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**IMPACT ASSESSMENT** PLAN

# People's Republic of China

## Guangxi Integrated Agricultural Development Project (GIADP)

**Authors:**
Alessandra Garbero
Tisorn Songsermsawas

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# Introduction

The Guangxi Integrated Agricultural Development Project (GIADP) project is a multi-component rural development project which takes place in the Guangxi Zhuang Autonomous Region (GZAR) of the People's Republic of China. The project was approved by the International Fund for Agricultural Development (IFAD)'s Executive Board in December 2011, and entered into effect in January 2012. The project is expected to complete its implementation activities in March 2017. The main focus of the project is to foster rural development and poverty reduction. Through the activities implemented during the course of GIADP, project beneficiaries are expected to increase their revenue from agricultural production through innovative approaches.

The objective of this document is to provide an outline of the plan to conduct an ex-post impact assessment of GIADP, which is a project supported by IFAD. 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 policy purposes as they seek to provide the answer to the accountability question, and help generate lessons learned for future project design and implementation. A review article by Winters et al. (2011) notes a small number of rigorous impact assessments of agricultural projects. Further, international donors including the World Bank and the Inter-American Development Bank (IDB) have called for more rigorous assessments of agricultural projects (IDB, 2010; World Bank, 2010). IFAD responds to this growing demand for rigorous impact assessments by commissioning the IFAD9 Impact Assessment Initiatives (IFAD9 IAI) to generate evidence of success of IFAD-supported projects beginning in 2012. The impact assessment of GIADP is part of the IFAD10 Impact Assessment Agenda (IFAD10 IAA), which follows IFAD9 IAI and started in early 2016.

The Research and Impact Assessment Division (RIA) within the Strategy and Knowledge Department (SKD) at IFAD, provides technical support to the Programming and Management Department (PMD) to mainstream impact assessments into IFAD-supported projects, and build government capacity for impact assessments and evidence-based policy making. As part of the Tenth Replenishment of IFAD resources (2016-2018), IFAD will continue to commit to conduct rigorous impact assessments with ex-ante and ex-post evaluation designs through IFAD10 IAA. The findings from the impact assessments of projects are essential for generating lessons learned to help plan, design, implement, and monitor IFAD-supported projects in the future (Gertler et al., 2011).

The GIADP project has been selected to become an ex-post impact assessment for IFAD10 IAA. The project consists of three components: (1) community infrastructure, (2) agricultural production and marketing support, and (3) rural environmental improvement.[1] According to our review of relevant project documents and our discussions with the project staff members in China, we found out that the main focus of the project intervention is community infrastructure. The community infrastructure component was delivered to all project communities, while the project activities from the other two components were delivered to only a selected number of project communities. Due to this reason, our impact assessment focuses on the community infrastructure component, but also takes into account the agricultural production and marketing support and the rural environmental improvement components into account. The key outcome indicators of interest in this impact assessment relate closely to the strategic objectives (SO's) of IFAD: increased agricultural productive capacity (SO1), strengthened linkages between smallholder farmers and agricultural markets (SO2), and greater environmental sustainability and climate resilience (SO3).

[1] The GIADP project also consists of the project management component. The project activities in this component includes the recruitment of project staff members, procurement of project intervention tools and equipment necessary to deliver the project activities, monitoring and tracking of project activities, and overall management of the project activities. However, this component is not the focus of our impact assessment.

# Theory of change and research questions

## GIADP project interventions

Given the structure of the project and the details of activities involved, we can summarize the logical framework of the project according to its theory of change (TOC) in Table 1 below. In Figure 1, we present the logical framework of the project from which derive the TOC. The project activities, which include activities related to community infrastructure, agricultural production and marketing support, and rural environmental improvement, should help the project beneficiaries in the following ways. First, the project activities construct and improve community infrastructures, which include irrigation infrastructure systems, water supply sources, and village roads, should increase the productive capacity of its beneficiaries through improved water supply and allocation/management, and greater market access/participation. Second, the project activities offer various capacity building and training activities related to agricultural and livestock production to the beneficiaries.[2] As a result, beneficiaries have greater access to information about agricultural knowledge and technology. Third, members of the beneficiary communities are offered greater access to the agricultural markets through the establishment of local agricultural stations and the strengthening of rural market linkages, which helps increase the access to market of GIADP beneficiaries. Finally, the project activities construct the biogas digester systems and improved sanitary systems in beneficiary communities, both of which may help the members of the communities have access to more sustainable agricultural practices and improve their ability to cope with negative exogenous shocks.[3]

The GIADP project activities can be categorized into three main components: (1) community infrastructure (e.g. paving of village roads, lining of irrigation canals, construction of safe water drinking sources, etc.), (2) agricultural production and marketing support (e.g. niche crop and livestock trainings, construction and improvements of local agricultural stations, support to cooperatives and complementary package for value chain development, etc.), and (3) rural environmental improvement (e.g. installation of biogas digester systems, improvements of sanitation facilities, upgrades of kitchens and latrines, etc.).

[2] The project activities related to agricultural and livestock production include training farmers on the cultivation and marketing of niche and cash crops (cultivation practices and improving crop values depending on the crop type) and landrace livestock (provision of improved livestock breed and cultivation of livestock products).

[3] Based on our discussions with the project staff, the project curriculum related to more sustainable agricultural practices mainly involves training the farmers to rely less on chemical fertilizers, and rely more on organic fertilizers for their crop cultivation. Further, the installation of biogas digester systems should make the beneficiaries less reliant on firewood collection from the surrounding forest areas. However, we learned that the impact from the biogas system is expected to be small, and we decided not to focus on evaluating this impact of the project.

**Table 1: GIADP's TOC**

| | |
|---|---|
| **Inputs/Activities** | Formation of village implementation groups (VIG's) |
| | Agricultural-related training activities offered |
| | Improvements of small-scale irrigation systems |
| | Construction of water supply sources |
| | Paving of village roads with concrete |
| | Construction of biogas digester systems |
| | Improvements of local sanitation facilities |
| | Operation and maintenance training activities offered |
| | Agricultural extension, niche/cash crop, livestock training activities offered[4] |
| | Improvements of local township agricultural stations |
| | Provision of support to coops and complementary package (training curriculum) for value chain development[5] |
| | Strengthening of linkages between farmer cooperatives and markets |
| **Outputs** | Irrigation canals lined, water sources built, roads paved, biogas digesters built, sanitation facilities improved, kitchens renovated |
| | Farmers trained to operate, maintain, and repair communal infrastructures |
| | Crop cultivation demonstrated and scaled-up, breeding stock and livestock shed offered |
| | Farmers trained to cultivate crops and rear livestock separately by gender |
| | Agricultural stations, agricultural facilities, coops, and markets built, market equipment provided |
| | Farmers admitted to marketing groups and trained, value chain support provided |
| **Outcomes** | Increased agricultural productivity |
| | Increased market participation |
| | Reduced transportation costs from farm to markets |
| | Reduced vulnerability to shocks and negative events |
| | Improved health and environmental outcomes |
| **Impact** | Increased household income, consumption, and asset accumulation |
| | Greater nutrition, dietary diversity, and caloric intake |
| | Changes in migration pattern and remittance levels |

**Source: Authors' illustration**

[4] Training activities demonstration of improved technology use, scaling-up initiatives, and marketing strategies of niche/cash crop production. (e.g. grapes, chestnuts, oranges, teas, taro). For landrace livestock, activities include provision of animals including improved-breed goats and pigs, and demonstration of livestock rearing technologies and marketing strategies.

[5] Activities include establishment of new cooperatives and strengthening of existing cooperatives. The project also helps the cooperatives recruit new members, and train existing members on the niche/cash crop production and marketing technologies through demonstration sessions.

The activities under the community infrastructure component and the agricultural marketing support activities were delivered to all administrative villages (AV's) covered by the project[6]. However, the activities under the agricultural production (both niche/cash crop and landrace livestock), and the rural environmental improvement components were designed to tailor them to the local needs and suitability of each AV. Specifically, the village implementation groups (VIG's) formed as part of the project in each AV discussed with the project staff members in each county about the types of crops and livestock to cultivate and to be supported as part of the project. After the types of crops and livestock were agreed upon, the VIG leaders worked on the project activities curricula related to the crops and livestock. After that, the marketing activities were designed to tailor them to the types of niche/cash crops and landrace livestock covered by the project. The GIADP project activities can be listed by component in Table 2.

**Table 2: GIADP project activities by component**

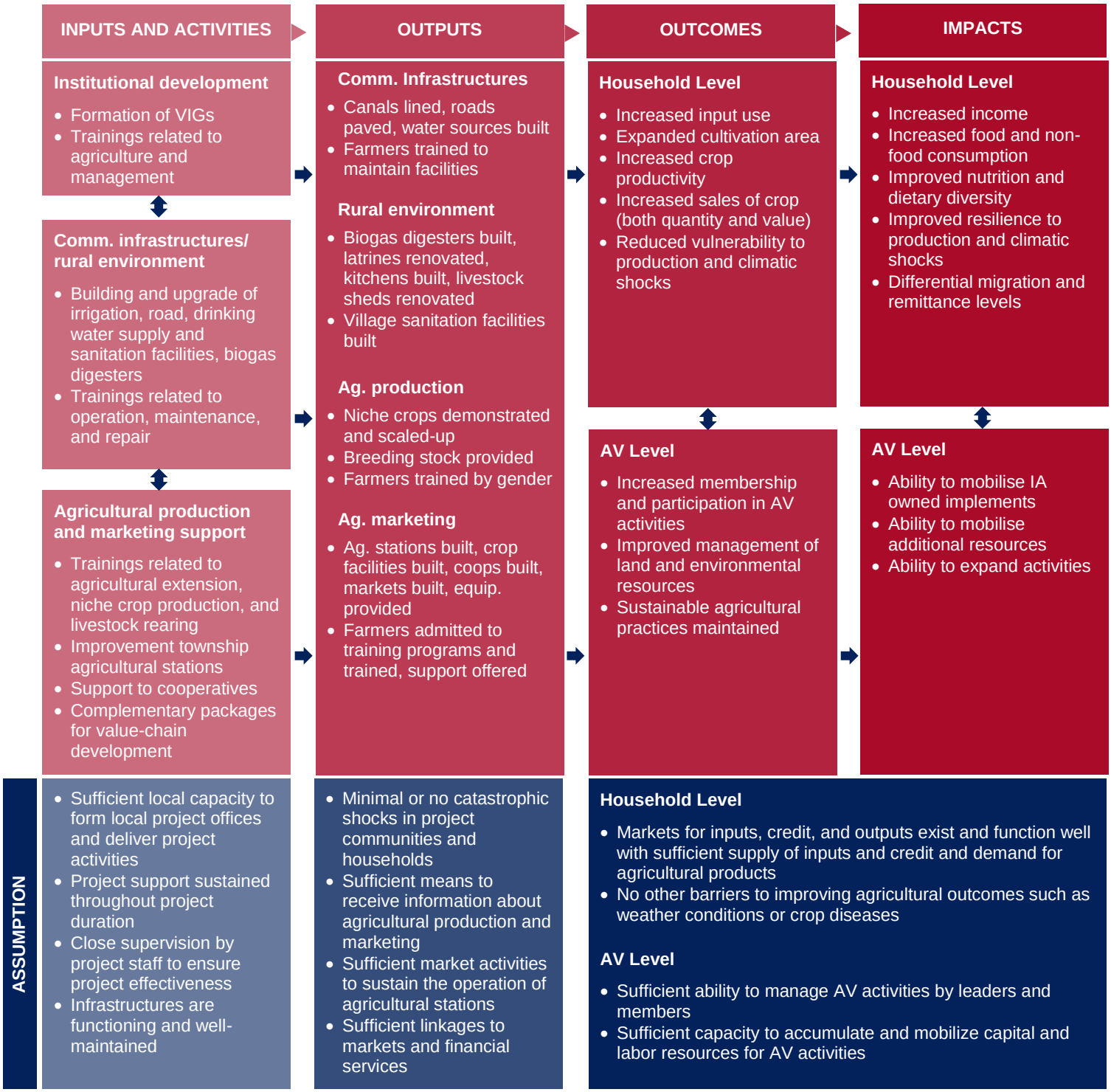
| | |
|---|---|
| **Community infrastructure** | Paving of village roads |
| | Lining of irrigation canals |
| | Construction of safe drinking water supply systems |
| **Agricultural production and marketing support** | Annual cash crop production training |
| | Perennial cash crop production training |
| | Landrace Livestock Demonstration |
| | Construction of township agro-extension station |
| | County and township agro-extension institutional support |
| | Farmer cooperative support |
| | Value chain enhancement support[7] |
| **Rural environmental improvement** | Construction of biogas digester systems |
| | Construction of improved sanitation facilities |

**Source: GIADP project RIMS reporting (1st level indicators)**

[6] The community infrastructure component of the project is designed to contain three types of infrastructure: roads, irrigation canals, and drinking water sources. However, our discussions with the project team revealed that the paving of village roads were delivered to all AV's covered by the project, whereas the lining of irrigation canals and the construction of drinking water sources were delivered to only a selected number of AV's.

[7] Activities under this component include construction of new local markets, and upgrades of existing markets. They also include arrangements of cooperative members to sell their agricultural products in these markets.

**Figure 1: GIADP's logical framework**



## TOC considerations

While it is true that separate project components may provide distinct causal channels through which the project interventions may lead to changes in the outcomes of beneficiary households and communities, it is imperative to recognize that the project activities in each component may interact. Having a good understanding of how project components interact allows researchers to design the impact assessment plan to collect comprehensive outcome and impact indicators relevant to the project logic. For example, improvements in road conditions allow farmers who have been trained to raise their productivity to access the agricultural markets at the right time and ensure the best prices for their harvest. Further, farmers who have greater output levels due to improved access to irrigation can take advantage of the improved road access to markets and the strengthened linkages to markets to raise their agricultural income. Similarly, it is expected that AV's receiving the project will be more strengthened and empowered by participating in project activities. More strengthened AV's might imply that the communities would have greater organization skills and capacity to take advantage of investment opportunities related to agriculture and infrastructure in the future.

Two further considerations are important while designing impact assessments: the assumptions related to the project's logical framework, and the potential effects of the project on non-beneficiaries. Regarding the former issue, Figure 1 outlines the assumptions within the logical framework necessary to generate the expected changes at the output, outcome, and impact levels. These assumptions include (1) having the project activities tailored to suit the local conditions and institutional context, (2) having sufficient demand and take-up of project activities by communities and households, (3) having sufficient market linkages between farms and markets, (4) having sufficient market demand for agricultural products in the area, (5) having continuous provision of project activities throughout the project life, and (6) beneficiaries not facing any unforeseen shocks or constraints that might prevent the beneficiaries from taking advantage of project activities.

One potential concern related to any potential impact of the project on non-beneficiaries is that the project involves upgrading of village roads. It is possible that the non-beneficiaries living in nearby communities might also benefit from these road improvements. Based on our review of the project documents and the discussions with the project team, the upgrading of village roads mostly involved short-distance "last-mile roads," which are feeder roads linking the project AV's to the main road to replace traditional walking paths. As a result, we expect that the spillovers to other non-beneficiaries to be minimal given the fact that these roads are highly localized and for specific use of the AV residents.[8] Regarding all other project components, all farmers within each AV receive the project activities. Thus, it is likely that the majority of the impacts of the project should be contained within the project AV's. However, it may be possible that the project interventions might have impacts on the local economy beyond the project AV's. For example, Aggarwal (2016) shows that road construction in India has an effect on local crop prices in the project districts. Project activities may generate greater demand for agricultural labour from non-beneficiaries through the improvements of irrigation canals and the strengthening of marketing linkages (Del Carpio et al. 2011; Headey et al., 2010). Finally, while it is likely that farmers who receive training activities offered by the project may share the knowledge with those who do not receive any training, we anticipate that the extent to which this knowledge sharing takes place is minimal, and thus is not a major concern in this impact assessment (Witt et al., 2008; Songsermsawas et al., 2016).

## Project coverage and targeting

Eight counties in GZAR have been selected to be covered by GIADP. The GIADP project focuses on targeting the poor and vulnerable households in 509 AV's of 50 townships. Based on the project's database, a total of approximately 1,754,902 people are expected to have benefitted from the project.

[8] To further rule out the possibility of spillovers to indirect beneficiary AV's, the PPMO provided us a list of indirect beneficiary AV's. We exclude these indirect beneficiary AV's from our sample.

It is estimated that 60% of all beneficiaries are considered poor and vulnerable according to subjective wealth ranking which is used to rank households within each the project areas. The list of counties and townships selected to be part of the GIADP project is as follows in Table 3. The areas which received the project are illustrated in Figure 2.

The targeting strategy of the beneficiary communities and households was conducted in a participatory manner. First, eligible counties (a total of eight) and townships (a total of 50 in eight counties) were selected to receive the project through a participatory poverty assessment approach.[9] Next, the AVs selected to receive project interventions (a total of approximately 509 AV's) are identified through the poverty assessment in a participatory manner. Within each AV, a participatory subjective wealth-ranking assessment was conducted to identify the poor and vulnerable households, in order to prioritize them for project inclusion. Finally, the project activities were designed and implemented to meet the local demands of the beneficiaries, and to ensure benefits to the targeted population through extensive consultations among the VIG members in each AV.

[9] Based on our discussions with the project staff members, CPMO and TPMO staff members were invited to participate in the poverty assessment exercise as part of the selection process to be included in the GIADP project. Invited staff members were asked to assess the poverty levels of their counties and townships based on the number of households in each poverty category, as defined by the PAO. After that, the counties and townships were selected to receive the project based on their assessed poverty levels.

**Figure 2: GIADP project areas**


**Source: IFAD**

**Table 3: List of project counties and townships**

| County | Township |
|---|---|
| Beiliu (6) | Beiliu, Dali, Tangan, Liuma, Mingle, Xinrong |
| Cenxi (6) | Botang, Malu, Nuotong, Anping, Cencheng, Guiyi |
| Du'an (6) | Gaoling, Bao'an, Chengjiang, Longwan, Disu, Daxing |
| Leye (4) | Luosha, Xinhua, Gantian, Tongle |
| Longzhou (5) | Xiadong, Binqiao, Jinlong, Shuikou, Xiangshui |
| Pingle (6) | Pingle, Zhangjia, Shazi, Yangan, Qinglong, Dafa |
| Tengxian (10) | Jinji, Mengjiang, Heping, Taiping, Gulong, Tongxin, Langnan, Tianping, Tengzhou, Xiangqi |
| Yongfu (7) | Longjiang, Baishou, Sanhuang, Baoli, Yongfu, Luojin, Yongan |

**Table 4: Distribution of project areas at the township and at the AV levels**

| County | GIADP township | Non-GIADP township | GIADP AV | Non-GIADP AV | GIADP beneficiary | GIADP non-beneficiary |
|---|---|---|---|---|---|---|
| Beiliu | 6 | 8 | 84 | 197 | 395813 | 945517 |
| Cenxi | 6 | 8 | 90 | 182 | 298314 | 517564 |
| Du'an | 7 | 11 | 20 | 228 | 65032 | 578876 |
| Leye | 4 | 4 | 13 | 85 | 26955 | 127774 |
| Longzhou | 5 | 6 | 40 | 76 | 78530 | 168941 |
| Pingle | 6 | 3 | 62 | 72 | 176749 | 218754 |
| Tengxian | 10 | 1 | 118 | 73 | 474647 | 257640 |
| Yongfu | 6 | 2 | 82 | 17 | 238862 | 53139 |
| Overall | 50 | 43 | 509 | 930 | 1754902 | 2868205 |

In Table 4, we present the distribution of the number of GIADP and non-GIADP project areas at the township and at the AV level by each county. Also, we present the number of GIADP beneficiaries and non-beneficiaries in each project county.

## Research questions

In this impact assessment study, the key research questions follow the project's TOC as suggested in White (2009). The main research questions as part of this impact assessment are as follows.

**Question 1**: Do households in project areas have higher levels of technology adoption and use of complementary cash inputs (fertilizer, pesticide, and other improved crop cultural practices) as a result of the project? Also, do they adopt greater levels of damage abatement inputs to cultivate their crops than those in non-project areas?

**Question 2**: Do households in project areas benefit from greater access to rural infrastructure? Specifically, do they require less time to travel to markets, have greater cultivated areas under irrigation, have greater access to improved drinking water sources, and have greater access to biogas digester systems (in terms of quantity and volume) than those in non-project areas?

**Question 3**: Do households in project areas receive information about agricultural production and markets from a greater number of sources beyond the sources within their communities relative to those in non-project areas?

**Question 4**: Do households in project areas generate greater levels of income from crop and livestock production than those in non-project areas. Are their sources of income more diversified (as defined by income shares from different sources)?

**Question 5**: Do households in project areas have higher levels of per-capita food and non-food expenditures than those of non-project areas?

**Question 6**: Are there any significantly differences in the migration patterns and the amount of remitted income between households residing in project and non-project areas?

**Question 7**: Are households in project areas better connected to markets and traders than those in non-project areas? Specifically, do we see that households in project areas sell a greater share of their crop and livestock outputs in the market relative to those of households in non-project areas?

**Question 8**: Are households more resilient to negative exogenous shocks than those in non-project areas? Specifically, do they experience less frequent and less severe shocks, and are able to recover better from shocks than those in non-project areas?

## Relevance to existing literature

This impact assessment focuses on the community infrastructure component (especially village road paving). Improving road conditions by paving the village roads to allow all-season access should help improve the accessibility of farmers to larger towns and markets by reducing transportation costs (Jacoby and Minten, 2009). A number of existing studies have documented the positive effects of road construction or road upgrades. The closest study to our impact assessment is Qin and Zhang (2016), which studies the impact of road access and agricultural production in rural China. The authors find that farmers in village with better connectivity to rural roads are more specialilzed, use higher level of improved farm inputs, and hire more labor to work on their farmers. In other countries, Casaburi et al. (2013) evaluates the effects of a feeder road upgrading project in Sierra Leone on the on marketing outcomes between farmers and traders. In China, Banerjee et al. (2012), and Faber (2014) investigate the impact of National Trunk Highway System on poverty and trade outcomes. In India, Datta (2012), and Aggrawal (2016) evaluate the impact of national highways on local firms and market access. With regards to the upgrade of irrigation canals and the construction of drinking water sources, existing studies have shown positive effects of the intervention on agricultural productivity and household welfare (Del Carpio et al., 2011; Dillon, 2011; Hamdy et al., 1998).

Regarding the other two components, existing studies in the literature have shown that agricultural-related interventions tailored specifically to the local conditions and institutional context may help farmers improve agricultural productivity, and subsequently household income (Asfaw et al, 2012; Azzarri et al., 2015; Minde et al., 2008).

Our discussions with the project staff members held during the scoping mission indicated that there was an interest from the PPMO to investigate the impact of the project on migratory patterns and remittances. Existing studies have shown that public projects may lead to changes in migration patterns and remittance levels (Bryan et al., 2014; Angelucci, 2015). Our impact assessment will therefore explore this research hypothesis in the context of an agricultural project. This has been done in a similar study by Nepal (2016) which investigates the impact of an IFAD-supported in Nepal on migration patterns and remittance levels.

# Impact assessment design

## Outline

Identifying the exact project impact may be difficult because of the heteoregeneity of treatment. First, the project consists of multiple components with different treatment intensity. As a result, project delivery and project implementation may be different in different areas according to the capacity of local institutions, timing, geographical attributes, and beneficiary characteristics. Second, there is limited documented information about the project's target group, targeting strategy, list of activities offered, and list of targeted beneficiaries. Third, the project was implemented in a non-random manner. The non-random assignment nature of project placement is particularly important for impact assessment since the presence of an agricultural project is likely to be correlated with agro-climatic factors, and pre-existing local conditions such as access to markets and roads (Dillon, 2011). [10]

[10] A subset of regions which received the GIADP project activities were already part of an earlier IFAD-supported project in GZAR, the West Guangxi Poverty Alleviation Project (WGPAP), which was closed in 2008. These regions originally under WGPAP were selected to also be part of GIADP to strengthen the impact of the WGPAP project as they were areas with high poverty rates. However, there is insufficient information about which areas/communities under WGPAP are now also part of GIADP.

In this ex-post impact assessment, we plan to employ a mixed-method approach, with a concurrent strategy where we will collect qualitative and quantitative information to identify impacts at the same time. The qualitative survey consists of key-informant interviews (KII's) administered to project staff members and AV leaders in the form of semi-structured interviews. In our quantitative survey, the AV is the unit of analysis. The information will consist of two main survey questionnaires: a household survey and a community survey. The household survey aims to collect information mainly on household-level indicators related to agricultural production and household consumption. The community survey focuses mainly on indicators related to access to community-level infrastructure, roads, agricultural markets, environmental conditions, and resilience.

### Constructing counterfactual

Due to the ex-post nature of this impact assessment, constructing the valid counterfactual group to estimate the impact of the project against the treatment group is challenging because there is no accurate way to obtain the pre-project data of both treatment and comparison groups. It is also likely that the roll-out of project interventions to project AV's was delivered in a non-random manner, which might lead to the presence of selection bias. To account for selection on observables, we employ a two-level matching approach to construct the counterfactual. First, we match project and non-project AV's with similar baseline characteristics to form the basis of our sampling frame. This first level of matching helps ensure that we obtain households in project and non-project AV's facing similar conditions. Then, we match households in the treatment and the comparison AV's to construct the sample to use in our analysis.

Based on our conversations with the project staff members, it was revealed that AV's were selected to receive the project activities mainly based on their poverty levels, as measured by the shares of household belonging to each poverty category.[11] Therefore, the counterfactual determination must focus on finding non-project AV's with similar poverty levels, and also with similar characteristics at baseline to the ones of project AV's to ensure that treatment and comparison AV's are comparable. Obtaining a valid counterfactual is a necessary condition to carry out a rigorous impact assessments, or the estimates derived from the analysis might contain bias.

The PPMO staff members provided us with a comprehensive dataset containing the list of all AV's in every township of all eight counties covered by the GIADP project from the project's monitoring and evaluation (M&E) system. In this dataset, there is AV-level detailed baseline information about the number of natural villages (NV's), the number of households, the total male and female population, the total Han and ethnic minority population, the size of dryland and irrigated areas, the annual precipitation level, the number of cooperatives, and the numbers of households in each poverty category: A, B, or C.[12]

## Sampling and data collection

### Sampling strategy

Our sampling strategy to select the treatment and the comparison AV's follows a two-stage stratification approach. First, we asked the PPMO staff members to provide us with a complete list of AV's (both project and non-project). From this comprehensive list of AV's obtained from the M&E system, we ranked the AV's in each county by the distribution of project activities and divided this

[11] More details about the poverty classification for households in rural China can be found later in this document.
[12] Households in China can be classified into three categories in terms of poverty level, according to the classification published by the Poverty Alleviation Office (PAO) of the People's Republic of China. Category A consists of households whose per capita income level are greater than CNY 3,000 a year. Category B consists of households whose per capita income level are between CNY 1,196-3,000 a year. Category C consists of households whose per capita income level are less than CNY 1,196 a year.

distribution into quartiles. Then, we randomly select a number of project AV's stratified by the level of project activity intensity implemented in each AV.[13]

After obtaining a randomly selected list of project AV's to sample, we ran propensity score matching (PSM, with five nearest neighbors and with kernel) the GIADP AV's (treatment) with the non-GIADP AV's according to a number of attributes of the AV's to come up with a list of tentative list of non-GIADP AV's which could serve as the counterfactual group (comparison) for the GIADP AV's. The PSM is conducted separately for each of the eight counties to ensure that GIADP AV's can only be matched with non-GIADP AV's within the same county.[14] The purpose of the PSM is to ensure that households in GIADP AV's and non-GIADP AV's are similar in terms of observable characteristics available in the data provided by the project's M&E system. In Table 5, we report the variables used for matching project and non-project AVs. As the project targeted AV's mainly based on poverty levels, the variables include the share of households belonging to either B or C category along with other AV-level characteristics.[15]

To ensure the appropriateness of the selected non-GIADP AV's as the counterfactual, we consulted with the PPMO and CPMO staff members to help us validate and select the non-GIADP AVs to be included in the final sample.

**Table 5: List of variables used for matching AV's by county**

| County | Variables used for matching AV's |
|---|---|
| Beiliu | No. of natural villages, No. of female population,<br>Paddy area (ha.), Dry area (ha.),<br>No. of households in categories B and C |
| Cenxi | No. of natural villages, No. of population,<br>Paddy area (ha.), Dry area (ha.),<br>No. of households in categories B and C |
| Du'an | No. of natural villages, No. of population,<br>No. of minority population, Paddy area (ha.), Dry area (ha.),<br>Share of households in category C |
| Leye | No. of natural villages, No. of population, No. of minority population,<br>Paddy area (ha.), Dry area (ha.),<br>No. of households in categories B and C |
| Longzhou | No. of population, Paddy area (ha.),<br>Share of households in category C |
| Pingle | No. of natural villages, No. of population, Paddy area (ha.),<br>Dry area (ha.), Rainfall level,<br>No. of households in categories A, B and C |
| Tengxian | No. of natural villages, No. of population,<br>Paddy area (ha.), Dry area (ha.), No. of households in categories B and C |
| Yongfu | N/A as matching is not possible |

[13] Detailed information about the sampling strategy can be found in the Appendix section of this document for reference.

[14] PSM is conducted at the county level for all counties except for Yongfu county where PSM was not possible. This is because in Yongfu county, there are 82 AV's which received the project activities, and only 17 AV's without the project activities. Due to the small number of non-project AV's, we cannot match project and non-project AV's. Instead, we ask the project staff members at the county level to help us select the most appropriate non-project AV's to be part of our control locations.

[15] We trim the matched sample at the 5th and 95th percentile ranks, which is standard in any PSM analysis.

## Potential spillover effects

To capture any potential project spillover effects, there are at least three key considerations: the type of spillover, the appropriate approach to account for the presence of spillovers at design (in an ex-ante fashion), and the identification of a valid counterfactual that is carefully-thought to minimize the presence of spillovers to non-beneficiaries. Collecting detailed data from non-beneficiaries to investigate the presence of spillovers would imply a larger sample size, which also has a direct cost implication. As discussed earlier, we expect spillovers of project activities on non-beneficiaries AVs to be minimal. Therefore, we choose to explore the extent of the spillover effects of the project impact on non-beneficiaries by a qualitative survey consisting of semi-structured interviews administered to key-informants both at the AV and at the township levels.

When it is suspected that presence of spillovers due to project activities might be high, it is advised that comparison locations in the sample are selected from areas located far enough from treatment locations to avoid any potential spatial spillovers. However, we rule out the presence of spillovers in our sample.

## Impact assessment plan

Considering the heterogeneity of the GIADP project activities, some of them may generate positive impacts to both direct project beneficiaries, and other non-beneficiaries living in the same community (indirect beneficiaries). For example, the construction of biogas digester systems for beneficiary households might generate an increase in demand for cow manure for process, which allows non-beneficiaries to sell their cow manure to beneficiaries for additional cash. Due to this reason, we plan to collect information from both beneficiaries and non-beneficiaries within the beneficiary communities. As a result, our estimates of the impact of the GIADP project are considered to be intention-to-treat (ITT) impact estimates.

The impact assessment activities started in November 2016 with a scoping mission. As part of this mission, a workshop was held in Nanning, China to (1) present the impact assessment methodology, (2) reconstruct the TOC of GIADP using a participatory approach, and (3) discuss and agree on the potential research questions related to GIADP that this impact assessment should address, and (4) plan the activities and timeline to conduct the impact assessment activities. As the GIADP project is scheduled to be completed by March 2017, we expect the data collection activities to take place between February and March 2017. This is to ensure that the findings and key messages from the impact assessment of the GIADP project may be incorporated to the project completion report (PCR), which will become available by June 2017.

# Key indicators and survey instruments

## Key indicators

Based on the discussions with the project's PPMO and CPMO staff members during the workshop in November 2016 in Nanning, China, we propose a list of key indicators to be included in the household and community surveys as part of this impact assessment. The list of the key indicators in the impact assessment surveys follow directly from the project's TOC and logical framework, and are presented in Table 6.

## Qualitative sample

Staff members from RIA initially developed a qualitative interview module right after the scoping mission to China. This interview module was handed over to the PPMO in November 2016. The latter were supposed to conduct the qualitative exercise with project funding before the quantitative survey. However, the PPMO did not carry out this exercise ahead of the quantitative survey, notwithstanding RIA's follow up. We therefore propose to administer the qualitative survey at the same time as the quantitative (in a concurrent manner) to be able to triangulate the results with the quantitative part of the impact assessment.

We plan to collect qualitative information to gain additional information related to project targeting, implementation, and about the socio-economic and cultural project context. Further, existing studies argue that qualitative information usually provides additional insights to the direct and indirect channels (including spillovers) through which the project activities may be associated with changes in the key outcome indicators of interest (Rao and Woolcock, 2004; Ravallion, 2003).

The qualitative survey used for GIADP will consist mainly of KII's using the computer-assisted telephone interviewing (CATI) methodology. There are at least two advantages of using the CATI method to collect qualitative data. First, the survey can be conducted quickly as it does not involve travelling to the locations of the KII's. Second, the scripts used in the interviews are generated by computer software, which helps guarantee consistency and timely processing of the interview responses.[16]

KII's include interviews with two groups: CPMO staff members and AV leaders in all eight counties covered by the GIADP project. The key themes of the KII's include general characteristics of the county and the AV, the project's targeting strategy and implementation details, the expected benefits from the project, and the development challenges in the county and in the AV.

[16] This methodology to conduct the qualitative survey was initially intended to be implemented by the PPMO.

**Table 6: Key indicators of interest**

| Indicator | Measurement | Data source |
|---|---|---|
| **Output** | | |
| Irrigation access | Seasonal access to irrigation | HH survey |
| Road access | Travel time to nearest landmarks | Comm. survey |
| Input investments | Cash and other physical input purchases | HH survey |
| Information access | Access to information from difference sources | HH survey, Comm. Survey |
| Market access | Travel time and seasonal access to agricultural markets | Comm. Survey |
| Environmental improvements | Number biogas digesters and improved sanitary locations built | Comm. Survey |
| **Outcome** | | |
| Agricultural productivity | Agricultural and livestock record, by type | HH survey |
| Market participation | Input and output prices, Amount of produce brought to market | HH survey |
| Vulnerability | Exposure to negative shocks, frequency and severity of shocks | HH survey, Comm. Survey |
| Environmental sustainability | Exposure to environmental degradation | HH survey, Comm. Survey |
| **Impact** | | |
| Income | Disaggregated income by source[17] | HH survey |
| Household consumption | Food and non-food spending | HH survey |
| Food security | Food Insecurity Experience Scale[18] | HH survey |
| Nutrition | Dietary Diversity Index[19] | HH survey |
| Vulnerability | Ability to recover from negative shocks | HH survey, Comm. Survey |
| Migration | Migration patterns and remittance value | HH survey |

[17] http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTRESEARCH/EXTLSMS/0,,contentMDK:21610833~pagePK:64168427~piPK:64168435~theSitePK:3358997,00.html
[18] http://www.fao.org/in-action/voices-of-the-hungry/fies/en/
[19] http://www.fao.org/3/a-i1983e.pdf

## Quantitative sample

We will administer two surveys as part of this impact study: a household survey (surveying AVs and non-AVs villages) and a community survey (conducted at the AV level). The household survey will collect information related to socio-economic characteristics, agricultural and livestock production and sales, household consumption, access to markets and information, shocks and resilience, and environmental sustainability. We will randomly select a number of households in the GIADP (treatment) and non-GIADP (comparison) AV's to be included in our surveys. The comparison households will come from non-GIADP AV's with similar baseline characteristics to the GIADP AV's, which resulted from both the first level village based PSM analysis and the consultations held with the PPMO and CPMO staff members.

The community survey will collect information related to the availability and quality of rural infrastructure and other facilities. The community survey will be conducted at the community level (as defined by the AV level, a bureaucratic entity consisting of approximately several smaller villages), and will contain information from the interviews with the community leaders and local PMO officers.

## Qualitative instruments and methodology

As described earlier in the section on the qualitative sample, our qualitative survey consists of KII's. Our KII interviews will be conducted with CPMO staff members and AV leaders. At the county level, we will interview two CPMO staff members in all eight counties covered by the GIADP project (a total of eight interviews). At the AV level, we will interview AV leaders from at least three GIADP and three non-GIADP villages in each county (a total of six interviews per county, and 36 interviews in total). Both sets of KII's follow a semi-structured format to allow consistency of the questions asked to all KII's. However, when necessary, the interviewers will be allowed to probe questions to ask for further details from the respondent.

## Quantitative instruments and methodology

There are two survey instruments: household and community surveys. As explained in the earlier section, the household survey focuses on gathering household-level information related to socio-economic characteristics, land and asset ownership, agricultural production and marketing, shocks and risk strategies, access to markets, financial services, and other rural infrastructures, migration and remittance. The final list of modules to be included in the household survey is as follows in Table 7.

**Table 7: Household survey structure**

| Module | Information |
|---|---|
| Demographic | Household composition, education, occupation, religion, ethnicity, time use |
| Income other than from agriculture | Wage income, enterprise or business income, pension income, remittance income, etc. |
| Asset | Housing characteristics |
| | Land ownership |
| | Durable assets |
| | Productive assets |
| | Livestock assets |
| Agriculture | Agricultural production (input use, labor use, cultural practices) |
| | Agricultural marketing |
| 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 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 social support and social capital |
| Migration and remittance | Migration history of household members |
| | Migration pattern of household members |
| | Remittance from household members and others |

The community survey aims to elicit information about the availability and quality of rural infrastructures and other facilities in each community. As the community survey is administered at the AV level, it will be fielded to one or two AV leaders. It covers five main categories: service availability, education services, health services, road infrastructures, and communal organizations. The final list of modules to be included in the community survey is as follows in Table 8.

**Table 8: Community survey structure**

| Module | Information |
|---|---|
| Service availability | Availability of services, distance and travel time to service locations, means of transportation to service locations, rating of service quality |
| Education | Number of schools in operation, distance and travel time to schools, means of transportation to schools, rating of school quality |
| Clinics | Number of clinics in operation, distance and travel time to clinics, means of transportation to clinics, rating of school quality |
| Road infrastructures | 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) |
| Resilience | Exposure to shocks, frequency and severity of shocks, ability to recover from shocks |

Central to the survey design is the calculation of sample size needed to detect any significant differences in the means of the indicators of interest between the treatment and the comparison group. Having sufficient number of observations also enables researchers to draw accurate statistical inference.

We use two Chinese datasets, within the China Household and Nutrition Survey (CHNS), 2011 wave (which was collected before the implementation of the GIADP project in 2012), to perform power calculations. Ideally, one would perform the sample size calculations using a comparable dataset over a range of outcome indicators of interest. However, some of the key outcome indicators (for instance yields or consumption expenditure) were not available in these datasets, and thus could not be use to calculate the desired sample size. Therefore given the limited number of outcome variables available, we calculated the reasonable sample size for our surveys focusing on the household income variable. We obtained the intraclass correlation coefficient (ICC) value (ICC= 0.04), and then calculated the desired sample size as shown in Table 9 according to different levels of assumed effect sizes. We acknowledge that income is a noisy measure and it might not be the most appropriate outcome indicator to be used for sample size calculations in a sampling design.

Accounting for ICC is important as it accounts for correlations among the observations within the same cluster. If there are positive correlations among the households in each cluster, one can no longer assume that each observation within the same cluster is independent with one another. As a result, the sample size required to detect any potential statistical significant effect must be increased conditional on the level of the ICC within the same cluster.

The following formula is employed to calculate the desirable sample size.[20] The formula can be expressed as follows:

$$N = \frac{4\sigma^2(Z_\alpha + Z_\beta)^2}{D^2}[1 + \rho(m-1)],$$

[20] http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTRESEARCH/EXTLSMS/0,,contentMDK:21610833~pagePK:64168427~piPK:64168435~theSitePK:3358997,00.html

where $D$ represents the impact on the outcome variable measured as the difference in means, $\sigma$ is the standard deviation, $Z_\alpha$ is the critical value of a confidence interval, $Z_\beta$ is the critical value of the statistical power, $\rho$ is the ICC value and $m$ is the number of units to be interviewed within each cluster (in our case in each AV). The parameters used to calculate the desired level of sample size are as follows:

- $D$= 34,271.03 CNY/year
- $\sigma$ = 37,055.58 CNY/year
- $\rho$ = 0.04
- $Z_\alpha$ = 1.96
- $Z_\beta$ = 1.28
- $m$ = 15 observations/cluster

We add 20% to the desired sample size for each outcome to account for having to trim observations that are off-support after conducting propensity score matching at the household level.

**Table 9: Recommended sample size based on different effect sizes**

| Effect size | ICC | Sample size | Sample size+20% |
|---|---|---|---|
| 10% | 0.04 | 3,200 | ~3,840 |
| 15% | 0.04 | 1,400 | ~1,704 |

Based on a study by Garbero et al. (2016), it is estimated that the effect size of an IFAD-supported project in China on household income should be at least 15% over the entire course of the project (approximately six to seven years). Similarly, for our sample calculations as shown in Table 9, we anticipate that the GIADP project should help increase the beneficiaries' income by at least 15%, which would require approximately 1,704 households in the sample. Thus, our plan to collect data from 1,890 households in 126 AV's (15 households from each AV) of eight counties should help us guarantee that our sample size can give us sufficient statistical power to detect any significant impact in the outcome-level and impact-level indicators of interest.

After obtaining the desired sample size level of 1,890 households (945 treatment and 945 comparison) in 126 AV's (63 treatment and 63 comparison), we distribute the number of AV's to collect data from in each county proportional to the number of project AV's in each county from the total number of 509 AV's. The breakdown of the sample size across eight countries is shown in Table 10.

**Table 10: Breakdown of AV's in our sample (15 households per AV)**

| County | Treatment AV | Comparison AV | Treatment HH | Comparison HH |
|---|---|---|---|---|
| Beiliu | 10 | 10 | 150 | 150 |
| Cenxi | 11 | 11 | 165 | 165 |
| Du'an | 3 | 3 | 45 | 45 |
| Leye | 2 | 2 | 30 | 30 |
| Longzhou | 5 | 5 | 75 | 75 |
| Pingle | 8 | 8 | 120 | 120 |
| Tengxian | 14 | 14 | 210 | 210 |
| Yongfu | 10 | 10 | 150 | 150 |
| Overall | 63 | 63 | 945 | 945 |

Our analysis relies mainly on the PSM method to estimate the average treatment effects on the treated (ATT), or the households which receive the GIADP project (with the necessary scaling due to the ATT estimates being the ITT estimates).[21] Mathematically, the impact of the project $T_i$ on household $i$ can be written as follows:

$$\delta_i = \frac{Y_{i1}}{m_i} - \frac{Y_{i0}}{m_i},$$

where $\delta_i$ denotes the impact of the project, $Y_{i1}$ refers to the outcome of household $i$ when receiving the project, $Y_{i0}$ is the outcome of household $i$ in the absence of the project, and $m_i$ is the number of observations in each cluster (in our case $m_i = 15$). Further, the estimated ATT can be expressed as follow:

$$ATT = E(\delta_i|T = 1) = E(Y_{i1} - Y_{i0}|T = 1).$$

Central to the PSM method is the conditional independence assumption (CIA). The CIA assumes that contingent on the observable characteristics, the treatment status is not dependent on the outcomes of interest (Rosenbaum and Rubin, 1983). One can express the CIA mathematically as follows:

$$T_i \perp (Y_{i0}, Y_{i1})|X_i.$$

To supplement the PSM results, we also employ regression-based analysis to generate consistent ATT estimates while controlling directly for selection into project participation based on observable characteristics. This method is similar to the one used in Godtland et al. (2004) and to estimate the impact of farmer field schools on the returns to potato production in Peru, and in Rejesus et al. (2011) to estimate the impact of an irrigation technology on rice production in the Philippines.[22] Specifically, the regression specification is the following equation:

$$Y_i = \alpha + \beta T_i + \gamma \boldsymbol{X}_i + \delta(\boldsymbol{X}_i - \overline{\boldsymbol{X}})T_i + \varepsilon_i,$$

where $Y_i$ is the outcome of interest, $\boldsymbol{X}_i$ is the vector of observable characteristics of household $i$, $\overline{\boldsymbol{X}}$ is the vector of the average of the observable characteristics among the households in the treated AV's, and $\varepsilon_i$ is the error term. The parameter estimate $\hat{\beta}$ from the equation directly above is the ATT

[21] To ensure that our PSM results are robust to different specifications, we employ alternative matching approaches to validate the PSM results.
[22] See also Wooldridge (2010) for more details about this approach.

estimate of the impact of the GIADP project, and allows us to compare the regression-based ATT estimate to the PSM ATT estimate already described earlier.

## Complementary data

Apart from collecting quantitative surveys, we plan to supplement our survey data with additional observational data and administrative data. For observational data, we plan to collect detailed geographical information including the location and elevation of the households using GPS devices, the community centers, and the landmarks within each community.

In terms of administrative data, we obtain administrative data at the AV level which include information regarding poverty prevalence (number of households in each poverty category), population size, income level, and types of interventions offered in each AV.

# Budget, deliverables and workplan

## Planned budget

The data collection activities will be carried out by Lattanzio Advisory Public Sector team selected after a competitive tender process. Lattanzio has proposed the following budget for the data collection activities (Table 11). All prices have been converted to US$ from the original costs in Euros.

**Table 11: Tentative itemized budget**

| Item | Proposed cost (US$) |
|---|---|
| Staff cost (including both supervisors and enumerators) | 146,950 |
| Travel accommodation | 15,163 |
| Office equipment | 5,229 |
| Material equipment | 8,366 |
| Training expenses and miscellaneous costs | 2,092 |
| Data entry platform | 5,752 |
| Management fee | 13,595 |
| Administrative costs | 63,845 |
| Total | 260,922 |

## List of deliverables and workplan

As part of the impact assessment activities of the GIADP project, the associated deliverables, along with their tentative time to deliver those items, are shown in Table 12. At the completion of the impact assessment activities, we will have produce three sets of main deliverables.

1. A set of presentations on the impact assessment methodologies, which introduces the concepts, requirements, and implementation plan, along with some key considerations about how to incorporate impact assessment into project design and implementation
2. Finalized household and community surveys and their cleaned datasets, along with an enumerator guideline explaining how to conduct field interviews using the surveys
3. An impact assessment report, which summarizes empirical findings from the analyses of household-level and community-level data and highlights key learning messges for future project design and implementation plan

**Table 12: List of deliverables and their timeline**

| Item | Completion date |
|---|---|
| Review of project documents and IA preparation | November 2016 |
| IA methodology training | November 2016 |
| Data collection plan and secondary data analysis | January 2017 |
| Household, community, and qualitative surveys drafting | January 2017 |
| Enumerator training and pilot testing | April 2017 |
| Data collection | September 2017 |
| Data cleaning and data entry | October 2017 |
| Preliminary IA analysis | November 2017 |
| Validation of results to produce final IA report | December 2017 |

## Impact assessment team and main counterparts

| Name | Role | Affiliation |
|---|---|---|
| Alessandra Garbero | Principal Investigator | RIA, IFAD |
| Tisorn Songsermsawas | Research Analyst | |
| Matteo Marchisio | Country Programme Manager | APR, IFAD |
| Philipp Baumgartner | Programme Officer | |
| Yinhong Sun | Country Programme Officer | |
| Ke Liu | Associate Country Programme Officer | |
| Chu Liao | Provincial Project Management Office | Guangxi Department of Finance |
| Weijun Zeng | | |
| Zhiheng Lv | | |

## Validation of results and dissemination plan

Upon finishing the final impact assessment report, RIA will share the report with the PPMO staff members and other key stakeholders to validate the results presented in the report. RIA will also work with other IFAD and PPMO staff members to plan the dissemination activities of the findings from the impact assessment through various seminars, conferences, and workshops.

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# Appendix: Sampling strategy

Based on our calculations to obtain a desirable level of sample size to use in our survey as described in the section on the quantitative instruments and methodology, we need to collect data from at least 1,890 households in 126 AV's. We spilt the total sample equally between treatment and comparison groups, resulting in a total 945 treatment and 945 comparison households in 63 treatment and 63 comparison AV's. This sample size implies that we collect information from 15 households in each AV.

Our sampling strategy follows a two-stage stratification approach: (1) by county, and (2) by level of project intensity. The first level of stratification is at the county level. As the GIADP project activities cover a total of eight counties, we calculate the breakdown of the number of AV's to survey proportional to the distribution of the number of AV's which received the project activities in each county.[23]

**Table 14: Breakdown of sample size distributions in each county according to the number of AV's receiving project activities in each county**

| (1) County | (2) No. of County AV | (3) No. of Non-GIADP AV | (4) No. of GIADP AV | (5) Proportion of GIADP AV in county to overall GIADP AV | (6)[24] Number of treatment AV's to sample in county |
|---|---|---|---|---|---|
| Beiliu | 281 | 197 | 84 | 16.50% | 10 |
| Cenxi | 272 | 182 | 90 | 17.68% | 11 |
| Du'an | 248 | 228 | 20 | 3.93% | 3 |
| Leye | 98 | 85 | 13 | 2.55% | 2 |
| Longzhou | 116 | 76 | 40 | 7.86% | 5 |
| Pingle | 134 | 72 | 62 | 12.18% | 8 |
| Tengxian | 191 | 73 | 118 | 23.18% | 14 |
| Yongfu | 99 | 17 | 82 | 16.11% | 10 |
| Overall | 1439 | 930 | 509 | 100.00% | 63 |

Since we split the sample equally between treatment and comparison groups, the breakdown of the number of treatment and comparison households to be surveyed in each county is given in Table 15. The sample sizes shown in the second and third columns of Table 15 matches the sample sizes shown in the second and third columns of Table 10, which appeared earlier in the main text of the document.

[23] We did not design our sampling frame based on the information at the township level because in the project counties, there are townships in which all AV's receive the project, townships in which only some AV's receive the project, and townships in which none of the AV's receive the project. We had tried matching project AV's with non-project AV's within the same township, but it was not always possible since in many instances there were not enough number of project and non-project AV's within the same township available for matching.

[24] The number of treatment AV's to sample in each treatment is calculated based on the proportion of the number of GIADP AV's within each county relative to the total number of GIADP AV's. This is calculated by row-multiplying the numbers in Column (4) with the numbers in Column (5) of Table 14.

**Table 15: Breakdown of sample size distributions in each county by treatment and comparison groups**

| (1) County | (2) Treatment AV's | (3) Comparison AV's | (4) Total AV's | (5)[25] Treatment HH's | (6) Comparison HH's | (7) Total HH's |
|---|---|---|---|---|---|---|
| Beiliu | 10 | 10 | 20 | 150 | 150 | 300 |
| Cenxi | 11 | 11 | 22 | 165 | 165 | 330 |
| Du'an | 3 | 3 | 6 | 45 | 45 | 90 |
| Leye | 2 | 2 | 4 | 30 | 30 | 60 |
| Longzhou | 5 | 5 | 10 | 75 | 75 | 150 |
| Pingle | 8 | 8 | 16 | 120 | 120 | 240 |
| Tengxian | 14 | 14 | 28 | 210 | 210 | 420 |
| Yongfu | 10 | 10 | 20 | 150 | 150 | 300 |
| Total | 63 | 63 | 126 | 945 | 945 | 1890 |

Our second level of stratification is according to the number of project activities implemented in each treatment AV. According to the project's M&E data, a project AV receives between 1 and 6 project activities. We classify the number of project activities into three levels: (1) 1 activity, (2) 2 activities, and (3) 3 or more activities. The overall distribution of the project activities each AV by county is given below. Note that this is the full sample before removing the treatment AV's that are off-support and whose propensity scores are lower than the 5th or higher than the 95th percentile ranks in each county.

**Table 16: Breakdown of the number of project activity distributions in each county**

| (1) County | (2) AV's with 1 activity | (3) AV's with 2 activities | (4) AV's with 3 or more activities | (5) Total |
|---|---|---|---|---|
| Beiliu | 63 | 15 | 6 | 84 |
| Cenxi | 28 | 42 | 20 | 90 |
| Du'an | 11 | 9 | 0 | 20 |
| Leye | 0 | 13 | 0 | 13 |
| Longzhou | 3 | 27 | 10 | 40 |
| Pingle | 7 | 32 | 23 | 62 |
| Tengxian | 95 | 23 | 0 | 118 |
| Yongfu | 43 | 31 | 8 | 82 |
| Overall | 250 | 197 | 71 | 509 |

[25] We set the number of observations (households) to collect data from in each cluster (AV) to be 15, as indicated earlier in this document in the section on the quantitative instruments and methodology. We calculate the number of treatment and control households to survey by row-multiplying the number of treatment in Column (2) of Table 15 and control AV's in Column (3) of Table 15. The total number of households in the sample shown in Column (7) of Table 15 is obtained by summing up the number of treatment and control households in Columns (5) and (6).

We calculate the breakdown of the number of treatment AV's to sample from using the matched and trimmed sample. The breakdown of the number of project activity distributions in each county according to the matched and trimmed sample is shown below.[26]

**Table 17: Breakdown of the number of project activity distributions in each county according to matched and trimmed sample**

| | Number of treatment AV's according to project activity number, full sample | | | Number of treatment AV's according to project activity number, matched and trimmed sample | | | |
|---|---|---|---|---|---|---|---|
| (1) County | (2) 1 | (3) 2 | (4) 3 or more | (5) 1 | (6) 2 | (7) 3 or more | (8) Total |
| Beiliu | 63 | 15 | 6 | 53 | 12 | 6 | 71 |
| Cenxi | 28 | 42 | 20 | 21 | 39 | 15 | 75 |
| Du'an | 11 | 9 | 0 | 8 | 7 | 0 | 15 |
| Leye | 0 | 13 | 0 | 0 | 11 | 0 | 11 |
| Longzhou | 3 | 27 | 10 | 1 | 18 | 9 | 28 |
| Pingle | 7 | 32 | 23 | 5 | 17 | 14 | 36 |
| Tengxian | 95 | 23 | 0 | 67 | 16 | 0 | 83 |
| Yongfu | 43 | 31 | 8 | 18 | 26 | 5 | 49 |
| Overall | 250 | 197 | 71 | 173 | 146 | 49 | 368 |

From the breakdown of the number of AV's according to project activity number in the matched and trimmed sample, we allocate the number of treatment AV's by equally distributing the number of AV's to collect data from in each level of project activity. This sampling approach is done to ensure that we have sufficient number of treatment AV's in all project intensity levels in our sample. Finally, from the proportions of treatment AV's categorized by project activity intensity, we allocate the number of treatment AV's to sample in each county equally for each level of project activity intensity (1 activity, 2 activities, and 3 or more activities).[27] The breakdown of the number of treatment AV's to sample in each county stratified by project activity intensity, and the proportion of treatment AV's to sample in each county are illustrated in Table 18 below.

After obtaining the list of the AV's, we randomly select one NV in each AV to be part of our sample. First, we exclude the NV's whose number of households in the NV are fewer than 20. Second, we match project NV's in project AV's with non-project NV's based on the number of households in the NV, the poverty status at baseline (whether the NV-level of income was above or below the national poverty line at baseline in 2012), and the interaction term between the two variables. Third, from the matched NV sample, we randomly select one project NV and one non-project NV within each AV to sample. And finally, we randomly choose 15 households per NV (and AV) to be part of our sample. Also, we randomly choose another 10 households per NV (and AV) in case the households in the first list cannot be found or are not available for interviews.

[26] The number of treatment AV's in the matched and trimmed sample shown in Columns (5), (6), (7), and (8) of Table 17 excludes project indirect beneficiary AV's.

[27] The numbers of treatment AV's to sample in each county as shown in Columns (10), (11), and (12) of Table 18 are calculated by row-multiplying the proportions of treatment AV's shown in Columns (6), (7), and (8) with the distribution of the number of AV's to sample from in each county, as shown in Column (13) of Table 18. In the cases where we had to round-up the numbers of the AV's to survey, we round-up the number of AV's to survey in higher levels of project intensity to ensure that we have a sufficient amount of observations from AV's with higher project intensity in our sample.

**Table 18: Breakdown of the number of project activity distributions in each county according to the matched and trimmed sample, the proportion of treatment AV's to sample based on project activity intensity, and the actual number of treatment AV's to be sampled by project activity intensity**

| | Number of treatment AV's according to project activity number, matched and trimmed sample | | | | Proportion of treatment AV's according to project activity number to be sampled | | | | Number of treatment AV's according to project activity number to be sampled | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) County | (2) 1 | (3) 2 | (4) 3 or more | (5) Total | (6) 1 | (7) 2 | (8) 3 or more | (9) Total | (10) 1 | (11) 2 | (12) 3 or more | (13) Total |
| Beiliu | 53 | 12 | 6 | 71 | 33% | 33% | 33% | 100% | 3 | 3 | 4 | 10 |
| Cenxi | 21 | 39 | 15 | 75 | 33% | 33% | 33% | 100% | 3 | 4 | 4 | 11 |
| Du'an | 8 | 7 | 0 | 15 | 50% | 50% | 0% | 100% | 1 | 2 | 0 | 3 |
| Leye | 0 | 11 | 0 | 11 | 0% | 100% | 0% | 100% | 0 | 2 | 0 | 2 |
| Longzhou | 1 | 18 | 9 | 28 | 33% | 33% | 33% | 100% | 1 | 2 | 2 | 5 |
| Pingle | 5 | 17 | 14 | 36 | 33% | 33% | 33% | 100% | 2 | 3 | 3 | 8 |
| Tengxian | 67 | 16 | 0 | 83 | 50% | 50% | 0% | 100% | 7 | 7 | 0 | 14 |
| Yongfu | 18 | 26 | 5 | 49 | 33% | 33% | 33% | 100% | 3 | 3 | 4 | 10 |
| Overall | 173 | 146 | 49 | 368 | | | | | 20 | 26 | 17 | 63 |

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
instagram.com/ifadnews
www.twitter.com/ifadnews
www.youtube.com/user/ifadTV