Improving smallholders' jobs through agribusiness linkages: Findings of the Mozambique Agricultural Aggregator Pilot (MAAP)

Michael Baxter, Christopher Delgado, Jose Manuel Romero and Ian Walker[1]

Jobs Group, World Bank
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1. Introduction

1.1. Overview of the Mozambique Agricultural Aggregator Pilot

Private sector "aggregator" schemes are a plausible approach to improving jobs outcomes for the rural poor in low income country (LIC) settings[2]. They can provide small growers with access to capital finance, technical orientation and markets on a financially sustainable basis, thus raising their productivity and earnings. They avoid the need for the consolidation of land holdings to achieve scale economies; and they side-step the challenges of managing hired field labor on a large scale. Aggregator schemes can also have additional jobs effects, beyond the income gains to the smallholders themselves, such as: wage jobs for temporary field labor; wage jobs in agribusinesses transformations; and jobs spill-over effects in other industries, such as input suppliers or through local economy demand multiplier effects.

The Mozambique Agricultural Aggregator Pilot (MAAP) research program investigated how jobs and earnings changed when seven different commercial aggregators worked with contracted growers in farm-based value chains in Mozambique in the period 2017-20. The study covered a range of crops and animal products including: cotton, sugar, maize, chickens, sesame and goats. It measured changes in the net earnings of the smallholders (to quantify the welfare effects for the growers) and the aggregators (to understand the profitability and financial sustainability of the schemes). So, the study provides new evidence on two metrics relevant to the design of public support to commercial aggregators: (a) the amount of the economic gains and their distribution between the commercial firms and smallholder growers; and (b) the marginal profitability of the commercial systems and (thus, implicitly) what subsidy amounts would make their expansion viable.

Our central premise is that, given the goal to reduce rural poverty, income gains for poor growers are a legitimate object of public support. In LIC settings with segmented labor markets and the lion's share of the workforce trapped in low productivity subsistence agriculture, providing government support to commercial aggregation is a plausible point of entry[3]. But in the absence of clear evidence about the effects on poor growers, policymakers may look askance at providing subsidies to commercial firms.

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[1] Michael Baxter is Director of Ozmozis Lda., Mozambique. Christopher Delgado and Jose Manuel Romero are consultants and Ian Walker is Manager in the World Bank's Jobs Group.

[2] The term "agricultural aggregator" is short-hand for a formal sector firm engaged in agricultural processing or trade that sources raw material from multiple farm suppliers ("growers") through an institutional link that integrates these primary producers vertically with the aggregating firm. This institutional link is typically (but not exclusively) through a contract that sets out the rights and responsibilities of farms and firms working together and is often referred to as "contract farming".

[3] See for example: World Bank, 2016. Linking Farmers to Markets through Productive Alliances. An Assessment of the World Bank Experience in Latin America.

An innovative aspect of the MAAP study is that it simultaneously estimates the effects on participating farm households and on the corresponding aggregator firms. We analyse both the aggregators' private financial returns and the full social returns of these systems, including the gains to the smallholders, and we compare them to the investment amounts needed. This provides a basis for discussing the potential role for public subsidies. To our knowledge, this type of integrated analysis has not been attempted previously. Most studies have focused either on the smallholders; or on the commercial entities.

Our study design allows us to focus on the possibility that smallholders might gain from the expansion of aggregator systems organized by firms – and that the smallholders' gains might form an important part of the total gains. Viewed from the perspective of a profit-maximizing aggregator firm, the smallholders' gains are an *externality*: they don't form part of the firm's objective function. So, even where the overall returns to the aggregator system (the sum of returns to firms and smallholders) are sufficient to justify the investment, if the expected returns to firms are insufficient, the system might not expand, because the firms are the key agent organizing it. If so, that might call for policies to offset the corresponding market failure, through support to the firms. An upper bound for dimensioning such support would be the expected net income gains of smallholders participating in the system.[4]

This Overview is intended for a non-technical professional and policy audience. It assesses the social and economic outcomes from the aggregation schemes monitored by MAAP. Based on this, it discusses the potential of agricultural aggregation to improve smallholders' welfare and what role the public sector can play. The study integrates the rationale laid out in the pertinent literature with the empirical results from the MAAP assessment. Greater detail on the analytical methodologies, data collection, empirical results and a discussion of the findings and conclusions can be found in the final project report prepared by the MAAP contractor, OzMozis Lda. (henceforth, MAAP Final Evaluation Report), which serves as a background paper for this report.[5]

1.2. Objectives of the MAAP Pilot

MAAP aims to improve our understanding of the viability of agricultural aggregation schemes involving agribusinesses working with smallholder farm suppliers in Mozambique and (by extension) similar African countries. It investigates the incremental costs and returns to firms and growers of *expanding the number of growers in existing aggregation schemes*. It does *not* explore overall firm or grower profitability.

We study whether these expansions make money (net profits) for the firms, for growers (on average) or for both. Understanding the economics of expanding these systems helps elucidate why firms are not expanding more; and why more smallholders are not currently participating in commercial agribusiness markets. In this context, MAAP seeks to address four sets of questions:

> I) What are the *economic and social impacts* of contract grower aggregator businesses? Specifically, does adding new growers in established aggregator schemes generate income gains for the growers?

[4] This paper thus contributes to the growing literature on "jobs-linked externalities": the gains that accrue to workers or independent suppliers when their earnings are enhanced by the expansion of business systems in dualistic economies characterized by a surplus of low-skilled labor. See Robalino, Romero and Walker (2020).
[5] OzMozis Lda., 2020. Mozambique Agricultural Aggregator Pilot (MAAP): Final Evaluation Report, OzMozis Lda., Maputo, October 23, 3 volumes.

II) What were the *success factors* for the sustainable expansion of contract grower programs? Was the expansion profitable for firms[6] and what was the distribution of the expansion's first-order benefits between firms, growers, and society (the additional social gains)?

III) What was the contribution of aggregator programs to jobs and employment in the aggregator firm and among current and potential contract growers?

IV) How might public support to aggregation schemes contribute to creating better jobs and increasing growers' incomes? Is there potential to promote lasting jobs gains through one-off transfers (rather than ongoing subsidies)?

2. Rationale and framing

2.1. Smallholder growers face market failures and economic exclusion

One of Mozambique's most important jobs challenges is to increase the productivity and earnings of smallholder growers that still constitute approximately 70% of the national labor force (Lachler and Walker 2018). Ninety-seven percent of agricultural production comes from 3.2 million subsistence farms that have an average size of 1.2 hectares and where rural poverty remains high (World Bank 2018a). Just two percent of growers have access to third-party financing (World Bank 2019). With the preponderance of smallholder farming and few off-farm wage-earning opportunities available to them, raising rural incomes depends on increasing the productivity of smallholder growers, regardless of progress in other sectors. Commercialization could lead to agricultural productivity growth and directly increase smallholders' incomes. It could also indirectly increase rural incomes through local economy multiplier effects generated by the spending of increased farm incomes in non-farm sectors such as building materials, prepared food and other services (Delgado et al. 1998).

The demand for agricultural commodities is increasing rapidly in the urban markets of Eastern and Southern Africa, especially for processed foodstuffs produced by agribusiness firms (Tschirley et al. 2015). But smallholders face significant barriers to increasing productivity and commercialization, which they often cannot overcome by themselves. Transport costs in rural areas (both in terms of time and cash) are high and rising (World Bank 2019). Access to quality inputs such as improved seeds and fertilizers and the finance to buy them are scarce. Business information and skills are also lacking. Moreover, smallholders cannot brand their small, anonymous market offerings. This is a problem when quality and safety characteristics are not immediately obvious at the point of sale, so even good quality produce is sold at bulk (low) prices. So, many smallholders, especially in remote areas, remain largely subsistence-based and outside the market economy. As a result, the gap between average rural and urban livelihoods, which is already large, will likely widen more as urban incomes grow.

Since the late 1980s, the New Institutional Economics began to suggest contract farming as a way to incorporate African smallholders into the expanding formal markets for higher-value agricultural products and processed goods (Grosh, 1994; Little and Watts, 1994). It argued that the expansion of agriculture beyond small village markets creates information asymmetries between buyers and sellers. Smallholders, who sell small amounts of unknown quality on irregular schedules, face increasingly long and anonymous market chains. Due to the well-known scale economies of financial transactions, it's also expensive for them to borrow money to purchase inputs. Under these conditions the costs of search, evaluation, bargaining, monitoring and enforcing exchange agreements increase for both sellers and buyers. That leads to buyers paying lowest common denominator prices, often below what

[6] Our estimation of whether the expansion is profitable for the aggregating firms is based on estimating the net aggregator profits per new grower added that are directly attributable to the expansion.

they might pay for items whose quality they can easily evaluate and whose purveyors they know and trust. Firms are also less willing to lend money to unknown, remote growers.

These transaction costs arise, essentially, from information asymmetries. They lead to net losses to society by reducing value added for both buyers and sellers. In theory, such problems could be solved by institutional innovations that address the underlying market failures. Typical solutions involve a loose form of written contract where a grower receives an advance (of *cash* to pay for field preparation or weeding or to buy inputs; and/or *in kind* provision of inputs on a credit basis). The grower undertakes to sell the resulting output to the firm that provides the advance. Smallholders get finance, sometimes technical advice, and an assured market outlet, and the credit costs are subtracted from what they are paid for output. The firms offering the financing get a supply of raw material, *de facto* access to land, and relief from the need to supervise field labor doing routine daily tasks (Barrett et al. 2012).

The "contracts" vary considerably across firms, geographies and even growers - but they are rarely enforceable. Default rates (by growers or firms) typically vary by commodity. The stability of contracts depends on the extent to which the arrangement generates gains for growers and firms and how market power is balanced between the parties (Staal et al. 1997; Delgado 1999; Barrett et al. 2012; Ton et al. 2012, Bellemare and Lim 2018). Defaults by growers typically involve "side-selling" their product to someone else, who is not trying to recover the input costs from them.

Early analytical work on these issues was mostly qualitative, because transaction costs are hard to observe and their measurement is typically complicated by the absence of a clear counterfactual (Sadoulet and de Janvry 1995). More recently, agricultural economists working empirically on African cases have tended to focus on whether contract farming has been beneficial for the growers, through the comparison of "with" and "without" samples. This literature has become quite rich, and continues to expand (Barret 2008, Bellemare and Bloem 2012, Bellemare and Lim 2018, Christiaensen 2019, Swinnen and Kuijpers 2020, Barrett et al. 2020). Much of the empirical work to date has focused on comparisons between a "treatment" sample (growers who participate in the contract farming scheme) and control groups of growers who are outside the scheme. The treatment effect is then a measure of the additional value generated by contracting. It is construed as the monetary value of the institutional solution to transaction costs (the contract), or, put differently, as an estimate of the size of the transaction costs that prevail in the absence of the contract.

Much of this work has focused on assuring that the treatment and control samples are "random draws" from a common universe of smallholders. The central methodological question is the need to ensure that the selection of "treated" growers is truly exogenous, and does not reflect unobservable underlying differences in the characteristics of participating and non-participating smallholders. This is vital for inferring that observed differences in outcomes are in fact due to the contract, and not attributable to the sampling procedure (Bellemare and Bloem 2012, Bellemare and Lim 2018). However, this approach can lead to problems regarding the "external validity" of the findings, as we discuss in Box 3 on page 13 below.

2.2. Work to date on contract farming in Mozambique

The literature on contract farming in Mozambique has tended to concentrate on supply chains for non-food industrial raw materials such as tobacco and cotton (Benfica et al. 2006, Boughton et al. 2007, Bijman et al. 2009, Barrett et al. 2012, Cipriano et al. 2017, World Bank 2018a). As with studies of contract farming elsewhere, the results have been mixed, with some commodities doing better than others. The successful cases are normally high value, quality-dependent commodities, where market

power is evenly balanced between producer groups and aggregators, and where side-selling by growers is not a realistic option (Christiaensen 2019, Swinnen and Kuijpers 2020, Barrett et al. 2020).

Some of the agricultural aggregation systems in Mozambique date from the colonial economy. Cotton has the largest number of growers linked to aggregators, with 170,000 smallholder growers producing 90% of the country's crop. Cotton milling companies supply most of the inputs on credit and provide extension advice. Until recently, tobacco was the second largest crop for aggregation, with 120,000 growers in several provinces supplying the Mozambique Leaf Tobacco processing plant in Tete.[7] In both cases, the smallholders have few sales options other than through the aggregator. Sugar cane also has a long history of vertical integration through aggregation schemes. Overall, almost 12% of Mozambique's rural population is involved in aggregation relationships with processors (Curtis, 2015).

Perishable products whose quality is not easily observed are regarded as good candidates for aggregation. The output of many small producers is bulked together by an aggregator who is able to assure quality. Examples include: dairy, poultry both for meat and eggs, and some high-value vegetables and fruit. In contrast, smallholder crops with easier-to-assess quality attributes can be sold in "spot" markets. They include: soybean, sesame, maize, and vegetables like chili and green beans, and fruits like mangoes and banana. There are few sustainable contract grower systems working with these commodities, due to the risk of side-selling by growers, given the widespread availability of market outlets. This makes it difficult for the aggregating firm to recoup the costs of credit and extension efforts through procurement at below spot market prices. Although these crops do have some traits that are hard to observe (e.g. the lysine content of maize), spot market buyers can normally evaluate product quality without the need to trust specific growers. Under these conditions, it rarely makes sense to incur the cost of administering an aggregation contract (Delgado, 1998b).

The result can be understood as a "low quality equilibrium trap". The market failures analyzed in the "transaction costs" literature hamper growers from increasing their income through participating in commercial agriculture. They are trapped in poverty, with their resources (land and labor) underemployed (Carter and Barrett 2006, Baez Ramirez 2018). Similarly, aggregator firms may expand less than is optimal for them, because of the transaction costs affecting their relationships with growers. This might result, for example, in the persistent under-utilisation of processing facilities, even where the processed products can be sold into elastic global markets (e.g. those for cotton and sugar). So, both the growers and the firms may be trapped at sub-optimal levels of activity due to market failures (Barrett et al. 2019). In that case, a rural jobs strategy should aim to address these market failures and allow both firms and smallholder growers to raise their output and incomes. *To the extent that a significant part of the overall gains will derive to the growers, but the gains to the firms are insufficient to trigger them, such policies could consider providing support or subsidies to the firms whose agency makes that possible.*

2.3. Agribusiness firms working with smallholders

Agribusinesses that wish to exploit growing urban and export markets by procuring from many, widely dispersed smallholders need to confront the high cost of bulkers, transporters and other intermediaries. The raw material is often of mixed quality and limited availability at key times (Delgado, Costa and Ricaldi, in press). An alternative is vertical integration within firms, such as a food processor with its own large farm to supply raw material. But obtaining and enforcing land use rights in Mozambique is a lengthy process that cannot easily be extended beyond relatively modest levels

[7] Many tobacco aggregation schemes have closed in recent years and efforts are underway to convert the grower systems for other crops.

(Ibid.). In addition, quality-sensitive agriculture depends on well-managed labor inputs, which are often costly and may be difficult to supervise, beyond a limited set of standardized, centralized plantation crop activities.

Under these conditions, firms might aim to integrate vertically with smallholder suppliers, which would improve their *de facto* access to land and reduce the need for direct labor supervision, compared to operating a company farm. This model typically involves transfers of credit, inputs and extension knowledge from an agribusiness firm to growers, in return for a promise to sell output to the firm. The firm then deducts the costs of the transfers from payments to growers for their product. The administrative instrument to govern these transactions is typically a loosely structured formal contract, hence the name of "contract farming". Such contracts are difficult to enforce, so "side-selling" (to someone who didn't provide credit and inputs) is a real risk for the firms.

Expanding the number of growers is also limited by several other factors. As integration schemes expand, the firm's overhead in terms of facilities and staff can become stretched. Access to capital in Mozambique can be expensive (Ibid.) and many other factors limit firm and growers' engagement with the financial sector.[8] Capital costs and exposure to sunk investments may increase beyond an acceptable threshold, especially when expansion requires lumpy investments in infrastructure or plant. Expansion may also imply operating in more distant areas with increased transport and supervision costs. Or if firms expand an aggregator system on the "internal margin" by contracting more growers in the villages they already work in, they might have to work with weaker growers.

However, it is insufficient to focus only on the standpoint of firms. In aggregator systems, the engine of change is the firm, but change has to happen on the farms - so growers' decision-making is crucial. For agribusiness to expand for the long term, smallholders must improve supply and cooperate with the processors. This implies building trust on both sides. The growers must be convinced to go into debt and increase their economic dependence on commercialization—including relying more on markets for their own food supply. Growers' behaviors in response to risks and uncertainties affect not only themselves and their families, but also those that trade with them. The way that traditional agrarian culture conditions growers' willingness to commit to "commercial" production has been studied for many years, but our understanding remains insufficient[9].

So, we can see the low level of agricultural commercialization as the result of firms and farms being stuck in a "low level equilibrium", where neither party benefits as much as they might from demand growth in cities and foreign markets. Market failures such as asymmetries of information negatively impact incentives to trade between smallholder growers and agribusiness firms, keeping both from realizing their potential. On the farm side, growers cannot get the inputs to respond to market signals and cannot fully access competitive markets for their products. On the agribusiness side, firms cannot generate the increased profit that would be viable if smallholders were producing up to their full potential. Institutional solutions to resolve the related market failures must also address the possibility that the distribution of the aggregate benefits from expansion is different from the distribution of the costs, with firms shouldering more costs and growers receiving more of the benefits. Where this is the case, the system may remain stuck in a low level equilibrium, because firms are the key agent in organizing and financing its expansion.

[8] Few banks have the knowledge or appetite needed to lend to growers or, to some extent, processors.
[9] See for example Chambers et al. (1989).

Firms may have non-financial motivations for aggregation and they often understand that it generates significant social benefits[10]. But, if it isn't profitable, they are unlikely to expand contract grower schemes on a large scale. So, policies to promote the expansion of aggregation schemes might need to focus both on addressing obvious constraints *and* making them more privately profitable. The necessary firms' investment can take various forms, such as laying out funds to cover the initial operational expenses, expanding processing capacity and hiring (with a commensurate salary) the talent needed to manage an operation over the long term. When the total social benefits from aggregation schemes can cover the necessary investments, but many of them do not derive to the firms that must make them, public policy may have a role to play.

2.4. Formulating a research approach that involves both firms and farms

The foregoing discussion motivates the application of the concept of "Jobs-Linked Externalities" (JLEs), which is drawn from the literature on cost benefit analysis and from labor economics (Jenkins et al. 2011, Robalino and Walker 2017). This is an approach to quantifying the overall positive externality produced from better jobs that can be applied to the aggregation of smallholders. Where aggregator expansion terms are set by a firm's profit maximizing decisions, but growers also have potential for increased net income from participating (net of their opportunity costs), the corresponding JLEs (the income gain to the growers) might constitute a significant element of the market failure which drives the "low level equilibrium".

The overarching idea behind the application of JLEs to the conundrum of the low level equilibrium of Mozambique's rural economy is that they capture the potential for smallholders' income growth and poverty reduction - which might, in turn, motivate public policies to support the expansion of commercial aggregator systems. Doing that effectively means identifying and addressing the specific constraints to firms and growers expanding the systems. A grant to raise firms' or growers' profitability may do the job – but other things may also be needed. Skills training and local infrastructure are common issues. The detailed design of corrective policies should be based on a careful analysis of the constraints and their costs in specific settings. Simply put, JLEs are an estimate of the gains to be had from releasing them. They therefore also determine a ceiling in how much it is worth spending to do that, regardless of the specific constraint(s) or policy(ies) that might be sufficient to achieve it (e.g., grants to firms, training, extension services, infrastructure).

JLEs are the sum of a labor externality and a social externality. The first arises from the difference between what growers can earn as independent growers and what they can achieve under aggregation, where they are less hobbled by the market failures that limit their access to capital, information, markets, skills and the ability to brand their output to potential buyers. The second element of the JLE, the "social externality", arises from any additional benefit to society from the increased incorporation of smallholders in commercial processes and the resulting increase in their incomes, such as: skills transmission, improved social cohesion, reduced fecundity and increased household investments in human capital - or any other benefits, not otherwise accounted for, that might be triggered by the increase in smallholders' incomes[11].

Labor externalities (LEs) are the differential returns to growers' labor under contract farming, compared to their alternatives (the opportunity costs). They are externalities in the sense that they are gains for the growers that result from the business decisions of the commercial aggregators. The LE is

[10] While being commercially anchored, all of the aggregator firms we studied prioritized community engagement through contract grower activities, transparent marketing, and employment creation.

[11] In the contract grower context it can also be argued that an additional social benefit is the increase in consumers' welfare derived from access to locally produced and higher quality products.

defined as the income increase of the new growers being aggregated, after adjusting for what they would have earned otherwise. These gains for growers are not normally part of the objective function of profit-maximizing commercial aggregators.

Total JLEs are a proxy for the magnitude of the market failure faced by the aggregation scheme as a whole. By definition they are equal to the number of growers times the per-grower JLE generated. The total benefits from the aggregator scheme are composed as follows: gains to aggregators through their added profits from expanded procurement (their net financial returns from expansion), plus gains to growers through their higher incomes from aggregation (the LEs), plus gains to society at large through additional benefits from skills transfer, education, market culture, etc. (the SEs).

The link between the agricultural transaction cost literature and the project economic evaluation literature hinges on the definition of the net gains to treated growers (relative to non-treated growers) as being *both* a Labor Externality *and* the share of the value created that goes to growers. This, in turn, is equivalent to the treatment effect estimated by agricultural economists studying the benefit to growers from aggregation schemes. Firm-level Cost-Benefit Analysis (CBA) techniques are used for the computation of financial returns to firms from new contracting. We also estimate net social benefits from increased commercialization that are not included in the returns either to growers or firms (Ryan and Lyne 2008, Millar and Hall 2013). As far as we are aware, this type of analysis linking the two approaches has not been previously attempted empirically. This comprehensive approach to the definition and estimation of benefits allows an analysis of their distribution between firms, growers, and society at large. It also allows us to relate these gains to any expenditure of public funds to incentivize aggregation schemes.

When JLEs are substantial and an aggregator faces high costs and risks for expanding their scheme to incorporate new growers that may lead to low net financial returns for the firm, it might make sense to provide a one-off public transfer to the firms to reduces the net cost of expansion and enables them to take on more growers, thus generating the corresponding income gains for the growers. This can be thought of as shifting the aggregation scheme to a higher-level equilibrium. If the initial process of incorporation of the new growers permanently removes barriers that were preventing expansion, the positive income effect for the smallholders could persist without the need for further subsidy. For example, growers who were previously unknown to the firm might now be trusted and have acquired skills they did not have before. Similarly, the growers themselves might now be more willing to trust the aggregator to keep their bargains on inputs and prices, having understood the benefits they receive from a "repeated game". In effect, the equilibrium level of operation for both firms and smallholder growers is increased with public support for the removal of transaction costs, which were net costs to everyone. *De facto,* the aggregator firms become a tool for internalizing the externalities affecting the growers. Private firms become delivery agents for public goods that are realized by smallholders.

Of course, the fact that this is possible does not mean that it will always happen; or that the resulting social benefits will always be sufficient to justify the (public) costs of supporting the schemes. These are empirical questions. It will be necessary to observe a series of expansions in diverse kinds of aggregation schemes to gain insights on the costs and gains and how they vary across products and institutional designs for the public support scheme. Expansions should be observed over time, and the quantitative analysis should be undertaken at both firm and farm levels. The present study is an effort to clarify the conceptual framework for such work and offers an initial contribution to the empirical literature.

2.5. Factors beyond firm and farm affecting agricultural aggregation in Mozambique

Factors encouraging aggregation include the government's concern with increasing employment and earnings in agriculture, and the growing priority given to support for private investment in agricultural value chains. Government prioritization of food security and economic diversification have also played a role in encouraging aggregators. However, recent assessment of agricultural policy suggests there is more to be done to support the private sector and investment in aggregation (See Box 1).Some support schemes, such as in cotton (and tobacco), encourage the promotion of food crops as a complement to raw material production, which should help ameliorate the risk to smallholders of shifting away from subsistence farming.[12] Donor funding focused on employment creation in value chains has also been important in the promotion of aggregation, both directly by subsidizing firms' fixed and variable capital investments. Donors have also offered support to non-profit agents such as non-government organizations and cooperative societies working with grower groups.

Box 1. Mozambique agricultural policy environment

Mozambique's main agricultural policy framework at the time of the study was the Strategic Plan for Agricultural Development (PEDSA 2011-20). It identified 15 strategic value chains, the first six of which are priorities: horticulture, rice, beans, cassava, chicken, red meat, maize, banana, sugar, sesame, potato, cashew nuts, cotton, soya and wheat (Deloitte 2016). The Ministry of Agriculture and Food Security (MASA), as it was known at the time, outlined the strategy to operationalize it, in the form of the National Agriculture Investment Plan (PNISA 2013-2017, extended to 2019). PNISA had four pillars: (i) agricultural production, productivity, and competitiveness, (ii) infrastructure and services for access to markets and agricultural investment, (iii) sustainable use of natural resources, and (iv) agricultural institutional improvement. In practice it was comprised of 21 supporting programs grouped, roughly, under these four pillars.

An assessment of PNISA was undertaken in 2017 (MASA 2017) and concluded that, while well-designed, the main challenge is expanding the role of the private sector. One of the main strategic conclusions regarding access to markets pillar is that "PNISA […] did not establish the target on the ratio of private sector investment to government investment in agriculture. PNISA did not formulate and implement an explicit operational strategy and interventions to stimulate directly inclusive private sector development."

Key recommendations on the most relevant programs suggested a lack of focus on aggregator firms of the form and scale studied under MAAP. Programs under the access to markets pillar were most relevant. The program for post-harvest management and marketing aimed at eliminating bottlenecks in the agricultural commercialization and promoting agricultural processing. The main corresponding recommendation was developing a strategy and action plan to promote agro-processing SMEs. Under the program on access to finance program, policies were mainly targeted at access to farmers and SMEs and the recommendation was to create an enabling environment to promote FDI. A third relevant program, on agribusiness support, aimed at increasing the contribution of agribusiness to national agriculture, including greater value addition activities. Here the assessment indicates that, based on data, the program made very limited progress.

Broader economic development has also facilitated aggregation. Improved roads have resulted in easier market access, and access to electricity has been a key element in the growth of agri-processing. General economic growth, especially in urban areas, has increased the demand for value-added products that are suited to aggregator system, such as: maize grits for the production of beer; and frozen broiler chickens and goat meat for urban food consumption.

On the downside, Mozambique's agriculture is vulnerable to serious climate shocks, which increase investment risks. Two tropical cyclones (Idai and Kenneth) struck in 2019, producing significant damage in the grain belt in the center of the country and in the far north. It is likely that climate change will

[12] In the case of MAAP, two products, cotton and sugar cane, are strongly affected by government policy support. Other products that the aggregators studied here worked with were not supported in this way.

continue having negative impacts, making the incorporation of climate change adaptation elements an important issue for the design of projects to promote increased commercialization.

Finally, the macroeconomic context is also important for the success of agricultural aggregation as a growth and inclusion strategy, as it is for any commercialization strategy. Aggregation typically implies greater exposure of growers to market risks. Mozambique is a relatively open economy and is an agricultural price taker on a global scale. Agricultural prices are therefore tied to world and regional prices and the national trade regime, and can fluctuate highly across seasons and years, and relative to other crops and to non-agricultural commodities. Aggregation typically implies greater exposure of growers to market risks, which can be affected by macroeconomic factors, and greater exposure of firms to credit and supply chain risks, again typically driven by events outside agriculture, such as: fluctuations in the inflation rate, in relative prices and in nominal and real exchange rates and interest rates. Macroeconomic fluctuations can dampen local, national, and international demand for agricultural products and may lead to rural populations seeking off-farm employment which is less exposed to the corresponding risks. Thus, events outside agriculture such as exchange rate fluctuations and international price shifts can affect the profitability of commercial agriculture. These also vary across regions, trading destinations, and as a function of GDP growth, of exchange rates and of prices. Major economic events such as the possible coming on stream of major gas and oil exports in the near future are likely to lead to real exchange rate appreciation, lowering the price of agricultural imports and depressing the profitability of domestic agricultural commercialization – the so-called "Dutch Disease" effect (Lachler 2020). Credit constraints are especially important to the expansion of farms and agribusinesses in Mozambique, and lending rates derive principally from events outside agriculture. The macroeconomic context during the MAAP study is discussed in section 4.3.

As a general rule, when agriculture in general is more profitable, increasing aggregation also tends to be profitable for both firms and growers; and *vice-versa*. In short: the profitability of aggregation depends not only on specific interactions between firms and growers but also on many highly variable factors outside their control.

3. Research Methodology

3.1. Overview

Our premise is that public financial support to share the risk of incorporating new growers (such as a subsidy for the aggregator, conditional on new grower incorporation or increased support) might shift an aggregator system to a higher-level equilibrium. Once the aggregator/contract grower relationships are established and capacity develops, the repeated game will be less risky and will therefore not need continuing public support.

However, MAAP was not funded on a scale that allowed large-scale incentive payments to firms. Nor was it designed with the intention of demonstrating that incentive payments to firms have a causal effect on the observed outcomes. *The intention was more modest: to generate empirical data on the distribution of the costs and benefits from the expansion of aggregation schemes that firms had already decided to undertake, in order to inform the design of public support in the future.*

But MAAP did offer small incentive payments encourage firms with ongoing expansion programs to participate in the study. These are referred to in this report as the MAAP Participation Incentive Payment (PIP). This was intended to help offset the nuisance cost to the aggregators of reporting detailed data on the new growers and their own results from these growers to the MAAP project for

analysis.[13] The project then monitored activities separately at the aggregator level (through a firm survey over two years in 2018 and 2019) and at the grower level (household survey over three years: 2017, 2018 and 2019). The first year of monitoring, 2017[14], is a "baseline" year and took place prior to the expansions.

Our analysis of the effect of program participation on growers based mainly on household data, comparing the outcomes for program participants to non-participant growers. The sample of the MAAP expansion growers, who started in 2018, is referred to as "treated growers".[15] A comparison sample of growers who were not part of the expansion was also drawn, with their selection/identification varying by aggregator. For some aggregators, multiple types of "comparison" growers were identified and sampled to improve the measurement of the program's effects.

Aggregator firms are studied by constructing financial and economic models of their contract grower expansion programs. These lay out the costs and revenues from their expansion over 2018 and 2019. To offset the possibility of distortion from the simple fact of participating in the study, the financial returns for the aggregators are calculated twice: with and without including the MAAP PIP in their revenue streams. In addition to the firms' net financial returns, the economic models also incorporate the estimated net benefits to the new growers (relative to their opportunity costs) and the posited social (de facto spillover) benefits to households, to compute a full measure of the social returns to the expansion. These measures are further elaborated on below.

In what follows, each research question is listed with an accompanying sub-section outlining the approach and use of the data used to assess it, including, when applicable, how they vary across aggregators. As mentioned above, we distinguish between financial, private, and social returns. Box 1 summarizes the corresponding definitions, which are elaborated throughout this chapter.

Box 2. The concepts of financial, private, and social returns used in this study

Financial profits / returns: Based on firms' receipts minus expenditures. Both donor funding (including PIPs) and grower and social benefits are excluded.

Private profits / returns: Based on firm receipts minus expenditures plus MAAP funding (PIPs). Grower and social benefits are excluded.

Social returns: Based on the sum of firms' financial profits and grower and social benefits. PIPs is treated as a transfer and excluded in the calculation.

[13] So, the PIP is not a capital subsidy nor was it intended as a payment to cover costs and make expansions possible. The PIPs were generally small compared to the expected costs and revenues associated with the addition of new growers The amount of the PIP-per-grower differed across firms, mainly as a function of the size of the expansion (since the nuisance cost of participating in the study was not expected to be a function of the number of growers added). Details can be found in the MAAP Final Evaluation Report (OzMozis Lda 2020).

[14] Here by 2017 we mean the 2017 harvest, with the corresponding household data corresponding second half of 2016 to first half of 2017.

[15] The treatment growers had the "treatment" in 2018 and 2019; the comparison growers did not have the treatment, though some of them had been contracted to the aggregator prior to 2018.

3.2. Estimating income gains for the new growers from the expansion of established aggregator schemes

The goal of this part of the analysis is to assess the potential of aggregation to boost the contract growers' incomes over what they would have otherwise received[16]. It is based on household survey data analysis that compares treatment to comparison, non-participant, growers to measure program's effects on income. For five of the seven aggregators (Amarula Farms, CHVM[17], ECA, Vanduzi, SAN-JFS) this is calculated through applying simple tests[18] that measure the statistical significance of average differences between the participant group before-after program changes in income (and other variables) with those of comparison groups. For these aggregators, the before-program outcome is the variable's value at baseline (2017) and after-program value that which is measured in the 2019.[19]

This is the well-known "difference-in-differences" method of calculating program treatment effects. [20] Subtracting changes for comparison groups from that of participant growers, in principle, captures the causal effect of program participation on the participant grower's outcome. In contrast, focusing just on outcome changes for the participants does not account for the possibility that they may have foregone other incomes. The accuracy with which the difference-in-differences estimates capture the program's causal effects depends on the similarity between participant and comparison samples. We assess these similarities by comparing the samples prior to program participation.[21] Specifically, we measure differences between samples for variables related to agricultural production, income, livestock, and labor use. Box 3 discusses the limitations of this methodology in the context of the MAAP study as well as future work that would add robustness to the results.

In the case of MozAgri, we use differences in incomes each period (rather than their before-after program changes) between participant groups and comparison groups, because the participant group growers were already selling to MozAgri (i.e., participating) in the baseline year, 2017.[22] The specific comparison groups and type of income considered varies by aggregator and the details are provided in the MAAP Final Evaluation Report (OzMozis Lda 2020).

[16] Alternatively, one can consider grower consumption as a measure of grower welfare. Here income is used to enable a comparison of benefits between firms and growers.
[17] CHVM is a cooperative and not a firm.
[18] Mainly t-tests.
[19] For reasons explained in the MAAP Final Evaluation Report (OzMozis Lda 2020), the 2018 (midline) household survey was used as the post-program income levels for Vanduzi.
[20] Other types of analysis to be conducted in follow-on work include: methods that consider continuous treatment that account for years treated; and methods that assess heterogeneity of program effects among participants.
[21] For CHVM and Vanduzi there are comparison groups made up of growers that were doing similar activities and had a similar engagement with the aggregator firm as what the treatment group would partake in. In these cases the DD estimates capture a 'catching-up' of the new participants to the previously engaged comparison group. Assessing similarity between the participant and comparison growers is based on post-program differences.
[22] This is referred to single differences (SD).

Box 3. Identification strategies for the estimation of the gains to growers

As discussed in section 2.1 above, many recent studies of the impact of contract farming on growers use random program assignment to generate comparable treatment and comparison groups. *However, such experimental approaches run the risk of generating robust comparisons between treatment and comparison groups that are actually systematically different from the farmers who will really be chosen to join an aggregator scheme*. This, in turn, undermines the external validity of the results. Aggregators don't chose growers at random. Rather, they vet candidate growers carefully, to reduce the risk of losses from defaults on input repayments due to side selling or poor productivity. Some relevant factors might be observable in survey data (e.g. age, gender, plot size, education level, etc.). But others will normally be un-observed (e.g. reliability, quality of technical knowledge about the crop, etc.).

Our approach in this study is different. We chose to prioritise reflecting *the firms' real approach to the selection of growers*. So, participants were not randomly chosen. We drew our treatment samples from the participants chosen by the aggregators. We then used three different quasi-experimental approaches to construct plausible comparison groups. These approaches vary by aggregator, depending on the types of data available. In the initial analysis reported in this paper, due to time constraints, we report simple before-and-after comparisons of the mean values for the relevant variables for the treatment and comparison groups. In the next phase of the analysis we will develop more sophisticated indicators.

Constructing a counterfactual from external villages: This approach was used for ECA and Amarula. We drew a comparison sample of growers from villages that are comparable to those where the aggregators worked, but were not covered by the program. For ECA, we found villages just outside the boundary of the maize catchment area (a 45km radius from the processor). Likewise, for Amarula, we identified similar villages situated further from the farm than those where ingrowers were recruited. We observed that the mean values of relevant characteristics for treated farmers in the treated villages are broadly comparable to the means of the samples drawn from the untreated villages. Based on this, we computed the "before and after" comparisons of means, which are used in this report. In the next phase of the work, we will use data for participant and non-participant farmers in the treated villages to estimate a proposenity score for program participation. We will then identify a sample of farmers in the non-participant village to match the set of individual propensity scores for the treatment group, and will conduct econometric analysis of the program treatment effect using individual household data (not just sample means).

Using differences in program exposure timing to build a counterfactual: This strategy is used for Vanduzi and CHVM. It relies on the fact that participant growers entered the program at different times, for reasons unrelated to their performance. For CHVM we compared two groups to the treatment growers who did did not harvest cane at baseline but did so in 2018 or 2019. One group (a) is new growers supported by the cooperative, who would not begin harvesting sugar cane until after the MAAP study; and (b) existing growers (not part of the cooperative) that already worked with the processor, Maragra Sugar, prior to MAAP. Group (a) is therefore a proxy for the pre-program (baseline) state of the treatment group Group (b) and post-program proxy and the difference between outcomes of treatment growers with these two groups is an indicator of the effect of producing sugar and selling it to Maragra. Similarly, for Vanduzi, we constructed a comparison group of growers that began working with the firm prior to MAAP and compare them to the new growers entering the program, whose exposure is shorter. Once again, in future work, we will move beyond the comparison of sample means and will adjust for observable grower characteristics that may have affected program participation timing, using multiple regression and matching techniques.

Using growers close to the selection threshold: This strategy, used in the case of SAN-JFS, is in the spirit of regression discontinuity. It uses information on how firms ranked candidate growers to create a comparison group of growers that fell just below the selection threshold. In the next stage of the work, this will be made more robust by analysing individual data (not just means) and adjusting for covariates.

3.3. The analysis of firms' contract grower expansion programs

To determine the sustainability of the expansion of contract grower schemes, it is insufficient to understand the gains to the growers. It is also crucial to understand if the expansion was also profitable for firms[23]. So we studied to financial viability of the cost and benefit streams for the aggregators linked to increased grower numbers and estimate firms' incremental profits. This is based on our analysis of the firm survey data. We consider whether the expansions generate financial profits and whether they are enough, over time, to achieve a self-sustaining cashflow. Financial profits are defined as the firm's reported total receipts less expenditures attributable to the expansion. Expenditures are broken down into the following categories: (1) inputs and services supplied to growers on credit, (2) free of charge inputs to growers, (3) gross cost of purchasing raw material from growers (4) processing, (5) firm overhead costs, and (6) capital expenditures. Against this, firm receipts include (1) sale of all final products and (2) repayment by growers of inputs supplied to them at the beginning of and during a season. We denote recurrent expenditures associated with the costs of operation as "working capital"; while the term "capital expenditures" refers to physical capital such as machinery and equipment. Following the normal practice of Cost Benefit Analysis modelling, we treat such capital investments as a one-off expenditure taking place the year the investment was made.[24] Correspondingly, we did not include the cost of depreciation of capital investment in subsequent years. These factors are taken into account in the discussion of findings below.

3.4. What was the distribution of the expansion's first-order benefits between firms, new growers, and broader society?

As firms expand aggregator schemes by adding new growers they generate net benefits, in the form of financial profits (or losses), measured as specified above. But the growers who join the scheme can also earn benefits. Our focus is centered on the net *economic* benefits growers receive. These are net earnings from the aggregator crop which are above and beyond the income they would have otherwise made. Even when growers are generating positive net earnings from the aggregator crop, it is not a given that the net economic benefits are positive. In other words, we do not rule out the possibility that their forgone income is larger than the net earnings under the aggregator scheme.

The concept of grower net economic benefits is consistent with the methodology to estimate treatment effects. The income trajectory of comparison groups is a measure of what the participants would have earned had they not joined the program (i.e., their opportunity costs). This is the rationale for using program treatment effect estimates on net cash income from the aggregator crop as the measure of grower net economic benefits.[25]

[23] We focus on the firm's profits associated with the expansion, computed based on the real cost and revenue flows, and not the overall profitability of the firm.

[24] Specifically, investments/expenditures were assumed to have taken place in their totality in the first quarter of each year.

[25] Another option for measuring the LE is the total household income since it is plausible that households reallocated resources and forego sources of income not related to the aggregator crop. We opted for using the direct aggregator crop income because it was most reliable vis-à-vis other sources of income where household mental accounting, memory recall, and accounting were likely less accurate. Moreover, for some crops, one can consider including the imputed value of any unsold aggregator product, but we felt cash income was more indicative of the development impact of participation in the aggregation scheme.

A central tenet of this paper is that net economic benefits to the growers are externalities, which result from a firm's decision[26] but which the firm does not itself capture. Even though the smallholders are self-employed, these income gains are a form of labor externality as defined in the cost-benefit analysis literature (see Jenkins et al. 2018).

As discussed above, jobs-linked externalities (JLEs)[27] include the labor externalities (LE) associated with the net economic benefits to the growers and, in addition, the broader social benefits that are triggered by growers having higher incomes, termed social externalities (SE). Hence, JLEs are the sum of the LE and SE. Although the concept of additional social benefits from better jobs is well established in the literature (World Development Report, 2013: "Jobs"), the empirical estimation of Social Externalities is complex and is not the central purpose of this study. We have reflected the likely existence of significant social externalities from better jobs in rural Mozambique by setting the SE at the equivalent of 20% of the LE, applying a simple multiplier[28], such that for each MZN 100 of net economic benefits to growers there are additional social benefits equivalent to MZN 20. Consequently, the per-grower JLE is 1.2 times the treatment effect. The total amount of JLEs is then calculated by multiplying the number of growers by the per-grower JLE.

It follows that the total benefits generated from an aggregator scheme expansion is the sum of the net financial benefits captured by the aggregation firm (i.e., financial profits), the LEs, captured by the participant growers, and the SEs, which are gained by broader society. The assessment of the distribution of benefits from an aggregator scheme entails contrasting these three quantities.

3.5. The contribution of aggregator programs to employment generation in the aggregator firm and among contract growers

The MAAP study looks at jobs effects from two angles. First: the aggregator scheme's ability to raise incomes, which is covered under the previous research question. Second: can it increase local labor demand? This question is assessed based on our findings from the firm survey on employment generation within the aggregator firms; plus the household survey evidence on the hiring of field labor by contract growers.

[26] Although the aggregator scheme is only possible with grower voluntary participation, the literature, discussed in the introductory sections of this paper, suggests that aggregator schemes launched will tend to attract growers in contexts such as Mozambique where the growers face binding constraints to commercialization and higher-productivity production of aggregation crops.

[27] In conventional applications, which are in the context of salaried work, these benefits are the worker earnings from wages. In the agricultural context, LEs are captured by the profits generated by growers after their opportunity costs are taken into account. Furthermore, we expect that the bulk of JLEs is created from aggregator scheme are the benefits to the growers, although taking on new growers may also be associated with the firm involved hiring new staff.

[28] The value of the multiplier is difficult to ascertain. To our knowledge there are close to no studies that estimate the value of social externalities from creating employment in developing countries. The good example of calculating these types of externalities is "Investing in All the People" (1994) by Lawrence Summers. For India and Kenya he estimated the cost of educating 1,000 girls for one additional year as well as how much it would cost to produce similar health and fertility benefits using standard medical and family planning interventions. Based on his estimates of the social benefits through health and fertility, Summers calculated social rates of return of 63% for India and 14% for Kenya. A recent study by Ricaldi and Mousley (2019) show that in Gaza and the West Bank, the average value of the social externality among beneficiaries of different characteristics (i.e., workers hired) in a private investment project was 43 cents per dollar of labor externality, or 43%.

Employment generation within the aggregator is measured as a comparison of staff prior to and after the expansion that are devoted to the support of the contract grower expansion program. It is calculated by (a) a count of staff attributed by aggregator management as engaged on the expansion program, and (b) as a proportion of all aggregator staff pro-rated to the share of aggregator raw material provided by expansion program growers.

Employment generation by expansion program growers is calculated from household survey data on the probability that participant growers will hire workers for their production, and the number of workers hired. We compare participant growers to similar growers (comparison subsamples) to estimate program treatment effects, as is done for measuring the program effects on income variables.

3.6. Necessary conditions for public support to private aggregation schemes to increase contract grower incomes and employment

When can a subsidy induce aggregator businesses to increase the number of growers supported in a financially sustainable fashion, so it will continue to serve those growers in subsequent years without further subsidy? The following paragraphs list the conditions and describe how they are assessed in this study.

Condition 1: The "without subsidy" projected financial return is below the cost of capital
This condition is necessary to justify a public intervention. If the expansion is profitable without a subsidy, it makes no sense to provide one. The key benchmark here is the relationship of the "without subsidy" internal rate of return to the market cost of capital faced by the firm. An expansion that yields a projected return above the market cost of capital should not require a public sector intervention. The financial rate of return (FRR) is the discount rate that sets the net present value (NPV) to zero:

$$0 = \sum_{t=0}^{T} \frac{Firm\ Receipts_t - Firm\ Expenditures_t}{(1+FRR)^t}$$

Our model computes quarterly returns. We report the return separately for 2018 and 2019. Estimating the FRR requires an outlay in early periods and a positive cashflow in subsequent periods. Several of the aggregators' expansion plans studied do not have cashflows in that form, so we estimate the financial return on investment (FROI), which uses the same data but simply divides the total benefits for the period by total costs, written as follows[29]:

$$FROI = \frac{Total\ Firm\ Revenues - Total\ Firm\ Costs}{Total\ Firm\ Costs}$$

Condition 2: Once the initial subsidy to support the expansion is factored in, the business model is profitable without the need for ongoing subsidies
If the expansion is not financially profitable for the firm based on the future stream of costs and revenues (after the initial subsidy has been received) then the firm is likely to eventually stop[30] grower support. The "with subsidy" private return (Private Return on Investment, PROI) is estimated using the same formula shown above for the FROI except that a proxy for a subsidy (the MAAP participation incentive payment, PIP, described below) is added in the numerator.

[29] Both measures are discussed in the MAAP Final Evaluation Report (OzMozis Lda 2020). Our discussion in this Overview paper presents only the FROIs. However, both measures yield the same conclusions.
[30] Firms are not always purely driven by profitability. Factors such as establishing a positive relationship with local growers and village, can be another motivating factor.

Condition 3: The impact on grower incomes and social returns is high enough to justify the subsidy needed to make the expansion viable

Even if there are positive program (treatment) effect on grower incomes, the subsidy cost per grower may be too high to justify the intervention. We calculate the Social Rate of Return (SRR) and Social Return on Investment (SROI). The SRR is calculated using the same formula shown above for the FRR except that the total amount of JLEs generated each period is added in the numerator of the right-hand term. The SROI is calculated using the same formula shown above for the FROI except that the total JLEs generated over all periods is added to the numerator in the right-hand term.[31]

4. Operationalization of MAAP

4.1. Aggregator selection

In August 2017, nine agricultural aggregators with a record of working with contracted growers as an integral part of their business models were selected from a list of 45 candidate aggregating firms identified as potentially suitable to participate in MAAP. To be eligible for the study, the aggregators had to present their business plan for a two-year "contract grower expansion program" that aimed to increase the number and/or productivity of contract growers supplying them, and to increase the aggregator's processing of the raw material bought from the growers. The aggregators committed to secure the necessary financing and to implement the program over two years. The 2016/17 Mozambique agricultural year (here referred to as 2017) is the "baseline," pre-MAAP program year. The first year that firms implemented their agreed contract grower expansion programs was 2017/18 (2018). The second year of program implementation and monitoring was 2018/19 (2019). The nine aggregators are spread widely in Mozambique's provinces, from the most northern to the most southern, as shown in Table 4.1.

Table 4.1. MAAP Aggregators at 2016/17 Baseline

Aggregator, Province, Business Focus (2016/17 turnover in US$ millions)	MAAP Raw Material	Ownership	Value Addition Product	Contract Growers (No.)	Own Employees (No.)
Amarula Farms Lda. Nampula. Vegetables, sesame, other ($0.2 m)	Sesame	Overseas- based Shareholders	None	178	31 FT 20 PT
CHVM, Maputo Smallholder cane growers ($55 m)	Sugar cane	Cooperative (see note below)	Sugar, molasses	593	3,132 FT plus seasonal labor
ECA Lda., Manica Maize milling ($2 m)	Maize	AgDevCo 55%; CEO 40%, other	Grits, meal, bran	1,745	75 FT plus seasonal labor
MozAgri Lda., Manica Goat/cattle processing, seed ($0.3)	Goats	AgDevCo 28%; CEO 54%, other	Goat meat, beef	550 sellers Apr-Dec 2017	51 FT 17 PT
New Horizons Lda., Nampula Broiler chicken prod./ process., supplies ($11 m)	Broiler chickens	PhilAfrica Foods 50.0%, others	Frozen chickens, feed, day-old chicks	125	371 FT 54 PT
SAN-JFS, Niassa Cotton concession ($6 m)	Cotton	JSF Group 100%	Lint, seed	26,000	94 FT 180 PT
Vanduzi, Manica Export vegetables ($7 m)	Baby corn	Aquifer 100%	Retail packaging of fresh baby corn, peppers, beans,etc.	900	850 FT 850 PT

[31] Once again, both measures are discussed in the MAAP Final Evaluation Report (OzMozis Lda 2020), but our discussion in this Overview paper presents only the SROI. Both measures yield the same conclusions.

Plexus Moz. Lda., Cabo Delgado Cotton concession ($7 m)	Cotton	50:50 Plexus Cotton/Great Lakes Cotton	Lint, seed	42,000	360 FT 330 PT
PUFAA Lda, Maputo Chili prod./processing($0.2m)	Chili	50:50 local firm, Nandos	Dried chili	80	20 FT 8 PT

Notes: Data for CHVM are for Maragra Açucar S.A., the aggregator for the CHVM cooperative. Maragra Açucar is 90% owned by Illovo Sugar Africa (Pty.) Ltd. and 10% by a founder of the firm. Plexus and PUFAA dropped out of MAAP and are excluded from our analysis. FT and PT are full-time and part-time employees.

Two of the chosen firms, Plexus (cotton) and PUFAA (Chili), dropped out of the study for idiosyncratic reasons. Plexus dropped out by mutual agreement because they did not implement the Year 1 MAAP program, and did not plan to do so in the following years. This change of mind was linked to the unstable conditions that prevailed in global cotton markets. PUFAA dropped out as they converted their in-grower trainees to become company staff after the completion of training, so they were no longer "independent growers".

This report focuses on the remaining seven firms, which represent a range of products and business models. Repeated firm surveys were carried out to capture details about the business model, interaction with contract growers, and financial returns from their contract grower expansion program.

With the exception of MozAgri[32], they all advance credit and supply services such as technical assistance and training, deliver inputs to and buy products in growers' fields (with whom they have a written agreement), and generate a value-added product. Six of the aggregators are either a limited liability (Lda) or private (S.A.) company; the seventh (CHVM) is a cooperative society that supports small cane growers linked via cane supply agreements to a sugar mill. The cotton production and milling aggregator holds a "cotton concession" that obliges it to provide basic inputs and technical advice to any grower interested in growing cotton within the concession area, and to buy and collect all seed cotton offered by growers.

Five of the seven aggregators are foreign owned (over 50% of their equity), and two have majority Mozambican shareholders. On-ground management reflects a similar foreign/national pattern. Most are heavily reliant on the raw material that is supplied through MAAP growers. For example, at least 80% of the aggregators' cotton and sesame seed supplies comes from contract growers[33]. In only two cases do contract growers provide less than one-third of an aggregator's raw material (baby corn and maize). In one case, chickens, the contract growers raise the raw material (birds) on behalf of the aggregator, who owns them throughout the production cycle. The use of credit and type of investments made also varied by firm (Box 4).

The equipment and facilities used by the aggregators includes: abattoirs and freezing facilities; mills to produce sugar, molasses, lint cotton, maize grits and meal; a drier for chili; and packing and cool storage for baby corn. In 2016/17 there was excess capacity for all this processing equipment and facilities. However, by 2018/19, equipment and facilities were approaching full capacity in the case of maize and goats, and slightly less so for sugar, and new investment was expanding chicken and goat processing and freezing capacity. Most of the aggregators are exposed to international markets and foreign exchange risk, with five exporting at least part of their product.

[32] MozAgri's "central buyer" business model in MAAP is the only one in MAAP. It purchases goats from remote communities, transporting and processing them at its abattoir and selling frozen goat meat principally in the Maputo market. Unlike the other aggreagtors studied, MozAgri has no written contracts or commitments from growers to sell their goats, and makes no commitment to them, other than to buy the goats at a fair price.

[33] However, for SAN-JFS only a small portion of their cotton comes from MAAP contract growers.

Box 4. Firms' use of credit and investment

As is well known, firms' favorable access to credit is pertinent to the development of aggregation schemes. A detailed analysis of this issue is beyond the scope of this report. However, information collected in the study illustrates the role of credit in Mozambican agriculture.

Most capital expenditures connected to the expansions were for working capital. The aggregators were already operating in a commercial setting and had established access to credit to cover their working capital needs. ECA, MozAgri, SAN-JFS, New Horizons, and Vanduzi all had bank lines of credit that could be used to cover pre-harvest operating expenses. In addition, ECA had pre-payment facilities from grits buyers, that covered 50% of the estimated costs at 18.5% p.a. over 5 months. MozAgri used a bank overdraft nominal interest rates of 28% p.a. in 2018 and 20% p.a. in 2019. New Horizons' overdraft facility cost about 28% p.a. CHVM offered cane growers access to a bank line of credit. Amarula did not take any significant bank credit; it had a relatively low total program cost, of which 84% was covered by the PIP.

The original sources of finance for the aggreagtors' fixed capital investment varied. However, most of the firms benefitted from de-risked investment in some form. For example, AgDevCo, a UK government- backed nonprofit impact investor, began providing start-up loans in the Beira Agricultural Growth Corridor in 2010. AgDevCo was involved in financing ECA and MozAgri. It provided both equity and debt and remains the majority shareholder in ECA ($323,000 investment to support the building of the corn milling facility) and held an initial 28% share in MozAgri (a $150,000 investment to support the construction of the abbatoir); MozAgri bought them out in 2018. Vanduzi was founded in 2004 by Aquifer Ltd., a U.K. investment firm linked to Sainsburys and dedicated to creating jobs and improving income, which financed the pack house. In 2018, it was bought by a Zimbabwean private equity firm. Amarula Farms was established by an Indian investor in 2013 via a land use right (DUAT), after the previous DUAT holder defaulted (so the usufruct of the land was effectively granted by the Mozambican state).

New Horizons stood out among the MAAP projects as having an expansion especially heavy in physical capital expenditures. It built a large new chicken production facility, staffed by in-growers. In 2017 a new investor took a 50% shareholding and these funds were the main financing source for the 2018-2020 upgrading and expansion program.

Maragra Sugar and SAN-JFS (cotton) both have long histories in Mozambique. Maragra Sugar's operations were shut down during the civil war and in 1996 it became a subsidiary of South African Illovo Sugar. In 2000 it received an IFC loan of $10.3 million to support the resumption of operations. SAN-JFS, founded in 1939, is Mozambique's oldest cotton company.

4.2. Household surveys and sampling

For each aggregator, a "treatment group" of participants in the expansion programs and relevant "comparison" groups (as discussed in Section 3.2) were studied. A household panel survey collected data annually on agricultural production, income and employment. This produced a balanced final panel dataset across the three years for each subsample. Sample selection, the handling of the attrition, data cleaning and the analytical procedures used are detailed in the MAAP Final Evaluation Report (OzMozis Lda 2020). The questionnaires and data dictionaries are also appended there. Table 4.2 summarizes the household data sample sizes.

Table 4.2. Final Household 2017-2019 Panel Sample Sizes

Aggregator	Households in Balanced Panel				
	Treatment	Comparison Growers Subsamples:			
	New and Continuing Growers in Expansion Program (1A)	Continuing Contract Growers (2A)	Non-contract Growers, Same Villages as Treatment (2B)	Non-contract Growers, Villages without Aggregator Support (2C)	Total
Amarula Farms	34		115	104	**253**
CHVM	115	127			**242**
ECA	81		75	78	**234**
MozAgri	92	--	73	88	**253**
New Horizons	6	13	--	--	**19**
SAN-JFS	89	111	--	--	**200**
Vanduzi	42	87	--	43	**172**
Total	**459**	**914 (all comparison groups)**			**1,373**

Notes: Data reported here refer to the final balanced panel. The total number of interviews completed and validated was greater. The subsamples above are: "1A Treatment", new contract growers or existing contract growers being supported under MAAP; "2A Continuing Contract Growers" contracted by the aggregator before MAAP and who would continue as contracted; "2B Non-contracted Growers from Treatment Sample Community", come from the same community location as the treatment subsample but were not contracted to supply the aggregator; "2C Non-contracted growers from Communities without Aggregator Support", selected with input from the aggregator and local government, have similar agricultural, economic, social, and access/service conditions as communities where the aggregator operates, and the aggregator has not and was not planning to work with them during 2017-2019.

4.3. Economic context and relevant events during the implementation of MAAP

Macroeconomic conditions in the period running up to the MAAP monitoring period were generally unstable. An economic crisis triggered by hidden debt revelations in 2015 caused elevated macroeconomic volatility that led to an economic downturn, linked to the worst currency depreciation and inflation episodes in Mozambique's history (Table 4.3). Price instability from 2016 to 2018 took a toll on the confidence of private sector to investment, especially for firms with heightened exposure to foreign exchange risk. The result was a drop of GDP growth from an average of 8% the preceding decade to 3.6% in the period 2016 to 2018 (Table 4.3). The stabilization of the Metical from mid-2017 onwards helped to reduce inflation and was a sign that the economy was emerging from the crisis. Therefore, the MAAP observation period occurred during the period of recovery from the debt crisis.[34]

However, in 2019, the cyclones, Idai and Kenneth, hit – causing GDP growth to further sink to 2.3% (Table 4.3). They struck in March and April and caused extensive losses of standing crops, plantations, livestock and fishery infrastructure, and fishing equipment. Around ten percent of the total national cultivated area (480,000 hectares) had near-total loss of crops due to the associated flooding (FAO 2019). The damage caused by Idai is estimated at over US$1.4 billion. (Government of Mozambique 2019). The impact was concentrated over a six week period that coincided with the grain filling stage and harvest period for maize. Moreover, the combined effects from crop losses and transport infrastructure damage (which halted food distribution to urban centers) resulted in a severe shock to the agricultural sector.

[34] Discussion of the debt crisis based the World Bank 2018 Mozambique Economic Update (Mahdi et al 2018).

Three of the MAAP monitored aggregators (ECA, MozAgri, and Vanduzi) were located in Manica, which was one of the four regions most affected.[35] No significant adverse direct production effects were reported by firms involved in MAAP. However, the cyclones had a major impact on agricultural markets. Such unforeseen price shocks could not have affected grower decisions earlier in the season. Price spikes for the raw materials they sell to the aggregator systems may be viewed as a windfall for the growers – but (unless they can be passed through) they may reduce profitability in the aggregator firm. Investors in aggregation systems are aware of these factors and will normally attempt to take a longer term view of the likely price trends of the raw materials and processed products they deal in, and weigh the risks and uncertainties linked to their short term volatility.

The marked price instabilities observed as a result of these exogenous events also underline the difficulty of reaching definitive conclusions about the profitability and sustainability of aggregator systems based on a study with a short time horizon, such as the MAAP pilot. It would be worthwhile continuing to analyse the economic returns of the system expansions covered by this study through a medium term time horizon (5 to 10 years).

Table 4.3. Macroeconomic trends in Mozambique, 2014-2019

Year	Exchange Rate (MZN per US$)			Inflation, Consumer Prices		Lending rate		GDP growth rate
	MZN per US$	Change from previous year (MZN)	Percent Change From Previous Year	Percent Annual	Change From Previous Year	Percent Annual	Change From Previous Year	Percent Annual
2014	31.35		-	3%	-	15%	-	7.4%
2015	39.98	8.63	28%	4%	1%	15%	0%	6.7%
2016	63.06	23.07	58%	17%	14%	21%	6%	3.8%
2017	63.58	0.53	1%	15%	-2%	28%	7%	3.7%
2018	60.33	-3.26	-5%	4%	-11%	23%	-5%	3.4%
2019	62.55	2.22	4%	3%	-1%	19%	-4%	2.3%

Notes: Exchange rate value is the annual average and do not show fluctuations within each year. A positive number for the rate change implies a depreciating nominal exchange rate that makes commodities priced in Meticais cheaper in US dollars, and those priced in US dollars more expensive in Meticais, other things equal. Inflation is measured by the consumer price index which reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services. The lending rate value is a simple average of rates charged by commercial banks on new loans to nonbank customers with maturity of 91 to 180 days in national currency. Source: International Financial Statistics database (Exchange and Lending Rates), World Development Indicators database (GDP growth and Inflation).

In the period of the study, crop price changes were observed, caused by various factors**.** MAAP crops differed in their export orientation. Domestic market factors underscored price movements in MozAgri, New Horizons, and ECA. Amongst these, only ECA saw significant price fluctuation, with an increase of the price paid to the contract growers by 95% (Table 4.4). Although ECA's output is mostly directed to beer production, rather than food consumption, its market conditions were affected by the spike in maize prices associated with the cyclones[36]. Amarula (sesame), SAN-JFS (cotton), and Vanduzi (baby corn) were all involved in export-oriented crops. The prices received by Amarula increased by 39% due to a switch towards exports, when it was able to arrange an export contract in 2019

[35] No aggregators monitored by MAAP were located in the other three regions mainly affected, Sofala, Zambezia and Cabo Delgado (FAO 2019).

[36] Immediately following cycones maize prices spiked in central provinces due to short-term supply shortfalls, trade patterns were impeded, and stocks were lost due to flooding. The arrival of the 2019 harvested crops in the subsequent months alleviated some of the supply pressure, stabilizing prices or resulting in seasonal declines. (see FAO 2019 for more details)

(previously it was selling domestically). The sugar industry is highly regulated and the drop in prices paid to growers (of 30%) reflected a declining international market price of processed sugar (Table 4.5).

Table 4.4. Crop/product Purchase Prices from Aggregators, 2017-2019

Aggregator	Crop/product	2017 MZN/Kg	2018 MZN/Kg	2019 MZN/Kg	Change 2017-19
Amarula Farms	Sesame	44.9	54.8	62.3	39%
CHVM	Sugar cane	20.7	17.7	14.7	-29%
ECA	Maize	5.8	7.8	11.3	95%
MozAgri	Goat (live weight)	49.0	49.5	56.0	14%
New Horizons	Chicken (live weight)	102.0	105.0	102.0	0
SAN-JFS	Cotton (1st grade)	23.0	23.0	23.3	1%
Vanduzi	Baby Corn	10.0	10.0	10.0	0

Note: The sugar cane price is for cane delivered to the mill and finalized through a retention payment at season- end based on sugar content. The price of chickens, cotton, and baby corn is for farm gate purchasing, and does not change during the season. Sesame prices (also farm gate) in the table are an approximate average of daily paid prices, which can vary during the buying period. Maize prices also vary during the buying season, and differ for type of grower (credit vs. cash), location of purchase (farm, delivered to mill), and period (early season premium – in addition to changes in the local market price). All prices are gross. Data source is MAAP Firm Survey , 2017-2019.

Table 4.5. Regional average market export prices

Crop	Unit	2017	2018	2019	Change 2017-19
Cotton lint	US$/Kg	1.51	1.61	1.66	9%
	MZN/Kg	96.30	97.17	103.65	8%
Sesame seed	US$/Kg	1.00	0.99	1.10	10%
	MZN/Kg	63.64	59.67	68.85	8%
Refined sugar	US$/Kg	0.69	0.56	0.51	-26%
	MZN/Kg	44.10	33.94	32.02	-27%

Note: Prices reported are mean export unit values calculated from the total values and quantities across all import partner countries per country across 40 African exporting countries that data was available for; Mozambique values were not included as they were not available in the dabase. Original data was reported in US$ and converted using exchange rates shown in Table 4.3. Source data is FAOSTAT.

The effects of the cyclones in 2019 overshadowed other weather events in the study period. Subjective assessments of community-level conditions collected at endline showed significant variations in weather, although no consistent shock (OzMozis Lda 2020). One possible exception is CHVM, where sugar growers reported that 2017 was affected by drought while 2018 was an average year weather-wise and 2019 broght both a drought and floods[37] in the cane-growing area, which is a low, flood-prone coastal zone, leading to the need to re-plant some cane.

Outbreaks of pests and diseases also took place during the study period. Fall armyworm (FAW) infestations, first identified in the country in early 2017, continued to affect crop productivity in 2019 (FAO 2019). Their adverse effects were felt by maize growers associated with ECA: three treatment villages in 2018 and 2019 reported being afflicted and two external villages reported, although

[37] CHVM is located in the Maputo Province, in the south of Mozambique, and did not experience the detrimental effects of the cyclones, which were concentrated in the northern and central regions of the country.

reporting similar conditions otherwise, did not report FAW infestation.[38] New Horizons (chicken) experienced an outbreak of Newcastle disease, which affected primarily the aggregator's site rather than out-growers, and caused the loss of about 50% of in-grower production cycles over six months**.** Foot and mouth disease, endemic in Mozambique, affected goat production and movement in MozAgri's operational area. In August 2018, the government banned the movement of goats in northern Manica and Tete provinces for four months as a precautionary measure. Although these measures did not directly affect goat production in MozAgri's source areas, purchases fell by 50% compared with in the first half of 2018.

Finally, immediately preceding MAAP, the armed conflict in Manica between the government and opposition forces in 2015 and 2016 affected ECA and MozAgri. In this period, just before the MAAP study, the number of growers ECA worked with was halved. Similarly, MozAgri and near-by communities were affected, resulting in the firm's principal owner and manager leaving the farm in March 2016 for a year, during which all business activity stopped.

5. Overview of Findings

5.1. Descriptive Statistics of 2017 Baseline Household Samples

Our sample characteristics at baseline in 2017 are broadly consistent with what is expected from rural households in poor regions of Mozambique (Table 5.1). The mean total household annual cash income in 17 of 18 of the subsamples was below MZN 20,000 (roughly US$330[39]); the exception is CHVM, whose growers live closest to the capital, Maputo. Most are smallholders, with subsample mean landholdings mainly between 1.25 and 2.5 ha.[40] Much of farm output is consumed by households rather than sold: in most subsamples, imputed income (the estimated value of own consumption) accounted for between 30% and 70% of household income.[41] However, income sources are diversified, with over half of households having income from off-farm sources, mainly from own-account work.

Prior grower experience with the purchased product varied (Table 5.1). In two cases, CHVM-Maragra/sugar and Vanduzi/baby corn, participant growers were being introduced to a new crop. Accordingly, technical support at these aggregators was comprehensive. In contrast, at ECA/maize and SAN-JFS/cotton, most growers produced the crop prior to the expansion program and the schemes were more 'hands off' in terms of technical support. Participation did, however, improve access to inputs and know-how. Similarly, for the aggregators working in livestock (MozAgri and New Horizons), goats and chickens were both already widely raised by growers. New Horizon's chicken in-growers were fully reliant on the aggregator in terms of the inputs they needed, but the MozAgri scheme was centered simply around market access for goat meat, without other elements of functional dependency.

Most treatment households were already engaged in the crop before joining the aggregation scheme. Treatment households tended to have higher gross household incomes at baseline at all the aggregators, except Amarula Farms, but these differences were statistically significant in only three

[38] Based on information compiled during the 2019 household survey by a survey field supervisor who asked households and local authorities for their perceptions of weather, crop pests and diseases, and production over 2017-2019.

[39] Using the June 30, 2018 exchange rate of 60.3 MZN/US$.

[40] Four of the 19 subsamples have average landholdings >2.5 ha.

[41] In some cases gross total household income (including imputed) is less than total cash income (not included imputed) due to the winserizing procedure being applied when calculating means to avoid disproportionate influence from outliers.

cases. Overall, the data suggest that aggregators tend to select growers who are already engaged in the product and who tend to be better-off than comparison growers (Table 5.1). To offset these elements of endogeneity in program participant selection, for the purpose of analysis we constructed sub samples of comparison growers which better-match the treatment sample on observable characteristics.[42] As mentioned above, in future work we will use more complex econometric techniques to improve the robustness of the comparisons.

Table 5.1. Household Characteristics by Subsample, 2017

Aggregator, Subsample	Cultivated ha, Main Season	Aggregator Crop as % of cropped area	Production of Aggregator crop	% of HH with off-farm earnings	HH Avg Net Cash income	HH Avg Gross Cash income	HH Avg Gross Income (includes imputed income)
	Ha		Kg produced/ No. of animals sold		MZN	MZN	MZN
Amarula Farms							
1A Treatment	1.42	22%	47	68%	5,084	8,766	24,332
2B Non-participant	1.59	11%*	38	51%*	12,612*	16,061	36,163
2C External village	1.16	7%*	14*	47%*	8,474	10,116	33,511
CHVM							
1A Treat./Harvest	1.25	14%	0	83%	39,231	47,192	43,809
1A Treat./No harvest	1.59	8%	0	85%	21,670	25,632	45,325
2A Continuing	3.53*	47%*	100,947*	94%*	253,907*	312,848*	47,291
ECA							
1A Treatment	2.81	76%	2,229	66%	12,371	16,132	29,498
2B Non-participant	1.95*	70%	1,521*	82%*	8,933	10700*	20,954*
2C External village	2.13*	65%*	1,552*	78%*	9,819	12,580	23,897
MozAgri							
1A Treatment	1.9	N.A.	222	60%	18,509	20,130	29,552
2B Non-participant	1.9	N.A.	33*	56%	4,406*	5,001*	12,558*
2C External village	1.9	N.A.	13*	65%	6,558*	6,954*	14,312*
New Horizons							
1A Treatment	1.9	N.A.	3,721	0%	15,932	45,703	29,771
2A Continuing	1.9	N.A.	6,343	11%	8,547	29,446	20,899
SAN-JFS							
1A Treatment	4.79	71%	1,227	39%	28,453	40,318	61,913
2A Continuing	3.63*	64%*	734*	27%*	20,492*	26,374*	52,953*
Vanduzi							
1A Treatment	2.37	7%	0	86%	23,640	31,732	47,225
2A Continuing	2.19	21%*	353*	77%	19,644	27,227	39,785
2C External village	2.04	0%*	0	90%	17,808	21,603	34,376

Notes: The data reported here are means. Asterisks indicate comparator subsamples that are statistically different from the 1A Treatment at the 10% confidence level, respectively. Production of aggregator crop figures are in kg produced except for

[42] For Amarula Farms, ECA, and MozAgri, which have non-participant same-village growers (2B) and external village (2C) growers, we opt for the external village growers as the preferred comparison. The logic is that selected villages were similar and the program was endogenous with the villages – but not so for external villages where no one participated. For CHVM, 1A growers who did not harvest did so for reasons not strongly related to their performance, elaborated on in MAAP Final Evaluation Report (OzMozis Lda 2020), making them a better comparison the continuing growers. In the case of Vanduzi, while endogenous selection may introduce problems in comparing growers within the same villages, the data indicated the external villages were considerably different.

MozAgri and New Horizons for which they represent number of animals sold. The definition of household gross income includes agricultural sales (crops and livestock), the imputed value of subsistence and net carry-over stocks, and income from off-farm activities, including that received from working as hired labor off the farm. Net income is computed by subtracting expenditures made to support household income generation directly, such as agricultural inputs. Data source: MAAP Household Survey, 2017.

5.2. Household aggregator crop engagement and expansion treatment effects

On average, program participants benefitted from increased net cash income from the aggregator crop, both absolutely and relative to comparison growers. Table 5.2 reports absolute changes in incomes and the share of income generated by the aggregated crop, based on gross and net income outcomes for treated and comparison farm groups over 2017-2019. Table 5.3 shows the estimated net benefit to the expansion grower (treated) households, relative to what they would have achieved without aggregation, as measured by the outcomes of comparison groups.

For four aggregators, participation in the contract grower expansion program increased net cash income from the sponsored crop even though production expenditures for those crops increased significantly. In most cases, treatment households had a higher contribution from the aggregator crop to household income, relative to comparison groups. This was the case both when total household income increased over the period (Amarula Farms, CHVM, ECA) and also when it decreased (MozAgri and Vanduzi).[43] When income from other sources fell at a greater rate, as happened with ECA and Vanduzi, the increase in cash earnings from the aggregator crop did not necessarily lead to increased total household cash income.

Two aggregators, CHVM and New Horizons, stand out as having especially large income effects on supported growers which are related, in turn, to the capital intensity of the schemes.[44] There was a 41% increase in total household income from 2017 to 2019 for CHVM expansion growers, and 46% for New Horizons. These firms stand out in that their new growers had access to large new fixed capital investment, such as irrigation (CHVM). In the case of New Horizons, the in-grower program gave selected participants use of 20,000 bird modern chicken houses.

The exception is SAN-JFS (cotton), where the expansion program consisted of helping already-treated growers to intensify their production. The poor result in this case appears to be due to reduced cropped areas outweighing the increase in yields. The reduced planted area may be due to the treatment growers being poorly supported by the firm, especially in 2018, which was a boom year on average for cotton growers in the SAN-JFS concession area. As a result, there was a shift in the income structure of

[43] Estimated treatment effects for MozAgri are less robust than for other cases. They are based on the average same-year differences between treatment and comparison growers, rather than difference-in-difference estimates. There are two reasons for this. First, MozAgri was already operating in the treatment villages at baseline (for 4 of 12 months of baseline year) so there are no 'without program' observations. Second, the treatment group (subsample 1A) is defined as growers who sold to MozAgri in 2017 when the comparison growers in the same village (subsample 2B) were also capable of selling to MozAgri and did not. The data suggests that growers who sold to MozAgri in 2017 already had higher incomes and were more engaged in goat commercialization. Therefore, same-year differences between treatment and comparison groups may reflect the fact that treatment growers were better-off even without MozAgri, rather than that MozAgri increased their income. Unfortunately, the data does not allow us to disentangle these two possible explanations.

[44] In the case of New Horizons the larger impacts were seen in 2018, as reported in the MAAP Final Evaluation Report (OzMozis Lda 2020). In 2019 a serious outbreak of Newcastle disease affected the firm and growers and led to treatment effects estimates based on 2019-2017 differences being smaller than those based on 2018-2017 differences.

the treated households, with cotton's contribution falling by 21% from 2017 while the share of off-farm income increased by 500% (OzMozis Lda 2020, Chapter 7).[45]

Table 5.3 reports estimates of the labor externalities that accrue from aggregation. As discussed above, these are the net income effects from participation in the scheme. These accrue only to farms, not firms. They estimate the value of overcoming the market failures that were holding smallholders back. They are based on the net cash income received from the aggregator rather than the change in total household income. We made this choice because we have more reliable data on the income that growers received from the aggregator (being able to triangulate household and firm data). In addition, there were multiple factors affecting total income that have little apparent relationship to growers' participation in the aggregator scheme. For example, there were major macroeconomic instabilities in the country during the study period, leading to sharp fluctuations in the exchange rate and prices.[46]

Amarula Farms, ECA, MozAgri, New Horizons, and SAN-JFS expansion program participants continued to have greater engagement with the aggregator crop after 2017 as is reflected in the production data. In fact, they widened the gap in terms of engagement as reflected in their positive treatment effect estimates. In the case of ECA and Amarula Farms, significant price increases over 2017-2019[47] appear to have led to an increase in the number of growers producing the sponsored crop. For ECA, the positive price shock may be related to the cyclones. Staples production in the region dropped significantly (FAO 2019) and since the treatment growers were larger and more engaged, they were able to take advantage of the resulting price increase. However, there was also a positive treatment effect detected for 2018 (see OzMozis Lda 2020).

Table 5.2. Household Cash Income and Contribution of Aggregated Crop Compared by Subsample, 2017 and 2019

Aggregator Crop/product	Sub-Sample	Total Household Cash Income of Grower Households						Share of Aggregator Crop in 2017 Income	Absolute Change in Share from 2017 to 2019
		2017		2019		2017-2019 Change (%)			
		MZN	US$	MZN	US$	MZN	US$		
Amarula Farms Sesame	1A	8,766	136	24,716	395	82%	190%	36%	6%
	2B	16,060*	249	10,116	161	-63%*	-35%	20%*	-3%
	2C	22,030	341	18,705	299	-61%	-13%	7%*	14%
CHVM/Maragra Sugar cane	1A	47,192	732	213,109	3,402	252%	365%	0%	41%
	1A No Harvest	25,632	397	85,376	1,363	133%*	243%	0%	0%
	2A	312,848*	4,849	370,157	5,908	-82%*	22%	76%*	-16%
ECA Maize	1A	16,132	250	30,168	482	-13%	93%	48%	-5%
	2B	10,700*	166	28,361	453	65%	173%	46%	-18%
	2C	12,580	195	24,514	391	-5%	101%	27%	-4%
MozAgri Goats	1A	20,130	312	17,154	274	-115%	-12%	47%	-23%
	2B	5,001*	78	5,673	91	-87%	17%	18%*	4%

[45] Potential motivations are that new off-farm earning opportunities became available or that due to poorer agricultural production households opted to increase off-farm earnings (either through wage employment or own account work)

[46] Total income includes remittances and income from off-farm work, which are hard to capture accurately. By not using total income, there is a danger that we miss the effects of reallocations of labor to or from other (non-aggregator related) activities, due to becoming a participant. However, treatment effects conditional on having off-farm income are all statistically insignificant at the 10% confidence level (Table 5.3).

[47] Increase of 39% for sesame and 95% for maize.

	2C	6,954*	108	15,846	253	28%	135%	12%*	1%
New Horizons Broiler chickens	1A	15,932	247	53,401	852	98%	245%	93%	46%
	2A	8,547*	132	47,530	759	-148%*	473%	70%	9%
SAN-JFS Cotton	1A	40,318	625	32,735	523	-119%	-16%	78%	-16%
	2A	26,374	409	29,797	476	-87%*	16%	67%*	-2%*
Vanduzi Baby corn	1A	31,732	492	38,880	621	-77%	26%	0%	47%
	2A	27,227	422	43,624	696	-40%	65%	30%*	12%*
	2C	21,603	335	17,067	272	-121%	-19%	0%	1%*

Notes: Subsamples are: "1A Treatment", new contract growers or existing contract growers being supported under MAAP; "2A Continuing Contract Growers" contracted by the aggregator before MAAP and who would continue as contracted, but are not involved in the MAAP treatment; "2B Non-contracted Growers from Treatment Sample Community", come from the same community location as the treatment subsample but were not contracted to supply the aggregator prior to the baseline survey, and would not be taken on as contract growers for MAAP; and similarly "2C Non-contracted Growers from Communities without Aggregator Support". Almost all of the treatment effects shown above are statistically significant at 10% or better. The statistical significance of treatment effects is examined in table 5.3 using the difference-in-differences approach to control for differences in the baseline vales. Vanduzi opted out of the MAAP program in January 2019. Data source is MAAP Household Surveys, 2017-2019. Net Cash income in case of New Horizons and based on firm data rather than household survey data.

There is no compelling evidence that off-farm income generating activities changed significantly as a result of displacement by program participation. Except for SAN-JFS, some households in every sample had income from off-farm sources at baseline, either in wage employment or in own-account work. This barely changed for expansion growers relative to comparison groups over the 2017 to 2019 period, as shown by small, statistically insignificant treatment effects for off-farm income (Table 5.3).

Table 5.3. Treatment Effects on Household Production, Income, and Labor

Aggregator (Product)	Preferred (alternate) reference comparison group	Production, Aggregator Product (Kg)	Net Cash Earnings, Aggregator Product (MZN)	% of HH cash income from aggregator crop	Total Net Cash Income (MZN)	HHs with Off-farm Income (%)	HHs Hiring Seasonal Employment (%)
Amarula Farms (Sesame)	2C (2B)	59* (89*)	3,659* (5,133*)	-8% (9%)	6,202 (7,737)	5% (6%)	21%* (17%)
CHVM (Sugar cane)	1A-No-Harvest (2A)	54,542* (37,637*)	96,792* (99,464*)	42%* (58%*)	90,226* (117,941*)	-2% (8%)	17% (36%*)
ECA (Maize)	2C (2B)	123 (73)	1,940 (2,305)	0% (13%*)	-1,412 (-5,262)	-4% (6%)	14% (10%)
MozAgri (Goats)	2C (2B)	4.18* (3.90*)	3,709* (3,397*)	34%* (29%*)	11,950* (14,102*)	4% (6%)	19%* (8%)
New Horizons (Chickens)	2A	1,989	3,980	21%	35,748	44%	6%
SAN-JFS (Cotton)	2A	-365*	-9,680*	-14%*	-10,396*	-6%	-2%
Vanduzi (Baby corn)	2A (2C)	179 (487*)	1,790 (4,872*)	25%* (39%*)	-8,465 (-7,986)	-9% (6%)	10% (-9%)

Notes: Treatment effects characterize mean additional outcomes for the treated sample vis-a-vis the comparator samples shown, and are calculated by the "difference-in-differences" method. Exceptionally, the treatment effect for MozAgri is calculated by using same-period differences of variable values between treatment and comparison groups, given data available. Asterisks indicate the statistical significance of the estimates for 2019, (except for Vanduzi where 2018 is the comparison year) compared with the baseline year (2017); * indicates significant at 10% confidence level; % of HH cash income from aggregator crop refers to gross income from crop, before costs subtracted, except for New Horizons. Income variables are defined in the notes to Table 5.1, above. Data source is MAAP Household Surveys, 2017-2019 (See OzMozis Lda 2020).

Several factors unrelated to participation in aggregation were likely influencing household agricultural production and labor allocation choices during the study period. The MAAP Final Evaluation Report (OzMozis Lda 2020) highlights a pattern of declining shares of total (gross) household cash income coming from agriculture and livestock[48] between 2017 and 2019, which occurred for 17 of the 18 household subsamples monitored under MAAP. Four of the seven aggregators had a uniformly high level of reliance on agriculture and livestock for cash income in 2017: 81% for Amarula Farms, across all subsample; 82 to 84% for ECA; 92% to 97% for SAN-JFS; and 86% to 93% for Vanduzi. Across these four firms and indeed all others, and across all subsamples, the contribution of agriculture and livestock to household cash income fell by about 15%-20% in 2019 (e.g., to 66% for the ECA treatment group). The impact of poor seasons and prices varied by crop and aggregator, so the uniformity of this trend towards reduced short-term reliance of agriculture and livestock for cash income may indicate a more fundamental change for the rural economy, which is beyond the scope of the present study.

5.3. Employment generation by firms and growers

The discussion in Section 5.2 summarizes how aggregation improved smallholders' own jobs by generating productivity growth and increased incomes. In this section, we turn to the additional jobs effects of growers' increased agricultural labor needs (eg for seasonal field labor); and of aggregator firms' labor needs to process increased volumes of raw materials.

The share of farm households that reported using hired seasonal labor increased more for the treatment group than for comparison groups in all cases except JFS, and some of these positive treatment effects were substantial (20% or greater). However, the reported increase was only statistically significant at the 10% confidence level for Amarula Farms, CHVM and MozAgri. Although these are generally low quality jobs they form part of the jobs effect of the expanding aggregation systems and add to the positive overall impact on the rural labor market. Unfortunately, the data do not allow for a precise calculation of number of net additional days of work (Table 5.3).

Table 5.4 summarizes the evidence on employment creation from the firm survey. It is clear that most of the aggregator firms create significant numbers of direct jobs. These are generally better quality jobs, paying well above agricultural wage rates. The number of jobs in field extension activities, input supply, training, crop purchase and transport is small. There are more jobs in processing, where women are also more likely to be hired. Jobs are also created in management and trading roles. Some of the aggregators hire large total numbers of employees: 2,000 at Vanduzi and over 3,000 at CHVM-Maragra. But - with the exception of ECA, where direct jobs doubled - there is little evidence that direct jobs in the aggregator firm increased due to the expansion studied in MAAP. Through their spending on salaries, raw material and services, aggregators can also generate additional local economy jobs multiplier effects. However, this "spillover" job creation effect is not addressed in this report.

Table 5.4. Employment created in firms

Aggregator	Summary of employment associated with contract grower expansions
Amarula Farms	Sesame created minimal employment in the company or by growers. From the company's perspective, this was because the sesame bought from growers was sold onto the local market and without value addition.
CHVM/Maragra	In 2019, 1,441 full-time equivalent (FTE) positions were directly attributable to the CHVM program, 97% of these at farm level and 46% being paid positions (i.e., excluding employment created in grower families, which is unpaid). Almost all

[48] Inclusive of aggregator sponsored product.

	paid positions were with contractors hired by growers to perform cane services such as harvesting, hauling, planting, applying fertilizer and herbicides, and weeding. The MAAP Final Evaluation Report (OzMozis Lda 2020) describes how the number of these jobs was calculated.
ECA	ECA employment almost doubled between 2017 and 2019, from 79 full- and part-time employees to 155. Some 25 of these new employees could be attributed to the expansion program.
MozAgri	Employment generation by the MozAgri goat program is limited. It involves 20 full-time positions at the company level, including the buying teams that purchase and transport the goats to the abattoir. Part-time buying agent and mini-aggregator (or trader) positions are also created.
New Horizons	The in-grower system creates little direct employment. Large-scale in-growers can employ six or more laborers. However, in parallel with the start-up of in-growing, the number of out-growers radically declined. Pro-rated against the firm's employees, the employment contribution is limited.
SAN-JFS	SAN-JFS's contribution to employment generation is limited. The main direct contribution would come from contracted growers and their hired labor involved in cotton production. Each growing household would have two members largely engaged in cotton production. The company has 95 full-time staff and around 180 seasonal staff, but the number of growers that can be attributed to the expansion is small given company works with over 40,000 growers some seasons.
Vanduzi	Prior to the rationalization that started in 2018, Vanduzi was the largest private sector employer in Manica, directly hiring almost 2,000 people, about half of whom were full-time, and half were female. Unfortunately, the company's financial troubles (unrelated to the MAAP-sponsored expansion) led to the end of its out-grower program and a significant reduction of direct employment.

5.4. Financial performance of the expansion

Notwithstanding considerable variation across crops, firm-grower arrangements, expansion program costs, revenues and profits, there are some clear takeaways about the financial economics of the expansion programs (Table 5.5). First, the expansions are heavily dependent on working capital. With two exceptions, incremental fixed capital expenditure was less than 5% of total Year 1 expenditure.[49] [50] [51] Second, raw material purchase[52] is the main outlay, accounting on average for 40% of the total cost. Amarula Farms had the highest share (61%) of raw material purchase cost, due to its limited expenditure on other items. The larger operations spent close to 50% on raw material. Third, most of the aggregators achieved repayment rates of 100% or close to that level for the credit they extended to growers (which was exclusively in kind).

A key result of our analysis is that aggregators' financial profits from the expansion were disappointing. To avoid distortion from participation in the study, we excluded the participation incentive payments (PIP) from this calculation. We found that only the ECA maize aggregator reported positive (financial)

[49] When the entirety of capital investment is charged to the expansion program that year.

[50] The construction of in-grower chicken houses at New Horizons, and field storage facilities at Vanduzi are the exceptions, accounting for 44% and 20% of Year 1 expenditures, respectively.

[51] Another possible exception can be considered CHVM aggregation schemes since there was heavy investment on irrigation and drainage infrastructure.

[52] Raw material cost is the price paid growers, and not including the cost of credit to growers, transport or other buying costs

profits from the expansion program in 2018 and 2019. And only two other firms had at least one positive year, MozAgri in 2019 and SAN-JFS in 2018, both on account of successful buying years. After two years, only the ECA expansion program had a positive cumulative cash flow (calculated all including all capital expenditure), and it was relatively small, equal to 12% of 2019 receipts (Table 5.5).

However, most firms did better in 2019 than in 2018, either raising their profits or lowering their losses from the expansion activity. This partly reflects the fact that (following normal CBA methodology) the (normally small) fixed upfront capital expenditures were all logged in 2018 (see Section 3.3 above). But even when fixed capital is left out of the calculation, most firms' financial performance improved from 2018 to 2019. This might indicate that, in the medium term, the expansions might eventually become financially sustainable.

An interesting finding from the study is that the relatively modest study participation incentive payments (PIPs) offered by MAAP were sufficient to tip the balance from loss to profit for most of the expansions (Table 5.5). Including the PIPs, the cumulative cash flow for four out of six aggregators was positive at the end of 2019. One exception was New Horizons's very capital intensive expansion program, which was still feeling the impact of the high fixed investment per grower in 2019. The other exception, Vanduzi, cancelled its grower expansion program, due partly to the weakness of its business model for working with contract growers; and in part to unrelated problems with the company's overall solvency, that led to a major restructuring initiative.

Table 5.5. Summary of Aggregator Costs, Revenues, Investments, and Profits attributable to MAAP Expansion Programs (US$)

	Amarula Farms		ECA		MozAgri		New Horizons		SAN-JFS		Vanduzi	
	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019
Firm Receipts (US$)												
Total	**44,480**	**29,132**	**536,200**	**650,604**	**180,221**	**367,851**	**349,683**	**1,970,891**	**537,056**	**265,902**	**59,054**	**19,594**
Sales of final product	31,347	23,210	503,634	599,195	180,221	367,851	191,150	1,117,172	470,584	211,803	50,639	16,879
Input repayment from growers	13,133	5,922	32,566	51,409	N.A.	N.A	158,533	853,719	66,472	54,099	8,415	2,715
Firm Expenditures (US$)												
Total	**52,935**	**30,176**	**516,099**	**598,971**	**221,015**	**347,100**	**686,191**	**2,008,780**	**516,605**	**315,916**	**117,082**	**32,094**
Inputs to growers on credit	14,733	5,922	32,566	51,409	N.A.	N.A	158,533	853,719	79,133	70,270	8,415	2,715
Inputs to growers not for repay	4,042	1,406	72,250	67,750	38,290	46,830	8,484	21,988	17,134	10,000	13,680	5,700
Raw material purchase	30,587	18,574	234,101	318,333	85,896	181,048	163,172	884,718	246,675	127,418	18,150	5,855
Raw material processing	1,032	146	39,049	48,943	25,872	40,083	24,022	152,301	61,758	39,523	28,205	9,402
Overhead	2,541	4,128	113,433	112,536	45,957	79,139	27,979	96,054	98,405	68,705	25,232	4,422
Fixed Capital investment	0	0	24,700	0	25,000	0	304,000	0	13,400	0	23,400	0
Profit/loss (US$)												
Profit/loss from added growers	**-8,455**	**-1,044**	**20,101**	**51,633**	**-40,794**	**20,751**	**-336,508**	**-37,889**	**20,451**	**-50,014**	**-58,028**	**-12,500**
MAAP PIP	47,500	47,500	65,000	65,000	50,000	50,000	55,000	55,000	55,000	55,000	16,500	16,500
Profit/loss, with PIP	39,045	46,564	85,101	116,633	9,206	70,751	-281,508	17,111	75,451	4,986	-41,528	4,000
Of note:												
Cumulative cashflow w/out PIP (end of 2019)	-10,052		71,734		-20,043		-374,397		-29,563		-70,528	
Cumulative cashflow w/ PIP (end of 2019)	84,949		201,734		79,957		-264,397		80,437		-37,528	
Number of growers supported		105		2,251		3,340		8		255	110	110

Notes: Data for Vanduzi in 2019 refer to July 2018 to January 2019, when the monitored contract grower expansion program closed. Cost of finance for the expansion program, all for working capital, is included in "overhead."; Capital expenditure is shown in the year it largely occurred. Aggregators: CHVM is not included as it is not a firm, and neither it nor Maragra Sugar kept commercial accounts for the expansion sample comparable to those of other aggregators. Vanduzi ended its contract grower expansion program on 31 January 2019, and thus the 2019 figures are part-year. Data source is MAAP Firm Survey, 2018 and 2019 (see OzMozis Lda 2020) .

5.5. Total economic benefits and their distribution between firms and growers

In this section we pull together the data from the household and firm surveys to analyze the overall financial and economic returns from the expansion schemes and their distribution between actors (firms and growers). The private, financial, and social returns varied across the aggregators – as did the distribution of benefits between firms and growers. But once again, some clear patterns emerge (Table 5.6).

Labor externalities (LEs) per grower were for the most part positive, and in the range of US$30 to US$60.[53] The exception is the cotton aggregator, SAN-JFS. In all the positive cases, the Labor Externalities (LEs) exceeded the net financial benefit to the firm. In other words, the smallholder growers benefited considerably from the aggregator firms' help to overcome market failures – but the financial return to the aggregator firm itself was low. The benefits of the expansions were negative for three of the six aggregator firms (Table 5.6). This central finding supports the motivating hypotheses of the MAAP study: (a) that aggregation is a socially profitable solution to well-known market failures of the agrarian economy, but (b) the skewed distribution of the benefits between firms and growers is a plausible explanation for a persistent "low level equilibrium" where a relatively small proportion of Mozambican smallholders is involved in aggregation systems.

Estimated total net economic benefits, which are the sum of the firms' financial profits and the JLEs generated for the growers, were negative for Vanduzi, New Horizons and, SAN-JFS, although for different reasons. In the case of Vanduzi and New Horizons, the positive effects for growers were overshadowed by large financial losses to aggregators of the two-year expansion programs. In the case of SAN-JFS, both the net financial benefits and JLEs were negative.

Finally, when the relatively modest MAAP PIPs are added into firms' revenue streams (the last column of Table 5.6), the expansion programs generally become much more attractive to the firms. The one exception was Vanduzi, which suffered from a poor business model with respect to contract growers and exited from the MAAP program in January 2019.

Table 5.6. Estimated benefit distribution between firms, growers, and society (2019) US$

Aggregator (product)	**No. of New Growers**	**Labor Externality (LE) per Grower** (US$)	**Net Economic Benefits (US$ w/o MAAP PIP) Going to:**					**Percent of Net Economic Benefits Going to Firms**	
			Firms (Financial profits)	**Growers** (LEs)	**Society** (SEs)	**Total JLEs** (LEs + SEs)	**Total** (Profits + JLEs)	w/o PIP	w/ PIP[(A)]
Amarula Farms Sesame	105	60* (83*)	1,044	6,300	1,260	7,560	8,604	12%	87%
CHVM Sugar cane	1,078	1,561*	N.A.	1,682,914	336,583	1,965,497	1,965,497	--	--
ECA Maize	2,251	31 (37)	51,633	69,781	13,965	83,737	135,370	38%	58%
MozAgri Goats	3,340	38* (35*)	20,751	126,012	25,202	151,214	171,965	12%	32%

[53] These are proxies since the treatment effect was estimated in MZN and then converted to US$ using 2019 rates, and not accounting for exchange rate fluctuations between 2017 and 2019.

New Horizons chickens	8	65	-37,889	520	104	624	-37,265	102% (of net loss)	Firm had $17,111 net gain
SAN-JFS Cotton	255	-158*	-50,014	-48,450	-9,690	-58,140	-108,154	46% (of net loss)	Firm had $4,986 net gain
Vanduzi Baby corn (2018)	110	30* (83*)	-58,028	3,343	669	4,012	-54,016	107% (of net loss)	111% (of net loss)

Notes: JLE=labor externality, LE=labor externality, SE=social externality, PIP=MAAP participation incentive payment. The Labor externality is the treatment effect on net cash income from aggregator crop, from Table 5.3. Aggregator issues: CHVM has some blank cells because it is not a firm. MozAgri treatment effects are approximated based on single differences (see Chapter 3 for elaboration); the shown figure is the average across years. Figures for Vanduzi are for 2018 due to January 2019 exit from MAAP. Asterisks indicate the statistical significance of the treatment effect estimate calculated by difference-in-differences between treatment and comparison subsamples at the 10% confidence levels. *(A)*: this column represents the ratio of the total private benefits to firm (profits + PIP) to the total economic benefits (profits + JLEs). Data source is MAAP Firm and Household Surveys, 2018, 2019 (OzMozis Lda 2020).

5.6. Financial, Social, and Private returns to expansion investment[54]

Even those expansion programs that generated profits for the firms had returns well below the market cost of capital. In 2018, the market cost of capital in Mozambique was around 25%, and in 2019, around 18%. Only two aggregators had a positive *financial return on investment* (FROI) from grower expansion (without counting the MAAP PIP), and these were well below the cost of capital (ECA - 9%, MozAgri - 6%) (Table 5.7).

But the *private return on investment* of firms (PROI), where the MAAP PIPs are added in, was positive for all but one firm in 2019. These spanned from 1% (New Horizons) to 154% (Amarula Farms Farms). ECA (19%), and MozAgri (51%) also had PROIs above the market cost of capital. This suggests that most of the expansion programs we studied were viable private investments, conditional on the availability of modest subsidy support (Table 5.7).

The social return on investment (SROI) adds the total JLEs (including social returns from the increased grower jobs and incomes) to the financial profits.

Table 5.7. Returns to aggregator scheme expansions, 2019

Aggregator Crop/product	**Return on investment (ROI)**		
	Private (PROI)	**Financial (FROI)**	**Social (SROI)**
Amarula Farms Sesame	154%	-3%	22%
CHVM Sugar cane	N.A.	N.A.	N.A.
ECA Maize	19%	9%	20%
MozAgri Goats	51%	6%	50%
New Horizons Broiler chickens	1%	-2%	-2%
SAN-JFS Cotton	2%	-16%	-34%
Vanduzi Baby corn (2018)	-35%	-50%	-46%

Notes: ROI is the net benefits divided by full expenditures. PROI includes the firm profits plus participation incentive payment (PIP) as net benefits, FROI includes firm profits excluding PIP as net benefits, and SROI firm profits excluding PIP but including grower and social benefits as the net benefits. Aggregator CHVM returns are not estimated because it is not a firm.

[54] This section presents results using return of investment (ROI) measures and not including rates of return (RR); the methodology described in Chapter 3 explains their difference. The findings do not change when the rates of return measures included in the analysis. The analysis including both returns measures is included in the MAAP Final Evaluation Report (OzMozis Lda 2020).

Our estimate of the SROI varies, with half the expansions having SROIs of 20% of greater – but the rest report negative total returns (Table 5.7). ECA and MozAgri are socially profitable aggregator schemes that yield modest (unsubsidized) financial returns, comfortably high (subsidized) private returns to the firms, and even higher social returns (including t7he JLEs). Amarula Farms' high social return is accompanied by a small financial loss (US$ 1,044, Table 5.5). However, considering the significant improvement in Amarula Farms' performance between 2018 and 2019, one cannot rule out it joining ECA and MozAgri in the set of programs with viable private returns. In contrast, despite a positive treatment effect/per-grower (LE), Vanduzi had a negative total social return (SROI -46%). The benefits to the relatively few growers were not enough to compensate for the firm's substantial financial losses. So this is a case where the level of subsidy needed to produced financial viability for the firm is likely too high in relation to the modest gains to growers.

6. Discussion of findings

Chapter 5 presented our findings about the gains to the participating smallholder households and firms. The results estimate the impacts of the aggregation arrangement on incomes for each firm and its growers. This included estimates of financial, private (including subsidies), and social rates of return.

The present chapter offers some insights into the potential to raise smallholder incomes through aggregation by agribusinesses and responds to the study questions outlined in the introduction.[55] First, what did aggregators actually do for the growers to help them to overcome the market failures affecting them? To what extent does the variation in the form and level of firms' support help explain differences in the benefits to growers? Second, when firms benefited from the expansion of contract farming, how and why did they do so? Third, what factors might limit the desired scale of expansion of contract grower systems for the firms? Fourth, given these insights, what is the potential for subsidies (or other forms of public support) to promote increased grower incomes through aggregation? And, if we propose using subsidies, how much is enough?

6.1. How did the aggregator systems overcome market failures that limit growers' incomes?

As shown above, the results for both firms and their growers varied across firms and years.[56] This provides a basis for insights about how aggregation helped the famers to do better. In most cases, we estimated that there was a positive impact on growers' incomes; that is, the "Jobs Linked Externalities" associated with the expansion of aggregation were positive. So, aggregation must have helped to overcome some of the underlying market failures discussed in the introductory section of this report. Those might include information asymmetries between buyers and sellers in smallholder contexts. For example, spot markets for smallholder produce are hampered by the fact that the product's quality is variable. Overcoming this implies that the buyer must incur the cost of separating the output of small lots. The alternative is to bulk together all the output and pay a lowest common denominator price, which is damaging to those smallholders whose product quality is good. Another example is the absence of credible branding for the repackaged agricultural inputs sold in small units to smallholders. In this case, the smallholder's

[55] Specifically, Section 6.1 is linked to the first question pertaining to grower benefits; Sections 6.2 and 6.3 are linked to the second question, pertaining to success factors for firm expansions and their profitability; Sections 6.4 and 6.5 are linked to the fourth question, regarding potential policies to promote private aggregation schemes. The third question, which pertains to employment generation is covered in the previous chapter's Section 5.3.

[56] Although not shown in this report, they also varied across growers within each aggregator and year. Intra-aggregator analysis of variation in results across households requires a significant effort to do and is secondary to the immediate purpose of the MAAP to establish the possibility of profitability of expansion for firms and the average gains to contract growers of overcoming market failures, especially those based on labor externalities. The MAAP team intends to investigate intra-aggregator household variation in a later effort.

willingness to pay for inputs might be reduced by uncertainty about their quality. Another example is the failure of credit markets. The scale economies of financial transactions raise financing costs for small loans to smallholders. A related problem is the lack of collateral, such as land titles - which is due, in turn, to land market failures. The same land market failures also lead to difficulties in consolidating holdings into larger units where scale economies might kick in. Even where land consolidation is an option, labor market failures might make it difficult to supervise field labor, leading to deficient productivity.

Although such market failures are conceptually plausible, the underlying transaction costs affecting specific growers are not directly observable. However, they may be correlated with phenomena that are. The following paragraphs discussed the specific measures taken by aggregators to help their growers overcome market failures. Some focused on different constraints from others. But they all addressed market failures where the organizational remedy of contract farming can help improve growers' access to markets.

Access to capital and productive assets

The transfer to growers of usufruct rights for productive assets under a contractual arrangement is an important facet of several of the aggregation schemes we studied. Three of the schemes are linked to major investments in fixed capital or infrastructure. CHVM is linked to an EU-funded investment[57] to rehabilitate drainage and flood control for land suitable for sugar production adjacent to the Maragra refinery. Vanduzi's expansion worked with new growers in a village where gravity irrigation infrastructure had recently been built by a World Bank project. The New Horizons in-grower expansion required investment in chicken houses with capacity for 20,000 birds. In all these cases, aggregation had strong positive effects on grower income levels.

Vanduzi and CHVM mediated the introduction of a new crop, and provided comprehensive technical support. Vanduzi's extensionists provided guidance and monitored production. CHVM staff supported production and monitored the products received at the Maragra mill. Maragra itself contributed extension services and arranged a line of credit for new growers for the first three years. In case of New Horizons, the firm made a large capital investment in modern chicken houses. Their ingrower contract conveyed the corresponding usufruct rights to the growers and they also offered technical support and supervision. The in-growers increased their chicken production tenfold over what they had been achieving as out-growers with small scale, rudimentary chicken houses. These results suggest that institutional solutions such as aggregation, especially those including technical extension, can complement infrastructure or capital investments undertaken by the aggregator or by third parties that alleviate major constraints to production, such as physical access, flood control, irrigation or on-farm infrastructure.

Market access

As discussed above, it is difficult for smallholders to enter a commercial value chain. Facilitating market access is thus one of the key benefits of aggregation. Markets for most commercial farm crops in

[57] CHVM is a cooperative society that organizes contract growers for Maragra Sugar, which is the eventual aggregator of the output for industrial processing. CHVM helps its members access credit, delivers technical support, and liaises with Maragra on their behalf. CHVM was created under an E.U. grant that funded flood control and other land preparation and capacity building on land controlled by emerging growers (20 ha mean farm holdings) near Maragra. The Maragra refinery provided credit to its new CHVM growers for the first three years, and then (when they had a financial track recod) this role passed to the regular banking system. The MAAP expansion sample (treatment group) consisted of CHVM members whose participation was facilitated by the EU project, and the main comparison group consisted of continuing Maragra growers outside CHVM.

Mozambique are evolving rapidly (Tschirely et al. 2015). Growers who used to sell small amounts to neighbors on an irregular basis now need to sell to distant, unknown buyers - often, commercial processors with stringent quality control. In the absence easily verifiable quality and reliability attributes, these buyers tend to pay a "lowest common denominator" price to smallholders. This reduces returns to both buyers and sellers, due to search costs, the cost of moving goods to more distant markets, and difficulties meeting product quality standards and establishing a reputation as reliable supplier. Aggregators who serve as reliable buyers from the farm standpoint and reliable suppliers from the end market standpoint can reduce search costs for both growers and buyers, and help growers transition to the evolving market structure.

In the absence of aggregation, growers in the MAAP study areas faced major (in some cases, prohibitive) costs to transport their product to market (World Bank 2019). Four of the aggregators (ECA, SAN-JFS, Vanduzi, and MozAgri) work in communities with limited road access. In the case in SAN-JFS and ECA, there is no vehicle access for part of the year. So, serving as a market entry point for remote producers is a fundamental part of the value proposition of the ECA (maize), MozAgri (goat), and Vanduzi (baby corn/horticulture) aggregation schemes.[58] Amarula Farms (sesame ingrowers) and New Horizons (chicken ingrowers), the growers were closer to local markets with strong product demand, so physical market access was less of an issue. But in both those cases the aggregator provided crucial quality assurance and acted as the offtaker and market intermediary. Similarly, although they are less remote, CHVM's sugar growers also sold their output to Maragra, which thus resolved their market access problem.

Access to inputs and credit

Smallholders have great difficulty accessing credit or working capital, so another benefit of contract farming is to provide the growers with credit from the aggregator (either in cash or in kind). All the MAAP aggregator schemes except MozAgri offered inputs on credit, which were generally valued by the growers.[59] Our household survey data shows that (with the exception of SAN-JFS) the provision of inputs by aggregators led to increased input use by growers. [60]

When intermediary suppliers break down large containers of fertilizer and chemicals for retail to smallholders, inputs sold to smallholders are often low quality, due to dilution or adulteration, e.g. by adding sand to fertilizer (World Bank 2018c). Input quality is hard for growers to assess and branding is often suspect, implying high transaction costs. Thus, inputs are not just a credit issue – the problem also relates to bulk procurement and quality control. When aggregators act as intermediaries in input supply they can realize cost savings from bulk purchases of good quality inputs - and they are less likely to indulge in adulteration, since they share an interest in maximizing growers' productivity and financial success.

[58] The cotton aggregator SAN-JFS also supported cotton growers in remote areas, but the MAAP study evaluated an intensification of production for some growers and the comparison growers had the same market access as treatment groups.

[59] The MAAP Final Evaluation Report (OzMozis Lda 2020) provides an extensive discussion of the factors that make for successful aggregation arrangements. It concludes that timely and appropriate input supply is one of three elements of the contract buyer systems that most directly affect growers. The others are: the presence of a clear and transparent contract and crop/product purchasing process; and high-quality training and technical assistance.

[60] In the case of New Horizons and Vanduzi this is implied by the statisitically significant increase in aggregator crop/product production since input repayment was paid per unit sold to the aggregator. Chapter 7 of the MAAP Final Evaluation Report (OzMozis Lda 2020) presents results on non-labor input useand expenditures for each aggregator.

Even in remote areas, we found that input supplies were normally accessible outside the aggregator contracts. Amarula Farms growers had access to commercial centers, CHVM is not far from Maputo and close to roads, and all growers in SAN-JFS already had access to a basic package of inputs (MAAP was an intensification). SAN-JFS and Vanduzi growers had had access to a local agricultural inputs store. Nevertheless, the aggregators played a significant role in input supply for their growers. Overall, most of the aggregators both provided credit for inputs and reduced growers' mistrust of inputs purchase from intermediaries with no interest in their productivity or capacity to supply extension advice on input use. New Horizons' in-growers must follow the company's norms for input use. In the cases of CHVM, SAN-JFS and Amarula Farms, the aggregator shared the benefit of a good harvest and had an incentive to ensure good input use.

However, there were also exceptions. ECA purchases maize, which is also a subsistence crop for the growers, mainly on the local spot market: 80% is bought from growers without any corresponding provision of upfront credit or inputs; and those growers that do get credit from ECA are not required to sell them their produce. ECA facilitates "fairs" where input suppliers offer their packages of seeds and fertilizers, and organizes training and demonstration plots to show the merits of the higher-cost packages - but most growers still prefer to buy cheaper packages.

Increased input use permits intensification. But sometimes, it is the non-profitability of the crop, rather than the lack of access to credit or well-functioning markets, which is the underlying obstacle to intensification. The cost of efficiently acquiring and applying the inputs could exceed the returns for other reasons, unrelated to transaction costs. In our study, benefits for the growers in SAN-JFS growers pertain only to intensification, and not to the resolution of market failures linked to transactions costs. The participants of the intensification pilot had the same access to inputs and extension as other growers. In this case, the program's minimal effects on income primarily reflect the failure of the intensification model in the context of unfavorable external cotton market conditions.

6.2. How and why did the firms benefit from expansion in the aggregation systems?

Diversity of firms and results

The aggregator businesses studied do not fit a common scale, focus, or ownership model. Three of the firms developed recently, based on individual initiatives (Amarula Farms, ECA, and MozAgri). They are also the smallest. Two of the firms are subsidiaries of international firms (Maragra Sugar, the firm that CHVM is linked with, and Vanduzi, which was linked to Sainsbury's); and one is a subsidiary of a Mozambican conglomerate (the SAN-JFS cotton concession and ginnery). Maragra Sugar has a turnover five-times greater than the second ranking aggregator's turnover. Finally, the New Horizons chicken business is an intermediate case. It started 15 years ago and is now an integrated operation that attracts significant foreign investment, and it lies second in terms of revenue.

As we saw above, some of the firms reported competitive financial returns on investment (FROI) on the working capital they allocated to support to the expansion, and some did not. However, there were some elements in common across some or all of aggregators. Examples of this include: (a) several firms had excess capacity in their processing facility that generated a need to expand and/or improve the quality of raw material; and (b) some firms sourced their raw material to reduce the labor supervision needed in plantations they operated directly.

Did firms make money on their investment?

The FROI data (Section 5.6) compares profitability across aggregators and years. Overall, the highest FROI in 2019, for ECA, was still only 9%, in a context where the market cost of capital was around 18%. In fact, ECA was the only aggregator with positive (unsubsidized) profits from the MAAP expansion in both 2018 and 2019. SAN-JFS and MozAgri had profits one year but losses in the other. Amarula Farms, New Horizons, and Vanduzi had net financial losses (before subsidies) in both years. Vanduzi's FROI was -50% in 2018.

Except for SAN-JFS, which had weather difficulties in 2019, all the firms did better (i.e. their profits rose or losses declined) in 2019 than they had done in 2018. This is consistent with the hypothesis that as growers become more experienced, they became more valuable to the firms. So it seems likely that (in the absence of public support) aggregator firms that want to expand will need to be prepared to lose money initially, in the hope that the added growers will become more profitable to them over time.

Role of excess processing capacity

Excess processing capacity was a serious concern before expansion for several firms and the aggregator expansion helped to reduce it. Low capacity utilization at baseline was an issue for all aggregators except Amarula Farms (which was also the only aggregator that did not add value to its sponsored product, sesame seed). The CHVM-Maragra sugar mill was operating at 74%, the ECA maize mill at 50%, the MozAgri abattoir at 31%, the New Horizons chicken abattoir at 30%, the SAN-JFS cotton ginnery at 28%, and the Vanduzi horticulture packhouse at 40%.

In 2018/19, after the grower expansion, capacity utilization at ECA was 100%, and it reached almost 100% at CHVM/Maragra and the MozAgri abattoir.[61] SAN-JFS reported a pattern of growth and then decline of capacity utilization, from 28% in 2016/17 (baseline), up to 49% in 2017/18 (early post-expansion) and back down to 32% in 2018/19 (full post-expansion). The capacity utilization issue at SAN-JFS is different from that of the other aggregators. Since SAN-JFS holds a regional monopoly concession, it processed all cotton grown in the region both before and after expansion of the grower program. Its capacity utilization is to be driven by overall regional cotton production, which, in turn, closely follows the variation in rainfall patterns and prices of competing crops, especially maize.

Access to raw material as the firm's motivation

Firms can be divided into two distinct groups on this issue. The desire to access more land to increase the supply of raw material is often suggested as a motive to expand contract farming in environments where firms have limited possibilities of acquiring their own land (Barrett et al. 2019). But in the MAAP case, five of the aggregators had access to land through DUATs (Government land usufruct leases): Amarula Farms, CHVM, MozAgri[62], New Horizons, and Vanduzi. In contrast, ECA only had land rights for the site of their industrial premises, but no agricultural land. There was a clear need to deal with external growers (contracted or not) for securing raw materials for SAN-JFS and ECA. In contrast, Amarula Farms and New Horizons both operate in-grower schemes which facilitated access to land for their in-growers, who (in turn) cited this access as an incentive to work with the firm. These two firms have also experimented with outgrower programs to further increasing their access to land and more raw material. However, New

[61] Data not available for Vanduzi or New Horizons; at New Horizons, the in-grower program took off much more slowly than forecast (about 30% of forecast). While it is believed that their production nonetheless would have increased capacity utilization of the abattoir in 2018/19 over what it would have been without expansion, other major developments during the same time period (principally a major disease outbreak within the New Horizons grounds leading to major culling) made it impossible to demonstrate this.

[62] MozAgri land use was not for goats.

Horizons, Amarula Farms and Vanduzi all cut back their outgrower efforts either shortly before or during the study period. Their motives for doing so included: difficulties in providing security, extension services, pest and disease control, achieving timely delivery of inputs, and ensuring repayment of loans from the outgrowers. Where the raw material is both high value and inherently risky (as in disease risks for livestock and poultry husbandry), risk sharing with contract growers is seen by aggregators as especially beneficial.

Relevance of hired labor supervision cost as a motive for aggregation scheme expansion
In some products, the high supervision cost of hired labor can provide a powerful incentive for aggregation (Delgado 1999). Poultry, for example, requires twice-daily supervision during the growing period - which is typically at least six periods of 45 days per year for broiler chickens in Mozambique. Yet margins are thin, in the order of 2% to 4% , and neglecting a single task can lead to the loss of a whole batch to disease. Under these conditions, adequate supervision is difficult to finance. So, it makes sense to give the on-farm manager a strong financial stake in doing things right at all times. For other crops, such as maize, supervising hired labor might be more feasible, but commercial maize growing might not be possible due to land allocation issues.

Firms have other motivations besides profitability
Financial sustainability is necessary for businesses to prosper, but it isn't the sole factor in firms' decision making. Generally, we found that the commercial focus of most of the contract growing systems we studied was strong. But there are interesting nuances in the cases of Amarula Farms and Vanduzi. Amarula's contract growing of rainfed sesame helped attract donor funding, which the firm's most important revenue source; and its use of in-growers helped to establish land occupancy. These business motives are separate from the robustness of the commercial sesame growing system as such. The commercial orientation of Vanduzi's out-grower program was undone by the firm's excessive cost structure and corresponding loss of competitiveness. But we observed non-financial motivations in all the firms we studied. Even when commercially anchored, all the business models prioritized constructive community engagement through contract grower activities, transparent marketing, and employment generation.

6.3. What were the limiting factors from the firm's point of view?

Ability to expand without incurring major new investments in fixed plant is a key consideration
The balance between input supply and processing capacity is a key element of the economics of the outgrower systems we studied. Most of them did not require large scale investment in processing plant to make the expansion of outgrowing feasible. On the contrary: they had spare processing capacity and their key requirement was the expansion of input supplies. The exception was New Horizons – and the consequence there was negative profitability within the time horizon of this study. But once processing capacity utilization is high, as was the case for several aggregators by 2019, the cost of financing new installations would need to be factored into the cost of further expansion. Given the lumpiness of much of the available plant, this in turn, would likely call for bigger grower expansions to supply inputs for the new processing capacity, adding additional elements of risk to any expansion decision.

Access to working capital limited outgrower system expansions
Most of the firms we studied faced constraints to their ability to access credit for working capital. This explains, in part, why most of the expansions were limited to a relatively small cohort of new growers. Faster expansion would require significant increases in their capacity to mobilize working capital, so the threshold effect of borrowing limits would become a binding constraint.

Aggregator-level averages mask big variations in outcomes across the new growers

The performance of new growers varies considerably, which might give the aggregator a motive to "cherry pick" the best performers for subsequent years.[63] This may increase the profitability of the aggregators - but could also create resentment among growers who are dropped and tend to limit the scale of expansion in terms of the number of new growers who are supported over time.

Limited managerial capacity

The success of aggregator schemes depends as much on operational and management considerations as on agronomic issues. Our close monitoring of the firms involved with MAAP over three years highlighted the limiting effect of the shallow cadre of Mozambican managers with the combination of skills and experience needed to run such systems. Foremost among these skill needs are: (a) a commercial orientation towards adding value to the raw material, willingness to share risks and a commitment to the long-term growth of the business; (b) financial, and business management skills in general; (c) a practical understanding of production and processing issues; and (d) local knowledge and empathy. To support fast expansion, many of these leadership skills would likely need to be imported.

Irrespective of whether the leaders are foreign or national, given the limited profitability and high risk in aggregation systems, attracting such managers is difficult. In most cases, firm locations are undesirable (e.g., limited public services and educational options), so compensation may have be high to attract managers fitting this profile. Being a manager can also be dangerous. One aggregator participating in MAAP suffered crop burnings that might have been caused by disgruntled employees; another experienced the murder of an owner/manager's son, and a separate office invasion and staff assault; and yet another, a home invasion and robbery. An extensive discussion of issues linking aggregator success to management capacity can be found in the MAAP Final Evaluation Report (OzMozis Lda 2020).

Commercial agriculture in Mozambique is an inherently risky venture

Uncertainties and risks limit the expansion of agribusiness firms. Weather is especially fickle in Mozambique. Cyclones Idai in Central Mozambique and Kenneth in the North both struck during the period of the current study (in 2019), leading to 15%-20% declines in agricultural production in some zones (World Bank 2019). Although in these cases a direct effect on the evaluated aggregator firms was not reported, the risk element needs to be factored in. Such weather risk is likely to increase with climate change (Ibid.). Market risks are also high. Mozambique is for the most part an agricultural price-taker, so fluctuations in world and regional markets determine what aggregators can pay. Unpredictability of domestic prices is further amplified by unpredictable exchange rate changes, as was shown in Section 2.5.

For products with locally available spot markets, side-selling by growers who have received credit from aggregators is another risk. When open market demand for the aggregated commodity is high, some growers will opt to sell to third parties at the high spot price, rather than to the aggregators at the lower contract prices that factor in loan repayment. However, intriguingly, side-selling was only found in SAN-JFS cotton aggregator. This occurred, in spite of its remote location and the fact that it is a bulky non-food product requiring industrial transformation and legal monopsony – all factors that might be expected to

[63] We have not at this stage investigated this proposition, as our goal with this first report was to assess how average benefits compared to average costs. However, the data allow for this inquiry, which the team plans to investigate in future work.

reduce or eliminate side-selling.[64] So, this finding runs counter conventional theory about what products are most exposed to side selling (See Box 5)

Finally, policy risk is always present. The government intervenes in myriad ways in agriculture and transport in Mozambique (World Bank 2019). Although Government policy is generally intended to be benign to aggregators, the unintended consequences of policy changes can be severe.[65] The future viability of agribusiness in Mozambique will depend greatly on how the Government handles the real exchange rate effects of the huge resource inflows projected from 2021 onwards from oil and gas development in the north. Such decisions will, in turn, affect the rate of return for agriculture, which uses non-tradable inputs (such as land and labor) to produce tradable outputs (World Bank, 2020).

6.4. The potential to support better rural jobs through subsidies to aggregator businesses in Mozambique

This section builds on our findings regarding the benefits from the expansion of aggregator businesses and their distribution between growers and firms. If profits are sufficient for firms to raise capital commercially, the expansion will be privately sustainable without the need for public support. However, if firms' (risk adjusted) returns are modest, a subsidy might be an effective way to catalyze an expansion. To determine whether a subsidy is justified from a public policy standpoint, we need to take account of grower benefits, other labor externalities linked to job creation in the value chain (such as transport workers) and social benefits. Our results suggest that in the initial phase of an expansion, the level of returns and their distribution between actors is such that many aggregator firms will not expand much on their own. However, there is a potential for a catalytic up-front subsidy to jump start a sustainable expansion process.

Donors in Mozambique have understood the potential to generate developmental benefits by offering funding to rural firms. Many programs seek to deliver public goods via private agents and to multiply the impact of their funding by leveraging private capital. Although the MAAP study sample was selected from firms that were using smallholder suppliers, without considering other public goods considerations, many of the firms studied had received public or donor funding at some point. Others were beneficiaries of public policies such as concessions which create local monopsonies. However, donor funding is rarely informed by an estimation of the benefits to smallholders or other public goods effects. Some firms (which we might call "aid entrepreneurs") are successful in mobilizing quite large amounts of subsidy, relative to the likely size of externalities from their businesses. Some are even able to get more than one donor involved, possibly getting double subsidy for the same activity.

[64] Some recipients of credit tended to use the inputs for non-cotton crops or sell the cotton in another person's name to avoid repaying the credit.

[65] Two industries in which aggregators worked were strongly influenced by government policy: cotton and sugar. Otherwise, support from government, e.g., to resolve licensing or fee issues was limited (and not necessarily sought by these private sector operations). All aggregators were linked to the government through licenses, taxes, transit and inspection fees, and official minimum wage rates.

Box 5. Comparing MAAP's findings with the literature on success factors for aggregator schemes.

Some of our findings run counter to the established literature on success factors for contract farming. Circumstances considered conducive to contract farming were discussed earlier (Section 2.3) and are reviewed in Minot and Bradley Sawyer (2016). Perishable commodities whose quality is not easily observed at the time of sale, like fresh milk, are considered good candidates, due to: high quality differentials in pricing, the sellers knowing better than the buyer what the true quality is; and sellers being vulnerable to a danger of losing entire cargoes if buyers do not purchase in a surplus situation. Non-perishable commodities may also be suitable when markets are sensitive to hard to observe attributes, such as the tannin content in grains. Other crop-specific conditions listed as conducive to contract farming include:

- consumers' willingness to pay premia for some varieties;
- having a high value-to-weight ratio;
- technically difficult production, where contracting firms can reduce growers' production costs through technical expertise and specialized inputs.
- when a capital-intensive processor needs a steady and reliable flow of raw materials.

In this context, ECA's results stand out as counterintuitive: maize fails the first three conditions listed above and is thus generally not considered suitable for contract farming. Nevertheless, we found positive effects for the firm and growers. In this case, the firm's linkage to a specialized niche market for the product (maize grits for brewing) seems to have been important. ECA enters the local market paying market spot prices – which eliminates the issue of side selling. The firm's drying facility allows it to buy moist maize early in the season, at competitive prices, when few others are buying. ECA keeps separate the financing arrangements for inputs. In fact, about three quarters of the farmers it buys from, don't get inputs from ECA. But those that do, repay their loans: ECA achieved 100% repayments. This indicates that even in a setting where there is a competitive spot market, farmers are reluctant to lose access to a large, strategically positioned buyer by defaulting their loans.

In the case of Vanduzi (baby corn), production is technically demanding, there is a high value-weight ratio, it is perishable and it targets an export market. These crop-related factors all make it likely that growers will benefit from contract farming, which was the case. However, the scheme did not work out for the firm and was abandoned. High transaction costs for technical support and transport were crucial.

In the case of SAN-JFS, (cotton), the negative effect on grower income appears counter-intuitive, since cotton is recognized as well-suited for contract farming. The explanation is that in this case, we were not comparing contract farming to non-contract farming. We were studying the intensification of existing contract farming (compared with less intensive contract farmers). However, the fact that SAN-JFS apparently lost out due to side selling is counter-intuitive, since there is no other ginnery in the area. The take-away is that even monopsonies are not impervious to side-selling: growers can circumvent contracts, in this case by selling under a different name or through relatives.

Similarly, Amarula's experience (sesame) also suggests that the buyer firm's attributes were crucial. The program's closure was not due to side-selling. Rather, the absence of value-added activities by the firm, undermined the motivation for continuing the program. It seems likely that the ingrower scheme was initially set up to strengthen the political case for the granting of the DUAT (usufruct tile to the land).

Since we are focused on understanding the marginal commercial viability of these systems, our base calculation of firms' financial returns omits any revenue from donor funding (including the participation incentive payment (PIP) offered by the MAAP program). However, to understand the marginal impact of modest subsidies on firms' returns, we recalculated the returns including the PIP as part of the firm's revenue. This gives us a measure of the firms' total private return from the MAAP-supported expansion (Table 5.5, above). The PIP amounts were in all cases modest, both in relation to the firm's total budget for the expansion; and in relation to the number of jobs supported. The total amount per firm ranged from $50,000 to $130,000; and the ex-ante estimate of the PIP per job supported (outgrowers, ingrowers and direct hires linked to the expansion) ranged from $14 (CHVM) to $393 (New Horizons). The total MAAP budget for PIPs was $835,000 and the ex ante estimate of the number of jobs supported was 15,000, giving an average PIP of $56 per job (MAAP Operations Manual, Table 1, page 10). The final amount of PIPs paid to the six firms which completed the study was $671,000 and the average per firm was $103,000 (Table 5.5, above). These parameters mean that (although they were not designed for this purpose) the PIP payments represent a plausible proxy for public subsidies in a range that might be fiscally viable (that is, they are comparable to the cost-per-beneficiary of many agriculture and social protection programs).

Given their modest size, it is remarkable how large an impact the PIPs had on the financial viability of the expansions in the first two years. Only one firm (ECA) had a positive cash flow without the PIP. In three of the six cases analyzed (Amarula, MozAgri and JFS), the PIP made the difference between a negative and a positive cumulative cash flow from the expansion. But two firms (New Horizons and Vanduzi) still had negative cashflows, even after the PIP was incorporated (Table 5.5, above).

6.5. Optimizing the allocation of subsidies to promote better rural jobs

An optimal subsidy strategy would aim to maximize the jobs effects from a given subsidy budget. To avoid dead weight loss, the instrument design should aim to "discover" the subsidy amount needed to trigger the investment (and avoid paying more than that). Projects should then be ranked based on the expected jobs effect (proxied by the JLE) per dollar of subsidy needed to trigger viability (Robalino, Romero and Walker, 2020).

In this section, we estimate the subsidy amount that would have been sufficient to raise the private rate of return for firms to 20%, which is close to the market cost of capital for agribusiness investments in Mozambique which prevailed during our study period. The required subsidy ranges from just over US$7,000 for Amarula Farms to more than US$400,000 for New Horizons. In most cases, the required subsidy would be small, relative to the total expenditures by firms on their expansion growers. In four of the aggregators (Amarula Farms, ECA, MozAgri, and New Horizons) it is below 25% ; and for SAN-JFS it is 33% (Table 6.1).

Supporting the expansion of private aggregator systems is in line with the "maximizing finance for development" philosophy of leveraging private investments linked to public goods creation. However, for this purpose we also need metrics for the public goods. So we compare the required subsidy amounts to our estimate of the jobs-linked externalities that the expansions generated, based on our household data. In three of the six cases (MozAgri, ECA, and Amarula Farms) the social returns are clearly large enough to justify the necessary subsidy. The other three firms had much higher per-grower costs for the expansion; and the subsidy amount required to make them viable dwarfs the estimated labor externality (Table 6.1).

Overall, our results support the case for using public subsidies to catalyze an expansion of aggregator systems in Mozambique and similar economies, where policymakers aim to improve smallholder growers' welfare through increased agricultural commercialization. Well-designed public programs could

potentially leverage significant amounts private capital to expand aggregator schemes that produce long-term benefits for participating growers and are viable for the firms, without the need for ongoing public subsidy. The next challenge is to design program instruments that identify viable, labor intensive programs, optimize subsidy allocations and factor in financial sustainability concerns.

Table 6.1. Subsidy amounts required to achieve 20% private returns, compared to estimated labor externalities from the outgrower expansion (2019, US$)

	Amarula Farms	ECA	MozAgri	New Horizons	SAN-JFS	Vanduzi
Total profits from expansion, 2019	-1,044	51,633	20,751	-37,889	-50,014	-58,028
Subsidy required to get to 20% return	7,079	68,161	48,669	439,645	113,197	81,444
Required subsidy per grower (US$)	**67**	**30**	**15**	54,956	444	740
Total expenditures by firm per grower	287	296	104	251,098	1,239	1,064
Subsidy as a % of aggregator expenditures on expansion subsidy	23%	11%	14%	22%	36%	70%
Estimated annual labor externality (LE) per grower generated	60	31	38	65	-158	30

Note: LE is labor externality as measured by the treatment effect of participation in the MAAP expansion.

7. Policy implications and recommendations from MAAP study

This chapter discusses the implications of the MAAP findings for policies to support smallholder welfare.[66]

7.1. Scope for generalizing MAAP findings

The focus of this report is solely on aggregation and contract farming schemes. Its focus is the potential for public policy to shift interactions between smallholders and aggregators in agricultural value chains to facilitate a higher-level equilibrium. It is motivated by the wide-spread promotion of contract farming and aggregation coupled with the absence of clear guidance from the research literature on the appropriate level or form of public subisdies[67].

Our main messages apply to a wide spectrum aggregation models. Our findings show that public subsidies to support the expansion of private aggregation schemes are often justifiable, based on the income gains for poor farmers, coupled with the commercial viability of the scheme once the (subsidized) expansion has been implemented. An assessment of the national and regional circumstances under which MAAP

[66] These are conclusions based on the analysis and content of the Final Evaluation Report (OzMozis Lda 2020) but are not explicit messages from that report.

[67] There are many other policy options for supporting smallholder development apart from aggregation, but they are beyond the scope of this report. Some examples include: farmer owned and managed companies, warehouse and processing infrastructure-based approaches, digital Agtech, e-commerce and fintech enabled approaches, and introducing quality standards linked to price incentives.

took place suggests that the main messages are applicable beyond Mozambique to similar low-income contexts (see Box 6 for discussion).

Box 6. The external validity of our findings

The generalizability of the main messages hinges on the finding that there are viable aggregator schemes that (sufficiently) benefit growers and are also financially sustainable, but are not profitable enough to attract investment in a private market ,unless the full benefits to growers and to the country as a whole are factored in. The argument for generalizability is that the results are based on a consistent methodology applied to a broad array of value chains, crops, firm profiles, and program designs.

It seems unlikely that the turbulent macroeconomic and climatic context overly determined the observed outcomes. In 2019, MAAP-monitored firms did not report agricultural output or operation costs being affected by the cyclones. These contextual factors do not appear to have overly affected firms' access to credit or lending rate (Box 4, above). Price fluctuations in the sponsored crops were also unlikely the have been the underlying cause of the findings. Prices paid to growers were at least partly based on idiosyncratic factors in multiple firms; in ECA (in part) connecting with a beer company, in Amarula finding an exporting buyer. Exogenous price flucations *did* affect some comparison growers in the case of the CHVM evaluation, so our estimates could overstate effect of involvement in sugar cane production. Another instance where price flucations could have distorted results is maize. Its price surge in 2019 caused by the cyclones could be considered a windfall mainly for treatment growers. However, 2018 results, prior to the cyclones' landfall are also positive (see OzMozis Lda 2020).

Beyond the statement that there are opportunities for public support of aggregators, this study does *not* propose or recommend a specific form of support. Conceptually, public sector support was stylized as a subsidy and the range of *values* of subsidy that might be justified was estimated.

These findings open the way for carefully considering *how* aggregators ought to be subsidized. *Direct transfer of funds to firms* is one form of subsidy. It can leverage private investment and allows firms to optimize the use for the funds (section 6.3). But there can also be challenges to this approach. One is the fiduciary risk of firms committing to long-term expansions but then not delivering. Our study showed this in the case of Amarula, whose expansion had high private returns that would allow operations to continue and seemed to benefit the growers, but did not expand long term.

Other forms of subsidies may be more appropriate. One possibility is *upgrading transport infrastructure, shared facilities (such as packhouses) or power supply* to improve the profitability of aggregator schemes that use them. This is less direct than a targeted transfer to a specific firm, so its effect might also be more diffuse, but it is more clearly linked to a public good (or quasi-public good) so it may be easier to justify from a policy perspective than grants to commercial firms. Another possibility is *facilitating training and skill acquisition*, since having staff with requisite skills is a prominent challenge for aggregator arrangements (for firms *and* growers) and the training of participants is often an important cost element of the schemes' expansions. This might involve both the skills of growers and the skills of technical supervisors and managers. In this case, risks include the likelihood that trained staff are poached by other firms.

7.2. Design issues for subsidies and incentive payments for expansion programs

The design of effective subsidy programs and their implementation is an important challenge and it is not the subject of this report. Not all subsidy programs have positive effects - and some might be damaging. Badly designed subsidies can have the effect of undermining businesses rather than strengthening them.

The *quality of the firm's business model* should be a criterion for selections of firms for support.[68] The existing literature on predicting start-up firm success may provide guidance on methodologies to investigate.[69] Both Amarula Farms and Vanduzi saw donor funds skew their business models and firm viability. The former's contract growing helped attract donor funding (the firm's most important revenue source) and, in the case of in-growers, to establish land occupancy. After receiving donor funds worth 4.5 times its revenue over 2017-2019, Amarula Farms cancelled its contract grower programs to focus on donor supported horticulture. Similarly, cheap funds shielded Vanduzi from market challenges and its excessive cost structure (largely overhead) eventually[70] led to a loss of competitiveness and cancellation of its contract farming.

When subsidies are directly transferred to firms, *project designs should be clear about what can be funded with the public resources and avoid incentives for overstatement the of costs.* In preparing proposals for the MAAP contract grower expansion programs, most aggregators appear to have over-estimated the cost of their expansion program and under-estimated the time required for implementation. Some also under-achieved on the proposed number of incremental contract growers.

We only analyzed the expansion of *existing schemes*, where the main incremental investment is working capital. The existence of a functioning, successful scheme reduces the level of uncertainty linked to the incremental investment. There are greater risks when fixed capital investments such as a new processing plant are needed for launching a new aggregator program.

Finally, *a longer time horizon is needed to confirm the robustness of our findings*. Idiosyncratic factors (such as price fluctuations driven by weather events or macroeconomic changes) can cause a lot of "noise" in outcomes over the short term. But even in the three year time horizon of this study, there were signs that "learning by doing" was gradually producing better outcomes. In the case of Amarula, the change in the plot size allocation the firm afforded to ingrowers from the first- and second-year improved program results. In ECA, many growers "graduated" from being loan financed in year one to being self financed in year 2.

8. Conclusions

Scope of the study and business models of the aggregators studied

[68] Important dimentions in the assessment of magnitude of benefits to growers while other dimensions related to aggregator financial performance: whether the aggregator will be financially sustainable once it is put in motion and that it is not so profitable that it doesn't need the loan. Our study suggest that the financial aspects are likely most challenging since most aggregator showed benefits to growers.

[69] Research suggests it is possible to form sensible prediction of business performance (such as see Scott et al. 2016). For example, Astebro and Elhedhli (2006) investigated the heuristics used in scoring business proposals and showed successfully predicted sucesfully launching a business with 80% accuracy. Recently two studies of business plan competitions, Fafchamps and Woodruff (2016) in Ghana and McKenzie and Sansone (2017) in Nigeria, have shown expert panels can also have some success in ex ante assessment business outcomes.

[70] Vanduzi was undergoing a change from a donor-dependent to commercial orientation at the start of MAAP and had not yet tested whether the outgrower model was financial viable.

MAAP assessed income growth for smallholder growers and firms resulting from an expansion of established aggregation schemes. We studied seven firm aggregator scheme expansion programs, each working with a different crop/product, that connected over 7,500 growers to agricultural value chains. The contractual relationships between aggregators and growers was varied. *SAN-JFS' scheme (cotton)* is a classic case of contract farming: the firm provided inputs on credit and provided extension advice to out-growers in return for mandated sales of product to the firm at a regulated price, from which credit repayments were deducted. *New Horizons (poultry)* and *Amarula Farms (sesame)* operated in-grower schemes where growers operated in company-owned facilities and on company land. The expansion growers for *Vanduzi (baby corn/horticulture)* were out-growers, but the firm decided half-way through MAAP to refocus on hired labor. *ECA (maize)* provided credit to some farmers for inputs and technical advice without creating an obligation to sell the product to them, but achieved good procurement of maize on the open market and 100% voluntary repayment rate for the credit line. It channeled the finance through credit clubs and it could pay above spot market prices for maize due to its drying facilities and its contract to sell maize grits to a beer company. *MozAgri (goats)* did not have any contractual or credit relationship with growers but was reputedly the most transparent and best paying outlet for growers to regularly sell their goats in the remote region where it operated. It paid in cash and provided transport to take the animals to its abattoir which was some 250 km from the growers. *CHVM (sugar)* is a coop which supports growers whose sugar is sold to the local refinery (Maragra) at the nationally regulated price. Although the refinery provides some technical support, it is not otherwise engaged in supporting the growers.

Farm incomes

The net gains to expansion growers in 2019 compared to comparison groups (the "Labor Externalities" from the aggregator scheme expansions) were estimated in the range between US$30 and US$60 per grower household. That's an appreciable amount. Average household incomes ranged from US$91 (for MozAgri non-participating growers in the same community as MAAP expansion growers) to US$696 (for experienced baby corn contract growers at Vanduzi).[71] The benefits to expansion growers (the positive "labor externalities") are the returns from overcoming market failures they faced as independent smallholders. On average, the contract relationship benefited all groups of MAAP expansion growers, with the exception of the SAN-JFS cotton scheme. The latter focused on intensifying the production of existing out-growers rather than on expanding the number of growers, and idiosyncratic factors affecting all cotton growers appear to have been at play in undermining the intensification effort. We also found that the expansion growers in most schemes hired additional temporary labor, generating further jobs benefits.

Aggregator profits

The story was somewhat different for firms. Before the expansion, most of the aggregators were operating their processing facilities at 25% to 50% below capacity, leading to optimism about the potential to profit from an expansion of outgrowers. Yet the results of the expansion were mixed. Half the firms lost money on the expansions in the 2018 and 2019 production years. However, results were better in 2019 than 2018. Since 2019 was a more difficult year for agriculture in terms of climate, it seems likely that the new growers were more valuable to aggregators in the second year, even if they were still not

[71] This range excludes CHVM, where far wealthier households (US$1,363 to US$5,908) participated in the irrigated sugar scheme.

profitable.[72] The best results in 2019 were for ECA, which logged a US$51,633 in profit from expansion; and the worst was SAN-JFS, which logged US$50,014 in losses from promoting the intensification of existing growers. Firms' financial returns on investment (FROI) associated with allocating working capital to grower expansion ranged from a worst case of -50% (Vanduzi) to a best case of +9% (ECA). We conclude that overall the short term gains to the aggregator firms from the expansions were underwhelming. To undertake these investments, firms would have to be prepared to carry the short term losses and expect future returns to improve as new growers are consolidated and become more experienced. Some firms might be more willing and able than others to take that risk.

The distribution of benefits between growers, aggregators, and society at large

As summarized in the previous paragraphs, in most cases, the expansion growers did better than the aggregators. In addition, the expansions likely produced additional social benefits not directly captured by either growers or aggregator firms. Examples include: growers acquiring new commercial skills, and the multiple spillover effects from new money circulating in poor villages. We did not make specific estimates for these social externality effects. We simply added a multiplier of 20% on top of the gains to growers to indicate their likely order of magnitude. The sum of the Labor Externality (income gain to growers) and the social gains from better jobs is called "Jobs Linked Externality" (JLE) of the expansions. We saw in Chapters 6 and 7 that JLEs were substantially greater than firms' financial profits. The ratio was about 8 to 1 for Amarula Farms and MozAgri, and 2.5 to 1 for ECA).[73] JLEs were positive for New Horizons and Vanduzi, but the firm's financial profit was negative. In the case of SAN-JFS, both firm profits and JLEs were negative and about the same order of magnitude (-US$50,000 to -US$58,000), suggesting that the pain was shared.[74]

Firms may lack the incentive to expand aggregator systems

The expansion of the aggregation systems generates clear benefits for the growers and for society at large, but the gains for the firms which organize the expansion, provide the finance and carry the risk seem often not to materialize in the first two years. This skewed distribution of costs and benefits between firms and growers may help to explain why most of Mozambican growers are stuck in a "low level equilibrium", unable to overcome the gamut of market failures which hinders their productivity and income growth. Only 11% of Mozambique's smallholder growers are involved in contract farming arrangements. This also provides a strong justification for using public resources and policies to support the expansion of these systems. Two areas of inquiry pursued by MAAP can help to orient the design of such policies. First, what grower characteristics are most valuable to firms, and what can be done to develop these characteristics further and spread them more widely? Second, what is the scope for public transfers to firms to internalize part of the social benefits generated from their aggregation schemes, which they do not capture directly in their commercial financial returns?

Potential for jobs and employment generation

[72] This result is speculative given the small number of cases examined and insufficient control for other factors affecting the profitability of new growers for farms in both years, but it provides an enticing thought for follow-up work.

[73] This relationship is also expected to apply to CHVM, where JLEs amounted to nearly US2 million in aggregate, but we lack the profit data for Maragra to make the comparison.

[74] As noted above, firm financial returns for SAN-JFS are not comparable to those for other aggregators, as all growers of cotton in the concession area are SAN-JFS growers by definition. Thus the financial results for SAN-JFS are based on the full costs and returns to the firm for expenditures on those growers selected for intensification by SAN-JFS, not just the added cost of intensification.

As well as increasing their own incomes, participating growers often create employment on their farms, for short-term, seasonal hires for land preparation, weeding or harvest. These jobs are important given the absence of employment opportunities in rural communities, but they are not high-quality positions. Employment is also created by aggregator firms through contract grower expansion programs. Overall, the numbers of wage jobs involved in field activities are not large. More jobs are generated in processing, where also women are more likely to be hired. In the local context, these are generally "quality" jobs. "Quality" and higher paid jobs are also created in management and trade roles of processors.

Potential role for subsidies for scaling up aggregation

Overall, our results support the case for the selective use of well-designed public subsidies to catalyze an expansion of aggregator systems in Mozambique and similar economies, where policymakers aim to improve smallholder growers' welfare through increased agricultural commercialization. However they also show the need for selectivity: based on our findings, almost half of the aggregator schemes we studied would *not* justify the level of subsidy needed to make them viable.

We estimated the amount of subsidy that would be needed to raise the private rate of return for the aggregator firms to 20%, which is close to the prevailing market cost of capital for agribusiness investments in Mozambique. The required subsidy ranges from just over US$7,000 for Amarula Farms to more than US$400,000 for New Horizons.

In most cases, the required subsidy would be small, relative to the total expenditures by firms on their expansion growers. In four of the aggregators (Amarula Farms, ECA, MozAgri, and New Horizons) it is below 25% ; and for SAN-JFS it is 33%. We then compared the required subsidy amounts to our estimate of the jobs-linked externalities that the expansions generated, based on our household data. In three of the six cases (MozAgri, ECA, and Amarula Farms), the social returns are clearly large enough to justify the necessary subsidy. The other three firms had much higher per-grower costs for the expansion; and the subsidy amount required to make them viable dwarfs the estimated labor externality. These results support the hypothesis that there might be potential to expand aggregation schemes in Mozambique using modest and fiscally viable amounts of public subsidy. Well-designed programs could potentially leverage significant amounts private capital to expand aggregator schemes that produce long-term benefits for participating growers and are viable for the firms, without the need for ongoing public subsidy. The next challenge is to design program instruments that identify viable, labor intensive programs, optimize subsidy allocations, and factor in financial sustainability concerns.

Challenges in subsidy design

The design of effective subsidy programs is an important challenge and it is not the subject of this report. Subsidy designs should be incentive-compatible and be clear about what can be funded with the public resources. They should aim to crowd in private investment and avoid incentives for the overstatement of costs in proposals. Badly designed subsidies can undermine businesses rather than strengthening them. Our experience implementing the MAAP study suggested some lessons in that regard. Both Amarula Farms and Vanduzi saw donor funds skew their business models and firm viability.

The challenges of identifying firms and aggregator schemes with viable expansion potential

Finally, the MAAP study also generated many important practical lessons regarding the potential for working with private firms to generate better rural jobs outcomes in the difficult Mozambican context. The key challenge is to identify firms that are suitable to support and likely to successfully carry out an aggregator scheme expansion. The key characteristics needed for success identified in the MAAP study are as follows: (a) The business model of the firm needs to be fully commercial and financially viable; (b)

Firms should have a commercial dependence on contract growers to access the raw material they need; (c) The contract program's viability depends on an ability to provide support activities; (d) A transparent, predictable and fair business proposition for growers is essential; and, last but not least (e) Competent management is crucial and should be assessed independently of the other factors listed above.

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