the average amount of experience of farmers on farmer *i*'s tertiary canal, or whether the farmer *i* has a farmer with a contingent plot who owned a mechanized tiller prior to the start of the AIP. X_i includes additional observable demographics at the individual and community level. Depending on whether PAPs or New Settlers (or both) are included in the analysis, we will need to be very careful in addressing the fact that not all of the variation in neighbor farmer quality is random.

Hypothesis 8: The process through which New Settlers create social capital in their new villages will be important for consumption smoothing and the functioning of village associations.

In addition to learning about agriculture, there is another important question about how households adapt to new social and living environments. Some PAP communities will be moved and provided additional social infrastructure such as schools and drinking water, although the structure of their villages will remain largely unchanged. However, some PAP villages will also receive New Settler households based on the two factors described above. Informal social networks are crucial in environments such as Mali, where there is little to no formal social assistance. Family and friends usually serve as safety nets. There is convincing evidence that villagers provide assistance to one another in difficult times (Townsend 1994) and that extended family networks are also important for ensuring that households maintain a certain level of well-being (Angelucci and De Giorgi 2008; Rosenzweig and Stark 1989). The analysis of this hypothesis will therefore seek to provide insights into how New Settlers create new social ties and social capital in new surroundings. This will involve the development of innovative measures of social capital, including the use of economic games. We will also look at how important common baseline characteristics, such as language and wealth, are for New Settlers to become integrated into the community.

Furthermore, the hypothesis also examines one of the innovations of the AIP: a novel way of organizing of farmers into associations. The impact evaluation can assess whether diversity, as measured by linguistics or pre-existing wealth levels, affects how successful different associations are at collecting water fees and managing water availability.

Outcome Measures

- Agricultural productivity, capital, farming practices (labor and fertilizer use; crop choice)
- Consumption: food and non-food
- Functioning of village associations: the frequency and amount of water fees collected, the number of members in the associations, the frequency and attendance at meetings, and the incidence of disputes

Data Collection Needs

For both hypotheses, it will be essential to collect information about each household's experience with farming, their agricultural capital, their previous choices over crops and fertilizer use, as well as their social capital. In order to measure social capital, we intend to capture both the size of an individual's social network, for example the number of network links, and also the quality of the network, as measured by the intensity of each link.

Implications for Implementation

The viability of this design will depend on how the lottery is implemented and how land is assigned to farmers. Therefore, this strategy will need to be revised as details of the land allocation process are finalized.

3. Land Tenure

Hypothesis 9: The provision of land titles will increase productivity in the AIP by increasing household investment in their plots and access to credit to finance these investments.

Providing full land titles to all AIP beneficiaries represents a significant departure from current ON policy. Therefore, an ideal impact evaluation would isolate the impact of providing land titles within the estimated total project impacts. However, there are serious methodological difficulties in rigorously evaluating this project component. In particular, there is no variation within the project on who will receive titles. All AIP recipients will simultaneously receive numerous benefits, including titles, extension services, improvements in financial services, and technical assistance on improved farmers organization to name a few. Therefore, it will be a significant challenge, and perhaps impossible, to disentangle these effects.

One possible strategy is to focus on New Settlers who came from existing areas of the ON. The idea is to compare New Settlers to their extended family members they lived with before receiving AIP land. If productivity is higher for the plots in the AIP compared to the productivity of plots cultivated by the New Settlers' extended family in older areas of the ON, the difference

in productivity either stems from differences in underlying agricultural conditions (soil) or due to differences, such as the land titles, provided in the AIP. The problem is that even if we can rule out differences in agricultural conditions by high quality soil testing, there is the remaining problem of separating the effect of the land titles from the other differences between the AIP and the ON. It is possible that some benefits, such as improved water management techniques, will only be implemented towards the end of the Compact and certain other benefits will be shared with extended family (financial benefits). This will help to isolate the role of land tenure, but it is likely that this analysis will leave at least some ambiguity on whether the effects are driven by land titles or other aspects of the AIP.

A second strategy would use the fact that not everyone will receive land titles during the Compact period. The reason for this is simply that the Cadastre is unable to map all the land during the project period. Therefore, farmers will receive their titles over time. In order for this to facilitate an evaluation strategy to estimate the impact of land titles on productivity, we would need the following assumptions:

1. Those farmers who receive titles early are not systematically different from those that receive titles later. We will only be able to determine this once the Cadastre Office has established their work plan. Ideally, the starting point should be randomized to ensure fairness.

2. Having a title in hand has a much larger impact on investment and productivity than the expectation of a title.

In order to address the second concern, we may be able to explicitly analyze one mechanism through which land tenure may affect productivity and income: access to credit. Since only those farmers with an actual title will be able to use the land as collateral, we may be able to estimate the returns to this one aspect of holding a land title.

VI. Data Collection Plan

The data collection plan is designed to accurately collect the variables necessary to test the hypotheses described in the above evaluation design. To test these hypotheses, quality data sets are required. These data sets are produced by ensuring that: the households surveyed are representative of their intended group, (i.e. the sample of ON households is proportional to the total ON population); the sample frame is careful constructed; the sampling is correctly implemented, and the questionnaire design follows best practice in organization of modules, the designation of primary respondents to be interviewed question phrasing and sequencing.

Construction of the Sample Frame

To develop the sample frame for the baseline survey, the data collection plan uses a list of possible communes to be included in the sample frame, identified during our preliminary research trip. Because our sampling strategy will use a two-stage cluster sampling technique whereby villages are selected in the first stage and households in the second stage, it is necessary to first define the sample area (communes) from where the villages will be selected. Identifying

the communes to be included in the baseline depends on several factors. First, we want to ensure that the households that are drawn for the two comparison groups are similar to the types of households that exist in the project zone. In order to match the diversity found in beneficiary communities, we will need sufficient variation in characteristics, such as livelihood, in the sample used to construct the comparison groups. The qualitative interviews with villages in Macina, M'Bewani and the Alatona conducted during our preliminary research trips facilitated our understanding of household characteristics among the PAPs, the potential New Settlers and the potential comparison households for both groups. Using this information, we can design the sampling strategy to maximize the likelihood of drawing a sample of households which can be used in the examination of the hypotheses explained above.

A list of communes provided in Appendix A are the communes that were selected to assure sufficient variation among ethnic groups and livelihood strategies (level of sedenterization, rice versus millet cultivation, women's involvement in agriculture, etc.). Our criteria was to select communes for the comparison groups including all communes with villages that are participating in the Office du Niger irrigation scheme and all peripheral communes to the ON communes that are practicing rain-fed millet agriculture and pastoralism north of the city of Segou's longitudinal position in the *cercles* of Macina, Niono and Segou.

Given the list of communes in the sample frame, it is necessary to determine the work required to update the information from the 1998 Census. Over a ten year period, the population in villages has changed, new villages may have formed, and existing villages may have merged or disbanded. In addition to these fluctuations in numbers of villages and population within communes, there is also the problem of multiple administrative and traditional names for villages identified during our research trip[5]. This suggests that a verification of current villages in communes and their populations in localities outside the Alatona will be essential to establish a legitimate sample frame. Significant time will be spent in the field in late September-October to identify villages within the communes and households within theses villages. The following table summarizes our strategy to construct the sample frame, while the sampling strategy is discussed in more detail in the next section of the report.

Table 1: Activities for 2008

Sample Frame Construction Activities	Month
Determination of communes to include	June
Verification of villages and population by village	September
Final decision on sample probabilities given updated population figures	October
First stage selection of villages	October
Enumeration of households in villages	October
Selection of sample households provided to survey firm	November

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[5] This was most apparent when we made a simple comparison between the villages in Dogofry and Diabaly communes listed by the RAP and 1998 Census. Significant differences and changes in village names were documented in the RAP, while some villages listed in the 1998 Census with significant populations were not present in the RAP data.

Sampling Strategy: Baseline

The sampling strategy is based on the communes chosen as part of the sample frame. Among the three *cercles* (Macina, Niono, and Segou) included in the sample frame, a total of 32 communes are proposed for the baseline survey. The *cercle* of Macina has 7 communes included in the sample frame. From the 1998 Census, there were 175 villages in the Macina *cercle* included in the sample frame. The estimated total population of Macina villages in the sample frame was 148,523. In the *cercle* of Niono, 11 communes are selected in which there should be 202 villages with a population of 195,059 according to the 1998 Census. Lastly, the *cercle* of Segou has 14 communes selected, and there should be 225 villages with a population of 195,824.   The proposed sampling strategy consists of the following:

1. All villages which contain PAP households will be selected in the first round and included in the sample.

2. ON villages and non ON villages outside of the project zone will be included. Households in these villages will potentially serve as comparison households for both PAPs and New Settlers. In addition, we want to assure there are enough villages in the sample that will continue to practice rainfed millet agriculture throughout the duration of the Alatona project. This is essential for estimating project impacts for the PAPs. To achieve this objective, given proposed expansion in other parts of the ON, we will oversample rainfed millet producers by increasing the probability that these villages outside the ON are selected in the sample. Because of the high number of ON villages, we do not think it will be necessary to oversample ON villages to gain enough female agricultural producers or agricultural households with access to irrigation. We also believe from our trip that sampling according to livelihood system rather than ethnicity (i.e. Peulh households) is appropriate, since many Peulh households in the ON consider themselves sedentarized and there were widespread observations by ON officials and Bambara villagers that Peulh agricultural producers with irrigation were no different than other ethnic groups with respect to their productivity.

Sampling Strategy: Follow-ups

After the initial baseline sample is selected, in subsequent years, this sample will be tracked and re-surveyed. Therefore, village and household enumeration activities will be limited to 2008 to establish the sample frame. In 2011, we have proposed re-surveying half of the original sample before the final, full-sample follow-up in 2012. This will permit us to observe changes over time in agricultural production and household well-being that may be associated with learning how to most effectively use irrigated technology for the PAPs and resettlement dynamics for the New Settlers as they form new villages. In 2012, we will track all households from the baseline survey in 2008 and re-survey them to assess the AIP's impact on the multiple questions described above.

Sample Size and Power Calculations

More detailed power calculations will be conducted once the data from the RAP data becomes more easily accessible, but our initial calculations suggest that for the PAPs, a comparison group of approximately 2,000 households will assure sufficient statistical power to measure project impacts. We anticipate surveying 800 PAP households, due to the heterogeneity within PAP communities and differences in treatments (some being displaced, others not). The sample of New Arrivals and unsuccessful lottery participants will be approximately 1,500 households. This would yield a sample size of approximately 4,200 households in total. For the baseline, the sample size will only include the PAPs and their comparison group, a sample size of 2,800 households.

According to a power calculation with a significance level of .05, power of .90 and an assumed effect size of 0.20 standard deviations, we need a sample size of approximately 1060 under RCT conditions. An effect size of 0.20 standard deviations is considered a small effect size. Dillon (2008) finds a larger effect on household consumption, of about 0.40 standard deviations, among households in Northern Mali. However, one of the most common mistakes in power calculations is being too ambitious and therefore designing an under-powered study. Additionally, the evaluation of the PAPs is not an RCT, and the design also calls for disaggregating the effects into various sub-groups and looking for effects which may be more subtle than the main impact.

The evaluation of the PAPs will use propensity score matching. Given the diversity of livelihoods and asset levels within the PAPs, we need to have a diverse pool of potential-comparison households to select from in order to find good matches. Moreover, we expect that the distribution of characteristics will differ across PAP and non-PAP villages. Therefore, we are allowing there to be a match rate of 50% within the non-PAP sample. In this case, in order to detect a minimum effect size of .20, we will need 500 treatment households and a sample size of 1000 non-PAP households. In order to allow for disaggregating PAPs by variables of interest, such as initial experience with irrigated rice cultivation or agricultural in general, we propose increasing the number of PAP households interviewed to 800 and non-PAP households to 1600.

Additionally, we will use the sample of households in the ON to measure the evolution which would have happened in the zone in the absence of the AIP. This will provide an opportunity to look at the dynamics of learning within the AIP to the change over time that occurs over the same period in the rest of the ON. This would increase the sample of non-PAP households to 2,000.

Questionnaire Design

The questionnaire design is the last main component of the data collection plan that is essential to the production of a quality data set useful for the AIP evaluation. The survey instrument will be designed as three distinct questionnaires: community, male and female. Table 2 describes each of the components of the questionnaires and their corresponding modules.

The community questionnaire will collect demographic and physical characteristics of the community in addition to information about the functioning of markets (Migration and

Agriculture), access to infrastructure and the quality of the infrastructure (Health and Education) that exists. In the Agriculture module, community level information with respect to the functioning of farmer's cooperatives, access to inputs, and management of irrigation plots (collection of water fees, community level investment, land tenure and transactions) will be collected. The household questionnaire composed of a male and female questionnaire will contain modules necessary to measure agricultural production, poverty via the construction of a consumption aggregate (composed of food expenditures, non-food expenditures, and the discounted present value of assets and housing), non-farm revenues, labor supply, and credit and savings behavior. A module on social networks will ascertain how men and women in households within the village are connected and how households are connected to other villages; this will permit us to measure the effects of networks on adaptation to a new technology (irrigation and inputs). A module on economic shocks will document and permit the analysis to control for the various types of economic shocks which may explain variations in the welfare indicators, uncorrelated with the project interventions.

Table 2: Proposed Questionnaire Structure

Module	Description
Community Questionnaire	
1. Meta-data	Information on GPS location of the community, respondents, enumerator names and date of interview. Questionnaire posed to village head, with complementary information collected from school, health and agriculture officials.
2. Health	Collects information on the health infrastructure of the community including access to medical facilities and their quality, availability of medicines, and common illness in the community.
3. Migration	Information to be collected includes the frequency of permanent and seasonal migration, reasons for migration and common migrant destinations.
4. Education	Collects information on the school infrastructure of the community including access to schools and their quality, school-specific characteristics and the costs of schooling. (Some school characteristics need to be asked of regional education officials.)
5. Infrastructure	Information on access to infrastructure, travel times to different locations and the means of transportation used.
6. Agriculture	Information on the agricultural season and agricultural practices of the community including wage labor rates, tenancy arrangements, primary crops, access to extension services, use of agricultural capital, collection of water fees and farmer cooperatives
7. Physical and Demographic Characteristics	Collects information on the communities access to water and electricity, history of the village, and population characteristics.

Household Questionnaires

Module	Description
Women's Questionnaires	Questionnaire posed primarily to female household head, with some individual female responses to selected questions
1. Household Information	General household information
2. Possessions	Durable and agricultural assets
3. Agricultural Exploitation	Production, input utilization, and marketing of production surpluses
4. Herding	Livestock holdings, revenue from livestock and costs of holding livestock
5. Non-Agricultural Revenue	Non-farm sources of income, costs of non-farm activities
6. Non-Food Expenditures	Expenditures on household items, clothing, and personal expenditures
7. Credit/Savings	Credit transactions, loans to others, and savings behaviors
8. Food Consumption	Interview together with Household Head on food expenditures and quantities consumed by the household
9. Food Security Survival Strategies	Food security indicators including reciprocal meal sharing, number of meals skipped, and reductions in portions served
10. Women's Time Allocation	Hours data on women's activities
11. Social Networks	Information on household members links within villages and between other villages
Men's Questionnaires	Questionnaire posed primarily to male household head, with some individual male responses to selected questions
1. Household Information	General household information
2. Household Composition	Interview together with the female respondent on the members of the household
3. Household Education	Educational attainment of all household members
4. Household Activities	Primary and secondary activities of all household members
5. Migration	Migration of current household members and migrant remittances.
6. Possessions	Durable and agricultural assets
7. Agricultural Exploitation	Production, input utilization, and marketing of production surpluses
8. Herding	Livestock holdings, revenue from livestock and costs of holding livestock

Module	Description
9. Non-Agricultural Revenue	Non-farm sources of income, costs of non-farm activities
10. Non-Food Expenses	Expenditures on household items, clothing, and personal expenditures
11. Credit/Savings	Credit transactions, loans to others, and savings behaviors
12 Men's Time Allocation	Hours data on men's activities
13. Social Networks	Information on household members links within villages and between other villages
14. Economic Shocks	Household-specific and macroeconomic shocks including agricultural shocks, illnesses, and other macroeconomic shocks such as price increases or changes in government policy.

An additional important element of the questionnaire design is the definition of the household. Given that we expect that household structure differs across PAP, ON and ON-periphery villages, we hope to extensively pilot the modules on household composition and consumption to allow for flexibility in structure. Moreover, flexibility is needed as PAPs will receive land as a concession unit, which may differ from the household.

VII. Data Collection and Research Hypotheses

Research Hypothesis	Methodology	Treatment Group	Comparison Group	Outcome Variables
New Settlers *The AIP will improve New Settler households' well-being by increasing agricultural productivity, agricultural incomes, and household consumption.*	Randomization	New Settlers	Unsuccessful Lottery Households	Agricultural income, non-agricultural income, and food and non-food consumption
PAPS *Hypothesis 2: Overall impact: Access to irrigation will increase agricultural production in PAP villages.*	PSM	PAP HHs	Rainfed Millet agricultural households around periphery of ON and/or ON households with access to some irrigation, depending on PAP characteristics	Production per hectare
Hypothesis 3: Distribution of the gains in agricultural income: Gains in agricultural income among PAP villages will be distributed among increases in consumption per capita, asset and livestock holdings, and input utilization.	PSM	PAP HHs	Rainfed Millet agricultural households around periphery of ON and/or ON households with access to some irrigation, depending on PAP characteristics	Consumption aggregate, durables, livestock holdings

Research Hypothesis (Continued)

Research Hypothesis	Methodology	Treatment Group	Comparison Group	Outcome Variables
Hypothesis 4: Access to irrigation will increase the demand for inputs (fertilizer and seed), agricultural capital and household and hired agricultural labor	PSM	PAP HHs	Rainfed Millet agricultural households around periphery of ON and/or ON households with access to some irrigation, depending on PAP characteristics	Fertilizer and seed utilization, agricultural capital value, days of male, female and child agricultural labor, hired agricultural labor
Additional Hypotheses Hypothesis 5: AIP will increase women's incomes in the AIP and potentially influence women's empowerment	Randomization, PSM	New Settlers and PAPs	Female members of households in above comparison groups for each group	Women's agricultural income
Hypothesis 6: the productivity of both New Settlers and PAPs will increase over time, possibly at different rates.	Survey data	New Settlers and PAPs	New Settlers, PAPs, ON households over multiple rounds	Agricultural production per hectare, fertilizer and seed utilization, agricultural capital value, days of male, female and child agricultural labor, hired agricultural labor
Hypothesis 7: Social learning in the AIP will complement formal extension services, leading to improved agricultural productivity .	Randomization	New Settlers and PAPs with high quality neighbors	New Settlers and PAPs with lower quality neighbors	Production per hectare; use of agricultural inputs and capital, ownership of capital
Hypothesis 8: The process through which New Settlers create social capital in their new villages will be important for consumption smoothing and the functioning of village associations	Randomization	New Settlers	ON households	Measures of social capital and how these change over time
Hypothesis 9: The provision of land titles will increase productivity in the AIP by increasing household investment in their plots and access to credit to finance these investments.	Randomization, PSM	New Settlers and PAPs	Either ON households or extended family members of New Settlers who did not directly benefit from the AIP	Agricultural output, inputs, investments, non-agricultural income

VIII. Budget

To finance these proposed data collection activities, field costs were estimated for the baseline survey and follow-up surveys proposed in 2011 and 2012. Three groups including the PAP households, an ON comparison group including villages in the ON periphery, and a New Settler baseline including selected and non-selected lottery participants will compose the baseline. However, the costs of surveying these different groups vary. We approximate that PAP and ON comparison group households will have similar costs, while tracking the New Settler households will cost a premium above the cost per household of PAP and ON households. These differences are reflected in the cost per household of the different groups. Another factor influencing the cost per household is the time period over which the survey will be implemented.   It is anticipated that household survey costs per household will become more expensive over time. The last feature of the data collection budgeting was to include not only field costs for a baseline and follow-up survey, but to also conduct a limited follow-up in 2011, the year before the compact ends.   The purpose of including this limited follow-up is to better understand the dynamics of irrigation adoption through learning by doing and the adjustment process of resettlement, two of the key features of the AIP intervention. By including a limited follow-up before the final complete follow-up, the evaluation will be able to observe households after they have had at least an agricultural season to produce and adjust to their new communities and plots to see if increases in household well-being are likely even after the full follow-up.

Data Collection Budget Justification			
Description	Cost per Household	Number of Households	Total
Year 2008			
PAP Baseline	80	800	64000
ON comparison group sample	80	2000	160000
New Settler Baseline	100	1500	150000
Year 2008 Total			374000
Year 2011			
PAP Follow-up	85	400	34000
ON comparison group sample	85	1000	85000
New Settler Follow-up	105	800	84000
Year 2011 Total			203000
Year 2012			
PAP Follow-up	90	800	72000
ON comparison group sample	90	2000	180000
New Settler Follow-up	110	1500	165000
Year 2012 Total			417000
Total 2008, 2011, 2012			994000

IX. Local Capacity Building

IPA agrees with MCC in the desirability of local capacity building. We have already started this process by having Kalilou Tigana, Director of Monitoring and Evaluation of MCA, attend a week long training course on impact evaluation by MIT's Abdul Latif Jameel Poverty Action Lab in Paris in late May.

A second part of IPA's local capacity building plan is our intent to work with the local survey firm. While there are a number of qualified survey firms, few have undertaken a large household survey with the depth – including both consumption and agricultural production information – that is proposed in this data collection plan. It is IPA's expectation that we will be involved in quality control and hope that the survey firm will benefit from this additional assistance and training (if so interested). It is hoped and anticipated that the follow-up data will require much less oversight by IPA.

IPA is also very pleased to have a young Malian, Nouhoum Traore, working as part of the IPA team in Mali. While Mr. Traore's primary work is on another project in Mali, he is cross-trained and will contribute to the evaluation of the AIP. While having undertaken his post-secondary studies in the United States, we hope that his desire to continue working on issues important to Mali will have a long-term impact on the ability of locals to undertake rigorous evaluation.

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Appendix A: Sample Frame: Proposed Communes[6]

Region	Cercle	Commune	Villages Per Commune	Commune Population
Segou	Macina	Boky Were	14	13030
		Kokry Centre	17	11056
		Kolongo	37	24836
		Macina	22	31655
		Monimpebougou	33	27838
		Solaba	42	31020
		Souleye	10	9088
		Subtotal Macina	175	148523
	Niono	Diabaly[7]	29	20340
		Dogofry[2]	19	15818
		Kala Siguida	15	12816
		Mariko	21	14900
		Niono	21	40513
		Pogo	17	8087
		Siribala	19	15441
		Sirifila Boundy	15	21547
		Sokolo	18	17010
		Toridaga-ko	17	16824
		Yeredon Saniona	11	11763
		Subtotal Niono	202	195059
	Segou	Baguindadougou	14	6534
		Boussin	15	8700
		Diganibougou	23	10653
		Dioro	29	20539
		Dougabougou	7	14483
		Farako	11	10640
		Farakou Massa	8	9789
		Markala	30	37114
		N'Koumandougou	15	9861
		Pelengana	26	19561
		Sama Foulala	7	6949
		Sansanding	15	19445
		Sibila	15	13010
		Togou	10	8546
		Sub-total Segou	225	195824
		Sample Frame Totals	602	539406

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[6] Number of villages and population size are from the 1998 General Census.
[7] Diabaly and Dogofry are the two communes in which the Alatona Irrigation Project will be installed and the PAPs reside.