Sustainable businesses development in post-conflict zones: a case in rural Colombia

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Abstract

Farmers in Colombia have faced economic instability due to a long-lasting armed conflict. An attempt to support the rural community has been through the creation of productive alliances--strategic associations between small--scale producers and processors with the assistance of the private and public sectors. This paper reports the situation of ASOPAY, an oil palm productive alliance formed by families displaced by the Colombian armed conflict and relocated in the eastern foothills of the Andes Mountains. This study addresses the long-term financial viability of this enterprise after the peace accord between the government and the guerrillas, and six months before farmers fully repay the debt incurred to startup operations. By closely examining ASOPAY's financial cashflows, the study investigates the challenges faced by small-scale agribusinesses in an emerging economy. This provides insights on key business strategies driving ASOPAY's financial success, providing a guideline for sustainable rural development analysis in post-conflict areas. A key finding is the critical role played by joint public-private efforts focused on improving net farm revenues for palm oil producers. In addition, technological transfers made through technical assistance programs may improve the association's profitability by enhancing agronomic practices, while decreasing palm mortality and disease incidence.

Keywords: oil palm, producer association, small business, sustainable rural development, post-conflict region

1. Introduction

Colombia is emerging from 50 years of armed conflict (Negret et al., 2017). In the last decades, many families were relocated by the government after being displaced by the civil war (Nelson, 2019; Potter, 2020). The migration caused major socioeconomic problems, aggravating poverty and crime throughout the country (Suarez et al., 2018). Families in rural areas were particularly affected by the relocation as their economy is based on self-sufficient agriculture and farming. In 2018, the World Bank Group (2020) estimated that 36.1% of the Colombian rural citizens lived with an income below the poverty threshold ($1.9 per day). Welfare losses due to this displacement are calculated to be 37% of the net value of rural lifetime consumption (Ibáñez & Vélez, 2008).

In 2002, the Colombian Ministry of Agriculture and Rural Development initiated the *Support to Productive Alliances* (AAP) project, with financial aid of the World Bank, in an effort to reduce the socioeconomic challenges faced by small-scale producers in rural Colombia (Parra-Pena et al., 2017). Productive alliances are strategic associations between small farmers and anchor companies with financial, marketing, and technical assistance of the private and public sectors. In this alliance, anchor companies offer technological transfer to farmers through the *Environmental and Social Technical Assistance and Audit Units* (UAATAS) program. Thus, productive alliances are designed to increase farmers income through enhanced market access and better management practices, while ensuring buyers with a reliable supply (Parra-Pena et al., 2017; Sanz et al., 2018). Since its creation, the AAP project has reached 49,000 households and established 802 productive alliances by 2014 (Marin-Burgos & Clancy, 2017).

The peace agreement signed between the government and the Revolutionary Armed Forces of Colombia (Spanish acronym is FARC) in 2017 offers the opportunity to de-escalate the armed conflict in the rural areas (Oliveros-Ocampo et al., 2020). Even though it faced some setbacks in recent years, this agreement is a milestone in creating opportunities for small farmers. In this

context, the productive alliances are seen by policymakers as a critical tool to generate inclusive and sustainable businesses (Lopez Barrera & Lowenberg-DeBoer, 2018). Evidence suggest that productive alliances may help link marginalized small-scale farmers to modern agricultural value chains (Carballo-Cruz, 2017; Poole & Donovan, 2014). Consequently, it is critical to better understand the challenges faced by the productive alliances in this post-conflict era to ensure their success.

This study highlights the case of ASOPAY, a Colombian oil palm productive alliance, created a decade ago by a joint public-private effort under the AAP umbrella. This association is comprised by 26 displaced families who were relocated in the municipality of Cabuyaro (in the department of Meta). By 2017, ASOPAY's members were debating different financial options: (1) continuing the productive alliance and stay in the oil palm fruit business, or (2) dissolving the association, selling the assets (land plus agronomic products) and dividing the earnings. This conversation occurred in sight of a financial milestone; they were close to fully repay the loan that allowed the association to launch the oil palm production project. As expressed by ASOPAY's members, "*being close to recovering our financial independence from the banks may allow us to also choose what to do with our lands in the future*".

Deciding on continuing or dissolving the association is a complex decision for each member. Every family has autonomy and a vote in the process (i.e., one vote per family). There are many factors to take into consideration: future value of money, palm mortality, incidence of diseases, plant rotation and maturity, opportunity cost of land, among other aspects. In this context, we develop a financial assessment that includes these factors to unveil the key profitability drivers of the productive alliance business model. Specifically, we consider the cost structure of the oil palm production and project cash flows throughout its life cycle to calculate the net present value (NPV)

of the enterprise. We then compare the NPV of continuing operations under business as usual with the alternative option of splitting the association and selling their assets.

In addition, we investigate the role of key public policies and private efforts on ASOPAY's financial success under: (1) changes on plant disease and tree mortality to highlight the role of the technological transfer to enhance agronomic practices through UAATAS, (2) uniform reduction of the oil palm fruit price which shows the importance of the National Biofuel policies and the *Price Stabilization Fund for Palm Oil* (FEP), and (3) transition towards more sustainable practices to meet the *Principles and Criteria of the Roundtable on Sustainable Palm Oil* (RSPO). Thus, by closely examining the situation, this case study aims to illustrate the challenges faced by small-scale agribusinesses in an emerging economy. Furthermore, in a broader context, the results from this study aim to inform similar post-conflict efforts focused on rural development and provide inputs for policymakers on the role of productive alliances and key strategies to provide feasible inclusive and sustainable businesses.

2. The context

2.1 The region

Orinoquía is a region in the Orinoco River watershed in eastern Colombia bordered by Venezuela and Brazil. It is east of the Andes Mountains and north of the Amazon River basin. Politically, it is divided in five departments: Arauca, Casanare, Guaviare, Meta and Vichada. This region exhibits high levels of land inequality, with half of the farmers owning only 10% of the land and more than one-third of farms being smaller than 500 hectares (Rodríguez Borray & Cubillos, 2015). Bad road conditions and constant floods during rainy season increase ground transportation costs and limit access to inputs and raw materials. Low

regional crop productivity further reduces revenue of the Orinoquía small-scale farmers, aggravating their socioeconomic conditions.

2.2 The Oil Palm Agroindustry in Colombia

The palm oil production has been steadily growing at a 7% annual rate for the past 20 years in Colombia, making it the second major national commodity after coffee. In 2019, the Orinoquía region accounted for more than one-third of the Colombian crude palm oil production, making this industry one of the largest sources of income for Orinoquía citizens, representing around twenty thousand direct jobs and thirty thousand indirect jobs in the region (Fedepalma, 2020). This growth has driven a significant rise in land devoted to palm, accounting for 230 thousand hectares (ha) in 2019, mostly at the expense of pastureland and former rice fields. However, some oil palm crops have been planted on forest gallery and riparian forests (Díaz Beltrán, 2017).

2.3 The traditional Colombian Oil Palm Supply Chain

The Colombian oil palm sector is organized in clusters, which are formed by a main node (anchor companies) and peripheral nodes. The main node produces oil palm fresh fruit bunches (FFB) in large scale and, it has an oil extraction mill where the palm oil is obtained. Peripheral nodes are comprised by small and medium sized FFB producers that sell their produce to the main node (Figure 1). This typical structure shows peripheral growers as a source of raw materials to the main nodes.

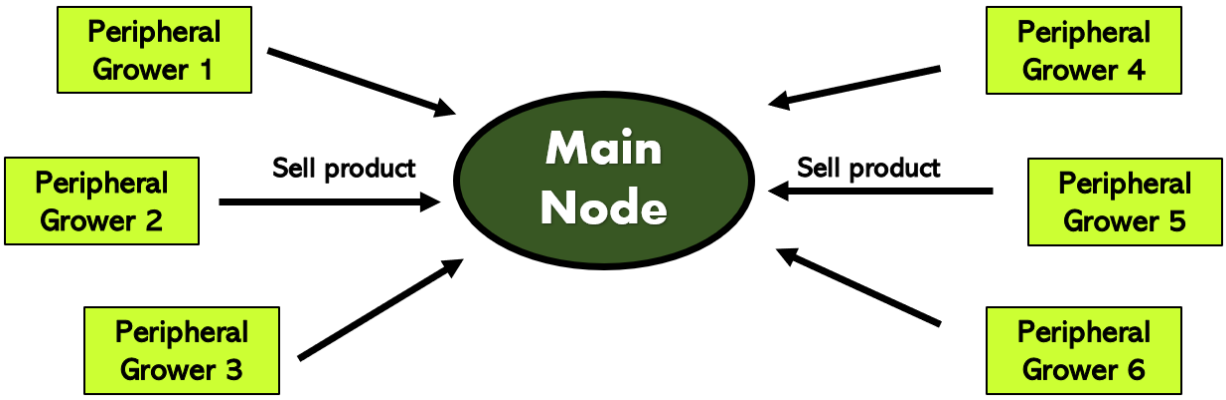

Figure 1. Illustrative example of a typical oil palm cluster, composed by six peripheral growers and one main node.

2.4 Productive Alliances

Productive alliances are strategic partnerships between small-scale farmers and processors (anchor companies) with assistance of the private and public sectors. The public sector coinvest – by subsidizing agrarian banks loan programs to launch agribusiness projects – with the small-scale and medium-scale farmers to facilitate their access to supply chains. The private sector supports small farmers by providing technical assistance through the *Environmental and Social Technical Assistance and Audit Units* (UAATAS) program. The joint private-public effort also ensures market access for farmers' produce by signing exclusivity agreements between producers and processor (Parra-Pena et al., 2017). The expected outcome is to provide a long-term source of income to farmers and their families, create employment, promote social cohesion of poor rural communities, and improve rural competitiveness. Productive alliances are an alternative form of cooperative, with the distinction that farmers agree to work collectively under the recommendations and supervision of the processor to ensure product quality.

2.5 Productive Alliances within the Colombian Oil Palm Supply Chain

With the development of productive alliances, there has been a change in this traditional view and, peripheral growers now consider anchor companies as strategic partners. Government funds,

administered by the *Colombian Federation of Oil Palm Growers* (Fedepalma)[1], have been used to promote the development of UAATAS in the oil palm sector. The UAATAS act as a mediator between the main nodes (mill plants) and the peripheral growers (organized allies). The traditional relation is preserved: members of the productive alliance provide oil palm fruit to the mill plants. But a new interconnection between both parties is added making them strategic allies: the main node also offers technical assistance to fruit providers as well as facilitating their access to credit, agronomic services, and machinery (Figure 2).

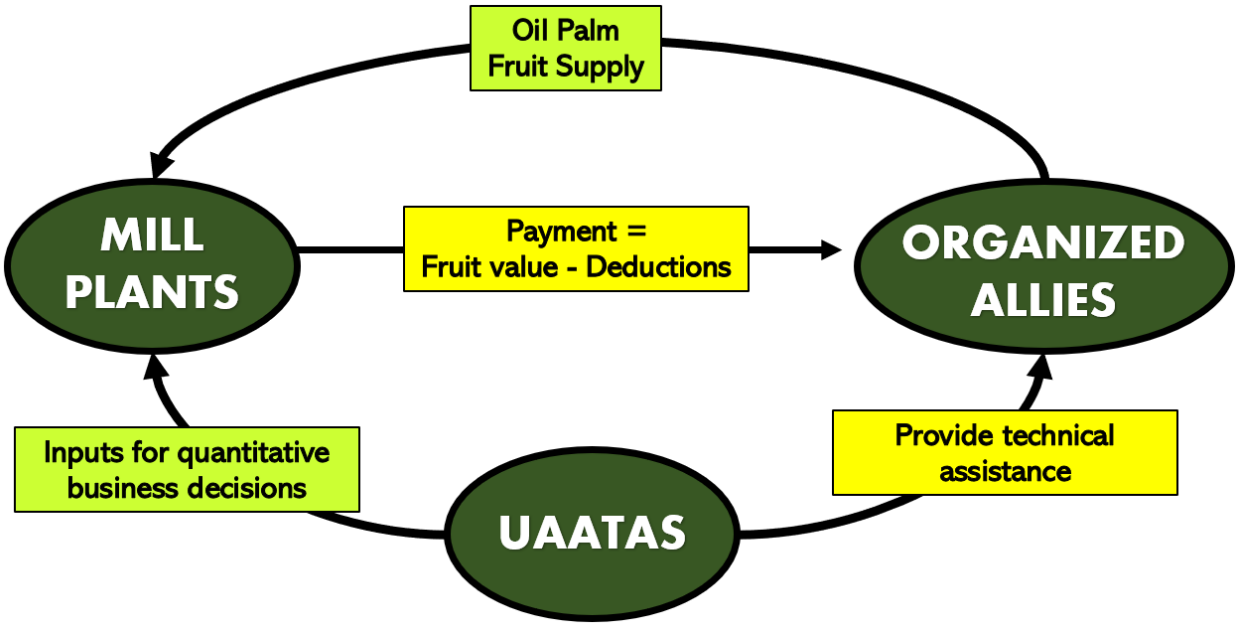

Figure 2. Strategic Alliances within the Oil Palm Supply Chain using UAATAS mediation.

The goals of the UAATAS are to (i) promote sustainable, environmentally friendly, and best production practices among the oil palm fruit suppliers and (ii) to provide access to productive inputs for low-income growers selling their palm fruit. This strategic alliance benefits both parties: The peripheral suppliers gain access to financing and receive assistance, while the main node

[1] Fedepalma is a private institution representing most oil palm growers from Colombia. Fedepalma motivates sustainable development for this agroindustry through programs that seek to improve yields, control pests, and implement sustainable practices.

benefits from a constant stream of raw material (i.e., FFB) with a desired product quality and healthier surrounding plantations.

This strategic partnership is crucial for small-scale farmers, who typically have limited access to credit and modern technologies. The main node acts as a guarantor, and the repayment of the loan is deducted monthly from the payment given to the organized allies. Likewise, the technical assistance offered through the UAATAS permits a more efficient technological transfer, enhancing the agronomic practices and land productivity, which ultimately increases the growers' revenue. Anchor companies also benefit from UAATAS as they can use more efficiently their mill productive capacity (Sanz et al., 2018).

2.6 The Price Stabilization Fund for Kernel, Palm Oil and their Fractions

During the 1980-2000 period, the oil palm sector in Colombia faced two adverse events. First, a collapse in the international price that disincentivized the exports of oil palm. Second, a significant growth in oil palm production that led to an oversupply in the domestic market which resulted in a decline in the corresponding domestic price (Mesa Guerra, 2018). Colombian farmers also face logistics challenges due to topographic conditions and lack of proper transport modes and infrastructure. This drives up transportation cost to ports. Thus, palm oil parity importing price tends to be larger than the difference between Bursa Malaysia FOB minus domestic transportation. In addition, Colombian palm oil production represents only 2% of the global production and less than 1% of global exports (LMC, 2021). Consequently, the Colombian price of oil palm is largely determined by the international prices (Mesa Guerra, 2018). As a response, the *Price Stabilization Fund for Palm Kernel, Palm Oil and their Fractions* (FEP) was designed in 1993 (Reina & Zuluaga, 2011).

163 The FEP was oriented to reduce price volatility and offer a stable domestic reference price to
164 Colombian oil palm producers (Reina & Zuluaga, 2011). The price established by FEP results
165 from taking the average between parity importing price and Free-On-Board price (from the Bursa
166 Malaysia price). Any sales at a market price higher than the reference price must pay a stabilization
167 transfer to the FEP. A sale at a lower price receives a compensation. Hence, the FEP reduces
168 stabilizes prices between domestic and international markets (Laguna, 2017; Tudela et al., 2004).
169 This has made the domestic market more attractive for palm oil producers, including Orinoquía
170 farmers.
171 The import parity price is used because Colombia acts as price taker in the global oil palm market.
172 This is explained by the fact that Colombia contributes with around 2% of the world palm oil
173 exports and palm oil production, while Southeast Asia countries account for about 85% of both
174 global production and global exports. In consequence, Colombian palm oil domestic price is
175 calculated monthly in reference to oil palm price at Malaysia and the price of other oil and fats
176 substitutes such as tallow (USA) and soybean oil (Argentina and USA). The Colombian reference
177 price also considers freights, insurance and nationalization tariffs. Additionally, since the
178 Colombian palm oil has been more costly than the one obtained at Malaysia and Indonesia (i.e.
179 Oil palm global market main players), Colombian producers have been less competitive in Global
180 markets, so they prefer to sell at the domestic market, which explains why most of the Colombian
181 palm oil production has been absorbed locally and why the biodiesel policy was implemented as
182 a means to keep Colombian palm oil at the inner market. The price of reference to compute the
183 cession or compensation equalizes importing parity prices and the domestic price. Thus, the
184 producers that sold the CPO at a lower price would be compensated in accordance with the
185 destination market (i.e., domestic or abroad). Normally, Colombian CPO exporters are located

close to ports and receive compensation while CPO producers selling in the domestic market are located at a greater distance to the ports and pay a cession. Note, cession/compensation mechanisms are applied to each unit of Crude palm oil that is sold above/below the reference price.

2.7 The National Biofuel policies

Since 2001, the Colombian government has implemented policies oriented to expand biofuel consumption by establishing mandatory blends of gasoline with ethanol, and fossil diesel with biodiesel (mainly, from palm oil). These policies aim to improve rural development, diversify energy sources of the country, and mitigate environmental pollution (Cortés Villafradez et al., 2012). Biofuels are also considered an alternative to reduce climate change impacts (Peña-Lévano et al., 2019). As a result, biodiesel production increased from 26 million liters (in 2008) to 508 million liters (in 2011), driving large expansions of palm planted in Colombia and creating employment opportunities in rural areas. Moreover, by establishing mandatory blends, The National Biofuel policies created a new niche market for palm oil, reducing downward pressure in prices (Cortés Villafradez et al., 2012; Mesa Guerra, 2018; Reina & Zuluaga, 2011). Hence, taking into account that climate change is an impending global concern, recently discussed in the Glasgow talks (Peña-Lévano & Taheripour, 2020), biofuels can be a viable and attractive option to support income generation in rural zones of Colombia.

2.8 The Principles and Criteria of the Roundtable on Sustainable Palm Oil (RSPO) certification

Global concerns on deforestation and labor use linked to the palm oil agroindustry have sparked debate in recent years. As a response, Colombia has transitioned towards more sustainable methods of production following the *Principles and Criteria of the Roundtable on Sustainable Palm Oil* (RSPO). The RSPO certification was created in 2004 and it is likely to be the standard for the palm oil supply chain in the short-term future (Mosquera & López, 2017). It is expected

that the RSPO certification will allow the productive alliances to comply with international regulations, and to keep exporting to other regions such as the European Union (main import destination) and the United States.

3. The background and current situation of ASOPAY and Hacienda la Cabaña

3.1 The oil palm processing firm: Hacienda La Cabaña

In Meta department, there are 23 palm oil mills, where oil is extracted from oil palm fresh fruit bunches (FFB). One of the largest operations corresponds to Hacienda La Cabaña. This company offers technical assistance to its fruit suppliers through UAATAS. Specifically, the consulting service is focused on technological transfer to bridge the productivity gap between the peripheral growers. It also promotes sustainability through the implementation of RSPO certification criteria among fruit suppliers.

La Cabaña's technical team is comprised by the UAATAS' coordinator Carolina Gonzalez and her assistant Jesús Vargas. Together they assist 20 productive allies in municipalities neighboring Hacienda La Cabaña´s oil palm mill: Villavicencio (with 442 ha equivalent to 14% of the total area planted by the allies), Cumaral (largest plantation with 1,058 ha - 34% of the total area), Paratebueno (1,137 ha - 25% of the total area), and Cabuyaro (with 844 ha - 27% of the total area). In terms of suppliers, according to Carolina Gonzalez, La Cabaña made an internal classification of its oil palm fruit suppliers in three groups: small-scale farmers (i.e., less than 50 ha of oil palm plantation), medium-scale farmers (plantations between 50 and 100 ha), and large-scale suppliers (above 100 ha).

3.2 The small-scale farmers' association: ASOPAY

ASOPAY is one of the productive allies that supplies oil palm fruit to La Cabaña on a regular basis. The association ASOPAY was established in 2004 as an organization with the purpose of

(i) promoting and providing sustainable, socio-economic, and cultural development to its associates, and (ii) preserving natural resources and the environmental quality.

La Cabaña originally offered the "alliance" to 30 families from different regions that had been displaced by the armed conflict and relocated by the Colombian government into the foothills of the Meta Department. In the original agreement, 26 out of 30 families accepted the proposal while 4 of them decided to follow other productive projects. On average, each family was provided with 7 to 8 hectares of land (comprising a total of 204 Ha). By the time our team carried out the field-visit, 24 out of the 26 original families were still part of the association. Two members sold their shares to the association to start personal projects.

Following the original agreement, ASOPAY sells its total production palm fruits to Hacienda La Cabaña. Although the association is composed of farmers with less than 10 ha, ASOPAY is categorized as a large-scale supplier according to La Cabaña's standards. This is seen as an advantage by many members, because according to them "*a relatively large share increases the likelihood of negotiating better deals with Hacienda La Cabaña*". Thus, this is considered a strength to keep working collectively.

To ensure the quality and a steady flow of raw material (i.e., FFB) supplied by ASOPAY, Hacienda La Cabaña provides the member allies with technical assistance to improve their yield through better agronomic management practices. Specifically, Hacienda La Cabaña offers to ASOPAY: (1) An agronomic engineer who provides recommendations on fertilization, irrigation, pest control and other agronomic activities, and (2) keeping record of all productive expenses.

This association has an irrigation system, and therefore it shows overall higher yields than non-irrigated suppliers (i.e., while ASOPAY achieves 16 ton/ha, the average yield in non-irrigated land is 15 ton/ha). Nevertheless, ASOPAY presents one of the lowest yields among the suppliers using

255 irrigation. Gonzalez, the UAATAS coordinator, stated two mayor causes that may be preventing
256 higher yields: (i) lack of commitment on implementing the advised agronomic practices, and (ii)
257 lack of specialized training.
258 Hacienda La Cabaña pays a monthly check to each family depending upon the amount of product
259 sold. Since the association was created as a nonprofit organization and cannot pay dividends or
260 profit sharing, the net revenue is distributed as land rent. Each member receives a percentage
261 corresponding to the size of the contributed lot. The check incorporates total revenue after sale
262 taxes adjustment. From that check, loan repayments deducted. For most families, this is the only
263 source of income and represents 1 - 1.8 monthly minimum wage in Colombia per family
264 (depending on their land contribution).

265 **4. The financial assessment under different scenarios**

266 The data for the financial assessment was collected in visits to the Meta foothills during 44
267 days of field work. Eleven members of ASOPAY were interviewed along with employees from
268 Hacienda La Cabaña. Using this information, we developed the cash flow for the oil palm
269 production assuming a 25-year cycle and computed the net present value (NPV) per hectare
270 (expressed in $/ha). Specifically, five scenarios were constructed (depicted in Figure 3). The first
271 four cases assume ASOPAY will continue operations:

272 (1) *Baseline Projections Case*: Members of ASOPAY decide to continue the association, and
273 it was developed to better understand the major factors driving ASOPAY's profitability in
274 the long run.

275 (2) *Disease & Mortality*: This scenario adds the risk of disease and mortality to the palm
276 plantation. In particular, we considered the Bud rot (BR) and the Lethal Wilt (WL), two
277 major diseases for the region. The former, is considered the most restrictive factor in oil

palm plantations in Colombia, while the later has drastically affected the Colombian Eastern Zone. Thus, this case highlights the importance of initiatives oriented to transfer knowledge through the UAATAS program.

(3) *Price Downward Pressure*: This case builds from scenario (*2*) while reducing the price of palm fruit uniformly by 10% to remark the impact of the National Biofuel policies and the FEP. This exercise highlights their role on boosting farmers net revenue by compensating farmers who engage in exporting palm oil.

(4) *RSPO*: This case assumes that palm plantations from scenario (*3*) will meet the RSPO standards and get certified. This will shed light of the efforts oriented of transitioning towards more sustainable practices.

All four scenarios were compared to the alternative option, *Leaving the Association*, in which the productive allies sell the land including the palm plantation. By comparing these alternatives, we provide insights on the financial success of ASOPAY's business model. All calculations have been translated to US dollars using the exchange rate of December 2019 between US dollars and Colombian Peso of 3,177 Peso/USD.

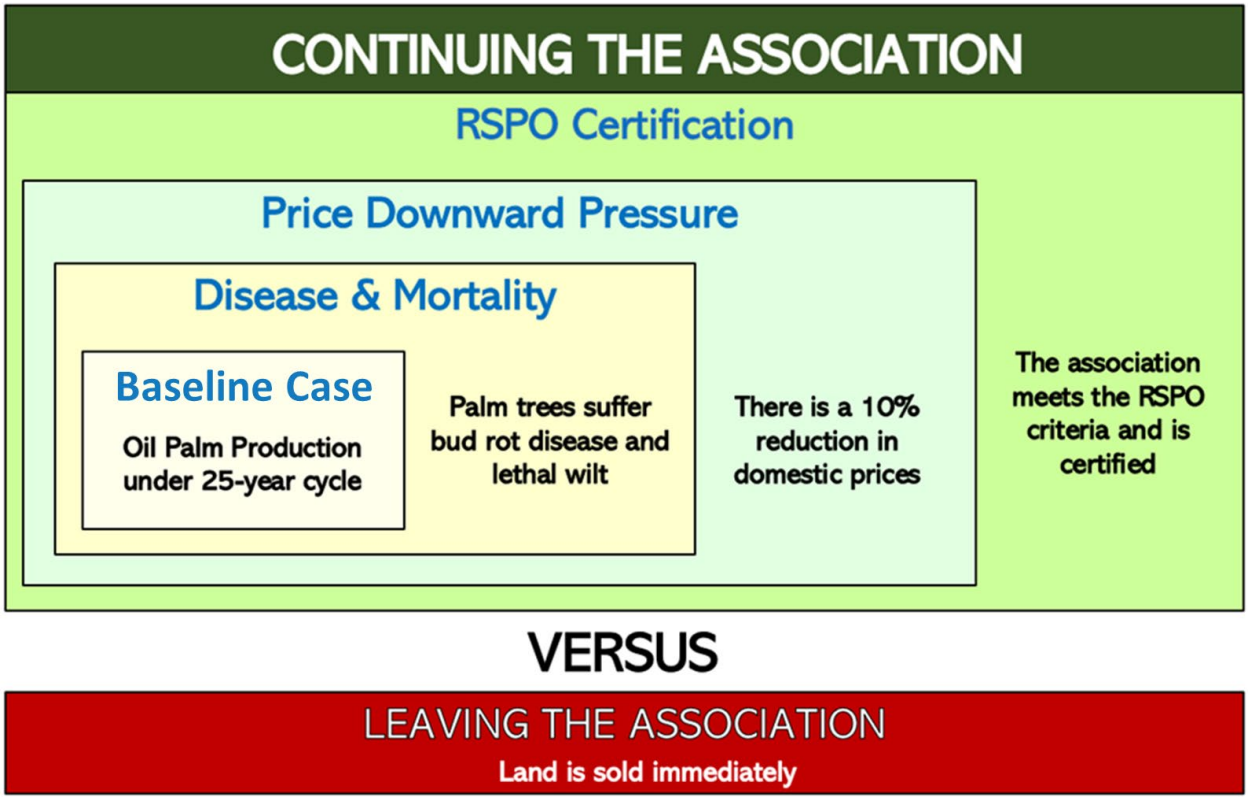

Figure 3. Scenarios of the case study

4.1 Leaving the Association scenario

In this scenario, members decide to split the association and sell the land immediately by August 2017. This sale includes the palm tree plantation. Several reasons lead us to consider "*selling the land*" as the only counterfactual scenario: (1) Some members of the association unsuccessfully attempted to produce citrus in their lands losing revenues. This made members risk averse to explore other enterprises. (2) Most members do not have any previous experience in farming and/or managing businesses, preventing them to immerse in alternative agribusinesses. (3) In mid-2017, time on our data collection, ASOPAY's members were only considering two options: whether to split the assets (i.e., selling their lands) and dissolve the association, or to keep producing under the business-as-usual strategy. (4) Two out of the twenty-six families actually "*sold their land*" prior our study as a way to leave the association.

306 The net present value calculated for *Leaving the Association* is $6,000/ha, which is the price of
307 land in the Orinoquía region in mid-2017, according to research made and interviewed experts.
308 This estimate becomes the opportunity cost of continuing the association. By comparing the
309 baseline and its expanded cases with the value of "*selling the land*", we provide insights on the
310 financial success of ASOPAY business model.

311 *4.2 Baseline Projections Case*

312 We start from some general considerations regarding the oil palm production. In Colombia, a
313 typical palm plantation has a lifecycle of 25-30 years. Overall, first production is harvested in year
314 3, and yield maturity is reached at years 7 to 8 years for palm trees. This means that the annual
315 production of oil palm fruits increases steadily until year 7-8 when it reaches a plateau. In the
316 absence of any extreme events (i.e., change in weather and/or diseases), at the start of year 9, palm
317 trees reach their maximum productivity level which continues until year 25-30, when the height
318 of the palm trees reduces the efficiency of fruit harvesting. Afterwards, aged plots must be replaced
319 with new palm trees. Thus, in this *Baseline Projections Case*, we consider that ASOPAY's palm
320 trees were planted in 2008 and reached maturity in 2015 (with an average age of 8 years). Palm
321 oil production continues until the plantation reaches 25 years and farmers still own the land at the
322 end of the production cycle. This means that our period of evaluation is 2018-2033.

323 The annual operating free cash flow (*OCF*) at year t (where t = 1 to 15) is determined as the
324 difference of total revenue (*TR*) and Total Cost *TC* in equation 1:

325 (1) $OCF_t = TR_t - TC_t$

326 Annual total cost, represented in equation 2, is the sum of the monthly payments (k = 1 to 12) to
327 fixed *FC* (field labor, fertilizer cost, personnel, machinery as they are expenses per hectare) and

variable VC costs (i.e., harvesting labor which depends on quantity produced Q, at an average cost monthly $AVC_{t,k}$):

(2) $TC_t = \sum_{k=1}^{12}(FC_{t,k} + AVC_{t,k} \times Q_{t,k})(1+\tau)$

This calculation includes administrative markup (τ =13%) employed when the data was collected. Table 1 shows a summarized example of data collected from ASOPAY regarding costs of producing palm in 185 hectares of the association (all costs are in USD using an exchange rate of 3,177 Pesos per USD). Note that production Q of palm fruit is relevant to calculate labor cost in the harvesting and fruit selection processes.

Table 1. ASOPAY's cost structure for palm production in January - April 2017 for 185 ha

Activity			YEAR 2017				
Farm Labor	**Price (USD)**	**UNIT**	**January**	**February**	**March**	**April**	**Total**
Leaf pruning	0.124	Palm			$ 3,084		**$ 3,084**
Herbicide around trees	0.022	Palm		$ 547			**$ 547**
Herbicide weed control in irrigation ditches	0.022	Mts		$ 217			**$ 217**
Legume cover trimming	0.063	Palm	$ 296	$ 296	$ 296	$ 296	**$ 1,184**
Roadside weed control	0.110	mts				$ 286	**$ 286**
Fence weed control	0.110	mts	$ 683				**$ 683**
Fertilization							
Boron	0.009	Palm			$ 234		**$ 234**
Personnel							
Supervisor			$ 488	$ 488	$ 488	$ 488	**$ 1,952**
Pest and disease Control			$ 488	$ 488	$ 488	$ 488	**$ 1,952**
Miscellaneous Staff 1	17.312	Day	$ 467	$ 467	$ 467	$ 467	**$ 1,870**
Miscellaneous Staff 2	15.738	Day	$ 425	$ 425	$ 425	$ 425	**$ 1,700**
Irrigation	17.312	Day	$ 467	$ 467	$ 467	$ 467	**$ 1,870**
Production	Kilo/Month		286,000	327,000	324,000	183,000	
Harvesting	0.014	Kg	$ 4,051	$ 4,632	$ 4,589	$ 2,592	**$ 15,864**
FFB Evacuation	0.006	Kg	$ 1,800	$ 2,059	$ 2,040	$ 1,152	**$ 7,051**
Tractor service							
Fumigation	9.128	Hour		$ 822			**$ 822**
Fertilization	7.554	Hour			$ 151		**$ 151**
	Monthly Total (USD)		**$ 9,166**	**$ 10,907**	**$ 12,730**	**$ 6,662**	**$ 39,465**
						Benefits (6%)	$ 2,368
						S.A.S (7%)	$ 2,763
						TOTAL	**$ 44,595**

The annual cost structure of oil palm production in the Meta department shows that the fixed and variable costs represent almost a similar share (Figure 4). Fixed cost accounts for 50.7% of total annual cost, this includes salary of permanent employees for typical farm activities such cleaning and irrigation (41% of total cost), machinery services (i.e., tractors for pest fumigation and fertilization) and cost of fertilizers. Thus, the cost structure is consistent with Fontanilla-Díaz *et al.* (2021) findings, who discuss the importance of labor for the oil palm industry. The variable cost, which depend on the palm fruit yield, are mainly driven by the monthly harvesting.

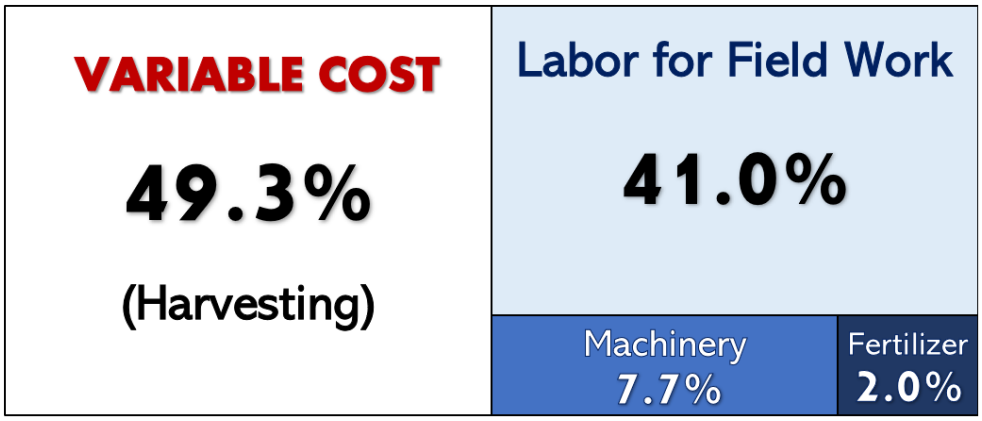

Figure 4. Overall annual cost structure in the *Base Case* scenario

Annual total revenue *TR*, represented in equation 3, is the sum of monthly payments received by the association composed by the following items: Net sales of product Q (in kilograms of oil palm fruit) times price P (Pesos per kilogram of fruit), and adjusted for the portion of product $\delta_{t,k}$ (in percentage of output) lost during the harvesting and post-harvesting processes.

$$(3)\ TR_t = \sum_{k=1}^{12} Q_{t,k} \times (1 - \delta_{t,k}) \times P_{t,k}$$

We assume that the net weight of the palm fruit sale may be lower than the product collected by the farm workers. Based on our survey, we calculated that the overall fraction of produce lost in the process is $\delta \approx 7.1\%$ of product. Table 2 shows the summary report of revenues obtained by ASOPAY in 2016 considering a palm plantation of 185 hectares.

Table 2. Summary report of revenues in 185 ha. for ASOPAY in 2016 ($=USD).

Month	Net Sale (Kg)	Price ($/Kg)	Total Sale ($)	Sales tax included ($)
January	249,720	0.126	31,465	**$32,802**
February	430,080	0.122	52,591	**$54,826**
March	368,840	0.126	46,544	**$48,523**
April	504,810	0.122	61,805	**$64,432**
May	171,530	0.123	21,078	**$21,973**
June	129,710	0.117	15,169	**$15,814**
July	123,630	0.111	13,686	**$14,268**
August	141,410	0.104	14,688	**$15,313**
September	170,180	0.108	18,344	**$19,123**
October	219,050	0.108	23,562	**$24,563**
November	182,200	0.104	18,925	**$19,730**
December	162,000	0.104	16,827	**$17,542**
TOTAL	**2,853,160**		**334,685**	**$348,910**

Assuming that by 2018 there is no debt payment, the overall revenue from the monthly sales are about 2.5 times the cost of production. This leaves an annual average net revenue of $1,116/ha, which serves as the annual cash flow ($OCF_{t=1,\ldots,15}$) for the *Baseline Projections Case*.

The terminal cash flow (TCF) (where t = 16, which represents year 2033) is calculated similarly to the operating cash flow except that we add the residual value of land L which is projected to increase by 1% every year, as is represented in equation 4:

(4) $TCF = TR_{t=16} - TC_{t=16} + L(1.01)^{16}$

The net present value of the *base case* (NPV_{1A}) is then calculated simply as the present value of all annual cash flows with an investment rate r (in percentage) as is represented in equation 5:

(5) $NPV_{1A} = \sum_{t=1}^{15} \frac{OCF_t}{(1+r)^t} + \frac{TCF}{(1+r)^{16}}$

Considering a discount rate of 12%, which is typically used for project analysis in Colombia, the net present value for the *Base Case* is $8,930/ha for the palm plantation.

4.3 Disease & Mortality: Base Case including disease and mortality of palm trees

In this scenario, we aim to provide insights on the importance of the efforts oriented to enhance agronomic practices as drivers of ASOPAY's financial success. Previous evidence (i.e., Fontanilla et al., 2015; Sanz et al., 2018) suggests that the UAATAS program, by enhancing agronomic practices through knowledge transfer, have a direct effect on decreasing palm mortality as well as reducing diseases' incidence. This scenario builds on the *Baseline Projections Case* by adding the risk of diseases and mortality of palm tree. Specifically, we consider the bud rot disease (BR), which is a major adverse factor for oil palm plantations in the Eastern Colombia since the 1980s. Although significant efforts have helped to reduce the disease spread and accelerate the tree recovery, it is not yet possible to fully avoid it (Tupaz-Vera et al., 2021). Furthermore, the interviews revealed that the lack of adequate agronomic practices are predisposition factors of BR, particularly the absence of adequate drainage. In addition, a portion of the palm trees get infected by lethal diseases such as palm eradication due to Lethal Wilt (LW). This is known to be one of the major causes of premature death of oil palms in Orinoquía (López et al., 2021).

Thus, in our scenario, we included the risk of being infected by both diseases BR and LW. As both directly affect the oil palm production, the formulation of total revenue was modified. In particular, based on ASOPAY reports, we considered an average yield loss of 7.06% due to BR with an average annual infection rate *INF* of 2.01% across the palm plantation cycle (i.e., 2.01% of the trees in the plantation are infected). We also considered that every year, there was 1% of mortality rate due to LW. Thus, total production after disease *QL* and infection at year *t* and month *k* was established as a portion of the original production left after diseases and mortality, as is represented in equation 6:

(6) $$QL_{t,k} = \left[Q_{t,k} \times (1 - INF) + Q_{t,k} \times (1 - 0.0706) \times INF\right] \times [1 - 0.01]^t$$

The first factor has two components $Q_{t,k} \times (1 - INF)$ represents the palms that are not infected, whereas $Q_{t,k} \times (1 - 0.0706) \times INF$ represents the production after losses due to BR. The second factor considers that every year 1% of the palm trees die. The formulations for total revenue, cost, free cash flow and net present values stay similar to the *Base Case*, except it uses $QL_{t,k}$ instead of the original production $Q_{t,k}$. Thus, propagation of BR and palm tree mortality are included into the annual cash flows for the *Disease & Mortality* scenario.

Without technological transfer and adequate agronomic practices, farmers may face a steady reduction on net revenue per hectare of about 1.57% every year, reaching a loss of 29% in annual net income by the year 2032. The NPV of the *Disease & Mortality* scenario at the 12% discount rate is $7,817/ha, which represents a loss of $1,113/ha that could happen in the absence of the UAATAS program, assuming that any incremental program cost is subsidized by the anchor company as a way to ensure a stable supply and preferential rights to purchase their fruit bunches[2]. Figure 5 expands on the importance of the technological transfer. Without serious diseases (*Baseline Projections Case*) and under a relatively low discount rate of 8%, this enterprise offers a NPV greater than $12,000 – twice the projected land sale value (estimated at $6000/ha). Including the presence of BR and mortality of palm plants due to Lethal Wilt (*Disease & Mortality* case) shows a lower NPV across different interest rates (Figure 5). Tracing a linear-log regression on the difference between both scenarios (R^2 = 97%) shows that as the rate of return increases by 1%, the NPV loss due to disease and mortality is overall 11.9%. This result may be worsened if disease dynamics resulted in a larger number of palm trees infected. This shows the critical role of the UAATAS program in the financial success of productive associations such as ASOPAY by

[2] Further costs of implementing UAATAS recommendations such as changes in farm management practices (treatment of bud rot and irrigation methods) are assumed to be offset by productivity gains from adopting such practices – which have been held constant in this exercise. In Colombia, the treatment cost of bud rot ranges between $5.71 and $158.44 per hectare annually (i.e., overall cost of $557 in net present value in Eastern Colombia).

boosting technological transfer and motivating sustainable practices that mitigate incidence of plant diseases and mortality.

Results from the *Disease & Mortality* scenario rely on two key assumptions. First, the investment risk in agriculture is reduced by implementing technologies that improve yields and mitigate phytosanitary threats. Second, although palm oil may face short term volatility as Colombian producers are price takers, there is a stable range in which prices fluctuate – reflected in the data collected on monthly palm fruit prices. The risk associated with farm operations may vary drastically depending upon the stability of the post-conflict region and the assumptions made on the incidence rates of Lethal Wilt and Bud Rot. The second assumption is discussed in the next section.

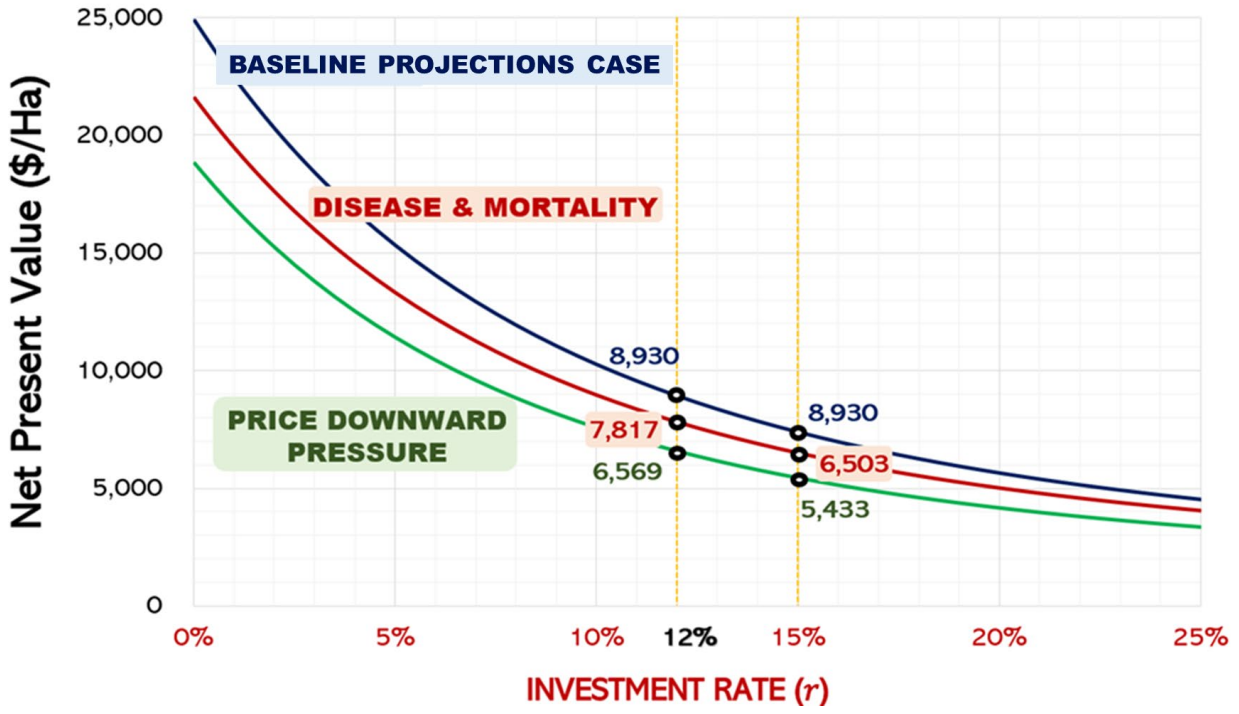

Figure 5. Net Present Value (NPV) for the first three scenarios under different interest rates, emphasizing the NPVs at 12% and 15%

4.4 Price Downward Pressure: Disease & Mortality case with price reduction of palm fruit

Evidence suggests that despite the country being a price taker, the FEP and the National Biofuel policies have impacted positively palm oil income. The FEP ensures a stable price for the domestic market. Palm oil producers selling at lower price markets overseas are indirectly compensated by those selling at higher markup in the domestic market. The National Biodiesel policy opened a new market segment by encouraging biodiesel sales in the local market, which has contributed to economic development of palm producers (Laguna & González, 2021; Laguna; 2017; Mesa-Guerra, 2018).

To analyze the economic importance of these policies, the *Price Downward Pressure* scenario builds on the *Disease & Mortality* case and applies a 10% uniform reduction in palm fruit price over the lifespan of the plantation cycle. This counterfactual scenario captures the importance of both, the National Biofuel policies and the FEP. Absent the National Biofuel policies' incentives, there would be a decrease on domestic demand for palm oil. This would lead to a greater volume of Colombian CPO needing to reach international markets where a lower price tends to prevail compared to price at the Colombian domestic market, because the main global exporters are more competitive (i.e., Obtain their CPO at lower costs). Note, it is difficult to analyze a commodity price that fluctuates as the oil palm does so for this work, we estimated the logistics and tariffs costs of taking Colombian CPO to the main destination of Colombian CPO, this is the European market), which averages about 10% of the historical Colombian palm oil reference price (Laguna & González, 2021). Thus, the second assumption of Disease & Mortality is relaxed – no subsidies are given to palm oil producers, resulting in a 10% decrease in income for each kilogram of fruit sold. Previous literature suggests that the National Biofuel policies—including the combination of mandatory blending and subsidies—have a positive impact for the producers of the palm industry (Castiblanco, Moreno, and Etter 2015). Indeed, previous simulation studies

suggest that the combination of mandatory blending and subsidy policies in the biofuel sector of Colombia has a positive impact of around 12% (on average per year from 2010-2020) on prices of raw materials to produce biodiesel. Following this, in the *"Price Downward Pressure"* scenario we use 10% as a rough approximation for a lower bound effect on prices linked to a hypothetical removal of such policies. However, caution should be used when analyzing these results given the limitation on the estimation of the level change on prices.

The annual average price in that year was about USD 115 per 1000 kilograms of fruit. In this scenario, $P_{t,k}$ (unitary price of oil palm fruit) is reduced uniformly by 10% for all months and years. This decreases the NPV of the business by 15.4% (using a linear-log regression with R^2 = 93%). At a conventional 12% rate of return, without the price stabilization programs, the loss in NPV is $1,248/ha for each member, equivalent to a 12.5% drop in income (Figure 5). This is a total loss of $230,880 in net present value for the association. In addition, the NPV at the 12% conventional rate is only $6,542/ha (Figure 5), which means that under these circumstances, there is only a small benefit from not to selling the land and the plantation for $6,000. However, this result is very sensitive, increasing the rate of return to 15% (which is also often used in project analysis) would switch the decision of the association and favor the sale of the land and plantation (figure 5). Thus, the investment rate plays a key role, and it is discussed in the section 5.

4.5 RSPO certification: RSPO case assuming that the plantation meets the RSPO standard

This scenario seeks to implement sustainable criteria in the oil palm supply chain in order to meet the RSPO standards, allowing the productive alliance to comply with international regulations, and export to foreign countries. Here, the scenario assumes that ASOPAY is certified as a smallholder association under the RSPO criteria.

This certification requires environmental and social impact studies such as the Conservation Value (HCV), Environmental Impact Assessment (EIA), and Social Impact Assessment (Espinosa et al., 2021). The costs associated to these studies are usually not priced per hectare, but the larger the area of analysis, the lower the per-hectare cost associated (Espinosa et al., 2021). The data on the per-hectare cost come from Indupalma (for 11,000 ha), and from Hacienda La Cabaña (for 5,300 ha). To facilitate the analysis, ASOPAY is assumed to satisfy all the RSPO criteria, thus there are no other major social, environmental, nor financial challenges for the implementation and certification.

We find that the implementation of the RSPO criteria and certification by ASOPAY does not have a strong impact on the profitability of the association. The NPV of the RSPO case at the 12% discount rate dropped to $6,542/ha, this is only $27 lower than its corresponding *Price Downward Pressure* case. Assuming there are no price premiums but neither a further drop in palm oil prices, the certification on sustainability should not decrease the profitability of farmers and even help with resource conservation, workers welfare and profitable businesses among small-scale growers. On the other hand, certifications on sustainability may become a requirement to work with Hacienda La Cabaña in the upcoming years, which means that its fruit providers must consider complying with sustainability standards in order to stay in business.

5. Comparative Analysis of the Breakeven Points

The imputed net present value for the counterfactual scenario (*Leaving the Association*) is $6,000/ha, which is the land value in Orinoquía during mid-2017. Assigning an NPV for this case allows the calculation of the *break-even* (discount) rate – the minimum profitability rate at which the association would prefer continuing operations. Mathematically, this is computed by setting an NPV formula:

(7) $NPV_{1,AS} = -LAND_0 + \sum_{t=1}^{15} \frac{OCF_t}{(1+r)^t} + \frac{TCF}{(1+r)^{16}}$

This $NPV_{1,AS}$ formulation is similar to the $NPV_{1,AS}$ in equation 5 – the NPV of the baseline scenario, except that it includes $LAND_0$ – land value in 2018 (year 0 of the cash flow), considered as the opportunity cost of continuing the enterprise. The *break-even* rate is the internal rate of return r from this formula, which value is displayed in figure 6 for each of the three scenarios. The *break-even* rate provides insights on the long-run profitability of the association.

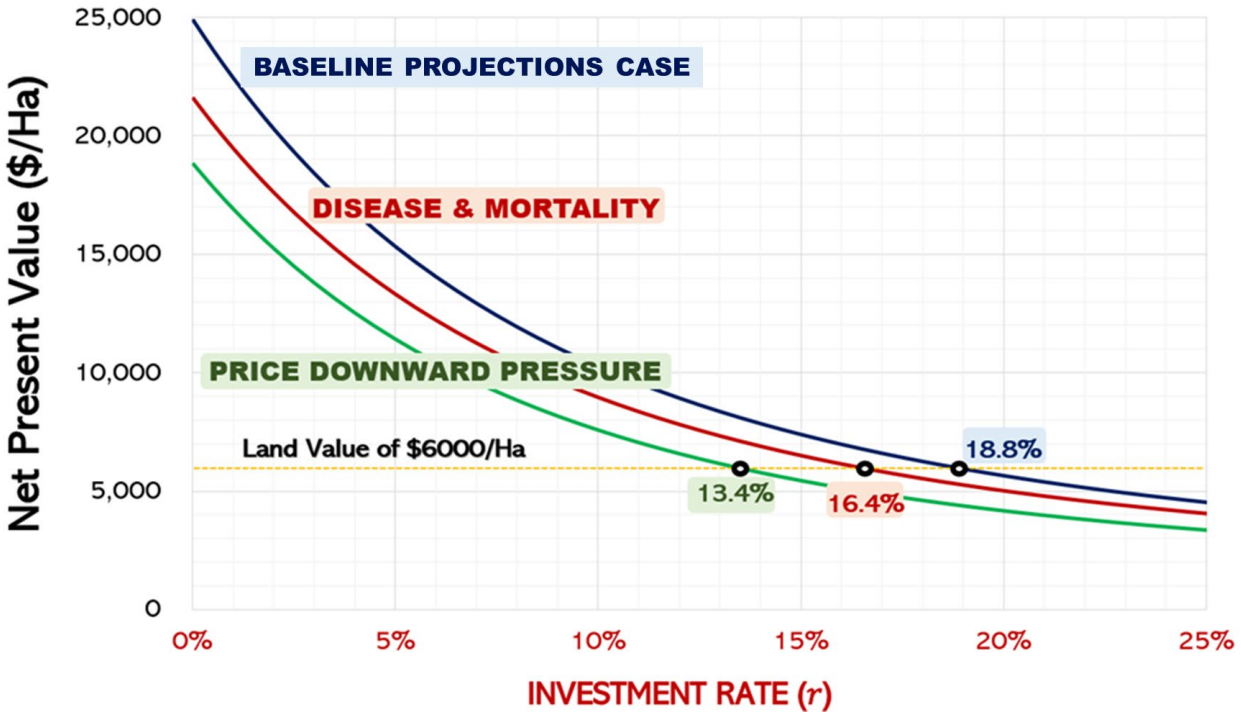

Figure 6 Break-even rates for the three scenarios, in contrast to the *Leaving the Association* scenario 2 (dotted horizontal line) with a land value of $6,000.

Moreover, in our comparative analysis, we isolate the contribution of each policy program (figure 7), at a 12% discount rate. This is calculated as the difference in net benefits (in % of NPV) between each policy scenario and the *Baseline Projections Case.* This method allows to capture not only the direct effects of each policy but also the interactions among these programs. By incorporating the potential implications caused by specific policy programs into the financial analysis, this study

sheds light on key business strategies and the role of joint public-private efforts driving ASOPAY's financial success.

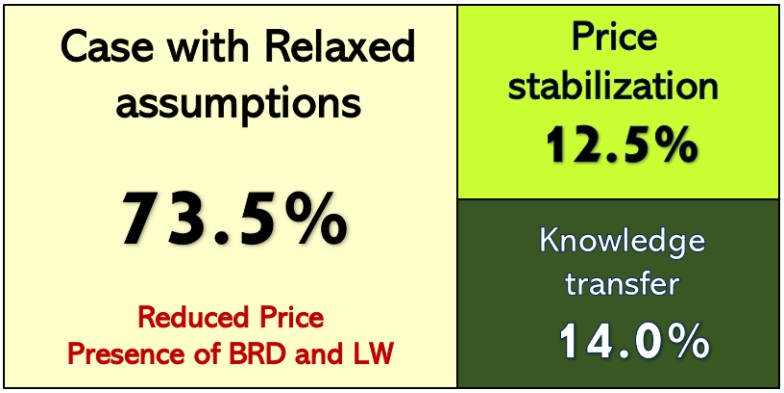

Figure 7. Contribution of UAATAS (through technological transfer) and price stabilization programs in the farmers' net present value (in %) at a discount rate of 12%.

In terms of break-even rates, the *Baseline Projections Case* and the *Disease & Mortality* scenarios are robust under moderate risk (16.4% and 18.8% rates, respectively) and preferred over the option of selling the land (Figure 6). Likewise, preventing the spread of diseases and lowering the rate of mortality of palm trees are key to preserve the profitability of the land. At a 12% investment rate, adequate agronomic practices may improve the farmers' net revenue by 14% (Figure 7), which shows the productivity boost from the UAATAS program clearly improves overcome the economic returns of the farmers.

On the other hand, the break-even rate of 13.4% of the *Price Downward Pressure* scenario shows a critical outcome, without the price stabilization programs, the farmers would be exposed to price risk that may force them to exit the business. As mentioned before, conventional rates for projects typically range between 12% and 15%. Thus, if the international market has a price decline larger than 10%, the NPV of continuing to produce palm oil could become less attractive than selling the land.

528 The implementation of the RSPO criteria and certification by ASOPAY does not have a strong
529 impact on the profitability of the association. The NPV of the *RSPO* case at the 12% discount rate
530 dropped to $6,542/ha, this is only $27 lower than its corresponding *Price Downward Pressure*
531 case. Assuming there are no price premiums but neither a further drop in palm oil prices, the
532 certification on sustainability should not decrease the profitability of farmers and even help with
533 resource conservation, workers welfare and profitable businesses among small-scale growers. This
534 is because the certification costs may be shared by growers from the whole region served by the
535 palm oil mill of Hacienda La Cabaña, including their own plantations. Thus, the cost increase is
536 marginal. Meanwhile environmental benefits such as lower use of pesticides can benefit ASOPAY.
537 On the other hand, certifications on sustainability may become a requirement to work with
538 Hacienda La Cabaña in the upcoming years, which means that its fruit providers must consider
539 complying with sustainability standards in order to stay in business (Mosquera & Lopez, 2017).

540 **6. Conclusions**

541 This study provides insights on the challenges faced by small-scale agribusinesses in an
542 emerging economy. By closely examining ASOPAY's financial flows, the article sheds light on
543 the economic incentives enhancing the cohesion of the small farmers' association. We find that
544 under baseline conditions the current business model presents a higher NPV than splitting up the
545 association and selling the assets. In addition, we examine the key drivers of association's financial
546 success by testing the NPV of the project under different assumptions of output prices and disease
547 incidence in the production. By doing this, we provide insights on the key business strategies and
548 the role of public-private joint efforts driving ASOPAY's financial success, providing a financial
549 assessment tool for sustainable rural development analysis in post-conflict areas.

We find that the positive NPV (i.e., the financial success) of continuing the oil palm production highly depends on two important assumptions: (1) the risk associated with the investment, and (2) the tools designed to ameliorate the impact of long-term fluctuations of oil palm prices. Under the current moderate or low risk of investing, the calculated NPV was larger than the selling option considered by ASOPAY's members. This is consistent with the result of the debate where members decided to continue with the association. Note, however, that in order to preserve current levels of profitability of the association, local prices should exceed production costs, which is not always the case when international prices are at its lowest values. This result is consistent with previous studies (Julio Cesar & Gonzalez, 2021) that have highlighted the importance of policies such the *Price Stabilization Fund for Kernel, Palm Oil and their Fractions* as well as the National Biofuel policies on the development and expansion of the oil palm sector in Colombia. In addition, we find that ASOPAY's profitability could be significantly affected by an increase on the palm mortality and/or disease incidence. Particularly, the control for bud rot and lethal wilt plays a key role driving ASOPAY's profitability. These results highlight the importance of the UAATAS program on the knowledge and resource transferences that enhance agronomic practices as a key driver to ensure crop yields. However, further effort to increase ASOPAY's average yield such as better irrigation systems is required, since this is the best manner to face the price fluctuations that feature commodity markets.

The scenario proposed for the implementation of the RSPO certification highlights the relevance for the palm oil to comply with international standards on sustainable production. However, the assumption that smallholders must certify their crops on RSPO relies on 1) where the palm oil will be traded (along with where it is produced), and 2) the age of the plantation. Letting alone the fact that local Colombian palm oil prices tend to be higher than its corresponding international prices,

573 some regions like the Orinoquía have additional challenges in terms of transportation costs and
574 road reliability to reach international markets (which is the case of Orinoquía, due to long distances
575 to ports). Besides, areas planted with oil palm in ASOPAY's plots may need to be renovated by
576 2033, so an eventual decision on the implementation of the RSPO certification should consider
577 whether the farmers are willing to stay in the oil palm business for a period longer than 15 years.
578 Furthermore, to keep the success of the productive alliance, the anchor company should continue
579 supporting smallholders with technical assistance for the interpretation and compliance of the
580 RSPO criteria, and it would also need to assist them by minimizing the burden of the certification
581 costs to the farmer.
582 By closely examining the financial flows of ASOPAY within this specific context allowed us to
583 deeply investigate a contemporary real-life phenomenon through detailed contextual analysis. In
584 many ways, ASOPAY is a good example of successful and inclusive business in the Orinoquía
585 region. The case study sheds light on the operational nodes within the Colombian palm oil value
586 chain that are critical for public and private efforts oriented to enhance rural incomes and alleviate
587 small farmers' poverty. Hence, the case study may be used to analyze similar post-conflict efforts
588 focused on rural development. Our study sheds light on the importance of joint public and private
589 interventions to create opportunities and help on the inclusion of small farmers into larger
590 productive chains. In the presented study, we illustrate the importance of the government support
591 to increase small farmers' welfare in the Orinoquía region. In particular, our scenarios emphasize
592 the relevance of the credit support that allowed the association to be started, which otherwise would
593 have been unaffordable. We also highlight the importance of institutional policies that have
594 contributed to the price stabilization throughout the supply chain. Finally, we also highlight the

595 importance of institutional efforts oriented to boost technology and knowledge transferences such
596 as the UAATAS program on driving small farmers profitability.

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