Economic Inclusion Through Value Chain Development in Côte d'Ivoire – Insights from one year of smallholder rice value chain development

June 12, 2020

1 Background

This report summarizes the key lessons and insights from the first year of implementation of a pilot that takes a value chain development approach to economic inclusion. It further describes the adjustments made in response for the second year of implementation, both in the pilot implementation arrangements as well as in the research design.

The pilot aims to demonstrate proof of concept of an integrated approach to employment and income generation for the poorer segments of society in developing countries. Integration happens at two levels. First, economic inclusion programs differ from other social protection interventions in that they combine social assistance (through cash or in-kind transfers or public work programs) with a host of interventions to assist the beneficiaries in developing income generating activities. These interventions typically focus on human capital and skills development (skills training, business counseling, life skills development), increasing access to finance (investment grants, village saving arrangements, loans); and coaching. The same intervention package is usually offered to all beneficiaries, based on an overall constraints' analysis of the target group. They do, however, rarely address particular constraints that sub-groups of beneficiaries might face.

Such a model hinges critically on the assumption that markets exist for the goods and services that beneficiaries may produce. This is often not the case, especially not for the more remunerative agricultural products, for which markets are usually more difficult to access in terms of distance and commercial contacts, especially for more vulnerable population groups. They are usually also more demanding in terms of quality and volume. As a result, poor smallholder farmers often confine themselves to production for auto-consumption instead, selling any surplus on the local markets. To enable smallholder farmers to access the more remunerative agricultural markets, different interventions along the agricultural value chain are usually needed,[1] which address the different constraints faced by producers and buyers at the same time. This is the second level of integration and is commonly referred to as value chain development (VCD).[2] By taking on an integrated approach, simultaneously addressing constraints on the supply and the demand side, synergies are expected to materialize.

Yet, with the integration of a multitude of simultaneous interventions also comes complexity which may in practice erode the potential synergies from integration. Through appropriate intervention design and survey control groups, this pilot tests the effects of such a joint approach on agricultural production and profits, overall household income and consumption, and food security. It examines the synergies from offering cash transfer (CT) beneficiaries with access to

[1] Christiaensen (2020).
[2] Put differently, it simultaneously addresses labor supply and demand side constraints.

markets through VCD, as well as the effects of CT and VCD separately. Details of the research design are provided in Appendix 1.

More particularly, the pilot tests this integrated approach to employment generation for poor rural producers in the context of rice production and cash transfers within northern and western Côte d'Ivoire. The reasons for this are multifold. First, more than 80 percent of Africa's poor live in rural areas, earning most of their income in agriculture[3], justifying a focus on income generating activities for the rural poor. Second, rising urban demand for rice in West Africa is increasingly met by imports, constituting a natural domestic market for import substitution. Third, rice is widely grown by smallholders in West Africa, though currently still mainly for auto-consumption. Fourth, cash transfer programs are increasingly becoming the intervention of choice for social assistance (as witnessed most recently in response to the COVID19 pandemic). These trends also hold in Côte d'Ivoire, where rice is considered a strategic crop. The lessons from the pilot can thus inform both support the expansion of the rice value chain in Côte d'Ivoire, as well as in the sub region more broadly.[4]

For the cash transfer component of the pilot, the project is associated with the Côte d'Ivoire Productive Social Safety Nets (PSSN) program, which provides cash transfers to poor households in randomly selected villages in the northern regions of Côte d'Ivoire. The households were identified following a proxy-means-testing (PMT) survey and a community validation process. Beneficiary households receive 36 000 FCFA (~ US$ 61.86) every quarter over 3 years. Cash transfers are complemented with economic inclusion activities, including coaching by social workers, entrepreneurship training and a business grant of 72 000 FCFA (~ US$ 123.71). The VCD component is developed by the pilot itself in partnership with the private sector and is offered both to a subset of the cash transfer villages as well as a subset of the villages not retained for cash transfer distribution from the original PSSN list of eligible villages.[5]

The pilot VCD interventions consists of simultaneous support to smaller scale rice processing units (PU, SME category) (which could be thought of as a labor demand side intervention), support to smallholder producers (which could be thought of as a labor supply intervention) and support to a micro-finance institute (which supports the connection between the labor supply and demand side) to cover some of the additional transaction costs for the micro-finance institution arising from working with smallholder farmers spread across the rural space. Support to the rice PUs consists of technical assistance regarding the technical and financial operation of a rice mill as well as rice marketing, as needed. Through the establishment of a collaborative partnership with the micro-finance institute, access to working capital for post-harvest rice purchasing is further facilitated. Lack of working capital is a common problem faced by smaller PUs, resulting in underutilization

[3] Beegle and Christiaensen (2019).

[4] Urban rice consumption is growing rapidly in Côte d'Ivoire, with imports filling at least half of the gap. On the other hand, rice is also widely grown in northern Côte d'Ivoire, including by the cash transfer beneficiaries, though mainly for auto-consumption. Preparatory analysis of the rice market suggests that domestic rice production could be competitive with imported rice given sustained technical support and access to finance along the chain to meet the volume and quality requirements of the urban consumers. It is a considered a strategic crop by the Ivoirian authorities, which the COVID crisis has only underscored.

[5] The program has been extended since, to include more regions, more and new villages within these regions and most recently also urban areas.

of their milling capacity and investment capital. It is also needed to switch from fee-based milling for which the margins per kg have become (too) small (10 FCFA/kg) to a model of transforming purchased paddy rice into white rice for sale. This fetches higher margins per kg of transformed rice, but requires working capital to buy the rice in the market or directly from the farmers. The pilot builds on this form of purchased paddy transformation for sale model through the development of contract farming of higher quality paddy rice permitting the PUs to obtain better margins per kg of white rice by supplying the more remunerative urban markets. The pilot's support to the farmers consists of agronomic training to ensure higher yields of betterquality rice, facilitating access to finance by the same micro-finance institute to buy inputs, and technical assistance to help the farmers organize themselves in commercial interest groups around rice.

The rice purchasing contract between the PU and the farmers stipulates the purchasing price and quality at harvest as well as the quantity to be delivered. It ties the different partners together. It forms the basis for obtaining input credit for the farmers and the amount of working capital for the PUs after the harvest. All modern inputs and credit are provided on commercial terms. There are no direct input or credit subsidies provided by the pilot. Instead, the pilot focuses on facilitating interaction and establishing trust between the partners, to reduce transaction costs arising from coordination and contract enforcement which are expected to be particularly high at the beginning. The pilot also takes charge of the extension services provided to the farmers and the technical assistance to the PUs. Annex 1 presents the different partners and service providers, and describes the intervention and evaluation design accompanying the pilot in more detail.

The first 18 months of the pilot (2017-2018) were spent on 1) the development of the collaboration agreements with the World Bank financed PSSN project, 2) identification of 3 piloting regions, 3) the design of the pilot VCD intervention, 4) identification of the private sector partners (PUs, micro-finance institute), 5) assessment of the agronomic knowledge of rice farmers in piloting regions, and 6) procurement of the different support agencies (technical assistance for implementation of the pilot, extension). The operation was implemented in 3 different regions (Tonkpi, Poro and Tchologo). These followed the selection of 3 PUs in rice producing areas[6] with at least 10 cash transfer and 10 non-cash transfer rice producing villages around them within a radius of 30 km. Presence of at least one lowland (bas-fonds) in the village was an additional condition for village selection to minimize the risk of harvest failure through drought. The three PUs (located in Man, Tonkpi region; Korhogo, Poro region; and Ferkessédougou, Tchologo region) represent a poorer, richer; and medium region respectively[7]. They each also have a local branch of the micro-finance institute, which was another criterion in the PU selection.

[6] In an initial stage, the pilot team, in partnership with the National Agency for Rice Development (*Agence Nationale de Développement de la Riziculture*, ANADER), conducted a census of all rice processing units throughout Côte d'Ivoire focused on PUs with a processing capacity between 1 and 2 ton per hour. Smaller PUs are artisanal in nature, with limited ability to process rice that meets the quality standards of the urban markets.

[7] With a population of 286,071 inhabitants, Korhogo is the 4th largest city in Côte d'Ivoire (2014 census). Ferkessédougou counts 120,15 people; Man 188,704 (figures based on the 2014 census). The micro-finance institute has a local branch in each of the three cities. Both Korhogo and Man are served by regular plane connections from Abidjan.

The pilot started its operations and first rice campaign in March 2019. This relatively late start follows delays beyond the pilot's control in the Procurement of the CIDR – CPM-DER consortium, the main service provider for the implementation of the pilot. Despite these delays, it was decided to proceed with the launch of the campaign to begin to test the operationalization of the scheme in practice. At the same time, the production performance observed during this first year of implementation inevitably reflect some of these delays, as well as the implementation challenges associated with the launch of any intervention, and should not be seen as reflective of the full potential of the approach.

Nonetheless, a number of important insights and lessons emerge already, which have led to some adjustments in the organization of the ongoing 2020 campaign. These follow from regional workshops held in each of the three regions of intervention at the end of the 2019 campaign in January 2020, immediately followed by a national workshop held in Abidjan with all key stakeholders (including farmer representatives). The insights obtained during these exchanges are further complemented here with a more in-depth quantitative analysis of the administrative data collected for the purpose of the credit administration. These contain information on the amount of land contracted for rice production, the amount of inputs ordered and the credit obtained, the amount and quality of rice to be delivered and delivered as well as a few indicators on the implementation. Comprehensive baseline data was further collected on the farmer's 2018 cultivation practices and incomes, both in treatment and control villages, which will be drawn upon when conducting the impact evaluation.

From this first year of experience it is clear that the establishment of sustainable private sector driven contract farming arrangements will require technical assistance and coordination support for a sustained period of time (at least three, if not four, agricultural campaigns). The transition from low-input, low-return rice production focused on auto-consumption to sustainable high-input, high-return commercial rice production in contracting arrangements can bring greater productivity and efficiency, but also implies greater interdependency. It requires a shift in farmers' mindset and effort, solid agronomic knowledge, risk taking capacity, and access to finance, timely and reliable transactions among the different partners in the chain, as well as sufficiently high and well distributed value added to buffer the inevitable climatic, agronomic and transactional perturbations for all the stakeholders involved (producers, millers and financial institution). Profitable rice production appears possible given concerted efforts, though not when it is only rainfed. The focus for the second year is to explore whether it can materialized, given a series of small adjustments to the contractual and implementation arrangements.

In what follows, Section 2 reviews the key findings from the workshop and quantitative analysis as well the remedial actions taken in next campaign. Section 3 reflects on the implications for the ongoing research design and budget allocation. These are followed by three appendices which give more information on the pilot and its implementation arrangements (Appendix 1) as well as the economic return of rainfed (Appendix 2) and lowland (Appendix 3) rice production and some of their agronomic, economic and behavioral correlates.

2 Review of the 2019 Campaign

From the 60 randomly selected villages in the 30 km radius around the PUs (20 around each PU, 10 cash transfer and 10 non-cash transfer), 44 decided to participate. Eight others were subsequently approached within the same catchment areas (some from the original replacement list, some based on expressed interest), resulting in a total of 52 villages (of which 24 participate in the PSSN project). The drop out was especially high around Man, in the Tonkpi Region, where only 10 villages participated. This was partly due to inability to pay the credit account opening fee (13,500 FCFA ~ US$ 22.5) at the micro-finance institute, which was waived later on, inexperience with more intensified rice production (the reason why an intensified extension program was offered in Tonkpi), and fear of indebtedness (Tonkpi is the poorest of the 3 regions and was also the most affected by Côte d'Ivoire's civil war during the 2000s; in addition, it wasn't fully understood by everyone that extensive agronomic training would be provided).

This resulted in a total of 548 participating households during the first campaign, of which 241 were cash transfer beneficiaries, i.e. between 36 and 52 percent of the participants in each region. Together they produced 420 ha of rice under contract (260 ha lowland and 160 ha rainfed rice), with a corresponding sales commitment of 761 tons[8]. By way of comparison, in the previous season, each PU had transformed around 1,000-1,500 tonnes, most of it fee-based (around 10 FCFA/kg). In other words, the volumes remain relatively small for now (as the focus is on getting quality and production up), but for the millers the margins per kg are substantially higher. And participation in the project also allowed the mills to obtain working capital from the micro-finance institution to buy and transform non-pilot rice.

Participation with rainfed rice plots was concentrated around the Korhogo PU (63 percent of farmers participated with rainfed plots, making up 72 percent of the total rainfed rice area under contract in the project). Around Korhogo, lowlands turned out to be much less widespread than anticipated.[9] Only 40 percent of the producers around Korhogo participated with a lowland, of which more than half with plots less than 0.25 ha. In contrast, almost 90 percent of the participating farmers around Ferkessédougou participated with lowland rice cultivation, with 95 percent cultivating more than 0.25 ha (and almost 20 percent cultivating more than 1 ha). Only 23 percent cultivated rainfed rice under the pilot. Around Man, farmers participated only with lowland rice.

Table 1: The 2019 campaign in numbers:

Processing Unit	Korhogo	Ferkessédougou	Man	Total
Participation				
Number of villages	20	22	10	52
Number of cash transfer beneficiary villages	9	10	6	24
Number of producers	234	258	56	548

[8] Yields for intensified rainfed rice production were anticipated at 1.5 t/ha. Yields for intensified lowland rice production at 2 t/ha.

[9] The requirement of having a lowland was established at the village level and the individual requirement of having access to a lowland was relaxed given that many farmers still wanted to participate with rainfed rice, possibly motivated by their interest in access to inputs.

Processing Unit	Korhogo	Ferkessédougou	Man	Total
Number of producers that are cash transfer beneficiaries	123	93	25	241
Number of producers cultivating « Bas-fonds » or lowlands rice	98	228	56	382
Number of producers cultivating « Plateau » or rainfed rice [(1)]	148	60	-	208
Contract volume and production				
Total land contracted (ha)	165	216	40	420
« Bas-fonds » or lowlands	*49*	*172*	*40*	*260*
« Plateau » or rainfed	*116*	*44*	*0*	*160*
Sales commitment by contracted farmers (ton)	272	410	158	761
« Bas-fonds » or lowlands (anticipated @ 2t/ha)	*98*	*343*	*79*	*521*
« Plateau » or rainfed (anticipated @ 1.5t/ha)	*174*	*67*	-	*240*
Credit and inputs (million FCFA)				
Farmers				
Total value of inputs obtained by farmers on credit from COOPEC	25.2	32.4	7.6	65.2
Cost of COOPEC credit to farmers	6.1	7.3	1.5	14.8
Total amount to reimburse	31.3	39.7	9.1	80.0
« Bas-fonds » or lowlands	*10.1*	*32.2*	*8.6*[(2)]	*50.7*
« Plateau » or rainfed	*21.2*	*7.5*	-	*28.7*
Processing Units (working capital)				
COOPEC credit to PUs (million FCFA) (to buy from project farmers and others)	70	70	24.5	164.5
Purchase forecast from farmers without producer contract with the PU (tonnes)	550	200	200	950
Production				
Total harvest (ton)	118.7	237.7	20.7	377.1
« Bas-fonds » or lowlands	*41.2*	*215.6*	*20.7*	*277.5*
« Plateau » or rainfed	*77.5*	*22.1*	*0*	*99.6*
Total sales (ton)	109	172.2	13.9	295.1
« Bas-fonds » or lowlands	*34.1*	*153.8*	*13.9*	*201.8*
« Plateau » or rainfed	*74.9*	*18.4*	-	*93.3*
Total value harvest (million FCFA)	16.4	34.2	2.6	53.3
« Bas-fonds » or lowlands	*5.9*	*31.1*	*2.6*	*39.6*
« Plateau » or rainfed	*10.5*	*3.1*	*0*	*13.6*

Note : [(1)] Some farmers grow both lowland and rainfed rice; [(2)] Credit for inputs typically includes seeds, herbicides, insecticides and fertilizer. In Tonkpi credit was also provided for the purchase of sprayers (480k FCFA) (not included here).

The total credit issued to farmers for input purchases amounted to 65.2 million FCFA or about US$ 108,666. This covered the cost for herbicides[10], improved seeds, and fertilizers, which accounted for about 1/6, 2/6 and 3/6 of total input cost respectively. Virtually all participants relied on credit to finance the inputs. The total cost of the credit amounted to 14.8 million FCFA, or about 23 percent of the total input cost.[11] The total amount to reimburse by farmers is 80 million FCFA (~US$ 133,000 or US$ 243/farmer on average). Less than 20 percent has been reimbursed by the farmers so far.

The total credit provided to the three PUs for post-harvest paddy rice purchase (project and non-project rice) amounted to 164.5 million FCFA. While smallholders make up the target clientele of micro-finance institutions, from a transactional point of view, it is in these loans to the PUs that they can earn its return. Their interest in loan provision to the smallholders lies in extending their reach into the villages to promote other savings and loan products (an activity which hasn't started yet). It is partly also motivated by social motives. From the pilot's point of view, the input loan provision to the smallholders is a pre-condition for pilot participation.

During the 2019 campaign, production fell far short of commitments. A total of 377 tons of paddy rice was harvested, with 295 tons effectively sold to the PUs. This is far below the committed amount of 761 tons. The total harvest value amounted to 53.3 million FCFA, which remains well below the incurred debt of 80 million FCFA. While the performance was below what is needed to be profitable for both lowland and rainfed rice, it was especially bad for rainfed rice where only 39 percent of the target was attained (93.3 tons vs 240 ton). With 63 percent of the target attained, performance was relatively better around Ferkéssedougou, especially for lowland rice (216 tons out of 343 tons committed). As a result, loan reimbursement has been low so far (less than 20 percent). Loan resettlement arrangements are being negotiated between the micro-finance institute and the farmers. The PUs have reimbursed the first tranche of their loans as scheduled. The PUs servicing Man and Ferkéssedougou are also on track to pay the remainder of their loans, though rescheduling will be needed for the PU servicing Korhogo, given low milling conversion (suggesting theft of white rice) and use of part of the loan to finance equipment for a new mill which the owner has mounted at the start of the 2019 campaign, resulting in a lack of working capital.

3 Performance analysis and adjustments

The discussions with the different stakeholders at the end of the campaign and the quantitative analysis based on the administrative data collected throughout the 2019 campaign (details provided in annex 2 and 3) reveal a number of areas for improvement which should make it possible to add sufficient value and make rice production profitable and competitive for all actors involved, at

[10] When insecticides are also used, the agro-chemicals' cost share will increase slightly.

[11] Credit costs consisted of the one-time account opening/membership fee (13,500 FCFA/account), monthly account fee (800 FCFA/month for 6 months), credit file cost (1.5% of total credit), death insurance (1% of total credit) and 1% interest rate per month for 6 months.

least for lowland rice. Seven areas for improvement are identified, including a series of concrete operational adjustments for the 2020 campaign.

First, intensified rainfed rice production is not profitable. It will be discontinued during the second campaign. The intensified production model proposed under the rice pilot has shown not to be profitable for rainfed rice. Average yield amounted to 615 kg/ha (or 761 kg/ha excluding those reporting no harvest) (Annex 2). Only 8 percent reported harvesting more than 1.5 ton/ha and the maximum yield attained was 1,899 kg/ha. As a result, only about 10 percent of the farmers (22 out of 208) produced just enough to cover their input and credit costs. But even these farmers were still only left with 34,300 FCFA on average to compensate for all other expenses (hired labor, machinery services) as well as their own labor and land. This happened despite relatively abundant, though somewhat unevenly distributed rainfall. While these results might be improved through a better output price based on quality, a reduction in input costs, and/or higher yields including through more intensified agronomic advice, average yields would have to increase 5 to 6-fold to about 3 t/ha on average for all farmers across time to generate sufficient revenue to be competitive with other crops or off-farm activities. With not one farmer getting close to achieving this, it was decided to discontinue the support for intensified rainfed rice production.

Second, lowland rice production could be profitable, even though the pilot is still far from achieving this. Average reported lowland rice yields were 1,192 kg/ha, or 1,359 kg/ha when excluding the 47 out of 382 lowland rice producers (12 percent) who reported zero harvest.[12] Yields were highest around Ferkéssedougou (1,368 kg/ha or 1,544 kg/ha when excluding zero reported harvest). They were lowest around Man (755 or 900 kg/ha) (Table A3.1). The latter is related to substantial underreporting due to disagreements with the sales price (set and agreed upon at 125 FCFA/kg between the PU and the farmers at the beginning of the season[13], but contested by many farmers from day one).[14]

Yet, the harvest of some farmers indicated that intensified rice production in lowlands can indeed be profitable: one in six farmers (61 out of 382) attained 2t/ha or more, 7 percent (27 farmers) reached more than 3t/ha and 2 produced more than 5 ton/ha. The value of production exceeded the recorded expenses for about 30 percent of the participating farmers. Ten percent of farmers were left with 150,000 FCFA to compensate any additional expenses as well as their own labor and land, most of them located around the PU in Ferkéssedougou. Finally, average yields on the 19 village demonstration plots in Tonkpi managed by the extension service company (each about 400 m^2) were 3.5-4 ton/ha (with the two worst performers yielding 1.05 and 1.63 t/ha and the two best ones yielding 5.8 and 6.96 t/ha). This suggests that reaching 2.5-3 t/ha is feasible, even though only a small minority of farmers managed to do so during the 2019 campaign.

Box 1 – Price, yield, input - profitability scenarios

[12] Zero harvest reporting resulted for a number of reasons, including early withdrawal from the project due to poor germination, neglect of the fields following ineffective application of herbicides, as well as underreporting and side-selling (especially around Man).

[13] The prices offered by the different PUs for the different varieties are as follows: Bouaké AM: 125 FCFA/kg paddy rice, 135 FCFA/kg and 140 FCFA/kg around Man, Korhogo and Ferkessedougou respectively; JT11: 160 FCFA/kg and 165 FCFA/kg around Korhogo and Ferkessedougou respectively.

[14] Other factors include underreporting to preserve enough for seeds for the next season and home consumption.

Production cost of 1 ha of lowland rice = 321,800 FCFA
Input package for 1 ha: 160,000 FCFA
Cost of credit per ha: 16,000 FCFA (including an interest rate of 1% per month; life insurance of 1% per year; and a credit application fee of 1.5%, each time on the total credit amount).
Fixed cost of credit: 4,800 FCFA (account management fees for 6 months) + 13,500 FCFA (account opening fees)
Plowing - transplanting – threshing (hired labor or machinery services): 127,500 FCFA
Total cost per ha: 325,800 FCFA

A yield of 2.5-3 tons per ha gives a revenue between about 75,000 and 150,000 FCFA per ha depending on the price (135 or 160 FCFA/ha). This is competitive with other activities to cover the farmer's labor and land.

Sale price (FCFA/kg)	*Yields (ton/ha)*	*Producer margin (FCFA)*
125	2	-75,800
135	2	- 55,800
160	2	- 5,800
125	2.5	-13,300
135	2.5	11,700
160	2.5	74,200
125	3	49,300
135	3	79,300
160	3	154,200

To make lowland rice production a profitable and competitive activity for all stakeholders involved, *the value added must be increased.* This is possible by *increasing yields substantially, reducing input and credit costs per ha and raising the paddy rice by producing better quality* to be able to sell in the more lucrative urban markets. Raising yields is the most important entry point, also because many of the reasons evoked to explain low performance can be improved through better agronomic knowledge, better agronomic practices as well as better supply chain coordination. But there is also room to reduce input and credit costs as well as to increase the paddy and white rice sales prices. Despite the disappointing performance during the first campaign, including because of challenges in project implementation, profitable rice production appears possible, at least for lowland rice, but requires great dedication and care by all involved.

Third, lowland rice yields can be substantially increased through better agronomic practices and tighter coordination between the value chain actors. The reasons for low yields are manifold. They include: choice of inappropriate fields (Man) and inappropriate land leveling (Ferkéssedougou), which led to drought or flooding; delay in input delivery (all 3 regions); poor germination of seeds (Korhogo, Ferkéssedougou); ineffective application of inputs (especially herbicides) (wrong timing, wrong dosage) (all regions); unforeseen insect and termite attacks (Man); delay in harvesting due to inattention and lack of labor (Man).

Following are the remedial measures that have been taken for the 2020 campaign.

- ✓ ***Land identification.*** Participating farmers will only be allowed to participate if they have a lowland of the right quality. The size of the land will be individually measured and its suitability for rice production assessed before contracting (relief, soil quality – no sandy soil or soil with accumulated vegetation). The potential works needed to render the lowland flood prone will be identified. Undertaking these works will be a requirement and farmers' commitment to do so will be confirmed. Only when works that can be conducted by hand

tools suffice will the lowland be retained (most available lowlands in the three regions have not been properly leveled or reinforced).[15] The micro-finance agent and the PU farmer liaison officer in each region will be trained to assess the fields for their suitability before the campaign starts and the farmers will be trained to undertake the works (small dikes to channel and better retain the water to avoid flooding (which would wash away seeds and/or fertilizer) and postpone droughts.

- ✓ ***Extension services will be substantially strengthened, with a demonstration plot and regular follow up visits throughout the campaign in all villages around each PU.*** An evaluation carried out at the beginning of the 2019 campaign showed that the rice cultivation practices practiced in the Tonkpi region were more traditional than those in the other two regions. The team therefore decided to provide extensive services in the villages around Man, which was highly appreciated. Only light agronomic follow up was conducted by the PU producer liaison officer around the two other PUs. However, feedback from the 2019 campaign experience showed that there is a significant need for agronomic support in all 3 regions to ensure that producers apply the right agronomic practices, including sowing (in pockets or transplanting, not broadcast) and herbicide application (right dosage, right timing).

  Based on the Tonkpi experience, following changes are further adopted for the implementation of the extension services (provided by a private company): 1) active involvement of input suppliers to demonstrate right application of inputs (especially for herbicides); 2) selection of community or neutral plots for field schools to encourage all producers to participate in demonstration sessions; 3) regular follow up visits to ensure that demonstrated techniques are applied, and if not, to understand why not; 4) signature of an engagement contract between the farmer and the PU which stipulates that participation in the village level training is obligatory for pilot participants, while open for anyone else in the village. In total, extension agents will spend about 10 days in each village during the 4.5 month-long rice production campaign. About half the time will be devoted to learning by demonstration on the demonstration plots; the other half to individual follow up in the field. Presence lists will be maintained[16].

- ✓ **Select dedicated farmers and incentivize them.** The qualitative evidence suggests that not all farmers have been equally committed to the pilot in the first year, resulting in partial application of the guidelines and frequent absenteeism during training and/or visits by the field agents. This also relates to subsistence mindset with respect to rice (mainly produced for auto-consumption as opposed for profit). Yet, intensified rice production requires especially dedication. A number of proxies of commitment bear this out in the quantitative analysis (Table A3.3), with those having paid the account opening fee in cash at the

[15] Conversations with IFAD which has a project to undertake lowland rehabilitation to include the pilot's sites into their project are underway. These works won't be completed before the 2021 campaign.

[16] For the 2020 campaign, the cost of this extensive extension will amount to about US$ 75 per contracted farmer (~ US$ 45,000 for about 600 contracted farmers).

beginning of the campaign, those providing higher quality paddy rice (containing less sand, weeds, or even stones), and those not over-declaring their plot size attaining (ceteris paribus) considerably higher net profits per ha. Importantly, in general, if anything, cash transfer beneficiaries performed at least as in terms of net profit as their non-cash transfer beneficiary counterparts within the village (18,164 FCFA/ha more, but not statistically significant). This arguably reflects dedication.

In light of this, following adjustments have been made: 1) the credit file costs and death insurance will have to be paid upon signature of the contract; 2) an experiment will be conducted whereby the participants in half of the villages (randomly selected) will be required to pay 3,000 FCFA upon receipt of the first inputs as a contribution to their rice commercial interest group which is formed in each village to facilitate the relationship with the PUs, the micro-finance institute and input providers. Those who don't pay risk to be excluded from the project; 3) farmers will be required to sow either in pockets or in seedbeds with transplantation. This practice yields the best results (but is also more labor intensive). The latter requirement has indeed led some farmers not to participate in the project during the 2020 campaign; and 4) farmers must have reimbursed their credit of last year's campaign or concluded an agreement with the micro-finance institute on a repayment plan. This could be the case when low yields were due to floods or other climatic-related hazards.

Fourth, input costs can be reduced, including by using a minimum threshold of the contracted area to qualify for pilot eligibility. Many farmers participated with small plots, and much of the self-reported contracted area was overestimated, resulting in surplus input purchase. While most input costs are variable (even though still somewhat constrained by packaging)[17], small plot sizes are especially detrimental given a substantial fixed cost component in the credit provision: account opening (13 500 FCFA) and management (4 800 FCFA) fees. Together they make up more than 50 percent of the total credit cost for the input purchases for 1 ha[18]. While the account opening fee is only a one-time membership fee for the credit union, it makes it challenging for those participating with very small plots to produce enough to cover the costs. Many farmers also overestimated their plot size. In response, each plot was measured by GPS, midway through the campaign to better identify the actual amount of inputs needed. Quantitative analysis shows the detrimental effects of this misreporting, with more than a quarter of farmers seeing their net profit decline by 9,400 FCFA/ha or more.

In response, the micro-finance institute has waived the account opening fee for the 2020 campaign for new participants. All lowland rice under contract will also be measured before contracting using handheld GPS tools. Further reductions in input prices will be attempted through bulk

[17] Seed prices were 670 (B-AM) and 675 (JT11) FCFA/kg. Fertilizer prices were 13500 FCFA/bag urea (50kg) and 15000 FCFA/bag NPK (50kg). The total weed destroyer was bought at 1,450 FCFA/l; the post-planting herbicide at 4,500/bottle (4 bottles/ha). The sprayers were sold at 10,000 FCFA.

[18] The input package for 1 ha of lowland rice costs 192,000/ha. Interest rate is 1%/month for 6 months (or 6 % in total), credit file costs and death insurance are 1.5% and 1% of the total loan or 2.5 % in total. Total variable cost for the credit is thus 16320 FCFA/ha.

negotiations with the providers. And prospective participants are requested to participate with a minimum of 0.25 ha.

Fifth, there is scope for a higher paddy rice price through quality improvement and better marketing. As discussed above, the low paddy price offered by the PU servicing the Man area proved problematic, resulting in low pilot uptake and side selling. The quantitative analysis confirms the importance of the output price, both for productivity as well as overall net profit. Ceteris paribus, farmers obtained 170 kg per ha more per 10 FCFA increase in the paddy price, and an additional net profit of almost 30,000 FCFA. The output price depends also critically on the seed variety, with the JT11 variety fetching 25 FCFA/kg more than Bke-AM (135 FCFA/kg vs 160 FCFA/kg around Korhogo), though reported harvest failure was higher and reported yields lower for the latter, resulting in a net lower profit for the higher priced variety during the 2019 campaign. While these prices are higher than those obtained for the local rice varieties (125 FCFA/kg), once converted to white rice, they also sell at a substantially higher price, generating a higher profit margin for the PU[19].

This highlights the importance of quality rice production, as well as the importance of incentivizing the farmers to do so. One factor of quality is the degree of humidity. Yet, it is not in the interest of farmers to reduce the humidity of their rice at sale. It reduces the total weight (it is more profitable to sell water for rice). The quantitative estimates suggest an increase in net profit of 8,800 FCFA per ha per percent increase in the humidity percentage.

In response, the PU in Man will be replaced and the other PU's marketing strategy will be reviewed and strengthened as needed. The particular rice varieties produced under the pilot should enable the PUs to fetch a higher price given the appropriate marketing strategy and thus also pay a higher price for the paddy rice to the farmers. To raise the PUs' comfort level that they can indeed sell the rice produced under the pilot at a higher price they will be assisted with their marketing efforts. Second, they will also be encouraged to provide a quality premium to the farmers for lower humidity and higher quality, which can save them costs at processing and increases the storability of the rice. Third, they will be assisted in finding financing to invest in better sorting equipment to reach the quality and standards required by the Abidjan market. The PUs in Korhogo and Ferkéssedougou already developed their own labels (Figure 1). Finally, given limited overall engagement with the objectives of the pilot, it was decided to identify another PU to serve the farmers around Man. A PU in Guiglo (@ 70 km from Man) was identified to be interested. This PU has already worked with the micro-finance institute, is willing to continue to employ a local

[19] At a conversion rate of paddy to white rice of 0.65, 1.53 kg of paddy rice is needed for 1 kg of white rice. In May 2020, local white rice was sold in Korhogo at 290 FCFA/kg, Bke-AM at 320 FCFA/kg and JT11 at 360 FCFA/kg. They were purchased at 125, 135 and 160 FCFA/kg respectively, resulting in margins of 290-191.2=98.8 FCFA, 320-206.55=116.45 FCFA, and 360-244.8=115.2 FCFA respectively. This illustrates the importance of raising the quality of the rice to enable increasing the paddy price for the farmer. As a rule of thumb to increase the price for paddy by 10 FCFA, the miller should be able to fetch 1/0.65 = 15.3 FCFA more for the white rice (depending on the milling ratio).

liaison agent to liaise on a regular basis with the farmers, and its President regularly visits Man. It will add further to the overall experience.[20]

Sixth, substantial time can be gained in the contractualization and thus the timeliness of input ordering and delivery by simplifying the credit administration procedures for farmers. Substantial delays were incurred during the 2019 campaign given the heavy administrative procedures of the micro-finance institute to open the accounts and credit files for each farmer. It required all farmers to come to the local branch in person to open the account and credit file, as well as a number of additional papers and costs (ID card, legalization of documents etc.). This slowed down the contractualization and credit application procedure substantially, which in turn caused delays in the ordering of the inputs. For now, the micro-finance institute takes charge of the ordering of the inputs, to avoid that farmers use the credit for other purposes. In other words, farmers directly get the inputs (after a quality control performed by the micro-finance institute, the PU and the WB local coordinators), and not the cash from the credit. Given the delays in the new account registration and credit file administration which are needed before the inputs are ordered, inputs arrived late in some villages.

In response, it has been agreed that farmers will be able to open the accounts and credit files within the village. This should help knowing the total amount of credit and inputs needed early in the process and allow for timely input ordering.

Seventh, efforts will be undertaken to strengthen the voice and participation of the farmers in the consortium through more active support to and engagement with the commercial rice interest groups. Farmers are not organized around rice. To overcome this, the formation of commercial rice interest groups (Groupement d'Intérêt Commercial or GIC) by the project participants was encouraged in each village, including the election of a president to serve as first contact point in the village. The model will be worked on further, and a contributory approach will be experimented with, whereby the participants in half of the villages will be required upfront to contribute 3,000 FCFA each to the GIC to facilitate its functioning. It will further be tested whether this up front contribution will motivate farmers to participate in the training and project activities.

The key objective for the 2020 campaign will thus be to consolidate the delivery model and demonstrate that the proposed model is profitable for lowland rice producers to meet the objective of increasing the incomes of smallholders. Old villages will be visited first to gauge their interest in continuation with the project, but new villages will be also accepted to participate in the areas around the around the participating PUs. Contrary to last campaign, when villages where randomly selected, the pilot partners will now suggest new villages based on their assessment of rice growing capacity and interest. This is also more akin to reality, where PUs will over time select their participating villages based on their assessment of their capability and trustworthiness.

Specific efforts will further be made to clearly communicate the terms of engagement, including input prices, before producer contract signing. Changes in participation conditions will be avoided during the campaign to establish a trustful relationship with producers. The role of the GICs in the

[20] In fact, this is akin to the situation in Ferkéssedougou where the PU is in fact located in Korhogo (at an hour's drive from Ferkessédougou, where the PU's producer liaison officer is located. The micro-finance's institution's branch is also located there).

preparation and during the campaign will be reinforced, especially to validate the seed quality, increase participation in agronomic training, etc.

To reinforce the coordination at regional level, the partners at the regional level will set up a monthly meeting schedule involving the micro-finance institute, the PU, the local agent of the National Rice Development Agency (ADERIZ) and the regional WB coordinator. Depending on the agenda, representatives of the GICs.

The set-up a (digital) information system for the project stakeholders (in particular the micro-finance institute and the WB coordinators) to facilitate project management and monitoring of commitments will be explored.

The request by many farmers for machinery services (especially ploughing and threshing) to respond to labor shortages will be explored at regional level. This could include setting up a directory of threshing providers; conduct a study on profitability of threshing services; and setting up a pre-financing mechanism for services. The micro-finance institute has already agreed to provide a credit line for such services.

4 Analytical activities and dissemination

Administrative data on the surface cultivated under contract, the amount and value of inputs obtained, the total amount of credit, the total harvest and sales as well as the humidity level and quality of the sold harvest were collected throughout the campaign.

Baseline data on about 3400 households in the 60 treatment villages originally selected for program roll out as well as 60 control villages were further collected in August 2019, with reference to the 2018 agricultural year for the agricultural income. Modules covered include the household roster, agriculture, assets, elaborate sections on rice cultivation, income sources, access to credit, project participation. The questionnaire is included in the appendix.

More details on the research design to analyze the effects of cash transfers, VCD and the potential synergies of combining both is in appendix 1. This will require a second round of data collection after one or two more cycles. Ideally, one would conduct the final evaluation only in 2022, i.e. after two more cycles (2020 and 2021) to allow the intervention to run its course and establish itself. Yet, for now, the second round of data collection is planned in Jan-February 2021, immediately after the completion of the 2020 agricultural campaign. This would require an extension of the project to June 30, 2021. As several new villages have been added, baseline information will further have to be collected in these villages during the summer of 2020.

In addition to the core evaluation question, a number of subtopics will further be examined, including the determinants of project participation using the 2019 baseline data (started), resulting overall in 3 papers of academic quality. Four blogs were further published during 2019 and another 6 are anticipated as the project unfolds. The project further seeks to reflect the lessons and insights of the pilot in a book, drawing on the practical experience of the pilot implementation and grounded in a rigorous analysis of the processes and results (including cost-benefit analyses of the

different sub interventions). It would be aimed at policy makers and practitioners. A preliminary outline of the book is below:

Outline

Value chain development in practice – Insights from an application to rice in Western Africa

Each chapter frames the challenge, reviews the findings from the literature, elaborates what the pilot did within this context, including insights on private and social returns, and present the lessons learned

1. Introduction
   - Principles of VCD and Economic Inclusion;
   - Underfunded and undercoordinated rice value chains

2. Finding reliable partners
   - Reaching everyone or selecting winners (farmers, mills, financial institutions)

3. Economics of rice production
   - Extensive vs intensive
   - Importance of water control
   - Other factors affecting profitability

4. The mill's perspective
   - Pros and cons of large vs small mills
   - Business models focused on volume (milling on order, purchase/mill/sell) or value (contract farming)
   - Efficient milling - cost/benefit of the different models

5. Who provides the credit
   - Business model (individual vs group lending; cross subsidization)
   - Cost/benefit of supporting value chain development

6. Employment generation along the chain
   - Farmer, transport, milling, distribution

7. VCD in a context of cash transfers
   - VCD as a way to sustainable economic inclusion

8. Lessons for VCD in staples
   - Way forward (value addition, transaction cost and digitization, role of producer organizations)

Annex 1 : Description of the intervention during the 2019 campaign

1. Piloting regions and project beneficiaries

The pilot intervenes in 3 regions: Tonkpi, Poro and Tchologo. The regions were selected based on the share of PSSN project beneficiaries already cultivating rice; the availability of an operating rice mill and presence of a regional UNACOOPEC branch; and water availability for rice production in the region.

The pilot works with one rice mill in each region that has the capability and ambition to play a catalytic role in developing the value chain in an inclusive manner. The pilot focuses on rice mills with a processing capacity of 1 to 2 tons of paddy rice per hour (or 2000-4000 t/year). Unlike the mills with a processing capacity below 1 ton per hour, which are widely spread across the villages, these medium sized mills (with separate modules for shelling and whitening) allow to produce white rice that meets the quality standards of the urban markets needed to compete with imported rice, They are also closer to the smallholder farmers than the mills with a processing capacity of 5 tons per hour, which have been the focus of the government..

The three rice mills the pilot is working with were selected following an in-depth assessment by a Consortium of the *Centre International de Développement et de Recherche (CIDR)* and the *Centre de Promotion de la Micro-Industrie et du Développement Rural (CPMI-DER).* The assessment focused on business performance, marketing capacity and the ability to act as a catalyst in the surrounding areas for high quality smallholder rice production for the urban markets. The selection of rice mills to work with was validated by a consortium of partners working on the pilot.

Direct beneficiaries of the pilot are rice farmers in the catchment area of selected rice mills, as well as the selected rice mills themselves. Beneficiary farmers are either cash transfer or non-cash transfer beneficiaries in beneficiary villages. In the catchment area of each of the selected rice mills, the pilot supports rice farmers in 20 villages, 10 of which are part of the PSSN project. Indirect beneficiaries of the pilot are the communities benefitting from spillover effects in the catchment area of the selected mills as well as those in the rice chain (transporters, wholesale and retail).

2. Consortium of partners implementing and evaluating the pilot

A consortium of partners implements and evaluates the pilot, in partnership with the PSSN project:

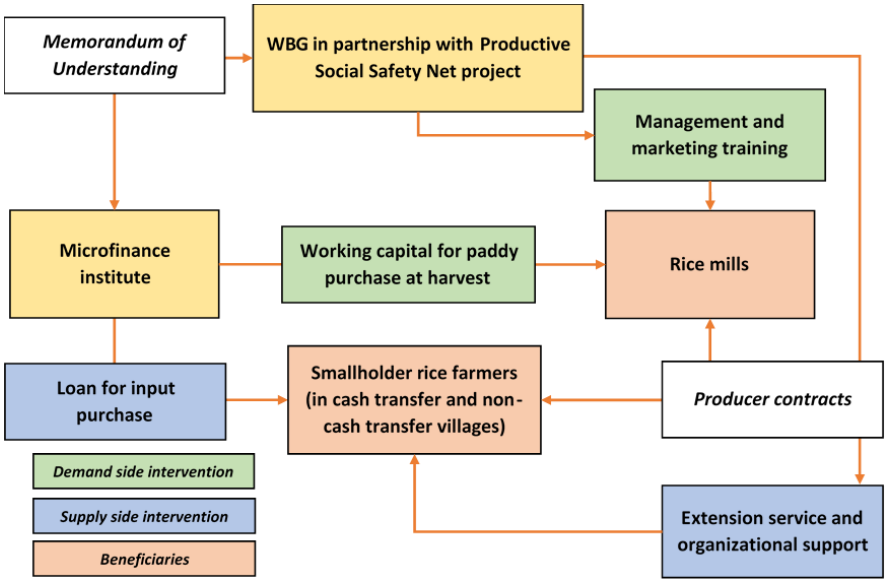
- National Rice Development Agency (ADERIZ, *Agence pour le développement de la filière riz*)
- Jobs Group of the WBG
- International Development and Research Center (CIDR, *Centre International de Développement et de Recherche*)
- Center of Micro-Industry Promotion and Rural Development (CPMI-DER, *Centre de Promotion de la Micro-Industrie et du Développement Rural*)
- Côte d'Ivoire Microfinance Institute UNACOOPEC-CI

- Crop Production Company (SPV, *Société de Production Végétale*)

In preparing the Economic Inclusion into Value Chains pilot, the WBG pilot team conducted extensive consultations with public and private stakeholders as well as other development partners, such as GIZ and the African Development Bank.

3. Intervention design

The economic inclusion into rice value chain pilot simultaneously addresses labor supply and demand side constraints, to improve the economic inclusion of poor households.



Component 1: Support package for farmers to improve productivity and enhance market access

This component focuses on addressing labor supply side constraints. It offers smallholder farmers (i) organizational support; (ii) access to finance for input purchase; and (iii) extension services to improve productivity and enhance market access.

Organizational support:

Beneficiary farmers are linked with a close-by rice mill through a production contract. The contract states the farmer's commitment of producing rice for the mill and the mill's commitment of buying paddy rice at a set price at harvest. The mill's Producer Liaison Officer (*Chargé de suivi des producteurs*) supports the development of a commercial interest group (*Groupements d'intérêt commerciaux*) among contracted farmers in each beneficiary village. It allows farmers to share knowledge on rice production and group their paddy rice for collection, and the mill to lower transaction costs in working with smallholder farmers.

Access to finance for input purchase:

The pilot facilitates access to a loan for input purchase for beneficiary farmers from UNACOOPEC. UNACOOPEC is a local microfinance institute with branches throughout Côte d'Ivoire. The poorer segments of society are at the core of their clientele. It partners with the pilot to expand its presence in the agricultural sector and thus extend its reach to this clientele. In a first step, producers open a bank account at the regional COOPEC branch. In a second step, producers submit a loan request for input purchase, such as seeds, herbicides and fertilizers that is being vetted by the COOPEC branch.

Extension services:

Beneficiary farmers are offered extension services to ensure the correct application of inputs and modern production, harvest and post-harvest techniques. These services include trainings on agronomic techniques, as well as an introduction to basic bookkeeping. The services are offered by the mill's Producer Liaison Officer officer as well as SPV, an external service provider contracted by the pilot.

Component 2: Support package to rice mills to improve milling capacity and enhance market access

This component focuses on addressing labor demand side constraints. It offers selected rice mills units (i) access to working capital on commercial conditions; and (ii) training on management and marketing practices to improve milling capacity and enhance market access.

Access to working capital:

The pilot facilitates access to working capital for participating mills from the UNACOOPEC. By connecting rice mills with the regional UNACOOPEC branch, the pilot addresses the mills' liquidity constraints. Additional working capital allows mills to buy larger volumes of paddy rice from its farmers and pay them cash at harvest. With a steady supply of quality rice, mills are expected to be able to serve larger markets in urban areas with higher quality requirements and obtain a higher price. This in turn allows them to offer a better price to the farmers and thus an incentive compatible contract.

Training on management and marketing practices:

The owners and employees of the selected mills are offered business management, marketing, financial management and technical operation trainings:

(a) The first type of training aims to structure the supply of paddy rice through cooperation with farmers. It mainly concerns the mills' Producer Liaison Officer (*Chargé de suivi des producteurs*), and to a lesser degree, the owner.

(b) The second type of training aims to improve the company's management, the technical operations and marketing. It addresses the mils' owner and the accountant.

(c) The third type of training aims to strengthen the mills' owner's management capacity (business plan development as well as management of human resources, quality, business partnerships, including with banks and wholesalers etc.).

The trainings are delivered by a Consortium of the *Centre International de Développement et de Recherche* (CIDR) the *Centre de Promotion de la Micro-Industrie et du Développement Rural* (CPMI-DER).

Component 3: Analytical work, project management, monitoring, evaluation and dissemination

This component supports the implementation and monitoring of pilot-related activities and the evaluation of project outcomes. It entails (a) preparatory analytical tasks; (b) project management; (c) coordination among actors involved in the implementation of the pilot with a field coordinator based in Abidjan and a decentralized coordinator in each piloting region; (d) monitoring and reporting on pilot results; (e) impact evaluation to measure project effectiveness on beneficiary outcomes; and (f) dissemination of findings.

4. Evaluation design

The pilot is accompanied by an impact evaluation (IE). The first set of research questions arise from identifying whether implementing the Cash Transfer (CT) program and the VCD approach separately have a significant and substantial effect on the target audience. Another research question is whether there are synergetic effects by combining the CT program with the VCD. The IE's core hypothesis is that an integrated CT and VCD approach creates synergetic effects on the income of poor rural households

Impacts are measured in terms of household income as well as its different subcomponents (rice production, rice income and other crop income, nonagricultural income, and transfers). Both interventions may further have spill-over effects on non-program participants within the villages.

The (random) assignment of the interventions is defined at village level. Villages were classified in four groups based on two criteria, i.e. whether 1) the village is beneficiary of the CT intervention or not; and 2) whether the village is within the (30km) catchment area of the rice mill that is supported by the pilot or not. Thirty villages were randomly selected from each group. Control villages without VCD were selected from Gbeke Region again within 30 km around rice mills with similar characteristics as the ones selected for the VCD intervention. This yielded another 60 villages (30 receiving cash transfers and 30 receiving no support from the project).

Treatment groups	Type of PSSN village	Village in catchment area of rice mill that is
1) VCD + CT	Beneficiary	Supported
2) VCD	Control	Supported
3) CT	Beneficiary	Not Supported
4) 0	Control	Not Supported

The baseline data collection took place during the Summer of 2019 and randomly sampled about 30 households within each village (with 5 of them first randomly sampled from the pilot

participants beneficiaries). The next round of data collection is expected to take place in Spring of 2021. It would be preferred to postpone this data collection one more year to enable the project to settle itself, but this would be require an extension of the funds (or the collection of additional funds) by 1.5 year, which may fall outside the scope of the possible. It is proposed to revisit this at the end of the 2020 campaign to see whether the results have been sufficiently improved to warrant such an extension. Rapid beneficiary surveys and administrative data collected by the implementing partners of the Jobs pilot allow to monitor progress over time.

A research program is further set up to examine a series of related sub questions such as the determinants of participation in rice commercialization (as opposed to more extensive production for auto consumption, given the other agricultural and nonagricultural activities (cotton, cocoa, maize, etc.), the formation and performance of commercial interest groups, the features of the local rural labor markets which are signaled to be characterized by labor shortages, an account of employment generation within the chain (in the mill, through transport, distribution), cost-benefit analyses for the different partners (farmer, mill, micro-finance institute).

5. Timeline

Implementation of the pilot project began in 2018, with the preparation of the project design and the intervention, as well as an in-depth analysis of the capacity of the rice processing units in the regions.

The actual implementation of the interventions began in early 2019, with the 2019 rice season. It is planned to support the various actors for a period of at least two agricultural seasons.

Data collection for the impact evaluation is anticipated for early 2021, when it will also be decided whether one or two more campaigns will be added to help put the scheme on a self-sustained footing.

Annex 2: Economics of rainfed rice production

Among the 548 participating farmers during 2019, 208 cultivated rainfed rice (Table A3.2).[21] This is many more than anticipated, given the pilot's focus on lowland rice production to mitigate the risk of harvest failure from drought and the presence of at least one lowland in the village an explicit eligibility criterion for village selection. Yet, lowlands proved scarce around Korhogo (and poorly developed when present) and when introduced to the project, several farmers also wanted to participate with rainfed rice production, which was subsequently allowed. The majority of rainfed rice growers during the 2019 campaign are then also around Korhogo (148 out of 208 rainfed rice growers), accounting for about two thirds of their participants in Korhogo (148/234). Around Ferkessédougou, where lowlands are more widely available, only about a quarter of the participating farmers (60/258) cultivated rainfed rice. Around Man, none of the participating farmers engaged in rainfed rice production.

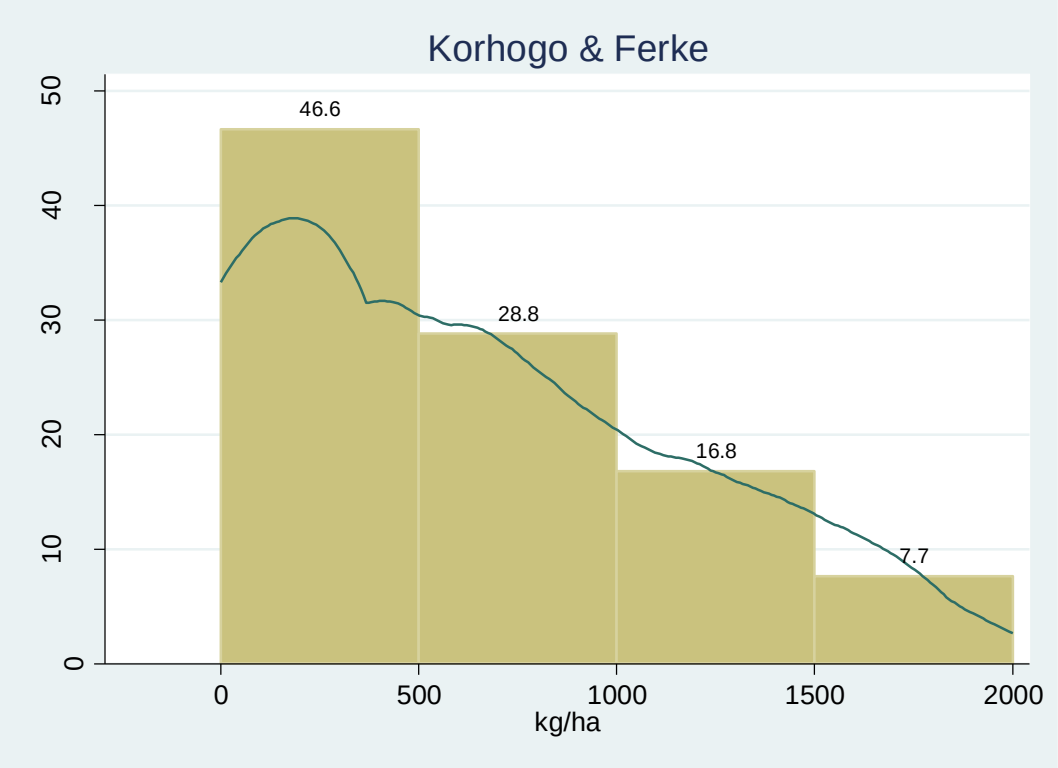
Table A2.1: Rainfed rice production 2019 – Key features

Processing unit	**# rainfed rice producers**	**Cultivated surface (ha)**		**Production (ton)**			
		Total	Average/producer	Total (ton)	Yield (kg/ha)	# producers with no production	Yield (kg/ha) excl. producers w/o harvest
Korhogo	148	116	0.78	77.5	653	21	760
Ferkessedougou	60	44	0.74	22.1	522	19	764
Man	0		-	-	-	-	
Total	208	160	0 .77	99.6	615	40	761

One hundred sixty ha of rainfed rice were cultivated in total, yielding a total of about 100 ton of paddy, and an average yield of 615 kg/ha. About 20 percent of farmers (40 out of 208) reported no production at all (about 1 out of 3 around Ferkessedougou). Excluding those brings the average yield to 761 kg/ha. Reasons for zero harvest reports include poor seed quality and poor germination, poor timing of the rainfall, poor application of the herbicides as well as neglect. There are also limited signs of harvest under-declaration (to keep some for own consumption) especially around Ferkessedougou, not around Korhogo. Even so, performance was well below the expectation of 1.5/ha on average, despite generally abundant, albeit rather uneven rainfall. Only 25% of all producers obtained 1 ton/ha or more, and only 8 percent reported more than 1.5 ton/ha. The maximum obtained was 1,899 kg/ha (Figure A2.1)

[21] Forty-three of them also cultivated lowland rice (see Annex 3 for the economics of lowland rice production).

Figure A2.1 Yield (kg/ha) distribution of rainfed rice production



Note : interval width = 500kg/ha

Yet, input and credit costs associated with the more intensified rice production approach promoted under the project are substantial (on average 190,000 FCFA/ha (~US$313/ha)) (Table A2.2).[22] Low yield performance combined with high financial outlays for input and credit left the vast majority of the rainfed rice growing farmers in the project indebted as a result. Only about 10 percent of the rainfed rice growing farmers (22 out 208) enjoyed a small net profit (value of their output minus the input and credit costs). The vast majority incurred a loss of 84,500 FCFA on average (US$139), resulting in a total debt among them of 15.7 million FCFA (~US$25,900).

Table A2.2 Rainfed rice - cost of inputs, credit and net profit, 2019

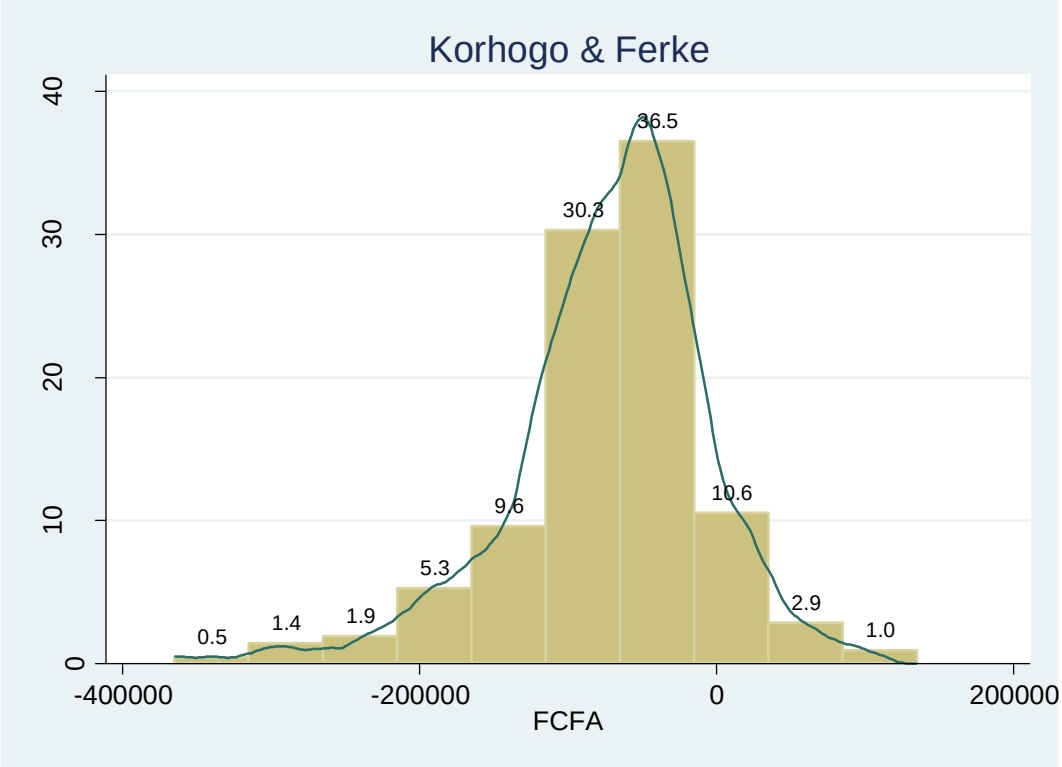
Processing unit	**# of producers**	**Cost (FCFA/ha)**			**Net profit (FCFA/ha) (value output minus cost)**			
		Inputs	Credit	Total	Positive		Negative	
					#	Amount	#	Amount
Korhogo	148	154,459	41,136	195,595	16	30,569	132	-124,238
Ferkessedougou	60	144,322	32,656	176,977	6	44,298	54	-120,357
Total	208	151,535	38,689	190,225	22	34,314	186	-123,111

Note: Costs include the cost of inputs (seeds, mainly herbicides, fertilizer) and the cost of the credit. Other costs, including for wage labor, or machinery services (land preparation, threshing) are not included.

[22] Costs per ha are larger for smaller farmers than for larger farmers, given high fixed costs related to the credit provision and imperfect divisibility of some of the inputs. Over-declaration of the field size by about half of the participants further led to some surplus ordering (see Appendix 3 for a more detailed analysis).

The distribution of the net profit of rainfed rice production per farmer is presented in Figure A2.1.

Figure A2.2 : Distribution of net rainfed rice profit per producer (FCFA) in 2019



Multivariate analysis of correlates of net rainfed rice profit per ha yields similar results as those obtained when examining the correlates of net lowland rice profit per ha (see Appendix 3 for details). For example, those delivering more humid paddy rice at harvest see their net profits per ha increase by 7,154 FCFA per percentage point humidity (the contractual threshold was 14% or less; the average was 15%). Those delivering good instead of medium quality paddy (less dirt/sand/stones; assessed subjectively at pickup) enjoyed a higher net profit of 28,000 FCFA per ha. As there is no financial premium for better quality rice, this may simply reflect better caretaking and farming practices (farmers delivering good as medium quality paddy produced on average 181 kg more per ha). Two other indirect indicators of farmer commitment point in the same direction. Those who settled the account opening fee at the start of the season enjoyed on average about 50,000 FCFA more per ha in net profit, while those who overdeclared the size of their land for rice production under the contract saw their profit decrease by 58,000 FCFA per ha (though this result was not statistically significant). The latter may also reflect an overestimation of the loss given diversion of some of the inputs to other crops. Importantly, there was no difference in the net profits experienced by cash transfer beneficiaries and others in the village, nor across the two regions.

However, unlike among lowland rice producers (see Appendix 3 for details) net profits among

rainfed rice producers do not follow an inverse farm size relationship. On the contrary, the larger is their cultivated area, the larger are their net profits per ha. Rising output per ha (by 851 kg/ha) added to reductions in per ha cost to raise net profits substantially as rice cultivated area expands (by 44,700 FCFA/ha).

Table A2.3 Village level fixed effects estimates of the effects of agronomic, economic, and implementation factor on rainfed rice yields and profit., 2019

	(1)	(5)
	Harvest (kg/ha) (given harvest>0)	Net profit (FCFA/ha)
Cultivated land (ha) (measured)	851.8***	44,723.2**
	(9.9)	(2.4)
Humidity level (%) (ranging bw 10-21)	45.4*	7,154.0**
	(2.0)	(2.5)
Quality[1)]	181.2***	28,412.5**
	(2.8)	(2.5)
Opening fee account paid (1=y; 0=n)	332.9**	49,978.1**
	(2.2)	(2.1)
Declared minus actual rice area (ha)	133.0	-57,781.2
	(0.9)	(-1.3)
Safety net beneficiary (1=y; 0=n)	238.1***	17,118.8
	(3.0)	(0.7)
Constant	-1,310.6***	-311,419.1***
	(-2.9)	(-6.1)
Village fixed effects	Y	Y
Number of producers	168	168
R-squared	0.22	0.13
Number of villages	33	33

Note: village fixed effects estimates with correction for heteroskedasticity and within village autocorrelation. t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1; post-harvest humidity, measured at farmgate pick up and ranging between 10 and 22% (contractual threshold $\leq$ 14%); delivery quality (presence of dirt, sand, stones): 0=bad, 1=medium, 2=good; 3=very good; Account opening fee paid when opening the account.

Appendix 3 : Financial and economic profitability of intensified lowland rice production 2019

This appendix elaborates on the drivers behind the 2019 lowland rice yields and profits. In particular, econometric techniques are applied to quantify the relative importance of a number of agronomic, economic and implementation related factors identified as areas for improvement during the January 2020 stakeholder evaluation workshop in Abidjan, organized following the end of the 2019 agricultural campaign. The administrative data collected for the loan servicing are used to conduct the analysis. Cultivated area and production are based on actual measures (with GPS and scales respectively). This is important given systematic bias observed in self-reported measures of plot size and production.[23] We also use actual records of input and output prices and harvest humidity rates. The analysis concerns all participating farmers, thereby removing sampling error.[24]

Not everyone is ready to engage in commercial contract farming

By way of recap, the intervention consists of setting up a lowland rice contract farming arrangement between rice processing units (PUs) and smallholders. Based on this post-harvest rice delivery contract at a guaranteed price with a PU, credit was provided to participating farmers by the micro-finance institute UNACOOP to purchase inputs. The inputs included improved seeds, herbicides, inorganic fertilizer and for the villages around Man also pesticides and sprayers. To participate in the program, farmers were asked to use the seed and fertilizer package at the recommended rates.[25] They were left free to use the other inputs or not. They could pay for the inputs directly or buy them on credit, but virtually all farmers opted to use and obtain the full package on credit. Farmers were asked to organize themselves in informal structures (Groupement d'Intérêt Commercial – GIC) to facilitate contact with the PU, the credit and input providers as well as the extension service provider. Extension services were provided to the farmers, based on an assessment of their knowledge of more intensified rice production (with extensive services offered through a dedicated service provider with demonstration fields and regular follow up visits in the Tonkpi region)..

Overall, 382 out of the 548 participating producers produced lowland rice under the project. They

[23] Farmers tend to overestimate the size of smaller plots, and underestimate the size of larger ones (Carletto, Savastano, and Zezza, 2013). They also tend to overestimate the harvests from smaller plots (Gourlay, Kilic and Lobell, 2019). It is unlikely that these errors will nicely cancel each other out when calculating yields. Self-reporting is typically relied on in survey-based data and analysis.

[24] On the downside, no information is available in the administrative data on many other characteristics that also affect production and profit (such as soil fertility, rainfall patterns, disease and bird pressures, labor input, modes of input application (timing, cultivation techniques), socio-economic characteristics of the farmers (education, gender) which influence agronomic practices, etc. Omission of these variables can induce omitted variable bias, changing the estimates on the effects of the factors analyzed here. The findings reported here cannot be interpreted as causal as a result. More generally, establishing causality is not possible with cross-sectional data. Nonetheless, inclusion of many of these other factors in the analysis would help mitigate against omitted variable bias. Such data is available from the baseline data, collected during the summer of 2019, and will be merged with the administrative data in follow up analysis.

[25] The recommended amount of improved seeds was 60 kg (Bouaké-AM (Bke-AM or JT 11). The recommended fertilizer package included: 200 kg/ha NPK (delivered in bags of 50kg) and 100 kg/ha urea (46% N) (also delivered in bags of 50kg). Herbicides included a total weed destroyer to clear the land before planting (recommended dosage: 4 bottles of 1 l/ha) as well as a post planting weed treatment (Pentaméthqlin 400 - 4 bottles/ha).

were distributed across 46 villages in total, spread around the three project sites (or 8.3 lowland rice producers per village on average) (Table A3.1). There were 98 producers in 14 villages around the participating processing unit (PU) in Korhogo (Poro region, northern Côte d'Ivoire), 228 producers in 22 villages around the participating PU in Ferkessédougou (Tchologo region, northern Côte d'Ivoire)[26], and 56 producers in 10 villages around the participating processing unit (PU) in Man (Tonkpi region, western Côte d'Ivoire).[27] Villages were each time situated within a 30-kilometer radius around the PU. Having a lowland in the village and proximity to the PU were both eligibility criteria for participation to enable regular follow up by the PU's liaison officers (at least 5 visits throughout the campaign).[28]

Table A3.1: Lowland rice production 2019 – Key features

Processing unit	# producers	Cultivated surface (ha)		Production (ton)			
		Total	Average/ producer	Total (ton)	Yield (kg/ha)	# producers with no production	Yield (kg/ha) excluding zero prod
Korhogo	98	49	0.50	41.1	1,033	12	1,178
Ferkessedougou	228	172	0.75	215.6	1,368	26	1,544
Man	56	40	0.71	20.6	755	9	900
Total	382	260	0.68	277.4	1192	47	1,359

Note: Average yield includes those reporting no production.

Altogether, the participating farmers cultivated 260 ha of lowland rice under contract with the project, or 0.68 ha per farmer on average, which corresponds to 9-18 percent of their farm, depending on the region.[29] In Korhogo, the average area cultivated with lowland rice under the project was only 0.5 ha. Lowlands are much less widely available around Korhogo and most farmers participated with rainfed rice cultivation (Appendix 2).

Across project sites, rice is usually grown for autoconsumption, not for sale, with cotton, cashew (and to a lesser extent maize) serving as cash crops in Korhogo and Ferké and coffee and cocoa the more important cash crops around Man. Only surplus production is sold on the market. Potential diversification of the cash crop portfolio was frequently mentioned as motivation to participate in the project, especially around Korhogo and Ferkessédougou.

Given the focus on auto-consumption and liquidity/credit constraints, modern input use (improved seeds, fertilizer, agro-chemical) in rice cultivation has been limited so far, especially around Man,

[26] The PU servicing the area around Ferké is located in Korhogo (1 hour drive from Ferké).

[27] With a population of 286,071 inhabitants, Korhogo is the 4th largest city in Côte d'Ivoire, implying more off-farm employment opportunities. The population of Ferkessédougou was counted to be 120,150, this of Man 188,704 (figures based on the 2014 census). Both Korhogo and Man are served by regular plane connections from Abidjan.

[28] These visits include project 1) introduction, 2) contracting, 3) input delivery + establishment of rice farmer alliance to facilitate interaction with the PU, 4) training on harvest and post-harvest practices, 5) organization of harvest sale including weighing and calculations of profit and reimbursement amount.

[29] The cultivated area per farmer is about 5.7 ha per farm in the villages around Korogho, 6.3 ha in the villages around Ferkessédougou, and 4 ha in the villages around Man (based on self-reported plot size).

the poorest of the three regions. In the other two regions it has been common practice to divert some of the fertilizer and agro-chemicals obtained on credit for the cash crops (especially cotton) to the maize and rice fields. Given the rather rudimentary knowledge of intensified rice production techniques in Man, intensive agronomic training through village field demonstration plots and follow up visits was provided in each of the participating villages in Man. Given greater familiarity with modern input use, including for rice production, around Korhogo and Ferkessédougou, agronomic training in these two regions was limited to short refreshers.

Loans and inputs were provided on a commercial basis, i.e. at market price (farm gate), without subsidization. The need for full loan reimbursement was emphasized during the introduction of the project. The fear of being indebted eventually withheld several farmers from participating (and also some villages), especially around Man. In the end, forty-four out of the 62 randomly selected eligible villages (~20 around each PU) decided to participate. Drop out was especially large around Man (10 out of 20 villages), but also non-negligible around Korhogo (5 out of 20). Around Ferkessédougou, only 3 villages of the 22 villages originally selected and visited, decided not to participate. They were replaced by new villages that met the criteria of being within 30 km of the PU and had access to a lowland (8 in total). These were identified and contacted on an ad hoc basis. For the 2019 campaign, the total number of participating villages settled eventually on 52 across the three piloting regions.

Within these villages, the actual uptake of the production contract and input credit was often also smaller than the number that pre-registered, with some more dropping out during the early stages of the season. The contract stipulated input delivery and output pickup at village level.[30] But farmers had to go to town to open their accounts and finalize their credit application with the microfinance institution. They also had to incur additional costs in that process (pictures, copy of ID card, notarization of the account). This additional administrative burden also led some farmers to opt out after pre-registration.

Figure A3.1: Inadequate soil conditions in Man: Iron toxicity and old vegetation overload.

[30] High transaction costs during the last mile have been mentioned frequently as an important impediment to input adoption (Liverpool Tasie, et al. 2017; Minten, Koru, and Stifel, 2013).

Yields were disappointing for a variety of reasons, many of which can be addressed

Average yield across the project participants amounted to 1192 kg/ha (Table A3.1). Twelve percent of farmers (47 out of 382) reported zero harvest. Field reports attribute this relatively high percentage of zero harvest to poor germination in some areas (Korhogo and Tchologo), the use of inappropriate fields for rice production (iron contamination) (Man), but also flooding of lowlands due to poor or no landscaping (Tchologo), belated availability of inputs in some villages, inappropriate application of herbicides (Man, Poro), neglect and abandonment following inappropriate weed management, as well as misreporting given disagreement with the sales price offered (and agreed) (especially around Man – see below). In addition to causing people to drop out, these factors also contributed to the relatively low output more generally.

When omitting those declaring zero harvest, average yield raises to 1359 kg/ha,[31] still well below the 2.5-3 ton/ha needed to recover expenses (for inputs, machinery services, hired labor) and be competitive with other crops (to compensate own labor and land).[32] This happened despite relatively abundant rainfall overall. On the other hand, rainfall patterns were rather uneven, with some farmer representatives pointing to lower yields across the board during 2019, for rice, but also for other crops, suggesting that the timing and intensity of of the 2019 rainfall wasn't particularly conducive, especially not during the early stages of the crop cycle (germination and root development) which determines up to 60 percent of the harvest.

Performance differed also substantially across regions. The harvest was relatively better around Ferké (1368 kg/ha on average, 1544 kg/ha omitting those that reported zero harvest). It was worst around Man (755 kg/ha on average, 900 kg/ha omitting those that reported zero harvest). This pattern is consistent with the regional difference in interest displayed at the outset of the project (high around Ferké, low around Man), possibly a prelude of each region's suitability for rice production and its farmers' commitment. Nonetheless, the low reported yields in Man (900 kg/ha, excluding zeros) are especially surprising given the additional investment in extension services and the very positive feedback obtained throughout the season about the extension services. Also, yields on the field demonstration plots in Man (on average 400 m^2) averaged between 3.5-4 ton/ha. In effect, of the 19 demonstration plots, the two worst performing ones still yielded 1.05 and 1.63 t/ha respectively; the two best performing ones yielded 5.8 and 6.96 ton/ha respectively.

Figure A3.2: Demonstration plot – during vegetation and harvest

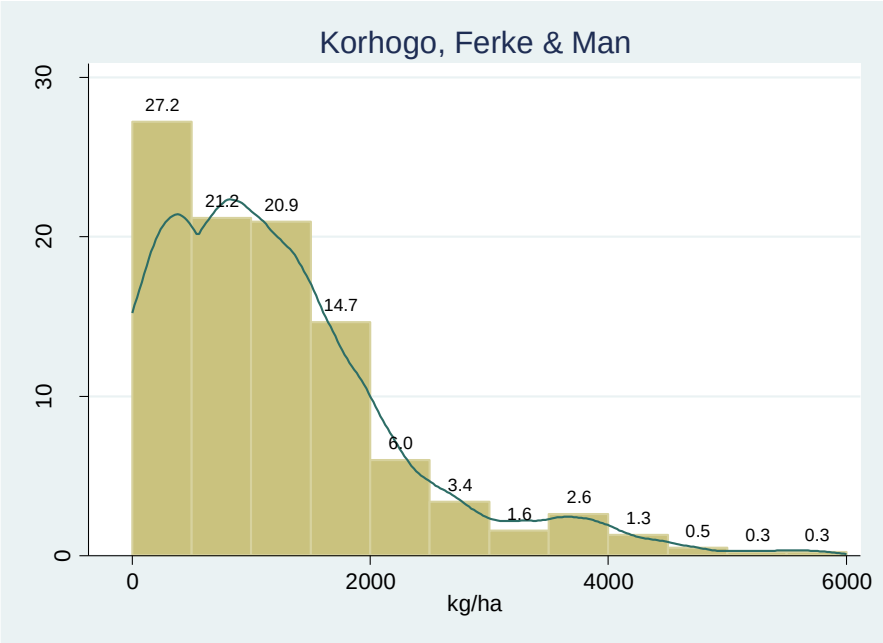
[31] The yields obtained were similar to the non-irrigated lowland rice yield observed by Depieu, Arouna and Doumbia (2017) in 2012 in Gagnoa (1.54 t/ha). Yet, the latter were produced using much lower rates of modern inputs and thus lower cash outlays.

[32] By way of comparison, in assessing the gains from the "System of Rice Intensification" approach promoted under the World Bank supported West Africa Agricultural Productivity Project (WAPP), 2.53t/ha was taken as the benchmark for rainfed lowland system conventional rice in West Africa, with SRI yields in the project averaging 4.71 t/ha (Styger and Traoré 2018).

Follow up field visits and conversations with the field coordinator in Man suggest that there has been substantial underreporting due to disagreement with the price offered by the PU and side selling (despite agreement at the time of contract signature). The purchasing price offered in the contract by the PU in Man was 125 FCFA/kg, while farmers could sell at 150 FCFA/kg after the harvest.[33] The lower purchasing price has been an issue of contention from the beginning in Man. Some were also reluctant to sell their rice as production was not enough to cover their own consumption needs. Others paid back their loans from other sources. But, agronomic factors likely also played in explaining the relatively low yields, including inadequate site selection for rice production (done before the extension started), lack of land management to prevent flooding (too late to do by the time the extension agents were deployed), late delivery of fertilizers, insecticide attacks, harvest neglect (due to competition for labor with other crops).

Figure A3.3 Distribution of lowland rice production yield, 2019

[33] 1 US$ = 606 FCFA (18 May 2020). The prices offered in Korhogo and Ferkessédougou ranged from between 135/140 to 160/165 FCFA respectively (farm gate), depending on the variety (Bouaké AM/JT11). This was well above the market price for local varieties. The price for the local variety was around 110 FCFA/kg. The decline in rice milling fees, given increased milling capacity in Korhogo, motivated the PUs servicing the Korhogo and Ferké area to engage in the project's contract farming approach and to offer a higher price to ensure their supply of rice to run their mill.



Note : interval width = 500kg/ha

In addition to variability in performance across project sites, performance varies also greatly across farmers, with 61 farmers (16 %) exceeding 2t/ha, 27 farmers (7%) reaching more than 3 ton/ha and 2 farmers reaching more than 5 ton/ha, (Figure A3.3). Decent yields appear possible, not just on the demonstration plots, provided adequate site selection and landscaping, quality seeds and good germination, timely delivery of inputs, and good agronomic practices all along the production cycle (including sowing practices, herbicide and fertilizer application, weeding, disease and insect treatment, bird control) as well as appropriate harvest and post-harvest handling.

Intensified lowland rice production during 2019 proved profitable only for a small minority

Whether this justifies continuation of the pilot even when confined to lowland rice cultivation depends ultimately on whether plausible entry points can be identified to increase output and whether this suffices to yield profitable outcomes that are competitive with other crops and nonagricultural activities. Furthermore, lowland rice production must not only be profitable for the farmers, but for all the actors involved along the chain in terms of private (including the banks and the mills) and social (government/donors) returns. Even if private returns are not sufficient to motivate private actors to engage, social returns may be large enough to justify support by the government and make the activity profitable for private agents (e.g. by alleviating coordination costs).[34] The data for a full cost benefit analysis of the activity for the different actors involved in this economic inclusion in value chains experiment are being collected and will be pursued for the final report. Here, the is on the profitability of intensified lowland rice production during the 2019 season is examined.

[34] Robalino and Walker (2017) Alternatively, when private exceed social returns in case of negative externalities (e.g. pollution), governments may be justified in taxing the activities to compensate society for the losses.

Table A3.2 Lowland rice - cost of production and net profit, 2019

Processing unit	Producers	Cost (FCFA/ha)			Net profit (FCFA/ha) (value output minus cost)
		Inputs	Credit	Total	Total
Korhogo	98	177,434	87,625	265,060	-116,356
Ferkessedougou	228	155,162	44,785	195,948	321
Man	56	194,507	49,723	244,230	-149,849
Total	382	166,644	54,112	220,756	-51,626

Note: Costs include the cost of inputs (seeds, agro-chemicals (mainly herbicides, and insecticides in Man), fertilizer) and the cost of the credit. Other costs are not considered (labor – hired or own, machinery services – ploughing, threshing).

The yield, together with the production cost (inputs, machinery services, labor) and output price are the three key parameters determining whether intensified lowland rice production is profitable. Total recorded financial outlays for inputs and credit amount to 220,700 FCFA/ha on average (Table A3.2). Inputs (seeds, agro-chemicals, and fertilizer) account for about 75% of this (167,600 FCFA/ha)[35]; the cost of the credit for about 25% (54,100 FCFA/ha). To cover these expenses at 135 FCFA/kg paddy rice, 1634 kg/ha is needed; at 140 FCFA/kg 1576 kg/ha: at 160 FCFA/kg, 1379kg/ha. Recall that the contracts with the PU in Man stipulated a purchasing price of 125 FCFA/kg, those with the PU in Korhogo 135/160 FCFA/kg (BKE-AM; JT11) and those with the PU in Ferké 140/165 FCFA/kg. Input and output prices are farm gate (inputs and ouputs were delivered and picked up at a central place in the village). Settlement of the credit accounts could only be done in town, however, which caused a lot of transaction costs and delays.

Unit costs vary greatly depending on the plot size, given fixed costs in credit provision and indivisibility in inputs.[36] Costs per ha are on average 31,000 FCFA less for a farmer cultivating 1 ha compared to a farmer cultivating 0.1 ha (209,720 FCFA/ha as opposed to 240,912 FCFA/ha respectively). This follows especially from the fees related to the credit account (opening and maintenance).[37] Given smaller plot size around Korhogo, costs per ha are also higher than around Ferkessedougou, where costs are lowest. In addition to smaller plots, higher costs around Man also follow from the additional use of insecticides, which were added to the package during the campaign to address an insect attack.

On average, yields do not suffice to compensate for the credit and input costs, resulting in a net loss per ha of 51,600 FCFA on average. Average recorded losses were especially high among participants around Man, though given underreporting of harvest and side-selling, this is likely an overestimate. For farmers around Ferkessédougou, the value of the harvest sufficed on average just about to compensate for the recorded expenses. This is also the region where most

[35] Among the inputs, seeds account for 31 percent of the costs, herbicide for about 17 percent, and fertilizers for about 52 percent (i.e. seeds ~ 2 in 6, herbicides ~1 in 6, and fertilizer 3 in 6).

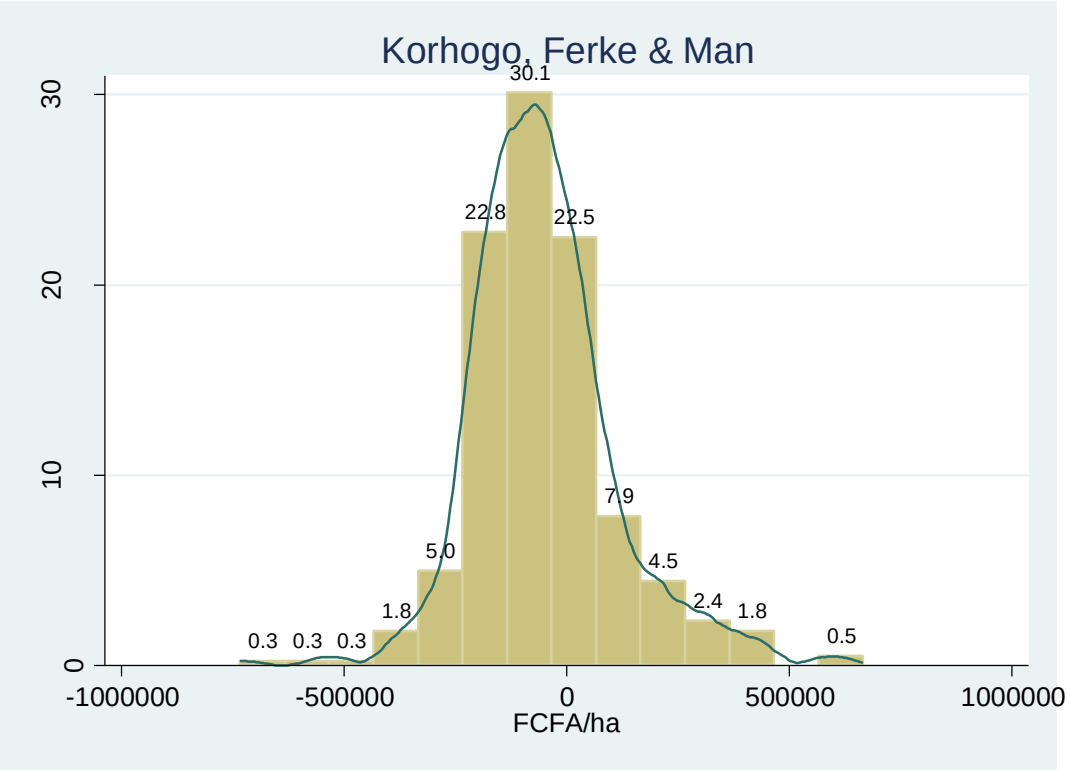
[36] Individual accounts were opened for each participants, which implies a one-time account opening fee of 12,500 FCFA as well as an account maintenance fee of 800 FCFA/months for 6 months or 4800 FCFA/account. Obviously, this rapidly raises the implicit interest rates for small loan amounts. Similarly, herbicides are sold in bottles of 1 l and fertilizer is sold in bags of 50 kg.

[37] Credit costs per ha were on average 20,893 FCFA/ha higher for those with 0.1 ha compared to those with 1 ha. Input costs were 10,297 FCFA/ha higher (or 31,190 FCFA/ha in total).

of the project's lowland rice production took place.

Looking at the distribution of net profit shows that the value of production exceeded the recorded expenses for about 30 percent of the participating farmers (Figure A3.4). This likely underestimates the net return, given underreporting in Tonkpi. Some of the surplus inputs may also have been applied to other crops or stored for the next season (confirmed during field visits). On the other hand, other cash expenses are still not accounted for such as land rental, hired labor and machinery services (ploughing, threshing) as well as within village transport and small equipment. The amount left after subtracting these expenses, is the compensation for own land and labor. Ten percent of farmers were left with at least 150,000 FCFA/ha to compensate for these additional expenses and their labor and land. Five percent are left with more than 250,000 FCFA/ha. Accounting 50,000 FCFA for the other expenses thus leaves at least 100,000 FCFA/ha for land and own labor for 10 percent of the farmers, which is considered competitive with other activities, a point that will be examined further during the 2020 campaign and additional analysis of the baseline data.

Figure A3.4 Distribution of net profit of lowland rice production, 2019



Note: interval width=100,000 FCFA

The relative contribution of different factors to rice profitability

Multivariate analysis based on the administrative data sheds further light on the relative importance of some of the agronomic, economic and implementation related factors identified above (Table A3.3). In particular, it is explored how 1) the size of the cultivated area, 2) the variety and output price of the rice cultivated, 3) the humidity level and quality of the paddy rice harvested, 4) the

payment of the account opening fee at the beginning of the season and the accuracy of the cultivated area declared and 5) the cash transfer status of the project participants (beneficiary or not) affect different outcome variables. The latter include: 1) incidence of harvest failure (column 1), 2) the yield obtained (column 2); 3) gross profit per ha (column 3); 4) total input and credit costs per ha (column 4); and net profit per ha (column 5).

The correlates of the incidence of harvest failure (zero declared harvest) are examined using a probit estimation. The effect of the correlates on the continuous outcome variables (yield, input costs and gross and net profit) is estimated using village fixed effects with correction for heteroskedasticity and within village error correlation. Village fixed effect estimation helps control against the non-random selection of the villages (17 villages of the original 61 randomly selected villages dropped out and 8 were added ad hoc, resulting in a total of 52 participating villages). As a result, the estimated coefficients are less likely to be statistically significant, though robust against omitted variable bias related to village characteristics (including those affecting selection in the project).[38] All regressions on the continuous output variables (yield, costs/ha, gross and net profit/ha) are non-censored at zero (they exclude the observations with zero reported harvest). Six insights emerge.

[38] When using village level fixed effects the effects of the different correlates are estimated from the within village variation as opposed to the variation across the sample. Random effects estimation which also corrects for heterosckedasticity and within cluster correlation is more efficient, but suffers potentially from omitted variable bias related to omitted village characteristics. Village fixed effect estimates are thus preferred, but random effects estimation was also conducted by way of robustness. The estimated coefficients were of similar magnitude and statistical significance which provides confidence in the findings.

Table A3.3: Village fixed effects estimates of the effects of agronomic, economic and implementation factors on lowland rice output and profitability

	((1)	(2)	(3)	(4)	(5)
	Zero harvest declared (1=y, 0=n)	Harvest (kg/ha) (given harvest>0)	Gross profit (FCFA/ha)	Input cost (FCFA/ha)	Net profit (FCFA/ha)
Cultivated land (ha) (measured)	0.0	-450***	-63,790***	-24,555*	-38,882**
	(0.6)	(-3.6)	(-3.5)	(-1.7)	(-2.3)
Rice variety (JT11=1; Bouake AM=0)	0.226***	-616**	-86,919**	-9,939*	-78,403**
	(3.1)	(-2.2)	(-2.2)	(-1.7)	(-2.2)
Paddy price (FCFA/kg) (farm gate)	-0.0068**	17***	3,627***	-	2,954***
	(-2.2)	(3.6)	(5.4)		(4.1)
Humidity level (%) (ranging bw 4-22)	-	30	4,730	-	8,776***
		(1.3)	(1.4)		(2.9)
Quality[1)]	-	331	46,851	-	55,972*
		(1.6)	(1.6)		(1.7)
Opening fee account paid (1=y; 0=n)	-0.1	244	36,677*	-19,359	54,148***
	(-1.2)	(1.7)	(1.8)	(-1.3)	(2.8)
Declared minus actual rice area (ha)	0.1	-254*	-36,208*	11,424	-47,639***
	(1.0)	(-1.8)	(-1.7)	(0.5)	(-3.0)
Safety net beneficiary (1=y; 0=n)	-0.0	298**	42,573**	19,381	18,164
	(-0.3)	(2.4)	(2.4)	(1.1)	(0.6)
Constant	-	-1,822*	-436,709***	236,453***	-645,500***
		(-2.0)	(-3.4)	(18.1)	(-5.6)
Region fixed effects	Y	-	-	-	-
Village fixed effects	-	Y	Y	Y	Y
Number of producers	382	335	335	335	335
R-squared	-	0.074	0.075	0.069	0.075
Number of villages	-	45	45	45	45

Note: village fixed effects estimates with correction for heteroskedasticity and within village autocorrelation. t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1; post-harvest humidity, measured at farmgate pick up and ranging between 4 and 22% (contractual threshold ≤ 14%); delivery quality (presence of stones, sand, foreign elements): 0=bad, 1=medium, 2=good; 3=very good; Account opening fee paid when opening the account.

First, there is a clear link between the size of the land cultivated and the different outcome variables, with those devoting more land to intensive rice production under contract gaining less per ha than those cultivating smaller plots (Table 3.3, row 1). This is consistent with the widely observed and documented inverse farm size relationship which holds that smaller farms are more efficient than larger ones. Nonetheless, two opposing forces are at work. Larger farms tend to fetch lower yields per ha (with those growing 1 ha harvesting on average 225 kg less than those growing 0.5 ha). It is arguably easier to devote more time and attention on smaller than on larger parcels, where hired labor is also more likely, which in turn is hard to supervise, bringing additional supervision costs. On the other hand, given substantial fixed costs related to the credit provision and the indivisibility of some of the inputs, costs per ha decline as plots become larger (by an estimated 24,555 FCFA/ha). These cost savings (24,555 FCFA/ha), however, appear not to outweigh the loss in yield and gross output (63,790 FCFA/ha), resulting in lower net profits per ha for larger farms (by 38,882 FCFA or 19,441 FCFA per 0.5 ha). When additional supervision costs of hired labor are added, the difference may even be larger. When machinery services are used, on the other hand, quantity discounts may be available for those with larger fields.

Second, while JT11 fetches a higher price, it also comes with a greater likelihood of reporting zero

harvest and lower yields (Table A3.3 row 2, columns 1 and 2). Comparing the size of those opposing effects shows that the 25 FCFA price premium over Bouaké AM barely suffices to compensate for the loss in output.[39] While statistically significant, these results are based on the experience of 61 JT11 growers only[40] and the experience of one growing season. They especially counsel caution against the perception that JT11 is necessarily the better variety for the farmers under the current growing and pricing conditions.

Third, the importance of price incentives for supply response has been widely documented, also within Africa.[41] It also comes through clearly in this sample, the somewhat limited price variation across farmers (see footnote 10) and despite generally limited yield performance. An increase in paddy price by 10 FCFA/kg reduces the likelihood of zero harvest reporting by 6.8 percent. Note that zero harvest reporting may follow from actual harvest failure, but also from field abandonment or harvest neglect (as has been reported around Korhogo and Man) and side-selling (as observed around Man). The costs of field neglect rise with the sales price, as do the benefits from sideselling. Higher sales prices induce farmers to take care of their crops and adhere to the delivery clause in the contract. Higher prices also increase the yields among those reporting a positive harvest, with those fetching the highest prices (165 FCFA/kg) reporting on average 680 kg higher yields per ha (40FCFA*17 FCFA/kg) compared to those fetching the lowest prices in the sample (125 FCFA/kg). This is substantial.

Fourth, higher humidity rates of the harvested paddy rice are associated with higher net profits. The need for adequate harvest practices and post-harvest handling has been emphasized in rice policy documents since the 2008 world food price crisis. Whether the delivery of drier and better-quality rice is also incentive compatible is less clear. It requires greater care and effort by the farmer and may as a result not be incentive compatible. Delivering drier paddy may even be at odds with their interest, as they are paid per kg. This is borne out by the data. Net profit increased on average by 8,776 FCFA per ha per percentage point increase in the humidity rate at pickup (Table A3.3 row 5, column 5).[42] A difference of 3 percentage points increases the return by about 25,000 FCFA/ha, which is nonnegligible. The contractual humidity threshold of 14 percent or less was exceeded by one quarter of the participating farmers, despite explicit post-harvest handling training on adequate post-harvest handling practices and an explicit contractual stipulation (which

[39] While the likelihood of zero harvest reports was 22.6 percent higher for those growing JT11, zero harvest reporting also declined with the paddy price offered in the contract, by 0.68 percent per FCFA/kg. It was thus 17 percent lower among those growing JT11 (0.68*25=17%). Similarly, among those reporting a positive harvest, JT11 growers reported on average 616 kg/ha less per ha than those growing BKE-AM. But input costs were also slightly lower per ha, resulting in a total decline of net profits by 78,403 FCFA per ha. Yet, each output price increase of 1 FCFA/kg paddy rice was also associated with an increase in net profit by about 3000 FCFA, or a total of ~75,000 FCFA/ha for JT11, barely sufficient to compensate for the lower yields.

[40] While statistically significant, the finding that the 25 FCFA/kg price premium at best just suffices to compensate for its lower yield compared to BKE-AM, is in practice based on the differential experience of 35 farmers in three villages only, given the within village estimation technique. Nonetheless, a similar conclusion is reached when looking at the random effects results, which compare the experience of all JT11 growers in the sample (61 in total), ceteris paribus, with those of the BKE-AM growers (321 in total).

[41] Magrini, Balié, Morales-Opazo, 2018.

[42] As the input and credit costs are not affected by the humidity levels at the time of sale, the net profit gain follows from the increase in yield (estimated at 30 kg per percent humidity). Given the village fixed effects estimator, the estimated effect on yield is imprecisely estimated. It is statistically significant when using the random effects estimator as well as when looking at the effect on net profit.

was not adhered to by the buyer in the end).

Fifth, three other variables were included which could be seen as broadly reflective of the farmer's engagement and capacity: 1) quality of the paddy rice at delivery; 2) payment of the account opening fee at the start of the season; and 3) the extent of overdeclaration of the surface dedicated to the project. All three indicators point in the same direction, often with sizeable differences, i.e. the more engaged and better informed the farmer, the higher, ceteris paribus, the net profit per ha (Table A3.3 column 5).

Unlike humidity, which is measured using a humidity meter, quality of the paddy rice is assessed subjectively by the consortium at the time of pickup using four categories: bad=0, medium=1, good=2, very good=3. For about one fifth of the participating farmers, the delivered paddy was classified as medium quality, for about three quarters among them as good, and only very few were considered to deliver bad or very good paddy. There is virtually no correlation with the observed humidity. The difference in yield associated with going from medium to good rice was estimated at 331 kg and an increase of 55,972 FCFA in net profit per ha. This is huge, but the reasons for this are not immediately obvious. It is hypothesized that it is a signal of the quality of the farmer and their farming practices more broadly, including greater caretaking of the crop in general and more rigorous application of guidelines. This deserves further investigation. Greater care might also a higher labor input. Whether this pays off, depends among others on farmers' opportunity cost for their own labor.

As many farmers indicated not to be able/willing to pay the account opening fee at the start of the season, they were given the option to do so after the harvest. This created an interesting experiment. Their willingness and ability to pay upfront could be seen as an indicator of their engagement and the payment itself as a commitment device. Net profits per ha among those who had settled their account was indeed substantially higher (by 54,000 FCFA per ha), mainly as a result of higher yields.

Finally, the surfaces for rice production declared by the farmers differed substantially from the actual field size dedicated to the contractual lowland rice production. As the field sizes formed the basis for assessing the amount of inputs and credit needed, they were all measured again using GPS subsequently. About one quarter got the surface right, one quarter underestimated the size of their plots and one half overdeclared (5 percent of which by more than 0.5 ha). Some of this most likely reflects genuine measurement error: Farmers have been documented to overestimate the size of small plots and to underestimate the size of large plots (Carletto, Savastano, and Zezza, 2013), which implies a negative relationship between the declaration gap (declared minus actual) and the actual plot size, as has also been documented by Carletto, Gourlay, and Winters (2015) across several country setting. For this sample, this relationship is positive, implying that the overdeclaration increases with plot size, suggesting that other elements may have been at work, including an attempt to get access to input credit and inputs for other crops. Such a mismatch between declared and actual plot size would induce a suboptimal application rates in case of genuine measurement error, or an overestimation of the costs in case of over declaration. Most of the input quantities ordered and delivered were adjusted after remeasuring all the plots, though this was not possible for the seeds and some of the herbicides, leading to suboptimal application rates and costs. As conjectured, those who overdeclared their

plot size saw their net profit decline, by about 47,000 FCFA/ha. As a result more than a quarter of farmers saw their net profit per ha decline by 9,400 FCFA/ha or more.[43]

Sixth, ceteris paribus, cash transfer beneficiaries appear to have performed at least as well as non-cash tranfer beneficiaries. Per ha, their net profits were somewhat higher, but the effect was not statistically significant, also not in the random effects model, which allows for a more efficient estimation. This is an important and positive indicative finding, as it suggests that the cash transfer beneficiaries, which make up the poorer segment within the village, are not disadvantaged in the scheme, compared to richer village counterparts.

[43] One quarter of farmers overdeclared by 0.2 ha or more.

Literature

Beegle, Kathleen, and Luc Christiaensen. 2019. *Accelerating Poverty Reduction in Africa.* World Bank Group: Washington D.C.

Burke, William et al., 2019. Area Mismeasurement Impact on Farmers' Input Choice and Productivity. *Feed the Future Innovation Lab for Food Security Policy Policy Research Brief 106.*

Carletto, Gero, Sara, Savastano, and Alberto, Zezza. 2013. Fact or Artefact: The Impact of Measurement Errors on the Farm Size-Productivity Relationship. *Journal of Development Economics* 103: 254-261.

Carletto, Gero Sydney, Gourlay, and Paul, Winters. 2015. From guesstimates to GPSstimates: Land Area Measurement and Implications for Agricultural Analysis. Journal of African Economies 24-5: 593-628.

Christiaensen, Luc. 2020. Agriculture, Jobs and Value Chains. *Jobs Group Note 9.* World Bank Group: Washington D.C.

Depieu, M., A, Arouna, and S., Doumbia. 2017. Analyse diagnostique des systems de culture en riziculture de bas-fonds à Gagnoa, au centre-ouest de la Côte d'Ivoire. *Agronomie Africaine* 29-1 : 79-92.

Gourlay, S., T., Kilic and D., Lobell. 2019. A New Spin on An Old Debate: Errors in Farmer-Reported Production and Their Implications for Inverse-Scale-Productivity Relationship in Uganda. *Journal of Development Economics* 141.

Magrini, Emiliano, Jean Balié, and Cristian, Morales-Opazo. 2018. "Price Signals and Supply Responses for Staple Food Crops in Sub-Saharan Africa." *Applied Economic Perspectives and Policy* 40 (2): 276–96.

Minten, Bart, Bethlehem Koru, and David, Stifel. 2013. "The Last Mile(s) in Modern Input Distribution: Pricing, Profitability, and Adoption." *Agricultural Economics* 44 (6): 629–46.

Liverpool-Tasie, Lenis Saweda O., Bolarin T. Omonona, Awa Sanou, and Wale O. Ogunleye. 2017. "Is Increasing Inorganic Fertilizer Use for Maize Production in SSA a Profitable Proposition? Evidence from Nigeria." *Food Policy* 67: 41–51.

Robalino, David, and Ian, Walker. 2017. Economic Analysis of Jobs Investment Projects. *Jobs Working Paper 7.* World Bank Group: Washington D.C.

Styger E, Traoré G. 2018. 50,000 Farmers in 13 Countries: Results from Scaling up the System of Rice Intensification in West Africa; Achievements and Regional Perspectives for SRI; SRIWAAPP Project Summary Report, 2014-2016; West Africa Agriculture Productivity Program (WAAPP). The West and Central Africa Council for Agricultural Research and Development (CORAF/WECARD), Dakar, Senegal.