Final Report

Evaluation of the Impacts of Sustainability Standards on Smallholder Coffee Farmers in Southern Sumatra, Indonesia

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September 2019

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Recommended Citation

Neilson, J., Toth, R., Sari, N., Bray, B., Donoghue, M., Arifin, B. and Ismono, H. (2019). *Evaluation of the Impacts of Sustainability Standards on Smallholder Coffee Farmers in Southern Sumatra, Indonesia*, ISEAL Alliance, London. https://www.evidensia.eco/resources/37/evaluation-of-the-impacts-of-sustainability-standards-on-smallholder-coffee-farmers-in-southern-sumatra-indonesia-final-evaluation-report/

Funding

This independent evaluation was commissioned by the ISEAL Alliance under the Demonstrating and Improving Poverty Impacts (DIPI) project, which received financial support from Ford Foundation.

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Executive Summary

This mixed-method study examines the impacts of sustainability standards on the livelihoods and poverty status of smallholder Robusta coffee farmers in southern Sumatra, Indonesia. The study combines qualitative and quantitative methodologies to assess whether farmer livelihoods are improved as a result of: i) initial involvement in a program audited against the Common Code for the Coffee Community (4C) standard; and ii) upgrading from 4C to the more stringent Rainforest Alliance (RA) Standard.

A rigorous quantitative evaluation of one particular sustainability program in the Semendo region of South Sumatra province used propensity score matching, and instrumental variables to construct a viable counterfactual for a 4C / non-4C comparison that was subsequently analysed using a differences-in-differences approach. The impact of RA upgrading was assessed through applying a randomised control trial (RCT). These quantitative approaches were complemented with a series of ethnographic village-based studies in the same region.

The results should be interpreted as identifying the impacts from the way a particular firm has introduced sustainability standards in this specific context, as the impacts of standards are expected to vary considerably depending on various contextual factors. In southern Sumatra, the introduction of standards generally consists of a series of exporter-managed farmer training activities that promoted “sustainable” agricultural practices. A sustainable value chain, where the exporter established a local buying station to source compliant coffee, usually follows, although in our important Semendo study, this value chain component was subsequently abandoned. As a result, this case-study reports on a fairly common occurrence whereby certified coffee is not actually sold into end markets as certified coffee.

Our study in the Semendo region indicated that 4C-enrolled farmers had slightly higher income levels, with a lower propensity to be in poverty, than non-enrolled farmers. Coffee management practices and coffee yields, however, had not dramatically improved. Therefore, we are hesitant to attribute improved well-being to the assumed theory of change pathway whereby enrolled farmers learn improved coffee-farming techniques, apply them, obtain higher coffee yields and subsequently higher incomes. Instead, it seems that program enrolment contributed to the enhancement of social capital and institutional strengthening, and these were responsible for generating significant non-coffee related benefits to the household.

Across southern Sumatra, where certification is a strongly exporter-driven process, sustainability standards performed a pivotal role in triggering the upstream engagement with farmers by coffee trading firms and manufacturers. This engagement was associated with the establishment of farmer training centres, field schools and enhanced knowledge dissemination. New knowledge-dense social networks linked to international coffee firms have consequently been created as a result of sustainability standards.

Coffee yields and coffee income decreased right across southern Sumatra during the study period between 2015 and 2017 due to a drought, but they decreased less among 4C farmers. 4C-enrolled farmers reported spending more time coffee-farming in 2017 than non-4C farmers, which could have been an important factor leading to lower yield decline. However, the relatively higher yields were not commensurate with the significantly increased labour allocations. The 4C program encouraged the increased planting of shade trees, and adoption

of this practice increased. We believe that increased shade tree density was an important factor enhancing the resilience of coffee production during a debilitating dry season.

Smallholder farmers participating in sustainability programs across southern Sumatra generally perceive positive benefits from program participation. Farmers are appreciative of the training activities delivered to them by coffee firms even if they do not always understand that training provision was related to sustainability standards.

In the Sumatran context, where coffee production is generally considered to contribute to livelihood resilience but not necessarily poverty alleviation, we found little evidence that sustainability programs were providing pathways out of poverty through enhanced coffee-related income. This suggests a need to reconsider the realistic benefits of sustainability standards in the context of local livelihood strategies, and to consider a more adaptive approach where sustainability-related knowledge transfer is oriented towards the needs of prevailing livelihoods.

The sustainability program in Semendo included a subset of farmers being further “upgraded” to Rainforest Alliance certification. This process involved additional training sessions on conservation issues and resource management, but did not involve a separate marketing channel. Following these additional training sessions, our randomised control trial did not identify significant changes in practices or outcomes. We detected a slight improvement in reported conservation and agricultural practices, which may have resulted in slightly higher yields per tree during the dry 2017 season, but these were generally not significant or only moderately so.

1. Background

This report presents the results of a research project with the overarching goal to examine the impact on farmer livelihoods and poverty alleviation within Indonesian coffee-growing communities as a result of processes of certification against different sustainability standards. These standards include the Common Code for the Coffee Community (4C) and the Sustainable Agriculture Network/ Rainforest Alliance (SAN/RA) standard. The project, co-funded by the Ford Foundation (and administered through the ISEAL Alliance under the Demonstrating and Improving Poverty Impacts – DIPI project) and the Australian Centre for International Agricultural Research (ACIAR), adopts an integrated, mixed-method, research design to address this overarching goal. The research team for this study is being led by researchers at the University of Sydney, in partnership with J-PAL Southeast Asia, the University of Lampung (UNILA) and the Indonesian Coffee and Cocoa Research Institute (ICCRI). Further information regarding the research team is found in Appendix A.

This report presents the integrated results and findings from various project activities during the period 2015-2018, including an analysis of main survey rounds conducted in 2015 and 2017.

Southern Sumatra is the major coffee-producing region (in terms of volume) in Indonesia, and includes the provinces of Lampung, South Sumatra and Bengkulu. Research for this project was undertaken across the provinces of Lampung and South Sumatra, with a detailed quantitative study completed in the Semendo region of South Sumatra.

The research was designed to answer the following primary research questions.

1. What is the impact on farmer livelihoods as a result of being involved in a 4C-verified production unit?

2. What is the additional impact on the livelihoods of farmers, currently part of a 4C-verified unit, if they become further certified to the SAN/RA coffee standard?

Secondary research questions addressed the: i) relative impact of standards in the broader context of livelihood change and rural development; ii) the relationship between sustainability standards and inequality within the community; iii) delivery of services and inputs as a result of the program; iv) farmer perceptions of sustainability standards; v) additional market-related benefits in Sumatra beyond training; vi) relationship between standards and local government; vii) impacts on producer group institutions; viii) methodological challenges of evaluating poverty impacts from sustainability programs. The relationships between these questions and specific methodologies are presented in Appendix B.

2. Research Methodologies

Use of theories of change

Methodologies were developed following a review of the following three Theory of Change documents.

- ISEAL (June 2013): *Working Together to Demonstrate & Improve Poverty Impacts*
- SAN / RA (February 2015): *Summary of the Sustainable Agriculture Network (SAN) / Rainforest Alliance Agriculture Theory of Change*
- 4C Association (June 2013). *For A Better Coffee World 1.0*

We undertook a review of peer-reviewed research reporting on the impacts of sustainability standards on producer livelihoods. The results of this review are presented as Appendix C, which included a reflection on likely impact pathways. We then considered these impact pathways with the published Theory of Change documents, and then considered them in the Sumatran context to develop a conceptual theory of change that formed the basis for the chosen research methods to capture the likelihood that impacts are occurring through the identified pathways (Table 1).

Potential Livelihood Impact Pathways from Certification
1 Human Capital Skill development as a result of certification-related training Producer investments in education (from higher incomes) Producer investments in health (from higher incomes)
2 Social Capital Strengthened producer organisations Enhanced networking opportunities Empowerment of marginalised individuals mandated by certification
3 Physical Capital New investments by producers / producer organisations New investments by downstream value chain actors New investments by other parties (eg. government and NGOs)
4 Natural Capital Adoption of sustainable agricultural practices Improved environmental awareness within producer community
5 Financial Capital Higher incomes from price premiums Higher incomes from more profitable agricultural practices Improved access to finance / credit Enhanced marketing opportunities

Table 1 Theory of Change for Livelihood Impact Pathways

Experimental and Quasi-Experimental Quantitative Research Designs in Semendo

The Semendo region of South Sumatra was selected for a detailed study of the impacts of 4C verification and Rainforest Alliance Certification. It was selected due to the absence of any prior introduction of sustainability standards, allowing a “clean” control baseline, and the

geographical remoteness that suggested "contamination' of the control would be unlikely. There are two primary dimensions to the quantitative study design in Semendo:

A. A quasi-experimental study involving a comparison between (i) a treatment group of farmers who worked with the exporter and received 4C certification and access to a new supply chain, and (ii) a control group of farmers in the same region who have not received any form of exporter training or certification. We have compared these two groups through comprehensive household surveys undertaken in 2015 and 2017 (a third survey round will be undertaken in late 2019). We applied a method of propensity score matching (PSM), combined with instrumental variables (IV) methods (Appendix D), to provide two alternative methods of ensuring a reliable control group. In addition, we leveraged the 2017 data and the availability of panel data to assess differences in differences (DiD) within each group over time. As described in detail in Appendix D, our primary results rely on a "differences in differences" econometric specification, taking the difference in the difference between 2015 and 2017 outcomes in treatment and control groups, respectively. This estimator is desirable when we have at least 2 rounds of data available on the same sample units (panel data). Two-round results are more efficient than those based just on comparing treatment-control in the 2017 data, as an extra round of data provides us with extra information. In addition, we winsorize the data at 5% and 95% to address outliers in the data.

   Both PSM and IV use a version of a "selection on observables" assumption: that if we use a rich enough set of control variables (in the case of IV also combined with a correlate – the instrument), we can account for any unobserved or difficult-to-measure sources of heterogeneity (e.g., ambition, ability, social connections) that might drive differences between farmers who work with the exporter and those who don't. This is a relatively strong assumption in cross-sectional data.

B. A randomized control trial (RCT) study that involved a comparison between (i) a treatment group of randomly-selected farmer groups who received an upgrade from 4C verification to RA certification in 2015, and (ii) a control group of farmer groups who were to remain with 4C verification. This design allows us to clearly evaluate the impacts of moving from 4C to RA.

The full allocation of farmer groups is captured in the following diagram.

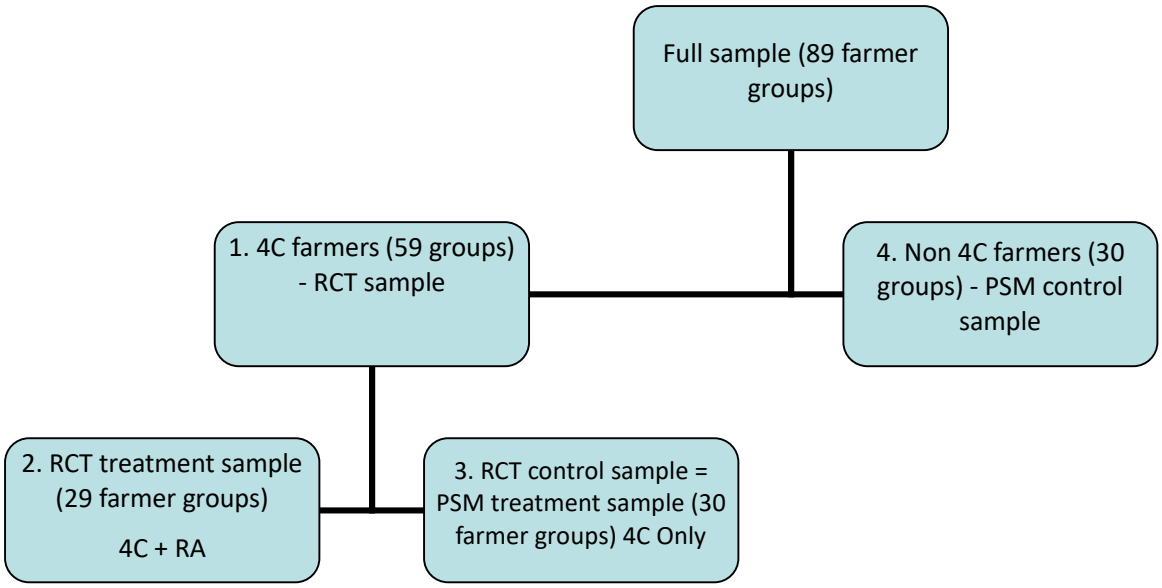

Figure 1. Household sampling Design

The study was conducted in close partnership with the implementing partner, an international commodity trading firm ("the exporter"), whose activities in Semendo were financially supported by an international coffee manufacturer under a broader corporate commitment to sustainability. 59 farmer groups working with the exporter under a 4C Unit were included in the study (29 of which were subsequently randomly selected for inclusion within the RA program). A further 30 farmer groups, with no direct relationship to the exporter, were approached to be part of a non-4C control group.

Randomization of RA Treatment

In implementing the randomization of treatment (RA inclusion), we stratified[1] the randomization according to village and livelihood status.
After initial analysis of the baseline data and preliminary ethnographic work, we categorized the farmer groups into four main categories (number of farmer groups in brackets):

1. Mixed livelihood (coffee dominant) (19)
2. Mixed livelihood (rice dominant) (20)
3. Mixed livelihood (fruit trees dominant) (7)
4. Mixed livelihood (off-farm dominant) (13)

We divided the farmer groups into unique cells based on their livelihood status, within each village. The result was a treatment assignment that has both treatment and control farmer

[1] Stratification allows us to ensure that treatment is balanced within sub-groups of the population. For example, suppose in a different study we have 40 groups of men and 10 groups of women, and we want to stratify treatment on gender so that we can precisely identify the effect of gender on the treatment effect. Then rather than randomizing over the 50 groups overall, which could lead to allocations like 23 male groups assigned to treatment and only 2 female groups assigned to treatment, we randomize *within* the groups. I.e., randomly select 20/40 male groups and 5/10 female groups separately, and then merge them together to create an overall treatment sample with 25 groups.

groups in nearly[2] every village, with as close as possible to an equal number in treatment and control in each village. Furthermore, the number of farmer groups in each livelihood category was as close to equal as possible across treatment and control *within* each village.

Further details of the RCT and PSM/IV/DiD methodologies in Muara Enim are provided in Appendix D.

Household Survey Tool

The key data collection method for the quantitative research in Semendo was the household-level survey instrument, which has included two survey rounds (in 2015 and 2017) implemented by a professional survey firm - SurveyMETER. A final survey round (funded by ACIAR) will be completed in 2019.

The household survey instrument covers a range of topics, including:

- household demographic characteristics,
- household assets and expenditure,
- poverty status and well-being,
- power relations within the household,
- household engagement with the farmer group,
- extensive information on the household economy including occupational status of household members and detailed status of the household head,
- the scope of the household farming operation and detailed information on the household's primary coffee plot, from production practices to output to labour practices and use of inputs such as fertilizers, pesticides and equipment, and
- detailed information on coffee marketing and trade.

Observation-based assessment of soil management and soil conditions

To complement the survey data collected in Semendo during the 2015 and 2017 rounds (which were based on household responses), we also undertook a survey of soil management practices and soil conditions using field-based direct *observational methods* on a subset of the population chosen for the quantitative study. 281 farmers were randomly selected from the 4C and non-4C households living in the Semendo Darat Tengah sub-district. This selection was made to leverage the aforementioned PSM design. 261 observations were made, covering 169 4C farmers and 92 non-4C farmers. Throughout 2017, soil scientists from ICCRI were blinded against whether they were recording target or control household farms, and collected farm-level data on the following indicators:

- Plot GPS location, including slope and altitude,
- Density of non-coffee shade-trees,
- Species of non-coffee shade-trees,
- Number of exposed roots,
- Length of exposed root,
- Composting Practices
- Waste management,
- Depth of litter fall / mulch layer,

[2] In a couple of cases a village only has 1-2 farmer groups so it is more difficult to guarantee representation.

- Evidence of gully and rill erosion,
- Soil conservation practices (terracing and sediment traps).

Simple t-tests have been applied to assess differences between 4C and non-4C farmers against these indicators.

Ethnographic field work and village-based case studies

Ethnographic field research was conducted by members of the research team together with students from the University of Lampung across three villages in southern Sumatra, each resident to between 1,000 and 3,000 individuals. Three case study villages were selected to be broadly representative of local districts and selected in collaboration with coffee industry representatives based on a short reconnaissance of the area immediately prior to field work. One village was in South Sumatra province (in the Semendo region), while two villages were in Lampung province. Two coffee exporters, each directly associated with global lead firms, were active in implementing coffee sustainability programs across the three study villages. A total of six months field work, involved repeat visits to each village, was completed across the three study villages during 2015, 2016 and 2017. The primary method of data collection was participant observation to understand the social settings across the village communities where sustainability standards had been introduced. This included visiting farms with producers and attending farmer group meetings. The timing of the fieldwork coincided with the annual coffee harvest. In addition to the case study villages, several field visits were conducted to other Semendo villages involved in the 4C program.

Each case study involved a profile of livelihoods and economic activities across the entire village, including in-depth interviews with representatives of the each of the main livelihood categories found in the village. We documented government infrastructure and spending in the village, and the details of any broader rural development initiatives in the community. Semi-structured interviews were completed with key informants in each village, including village and district heads, company agronomists (ICS “extension officers”), local traders, heads of farming groups, farmers (men and women) and rural labourers. A total of 248 interviews were completed. Where possible, interviews were conversational and aimed to triangulate key facts about coffee production and the sustainability program in the village. Interviews also aimed to establish a local perspective on standards. Wherever possible, interviews were carried out at the place of work of the key informant, or within their homes. In addition, a further 45 group interviews were completed in the study villages.

Survey of farmer perceptions of sustainability programs

A survey of farmer perceptions towards 4C was undertaken across Lampung and South Sumatra in an attempt to capture the lived experience of Sumatran farmer involvement in sustainability programs. A total of 558 participants were invited to participate in a survey from October 2016 and February 2017, consisting of 40 questions. Eight enumerators from the University of Lampung were recruited and trained one week before commencing the surveys.

Seven 4C-registered coffee companies based in Bandar Lampung were approached to provide access to their lists of 4C enrolled farmers. Of these companies, two had discontinued managing any VSS program, two were unwilling to participate in the study at the time, and three willingly participated, which are referred to as “Exporter A”, “Exporter B” and “Exporter

C" in this report. The areas targeted for the survey have a high coffee production volume and include the *Kabupaten* (regencies) of Tanggamus and Lampung Barat (both in Lampung province) and Muara Enim (in South Sumatra province, thus overlapping with our Semendo study). The exporters provided lists of over 6,000 4C-enrolled producers in total. Only producers who had been involved in a 4C production unit for at least two years were approached to participate. Farmer group lists were organised by village, and those with less than 10 4C-enrolled producers were removed from the sample population to ensure representativeness[3]. Enrolled producers in remaining villages were then randomly selected for participation in the survey. A summary of the participant locations is provided in Table 1.

The survey established background information about the respondent, before asking questions about their understanding and experience of the program, producer group function, attitudes towards training, attitudes towards practice implementation, and general outlook on coffee production following program participation. The survey team did not attempt to obtain equal gender representation of respondents, and women made up only 5% of all respondents. Men had been primarily involved in the 4C training programs and so they were considered (by both men and women in the household) to be more familiar with VSS and so better positioned to act as respondents. Further research on gender-specific experiences of standards is required.

Company	Tanggamus	Lampung Barat	Muara Enim	Total
Exporter A	-	96 (1,100)[1]	202 (2,000)	298
Exporter B	112 (1,000)	98 (1,600)	-	210
Exporter C	50 (300)	-	-	50
Total	162	194	202	-

1. Numbers in brackets indicate the total pool of producers from which the final number of respondents were randomly selected.

Table 2. Distribution of participant respondents in perceptions survey

Key Stakeholder Interviews

The research team undertook semi-structured 'stakeholder interviews', focusing on five sets of actors related to sustainability programs and the coffee industry: i) 'Sustainability Managers' and other leadership positions within coffee companies; ii) Government representatives, including District-level government agencies responsible for promoting development of coffee production across the various districts, as well as provincial and national level policy-makers; iii) National-level coffee industry associations (AEKI, GAEKI, SCOPI); and iv) Representatives of farmer organisations (such as APKI); and v) Sustainability agents (often known as "ICS" or "agronomists") working at the interface between the coffee company and the farming community. These interviews undertaken at both coffee industry

[3] On the basis that a smaller number of farmers from the total number of villages may lead to more idiosyncratic and variable results.

events, at offices and in the field. The primary aim of these interviews was to properly contextualise the VSS programs within broader development and industry contexts, and to illicit various attitudes towards VSS.

3. The Study Context

The Indonesian Coffee Sector

Indonesia is the world's fourth largest coffee-producing country, producing mainly low-grade Robusta coffee (estimated at around 85% of national production) alongside some highly sought-after specialty Arabica coffees. Approximately 95% of production is cultivated by smallholders (an estimated 2 million households in total) who generally farm less than two hectares of coffee, are materially disadvantaged, and who often rely on the sale of coffee beans as a source of cash income as part of a mixed livelihood strategy. Farmers are frequently linked via a chain of village-level collectors and local traders through to processing facilities, and then on to commodity trading firms located in major ports. By global standards, coffee yields in Indonesia are low (at around 500kg/ha). Indonesian coffee smallholders are poorly organised with relatively few supporting institutions, including limited government extension provision, and very few successful producer cooperatives. Government programs in the sector tend to be ad hoc, short-term and 'project-based' in contexts where public service delivery is generally poor.

Coffee production is geographically dispersed. While southern Sumatra is the centre of Robusta production and northern Sumatra the focus for Arabica, coffee is grown right across the islands, and coffees from Java, Bali, Sulawesi, Flores and Indonesian Papua are all sold into domestic and international specialty coffee markets. Research for this report was conducted in the provinces of Lampung and South Sumatra (at the southern end of the island, Figure 1), which are the largest producing provinces in the country.

Figure 2. The case-study regions in Sumatra

Robusta coffee is primarily sold into the global market (exported via Bandar Lampung Port) to be processed as instant coffee, or else used as an inexpensive filler ingredient for commercial blends. Key international markets for southern Sumatra Robusta include established consumers like Germany, the UK, USA and Italy, but emerging markets are increasingly important, including Russia, Malaysia, Algeria, Thailand and China. The Indonesian domestic coffee market is also growing considerably, generally at a faster rate than production. For the 2017/18 crop year, the USDA estimated that domestic consumption reached around a third of total production (GAIN, 2018). Indonesia has also significantly increased its downstream processing and export of soluble coffee, mainly to emerging markets in Asia (Figure 3). These shifting end-markets for Indonesian Robusta coffee have important implications for the market dynamics of sustainability standards in southern Sumatra. Less than half of Indonesian coffee production reaches established markets in Europe and the USA, where demand for VSS has traditionally been strongest.

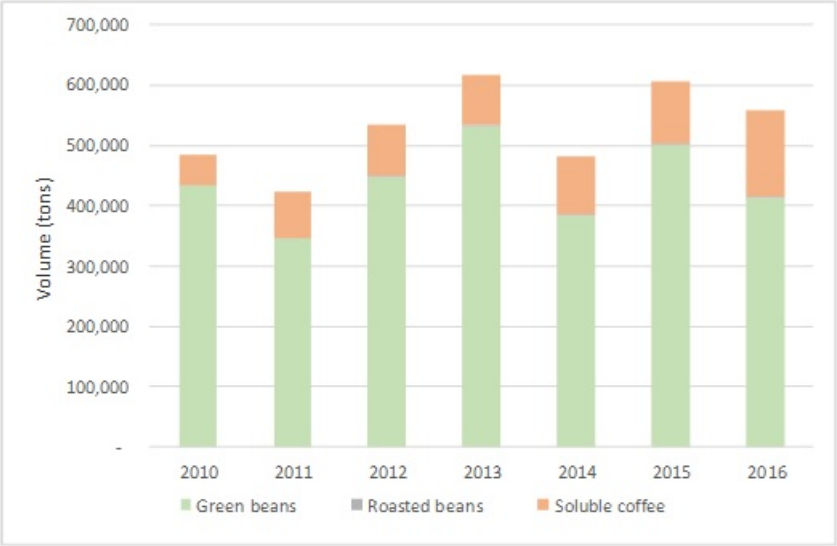

Figure 3. Indonesian export (volume) of various forms of coffee

(Source: UNComtrade 2018. Green coffee refers to HS Codes 90111 and 90112, Roasted coffee to HS Codes 90121 and 90122, Soluble coffee to HS Codes 210111 and 210112)

The typical coffee farmer in southern Sumatra is a household producer with a small plot (usually around one to two hectares), running a low-input and low-return farm. This can make it difficult for coffee farmers to support a family based on coffee production alone. Informal land tenure is common and there are few coffee producer organizations to lobby for farmers' interests. In the absence of specific sustainability programs, smallholder farmers tend to sell beans into an extended supply chain, which involves between four or five actors prior to reaching manufacturers or exporters. This chain would originate at the farm gate or in the village, where farmers have little information or market power. Many smallholders depend on local traders to provide them with credit to get access to inputs and bridge periods between harvests. A number of international trading companies and manufacturers are located in Bandar Lampung, which is responsible for approximately 65% of Indonesia's total coffee exports (Neilson et al., 2015).

Indonesian coffee farmers tend to apply low-input production techniques and are highly sensitive to natural conditions, such as weather. Output can vary considerably each year depending on weather. This is suggested by Figure 3 and Figure 4, although this national-scale production data actually masks even greater regional fluctuations caused by divergent weather patterns across the country. During the study period, an especially dry season had a significant impact on yields and income. According to a USDA GAIN report issued in December (2017):

> "El Nino-induced dry weather disrupted flowering and ripening for Indonesia's coffee crop, resulting in an expected decline in MY 2016/17 Indonesian coffee production. Drought was most acutely felt in lowland areas of Southern Sumatra and Java, where approximately 75 percent of Indonesia's Robusta crop is grown. Robusta production is thus expected to decline by approximately 15 percent"

This decline in output is important when interpreting the observed changes in livelihood indicators between 2015 and 2017 in our Semendo case study.

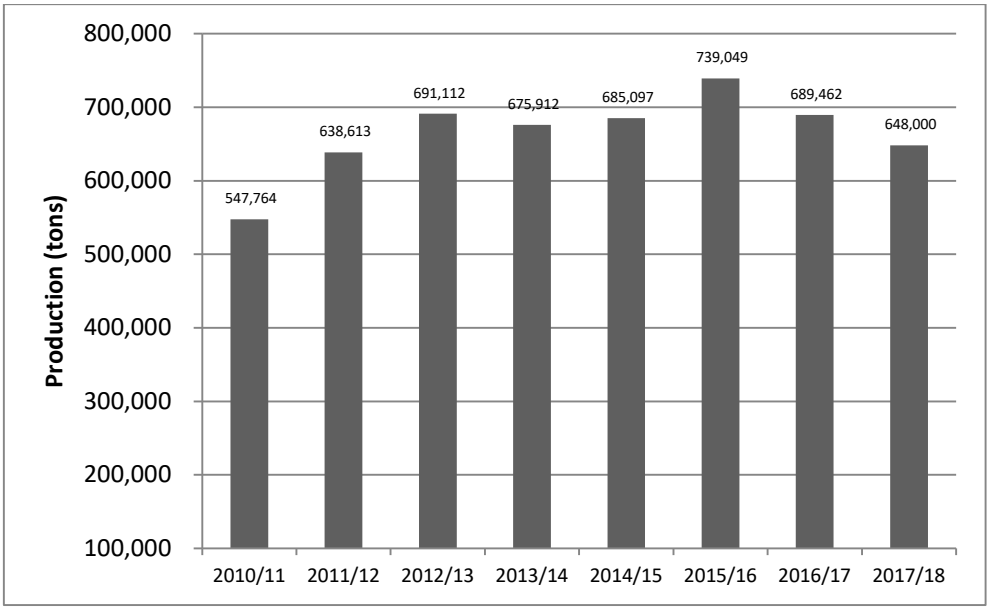

Figure 4 Indonesian production of coffee green beans

(Source: ICO 2018b)

The Semendo Region

Given the concentration of our research activities in the Semendo region, we provide some further background information about this particular region. Coffee was introduced to Semendo in the late 19th century, with its cultivation becoming widespread when Robusta was introduced by around 1911 (Huitema, 1935). Favourable market conditions in the late 1920s triggered the widespread incorporation of coffee within Semendo farms, and it has remained the primary cash crop ever since. Coffee was initially integrated with swidden rice farming as a fallow crop, and it continues to be less intensively grown in Semendo than elsewhere in Java and Sumatra.

The Semendo agricultural system has long been focused primarily on rain-fed wet rice cultivation (*sawah*) and fish ponds, and secondarily on dryland rice (*ladang*) using swidden

techniques and planted alongside fruit trees (Plate 1). Coffee has, over time, become integrated into, and partially replaced, this swidden system (Plate 2). Drawing on colonial-era forestry debates, Potter (2008) identifies the Semendo agricultural system as somewhat unique in the region, with a combination of intensive *sawah*, long-cycle swidden fallows and forests protected by customary law known as *rimboe larangan*. Individual plots are small and average less than two hectares with productivity estimated by government reports to be around 700 kg per hectare (we believe that even this is likely an overestimate), which is well below average yields of between 2,300-2,700 kg reported in Vietnam (D'Haese, Vannoppen and van Huylenbroeck, 2006; Agergaard, Fold and Gough, 2009).

Plate 1. Typical Semendo landscape with wet rice, agroforestry, coffee and swidden

Plate 2. Semendo Coffee plantings integrated with swiddens in a forest landscape

Culturally, the Semendo tend to prioritise the cultivation of rice as a central livelihood activity, social connectivity through marriage and kin networks, religious observances such as taking the pilgrimage to Mecca, and an adherence to customary law (*adat*). An important aspect of Semendo *adat* is *tunggu tubang*, referring to a matrilineal system of indivisible inheritance whereby the eldest daughter inherits family land, including rice fields, fish ponds, housing, and sometimes coffee farms (Salmudin, 2012). Our informants estimated that approximately 40% of land in the Semendo districts is held under *tunggu tubang* tenure. Around 90% of Semendo coffee farms are directly managed by land owners (the remainder are rented, lent without fee or sharecropped), although formal registration of land with the Lands Agency is rare (around 7% of respondents from our 2015 baseline survey claimed to hold formal title). Registration is limited due to the complications of the *tunggu tubang* system. *Tunggu tubang* land is not considered primarily as a productive asset, but is rather imbued with patrimonial and cultural value.

Traditional claims over forest and fallow land in Semendo frequently conflict with the territorial claims of the state, with the 1967 Forestry Act effectively declaring all forest lands to be the property of the state. While a 2012 ruling by the Indonesian Constitutional Court has since provided a legal basis for *adat* forest rights, forestry zoning remains strongly contested, with Ministry of Forestry and Ministry of Planning maps in disagreement on forest boundaries. Various forms of community forestry agreements have emerged over the last decade. This seriously complicates “no forest clearing” clauses within sustainability standards.

Semendo farmers performed a pivotal role in stretching the coffee frontier further south into Lampung province during the 1920s and again in the 1960s, where they continued extensive swidden-style practices, and have been associated with forest conversion (Verbist, Putra and Budidarsono, 2005). Several informants claimed that this out-migration from Semendo was triggered by the *tunggu tubang* inheritance customs, which effectively left many men landless. While the establishment of new coffee-related swiddens is still evident in the more remote villages of Semendo today, land shortages appear to be encouraging more permanent coffee cultivation in the more accessible villages.

Coffee is a popular source of income in Semendo due to its relatively stable price and low maintenance requirements relative to other cash crops like vegetables. Coffee farming has become an important part of the Semendo identity, with all villagers, from landless labourers through to the mayor of the district identifying themselves as coffee farmers (Plate 3). It is, however, important to emphasise the contingent role of coffee in livelihoods. During a period of low coffee prices in 2002, Potter (2008) reported how coffee farms were effectively abandoned and household resources were re-oriented towards *sawah*, the collection of non-timber forest products such as rattan, and out-migration.

Plate 3. Semendo coffee farmer in front of a *ladang* hut

Sustainability Programs in Southern Sumatra

The various forms of certification were introduced to the coffee regions of southern Sumatra more recently (since around 2008) than the Arabica-growing regions elsewhere in the country. In terms of volume, 4C is the most widely applied program followed by Rainforest Alliance and Utz, with all programs introduced by large trading firms and coffee manufacturers located in Bandar Lampung. An important impetus for firm-level adoption of sustainability standards in southern Sumatra was the publication by WWF in 2007, *Gone in an Instant*, which highlighted the role of coffee farming inside the Bukit Barisan Selatan National Park, where it was destroying habitat for critically endangered Sumatra tigers, rhinos and elephants. The coffee regions of Lampung are more closely located to the Bandar Lampung port and warehouse complex, and have generally been more exposed to various sustainability programs. In 2016, seven 4C-registered coffee companies were based in Bandar Lampung, although when approached, two of these had ceased sourcing 4C coffee citing a lack of market demand. Field research (the perceptions survey and village-based case studies) in Lampung was undertaken within the producer supply base of three of these companies.

The introduction of the 4C program to Semendo by the exporter occurred in partnership with, and was financed by, a large international coffee roaster as part of their corporate

sustainability commitments. The exporter established a trading warehouse in Semendo in 2012, followed by a training centre in 2014 as part of the 4C program (the buying station subsequently ceased operations in 2016). This was the first major trading investment by a large coffee buyer in Semendo and, by 2016, the initiative was directly employing a regional manager, a team of six agronomists and several security guards, most of whom were locally recruited, and had built a permanent training centre. The company financially supported the roll-out and audit process of 4C verification for more than 100 farmer groups (each consisting of around 25 members), most of which were established through previous government interventions. In 2012, 2437 households were listed as being part of the 4C production unit. The exporter offers registered farmers between six and ten training events per year (each lasting between three and four hours), although training was not dependent upon sales to the company. External 4C verification audits are undertaken, and are valid for three years if verification is obtained.

To encourage Semendo farmers to participate in the production unit, the exporter initially offered (in 2015 when the buying station was operating) a 'certification' premium of 300IDR/kg (around 3US cents/kg), in addition to a variable quality premium that may reach 2000IDR/kg (20 US cents/kg). A sub-set of the farmers involved in the 4C Production unit were subsequently 'upgraded' to meet the Rainforest Alliance standard in 2014, for which no further price premium was paid. The exporter pays the cost of obtaining certification, including the cost of training farmers and undertaking audits. This comes at an estimated cost of around 50 USD per farmer per year over the initial three-year life of the project. Participation in the exporter's programs is voluntary. The exporter initially held socialization events in villages, introducing the benefits of the 4C program and then inviting the farmer groups (usually represented by a farmer group head) to partner with the exporter and be involved in the program. If they agree, the exporter carrys out an internal audit to confirm if the farmer group is a good prospect for certification. This includes verifying that farmers don't have coffee plots in contested forest zones.

The exporter established a Farmer Training Centre, and recruited a team of locally-based agronomists who manage the Internal Control Systems (ICS) for the program. This team undertakes farmer training to those groups involved in the program, and offers advice on how to apply fertilizers, composting, pruning, harvesting advice, pest management and marketing. Sometimes training is offered only to representatives of groups (ie. group leaders) in the expectation that the knowledge gained will be shared with other members, but in principle all farmers are targeted. The exporter's agronomists also undertake occasional farm visits, which are highly sought after by many of the enrolled farmers we interviewed. The exporter also produced a calendar with monthly tree, pest and soil management tips. The calendar was widely distributed across Semendo, to both enrolled and non-enrolled farmers. The exporter also advises farmers on post-harvest handling, strongly encouraging improved quality and the use of tarpaulin for drying.

During the 4C training, farmers get up to 10 training sessions that cover unacceptable practices, use of equipment, safety procedures, and quality assurance[4]. Some sessions are seasonally targeted so that relevant issues are addressed when they are most salient (e.g., quality assurance around the harvesting season). The exporter's agronomists also provide various follow-up services, as well as internal audit support to review farm conditions and

[4] Although some farmers suggested that only farmer leads received this training.

compliance with standards. After completion of the training program, the exporter will arrange for an independent audit. If the farmer group passes the audit, they receive 'certification'. At this point, it was the intention that the exporter would integrate the farmer group into their certified supply chain, providing them with regular updates on market prices for coffee (through mobile phone services), and allowing them to sell coffee at the buying station with the associated premium. At the same time, farmers were never obliged to sell their coffee to the exporter, and are free to sell through local traders if they desire. In practice, many farmers would choose to do both, and integration within the supply chain did not always occur.

Those farmers who were approached to upgrade to RA certification were initially audited internally by the exporter prior to an external audit. There is not always dedicated training given prior to RA certification, though the exporter uses RA online training materials to make presentations at farmer group meetings. Pending the results of the internal audit, the group may require further training and capacity building to meet the standard (especially in relation to conservation practices). The additional services offered to RA farmers were minimal.

Following the closure of the exporter's buying station in Semendo in 2016, the exporter's Sustainability team continued to provide support to the Farmer Training Centre in Semendo with continued financial support from a large international coffee manufacturer. Then, in 2018, the exporter ceased all trading operations in southern Sumatra, but continued to provide technical support and field extension staff to the "sustainability program" in Semendo, which was no longer linked with any active supply chain.

Many of the coffee production regions in West Lampung are adjacent to the Bukit Barisan Selatan National Park and other areas designated "Protection Forest" by the government. Significant areas of officially designated protected forest have been cleared in this region since at least the 1980s, some of which has subsequently been recognised by the state as community forest land (including *Hutan Kemasyarkatan* or HKm) where coffee is permitted as an understory crop. The boundaries of such protection forest, some of which were established during the colonial regime, are often strongly contested by communities, and forest fallow cycles and swiddening is part of traditional agriculture. This is a complicated physical landscape for sustainability standards. Earlier studies (Verbist et al., 2005) demonstrated that coffee-based agroforestry, linked to community tenure, constituted a "re-treeing" of the landscape that actually improved hydrological functions, but some firms avoid sourcing from this land. The 4C code identifies the following as an unacceptable practice: "there is evidence of destruction of protected areas (designated by national and/or international legislation) by any business partner of the 4C Unit since 2006." Similarly, the RA standard requires that "High Conservation Value (HCV) areas have not been destroyed from November 1, 2005 onward" and that "production activities do not degrade any protected area". It is not entirely clear how such requirements should be interpreted in the highly-dynamic West Lampung community forestry landscape, where land use is in constant flux. At least one exporter would not (formally at least) work with farmers in these areas, while another was able to obtain 4C verification on HkM land.

4. Research Findings

Livelihood effects of participating in a 4C Program (2015 Data only)

The earlier analysis of the 2015 survey round was presented in the baseline report. These findings are updated below. We then conducted a more in-depth analysis with the 2015 data, using Propensity Score Matching (PSM) and Instrumental Variables (IV) techniques to estimate the effects of the combined treatment of participation in a 4C production unit and having a trading relationship with the exporter (as compared to not having either).

The 2015 results are summarized in the draft paper in Appendix E.[5] Our results suggest that within the narrow lens of coffee production, the program had a modest impact, at best. If anything, time spent on coffee production, and coffee yield, moderately declined for those who were part of the 4C program. However, overall household income rose significantly, and we saw important improvement on a measure of poverty, the Poverty Probability Index (PPI). However, these improvements are not driven by the coffee farm, where we did not observe significant earnings improvements. Rather, these patterns were generated by households tending to shift labour effort from their coffee plots into other, higher earning, agricultural work outside of their own coffee farm (especially higher value fruit and vegetable production). Non-agricultural income also increased amongst the 4C group in activities such as petty trade. We argued that this was consistent with the market access channel (then still active) bringing about a reduction in cash income risk, and the development of social capital as a result of program enrolment, which together allow households to diversify into higher-earning (but perhaps risker) economic activities. Hence this suggests that the household income improvements were not caused by the expected impact pathway of 4C training leading to higher coffee yields leading to higher income. These results pointed to the need for impact studies to take a broad lens to the potential impacts pathways of such programs, looking beyond just the targeted activity (coffee production) itself towards possible stimulation of other occupational portfolios.

Across a range of measures, the story from the 2015 survey round and analysis was quite clear: on average the farmers connected to the exporter were less likely to be in poverty than those who are not, but at the same time both samples have higher poverty rates than the overall population in Muara Enim district. The first fact could of course be driven by differential selection of farmers by the exporter, which we imperfectly corrected for, but it is also possible that the combination of 4C and market access had already begun to contribute to improvements in livelihood status amongst participants. This seemed to indicate that the program is managing to reach relatively poorer segments of the overall population in Semendo, but not necessarily the poorest coffee growing households.

Livelihood effects of participating in a 4C Program (2015 and 2017 Data)

In this section we describe a number of outputs that pair the 2015 data with the 2017 data round, which combine propensity score matching (PSM) with a differences-in-differences (DiD) impact estimation.

[5] These results were also discussed in ISEAL research webinar 28, on June 28, 2018, which is available here: https://www.isealalliance.org/get-involved/resources/research-webinars

Each set of outcome indicators begins by presenting summary statistics of the 2015 and 2017 rounds of the Semendo household survey following the PSM (ie. after removing poorly matched households). While this PSM process attempts to correct for selection bias, differences between these columns should not be interpreted as unequivocally causal (i.e., caused by 4C). The full summary statistics prior to the PSM are provided in Appendix F.

We then improve on the straight PSM analysis by estimating the treatment effect using PSM in combination with differences-in-difference (DiD). As a method of impact evaluation, this is an improvement over the straight PSM with more plausible causal interpretations. It allows us to more convincingly account for selection bias, and removes the effect of all time-invariant sources of heterogeneity using individual fixed effects. By more efficiently modelling the relationship between treatments and other variables, and outcomes, it is more likely that we will find a given treatment effect to be statistically significant. The findings from the PSM summary statistics and the PSM+DiD could differ because the latter controls for many more factors. It is also important to highlight that the PSM+DiD records change between the 2015 and 2017 data.

A negative estimated effect result equates to a negative impact of 4C participation and vice versa for positive results.

Interpretation of Tables

In the results below we present 2 tables for each set of outcomes. These cover: (a) summary statistics for the 2015 and 2017 survey rounds following PSM; and (b) the treatment effect between 2015 and 2017 (PSM + DiD).

The summary statistics (PSM) tables have the following 9 columns:

1. Variable name: includes code name in the dataset, enabling matching to the underlying dataset and the data dictionary, and a descriptive name;
2. Mean of 4C (2017): average value of variable in 4C farmer sample following PSM;
3. Mean of non-4C (2017): average value of variable in the non-4C farmer sample following PSM;
4. Stat. sig. (2017): for 4C vs non 4C. *** indicates high statistical significance, ** indicates conventional statistical significance, * indicates weak statistical significance;
5. Mean of 4C (2015): average value of variable in 4C farmer sample following PSM (2015);
6. Mean of non-4C (2015): average value of variable in the non-4C farmer sample following PSM (2015);
7. Stat. sig. (2015): for 4C for non-4C (significance stars as above);
8. Stat. sig (2015 vs 2017 4C): a test for whether the difference in average values for 4C farmers is significant between 2015 and 2017.
9. Stat. sig (2015 vs 2017 Non-4C): a test for whether the difference in average values for non-4C farmers is significant between 2015 and 2017.

The Treatment Effect (PSM+DiD) Tables includes the following 5 columns:

1. Column 1 gives the name of the variable;
2. The estimated effect size (i.e., the difference between 4C and non-4C);
3. Significance stars (as explained above);
4. The mean value of the variable in the control group. Ie. what the value would have been for the 4C group, in absence of 4C;
5. The units of the measure of the variable. If the variable is unit free (e.g., a proportion) then it may be expressed as "[0,1]" meaning that the variable can take any value between 0 and 1.

Household Demographics

Looking at demographics of the household head in 2017, little has changed since 2015 (Table 3). Male household heads of the Semendo ethnic group still dominate the sample. In regards to other household-level covariates, asset ownership has increased overall, as both toilet ownership and TV ownership have increased by about 10% in our sample, amongst both the 4C and non-4C groups (in fact, there is a more significant increase in TV ownership amongst the non-4C group). This suggests a significant increase in the material well-being of coffee farming households irrespective of the sustainability programs. Average landholdings have not changed significantly for either group in the two-year period, although the 4C group showed a moderate increase in the proportion of land allocated to coffee.

Variable	2017			2015			2015 v 2017 (4C)	2015 v 2017 (non-4C)
	4C (mean)	Non-4C (mean)	Sig. t-test	4C (mean)	Non-4C (mean)	Sig. t-test	Sig. t-test	Sig. t-test
Gender (male=1)	95%	94%		95%	95%			
Age of HH head	47.5	45.8	**	45.4	43.9	*	***	*
ab2_1 Semende ethnicity	88%	85%		87%	86%			
ab6 Father was coffee grower	81%	84%		84%	87%			
hdsize HH size (num. members)	4.6	4.5		4.6	4.8			
hs4 Does the house have a toilet	70%	69%		59%	55%		***	***
hs10 Is there a television set in the household	87%	85%		77%	78%		***	**
fc_total_land Total land area (m^2)	21,369	22,597		22,209	21,356			
fc_prop_land_coffee Proportion of land in coffee	84%	85%		81%	82%		*	

Table 3. Household Demographics

Coffee-related information and knowledge

In both 2015 and 2017, 4C farmers show superior outcomes on measures including price knowledge, time spent discussing coffee with colleagues, attending farmer group meetings, satisfaction with the farmer group, and record keeping (Table 4). However, the treatment effect analysis finds a significant decrease in time spent discussing coffee relative to the non-4C group (Table 5). It is possible that there was a more intensive learning and interaction period around or before 2015, when the farmers in the 4C program were going through the most intensive learning phase and the buying station was in operation, but this had dissipated by 2017. 4C farmers tended to stay more active in farmer groups than non-4C farmers.

Variable	2017			2015			2015 v 2017 (4C)	2015 v 2017 (non-4C)
	4C (mean)	Non-4C (mean)	Sig. t-test	4C (mean)	Non-4C (mean)	Sig. t-test	Sig. t-test	Sig. t-test
mc_price_info Index of knowledge of different prices	20%	16%	**	20%	17%	**		
ac10c_min Time per week spent disc. coffee (mins)	74	66		99	77	***	***	
pg_head_participation Attend All or Most farmer group meetings	37%	28%	***	34%	42%	**		***
pg_fg_functions Index of FG functions provided	5%	4%	**	5%	4%	*		
mc_records Index of production record keeping	12%	8%	**	16%	14%		**	***

Table 4. Coffee-related information and knowledge (PSM summary statistics)

Outcome variable	Estimated effect	Significance	Mean of control	Units
mc_price_info Index of knowledge of different prices	-0.004		0.164	(0,1)
ac10c_min Time per week spent disc. coffee (mins)	-24.253	***	66.960	Minutes per week
pg_head_participation Attend All or Most farmer group meetings	0.021		0.279	(0,1)
pg_fg_functions Index of FG functions provided	0.001		0.039	(0,1)
mc_records Index of production record keeping	-0.031	***	0.083	(0,1)

*** If t-test significant at 1% (highly significant)
** if t-test significant at 5% (significant)
* if t-test significant at 10% (moderately significant)

Table 5. Coffee-related information and knowledge (PSM+DiD treatment effect)

Coffee labour practices

We find that although all household heads spend 3-4 less hours per week farming coffee in 2017, they spend more total hours per year, suggesting that they work more weeks on coffee across the year between 2015 and 2017 (Table 6). 4C farmers appear to spread their farming

efforts across the year more than non-4C farmers, spending about 290 extra hours on coffee farming in the year (Table 7). 4C involvement does seem to have had the effect of increasing farmer dedication to coffee. Compliance with an index of labour practices is considerably higher in 2017 than 2015, and furthermore there is a much larger increase in performance on the index of labour practices among the 4C group. This index measure records farmers as non-compliant if they (1) employ children under age 16 on the coffee farm as their primary activity (i.e., so they would not primarily be in school), or (2) employ full-time or part-time workers at below the minimum wage.

Variable	2017			2015			2015 v 2017 (4C)	2015 v 2017 (non-4C)
	4C (mean)	Non-4C (mean)	Sig. t-test	4C (mean)	Non-4C (mean)	Sig. t-test	Sig. t-test	Sig. t-test
ac_coffee Total hours per week coffee farming	32.5	33.3		36.6	37.4		***	***
ac_coffee_yr Total hours per year coffee farming	1,224	1,141	*	931	961		***	***
hd_labour_prac Compliance with labour prac.	50%	42%	*	15%	12%		***	***

Table 6. Coffee labour practices (PSM summary statistics)

Outcome variable	Estimated effect	Significance	Mean of control	Units
ac_coffee Total hours per week coffee farming	-4.158	***	33.347	Hours per week
ac_coffee_yr Total hours per year coffee farming	290.082	***	1141.029	Hours per year
hd_labour_prac Compliance with labour prac.	0.346	***	0.426	[0,1]

*** If t-test significant at 1% (highly significant)
** if t-test significant at 5% (significant)
* if t-test significant at 10% (moderately significant)

Table 7. Impacts of program on coffee labour practices (PSM+DiD treatment effect)

Coffee management practices

Coffee management practices show a variety of results and it is difficult to make confident conclusions about impact in this area. The starkest improvement, especially relative to 2015, is the increase in shade tree use amongst 4C farmers, who reported less dense plantings in 2015 but equivalent planting by 2017. We see a notable improvement in conservation practices from 2015 to 2017, particularly among the 4C group, based on an index covering maintenance of natural vegetation along water bodies, no spray areas and forest protection. While we have some concerns about self-reported practice measures, as better-informed farmers may give themselves lower assessments on these self-assessed measures, the increased shade tree planting is broadly supported by our independent observations reported in the following section. While the PSM suggests moderately higher implementation of pest and disease management practices (Table 8), this becomes a negative effect once the DiD is conducted (table 9).

Variable	2017			2015			2015 v 2017 (4C)	2015 v 2017 (non-4C)
	4C (mean)	Non-4C (mean)	Sig. t-test	4C (mean)	Non-4C (mean)	Sig. t-test	Sig. t-test	Sig. t-test
fp29_pest_mgmt Index disease/pest mgmt practices followed (/7)	12%	10%	*	14%	13%		***	***
fp33_pesti_prac Compliance with 4C banned pesticides	84%	83%		92%	92%		***	***
fp_dispose Compliance with waste disposal prac.	27%	28%		21%	23%		***	
fp1_prod_prac Index prod practices followed (/6)	18%	18%		18%	20%	***		**
fc_shade_trees HH has shade trees on main coffee plot	79%	80%		48%	52%		***	***
fp1a_cons_prac Index cons practices followed (/4)	20%	16%	***	14%	16%	*	***	
ps_drying_prac Compliance with drying prac.	76%	68%	**	72%	49%	***		***
mc5a Do usually save the coffee in order to be able to sell it with higher price	27%	23%		35%	20%	***	***	

Table 8. Coffee management practices (PSM Summary Statistics)

Outcome variable	Estimated effect	Significance	Mean of control	Units
fp29_pest_mgmt Index disease/pest mgmt practices followed (/7)	-0.020	***	0.105	[0,1]
fp33_pesti_prac Compliance with 4C banned pesticides	-0.079	***	0.826	[0,1]
fp_dispose Compliance with waste disposal prac.	0.057	***	0.283	[0,1]
fp1_prod_prac Index prod practices followed (/6)	-0.003		0.183	[0,1]
fc_shade_trees HH has shade trees on main coffee plot	0.309	***	0.814	[0,1]
fp1a_cons_prac Index cons practices followed (/4)	0.060	***	0.159	[0,1]
ps_drying_prac Compliance with drying prac.	0.021		0.696	[0,1]
mc5a Do usually save the coffee in order to be able to sell it with higher price	-0.081	***	0.224	{0,1}

*** If t-test significant at 1% (highly significant)
** if t-test significant at 5% (significant)
* if t-test significant at 10% (moderately significant)

Table 9. Coffee management practices (PSM+DiD treatment effect)

Coffee production outcomes

2017 was a significantly worse production year than 2015 due largely to weather conditions, and nearly every outcome indicator worsens in 2017. We cannot detect noticeably positive yield effects from 4C participation. While average yield declines were not as severe for 4C farmers (Table 10), the subsequent DiD analysis actually suggest that 4C program participation results in overall yield declines (Table 11). While average yields were higher amongst the 4C group in 2017, this was only mildly significant. It is important to note that output per unit of labour exerted, however, was not significantly higher for the 4C group (Table 10), such that it is possible that the additional labour required to maintain production could have been used more rewardingly elsewhere. The 4C group also made significantly higher cash investments in coffee maintenance compared to the non-4C group. We have identified slightly higher coffee income for the 4C farmers, which appears to be largely due to price improvements (Table 13), Overall, 4C farmers appear to have been motivated to allocate more household resources to coffee, but with marginal benefits.

Variable	2017			2015			2015 v 2017 (4C)	2015 v 2017 (non-4C)
	4C (mean)	Non-4C (mean)	Sig. t-test	4C (mean)	Non-4C (mean)	Sig. t-test	Sig. t-test	Sig. t-test
fp30 Coffee health - was any of your coffee seriously affected by pests or disease	74%	69%		78%	75%		**	*
ps_coffeeyield_ha Coffee yield per hectare	301	271	*	357	385		***	***
ps_tree_output Yield per coffee tree	0.12	0.11	*	0.15	0.17	**	***	***
ps_coffee_percap Kg of coffee per HH member	125	114		142	141		***	***
ps_coffee_lab Coffee output per hr of head farmer labour (kg/hr)	17.3	16.9		32.3	31.5		***	***
fl_coffeeexpenses_new Total coffee expenses	1,950,990	1,895,032		1,717,034	1,792,857		***	
ps_coffeeincome income from coffee	10,858,415	9,830,144		10,139,971	10,641,702		*	
fp_coffeeprofit_new Coffee net profit	8,974,088	7,949,330	*	8,368,813	8,818,537			
fp_coffee_prof_ag_inc Coffee as proportion of agri. income	82%	84%		83%	92%	***		***

Table 10. Coffee outcomes (PSM summary statistics)

Outcome variable	Estimated effect	Significance	Mean of control	Units
fp30 Coffee health - was any of your coffee affected by pests or diseases seriou	-0.056	***	0.687	(0,1)
ps_coffeeyield_ha Coffee yield per hectare	-56.222	***	270.621	(Kg coffee yield)/ha
ps_tree_output Yield per coffee tree	-0.027	***	0.110	(Kg coffee yield)/(coffee tree)
ps_coffee_percap Kg of coffee per HH member	-17.222	***	113.842	(Kg coffee yield)/(# HH members)
ps_coffee_lab Coffee output per hr of head farmer labour (kg/hr)	-15.045	***	16.819	(Kg coffee yield)/(Hours of HH head coffee labor)
fl_coffeeexpenses_new Total coffee expenses	215218.956	***	1917801.619	Indonesian Rupiah (1 USD = 14500 IDR)
ps_coffeeincome income from coffee	671043.858	*	9729049.595	Indonesian Rupiah (1 USD = 14500 IDR)
fp_coffeeprofit_new Coffee net profit	574145.696	*	7832677.126	Indonesian Rupiah (1 USD = 14500 IDR)
fp_coffee_prof_ag_inc Coffee as proportion of agri. income	-0.019		0.840	(0,1)

*** If t-test significant at 1% (highly significant)
** if t-test significant at 5% (significant)
* if t-test significant at 10% (moderately significant)

Table 11. Impacts of program on coffee outcomes (PSM+DiD treatment effect)

Coffee market interactions

Overall, 4C farmers still primarily sell coffee to local buyers, although Table 12 suggests some degree of alternative marketing arrangements (i.e., selling collectively through the farmer group), but the DiD analysis does not attribute this to the program (Table 13). 4C farmers have, however, significantly improved their satisfaction rating with the first buyer (Table 13). The 4C farmers continue to receive a slightly higher price for coffee, and the DiD analysis even suggests that the effect of the program has been strongly significant in causing a 25c/kg difference. Prices increased by about 20c/kg from 2015 to 2017, but this appears to be a direct reflection of global price fluctuations, which (according to ICO data) increased from 87c/lb in July 2015 to 105c/lb in July 2017.

Variable	2017			2015			2015 v 2017 (4C)	2015 v 2017 (non-4C)
	4C (mean)	Non-4C (mean)	Sig. t-test	4C (mean)	Non-4C (mean)	Sig. t-test	Sig. t-test	Sig. t-test
ps91_2 buyer 1 is direct exporter	3%	2%		4%	2%	*		
ps91_4 buyer 1 is local buyer	90%	96%	***	89%	92%			*
ps121 satisfaction with sales to buyer 1	95%	94%		87%	91%		***	
Average price received for coffee	21,965	21,626	***	18,435	18,077	***	***	***

Table 12. Coffee market interactions (PSM summary statistics)

Outcome variable	Estimated effect	Significance	Mean of control	Units
ps91_2 buyer 1 is direct exporter	-0.011		0.017	[0,1]
ps91_4 buyer 1 is local buyer	0.007		0.961	[0,1]
ps121 satisfaction with sales to buyer 1	0.080	***	0.931	{0,1}
Average price received for coffee	3541.343	***	21610.319	Indonesian Rupiah (1 USD = 14500 IDR)

*** If t-test significant at 1% (highly significant)
** if t-test significant at 5% (significant)
* if t-test significant at 10% (moderately significant)

Table 13. Impacts of program on coffee market interactions (PSM+DiD treatment effect)

Household labour allocation

The overall story for time use is quite clear: significant increases in time investment, practically across the spectrum – in coffee, in non-coffee agriculture (including rice and vegetable crops), and in non-agriculture (including petty trade and casual work), for 4C farmers (Table 14 and 15). The story is consistent with the suggestion that households will invest significantly more time and effort during a poor season (ie. 2017) to make up a minimally acceptable level of earnings.

Variable	2017			2015			2015 v 2017 (4C)	2015 v 2017 (non-4C)
	4C (mean)	Non-4C (mean)	Sig. t-test	4C (mean)	Non-4C (mean)	Sig. t-test	Sig. t-test	Sig. t-test
ac_coffee_yr Total hours per year coffee farming	1,224	1,141	*	931	961		***	***
ac_ag Hours per year in agri. (incl. coffee)	1,556	1,448	*	1,200	1,241		***	***
ac_ag_noncoffee Hours per year in agri. (excl. coffee)	345	343		263	268		***	**
ac_non_ag Hours per year in non-agri. occupations	342	239	**	240	165	**	***	*
ac_total Total hours worked per year	1,954	1,731	***	1,495	1,447		***	***
ac1 Number of occupations in past year	2.0	2.1	*	1.8	1.7	**	***	***

Table 14. Household labour allocation (PSM summary statistics)

Outcome variable	Estimated effect	Significance	Mean of control	Units
ac_ag Hours per year in agri. (incl. coffee)	353.809	***	1468.599	Hours per year
ac_ag_noncoffee Hours per year in agri. (excl. coffee)	81.497	***	341.800	Hours per year
ac_non_ag Hours per year in non-agri. occupations	94.646	***	241.838	Hours per year
ac_total Total hours worked per year	449.250	***	1752.672	Hours worked per year
ac1 Number of occupations in past year	0.139	***	2.065	Number of occupations (1+)
he_ag_rev Total revenue from non-coffee agriculture	246759.149		1625400.810	Indonesian Rupiah (1 USD = 14500 IDR)
ac_non_ag_wage Total earnings from non-agri. occupations	1346247.037	***	2784309.717	Indonesian Rupiah (1 USD = 14500 IDR)

*** If t-test significant at 1% (highly significant)
** if t-test significant at 5% (significant)
* if t-test significant at 10% (moderately significant)

Table 15. Household labour allocation (PSM+DiD treatment effect)

Monetary measures of livelihood outcomes

Consistent with the significantly larger time commitments, particularly outside agriculture, these translate into larger earnings, with fairly notable earnings superiority among the 4C group over the non-4C group, including outside coffee, and outside agriculture altogether (Table 16 and 17). Gifting (an indicator of relative prosperity) seems to have gone up in the 4C group in 2017 in comparison to 2015, but not in the non-4C group, while average remittances received also increased.

Variable	2017			2015			2015 v 2017 (4C)	2015 v 2017 (non-4C)
	4C (mean)	Non-4C (mean)	Sig. t-test	4C (mean)	Non-4C (mean)	Sig. t-test	Sig. t-test	Sig. t-test
he_ag_rev Total revenue from non-coffee agriculture	2,109,394	1,605,896	*	1,871,632	981,603	***		**
ac_non_ag_wage Total earnings from non-agri. occupations	4,683,414	2,750,898	***	3,219,499	1,817,363	***	***	**
hs_income total HH monthly net income (Excl debts)	1,909,502	1,979,670		1,492,198	1,332,810	*	***	***
fp_totalincome Total HH annual income	19,720,328	19,208,115		17,804,520	16,113,186	*	***	**
hs_income_congive Net HH inc per month, incl. in-kind given/rec'd	4,146,011	4,468,224		3,586,094	3,465,765		***	***
he4 Remittances received in past year	264,220	198,608		86,027	55,385	*	***	***
he2_top Total kg. given away (rice, durian, other veg.)	239	282		245	277			
he2_21_kg Kilos of rice given away	200	226		195	257	**		

Table 16. Livelihood outcomes (PSM summary statistics)

Outcome variable	Estimated effect	Significance	Mean of control	Units
hs_income total HH net income	393815.205	***	1973679.757	Indonesian Rupiah (1 USD = 14500 IDR)
fp_totalincome Total HH annual income	1817564.036	***	19440076.316	Indonesian Rupiah (1 USD = 14500 IDR)
hs_income_congive Net HH inc per month, incl. in-kind given/rec'd	536763.702	***	4452157.931	Indonesian Rupiah (1 USD = 14500 IDR)
he4 Remittances received in past year	182552.770	***	197800.813	Indonesian Rupiah (1 USD = 14500 IDR)
he2_top Total kg. given away (rice, durian, other veg.)	-5.892		285.713	Kg
he2_21_kg Kilos of rice given away	5.389		228.478	Kg

*** If t-test significant at 1% (highly significant)
** if t-test significant at 5% (significant)
* if t-test significant at 10% (moderately significant)

Table 17. Impacts of program on monetary measures of livelihood (PSM+DiD treatment effects)

Well-being and coffee

All farmers have broadly similar neutral attitudes towards coffee farming prospects in the future, while 4C farmers have significantly lower subjective assessments of their overall well-being (Table 18 and 19). In the Semendo cultural context, it is tempting to associate this with the increased (drudgerous) work generally undertaken by the 4C group. However, consistent with the income results, we find a large and highly statistically significant impact (a reduction) on the probability of the household being in poverty.

Variable	2017			2015			2015 v 2017 (4C)	2015 v 2017 (non-4C)
	4C (mean)	Non-4C (mean)	Sig. t-test	4C (mean)	Non-4C (mean)	Sig. t-test	Sig. t-test	Sig. t-test
sa1 Prospects for coffee farming in your region over the next five years? (1-5)	2.53	2.54		2.49	2.40	*		**
sa9 Overall quality of life for the HH in the last production year was (1-5)	2.50	2.61	***	2.52	2.58	*		
PPI implied probability of poverty	17.50	19.66	**	22.11	23.99		***	***

Table 18. Indicators of well-being (PSM summary statistics)

Outcome variable	Estimated effect	Significance	Mean of control	Units
sa1 Prospects for coffee farming in your region over the next five years? (1-5)	0.048		2.534	[1,5]
sa9 Overall quality of life for the HH in the last production year was (1-5)	-0.016		2.615	[1,5]
PPI implied probability of poverty	-4.498	***	19.311	[0,100]

*** If t-test significant at 1% (highly significant)
** if t-test significant at 5% (significant)
* if t-test significant at 10% (moderately significant)

Table 19. Indicators of well-being (PSM+DiD treatment effects)

We present some additional outcome measures (e.g., converting some household-level outcomes into per capita terms), and some additional detailed coffee practices measures, in the more detailed presentation of the pre-PSM summary statistics in Appendix F.

Observational data of soil management

The observation-based farm survey measuring soil management practices and soil conditions complemented the two rounds of household-level survey responses. In light of the logistical challenges of reaching coffee farms in many parts of Semendo, this survey has a smaller sample than the household survey. The sample was deliberately selected within these logistical constraints, to further sample from a set of 4C and non-4C farmers where the PSM match was particularly effective. Soil scientists from ICCRI carried out the survey and were not aware (ie. blinded) of the treatment assignment between 4C and non-4C.

The results of these observations are presented in Table 20, showing that 4C-enrolled farmers were found to be maintaining significantly higher densities of shade trees. These practices appear to have resulted in a thicker organic layer, although we also observed higher incidence of erosion (exposed roots and gully erosion) on 4C farms. Non-4C farms were observed to less actively and regularly undertake weeding, and we believe that this has acted to reduce rates of erosion.

Variable	Mean of 4C	Mean of non-4C	p-value of t-test	Significance	Number of observations
Slope of land					
Number of shade trees	3.80	2.85	0.01	**	259
Depth of organic layer	2.16	1.68	0.05	*	258
Presence of exposed roots	3.10	2.46	0.15		259
Gully erosion	0.20	0.09	0.02	**	257
Rill erosion	0.63	0.70	0.28		259

Table 20. Observational data of soil management outcomes

*** If t-test significant at 1% (highly significant)
*** If t-test significant at 5% (significant)
*** If t-test significant at 10% (moderately significant)

Additional Livelihood Effects from Obtaining Rainforest Alliance Certification

In this section, we present the findings of the randomized control trial (RCT) component of the study in Semendo, drawing upon the 2015 and 2017 data rounds. We randomly selected 29 of 59 farmer groups to be “upgraded” the farmers to Rainforest Alliance (RA) certification, with certificates issued early in 2016. The RA-focused trainings primarily focused on conservation practices, including pesticide management. It is notable that the “control group” in this study is still connected to the exporter. Hence, it is critical in interpreting these results, to keep in mind that the differences in what these two groups received from the exporter are relatively minor, and focused on a small set of behaviours largely related to environmental and conservation practices on the coffee farm.

The following results present "differences in differences" (DiD) estimates, which best leverage both rounds of data. I.e., technically, we are comparing the change in outcomes from 2015 to 2017, between the RA and non-RA group. A negative estimated effect result equates to a negative impact of RA upgrading and vice versa for positive results.

Coffee-related information and knowledge

Perhaps unsurprisingly, since both the treatment and control farmers in this RCT have access to the exporter, we do not see significant differences in outcomes for knowledge sharing. Farmers in the RA group spend about 10 minutes more per week discussing coffee but this isn't statistically significant. On average, all farmers attend about 50% of all farmer group meetings with no difference between 4C and RA.

Outcome variable	Estimated effect	Significance	Mean of control	Units
mc_price_info Index of knowledge of different prices	0.007		0.186	(0,1)
ac10c_min Time per week spent disc. Coffee	10.403		79.968	Minutes per week
pg_head_participation Attend All or Most farmer group meetings	0.068		0.420	(0,1)
pg_fg_functions Index of FG functions provided	-0.003		0.057	(0,1)
mc_records Index of production record keeping	0.017		0.123	(0,1)

*** If t-test significant at 1% (highly significant)
** if t-test significant at 5% (significant)
* if t-test significant at 10% (moderately significant)

Table 21. Impacts of RA on coffee-related information and knowledge

Coffee labour practices

RA farmers reported spending slightly less time coffee farming and are slightly more complaint with required labour practices, but the differences are not statistically significant.

Outcome variable	Estimated effect	Significance	Mean of control	Units
ac_coffee Total hours per week coffee farming	-0.331		32.435	Hours per week
ac_coffee_yr Total hours per year coffee farming	-66.497		1195.704	Hours per year
hd_labour_prac Compliance with labour prac.	0.075		0.516	[0,1]

*** If t-test significant at 1% (highly significant)
** if t-test significant at 5% (significant)
* if t-test significant at 10% (moderately significant)

Table 22. Impacts of RA on coffee labour practices

Coffee management practices

Overall coffee management practices do not change greatly with RA certification, although there is a moderate increase in performance on an index of production practices (including drainage channels, soil ridges around trees, fencing, shade trees, and hedgerows) and in the likelihood to actively plant shade trees. Compliance with required drying practices moderately worsens.

Outcome variable	Estimated effect	Significance	Mean of control	Units
fp29_pest_mgmt Index disease/pest mgmt practices followed (/7)	-0.015		0.109	[0,1]
fp33_pesti_prac Compliance with 4C banned pesticides	0.040		0.846	[0,1]
fp_dispose Compliance with waste disposal prac.	-0.011		0.261	[0,1]
fp1_prod_prac Index prod practices followed (/6)	0.011	*	0.177	[0,1]
fc_shade_trees HH has shade trees on main coffee plot	0.070	*	0.807	[0,1]
fp1a_cons_prac Index cons practices followed (/4)	-0.025		0.194	[0,1]
ps_drying_prac Compliance with drying prac.	-0.074	*	0.767	[0,1]
mc5a Do usually save the coffee in order to be able to sell it with higher price	0.035		0.273	{0,1}

*** If t-test significant at 1% (highly significant)
** if t-test significant at 5% (significant)
* if t-test significant at 10% (moderately significant)

Table 23. Impacts of RA on coffee management practices

Coffee outcomes

RA farmers reported slightly improved coffee production outcomes, although these are not generally statistically significant, except for the moderate significance of coffee yield per tree.

Outcome variable	Estimated effect	Significance	Mean of control	Units
fp30 Coffee health - was any of your coffee affected by pests or diseases seriou	0.010		0.718	{0,1}
ps_coffeeyield_ha Coffee yield per hectare	22.725		287.301	(Kg coffee yield)/ha
ps_tree_output Yield per coffee tree	0.017	*	0.115	(Kg coffee yield)/(coffee tree)
ps_coffee_percap Kg of coffee per HH member	9.455		123.930	(Kg coffee yield)/(# HH members)
ps_coffee_lab Coffee output per hr of head farmer labour	2.259		17.704	(Kg coffee yield)/(Hours of HH head coffee labor)
fl_coffeeexpenses_new Total coffee expenses	141434.049		1865591.542	Indonesian Rupiah (1 USD = 14500 IDR)
ps_coffeeincome income from coffee	804361.502		10582588.388	Indonesian Rupiah (1 USD = 14500 IDR)
fp_coffeeprofit_new Coffee net profit	604847.028		8787060.015	Indonesian Rupiah (1 USD = 14500 IDR)
fp_coffee_prof_ag_inc Coffee as proportion of agri. income	-0.017		0.794	(0,1)

*** If t-test significant at 1% (highly significant)
** if t-test significant at 5% (significant)
* if t-test significant at 10% (moderately significant)

Table 24. Impacts of RA on coffee outcomes

Coffee market interactions

There is a slight, statistically insignificant, dissatisfaction with the RA farmer's main coffee buyer, and a statistically significant decrease in the price received for coffee. Given that the RA-certified supply chain was not operating in 2017, it is difficult to explain this and we did not hear of any reported marketing issues amongst this group. It is possible, however, that the RA farmer groups (or a subset of them) were encouraged to engage in collective marketing, but that this was unsuccessful and inefficient, resulting in higher transaction costs and downward pressure on farm-gate prices, but further follow-up research would be required to verify this possibility.

Outcome variable	Estimated effect	Significance	Mean of control	Units
ps91_2 buyer 1 is direct exporter	-0.008		0.027	[0,1]
ps91_4 buyer 1 is local buyer	-0.012		0.884	[0,1]
ps121 satisfaction with sales to buyer 1	-0.033		0.945	{0,1}
Average price received for coffee	-407.661	***	21894.136	Indonesian Rupiah (1 USD = 14500 IDR)

*** If t-test significant at 1% (highly significant)
** if t-test significant at 5% (significant)
* if t-test significant at 10% (moderately significant)

Table 25. Impacts of RA on coffee market interactions

Household Labour Allocation

The RA farmers did not significantly change their household labour allocation, although they did report significantly higher incomes (equivalent to around 47USD per year) from non-coffee agriculture, including fruit and vegetable production.

Outcome variable	Estimated effect	Significance	Mean of control	Units
ac_ag Hours per year in agri. (incl. coffee)	-24.239		1567.045	Hours per year
ac_ag_noncoffee Hours per year in agri. (excl. coffee)	3.481		375.411	Hours per year
ac_non_ag Hours per year in non-agri. occupations	-39.294		325.298	Hours per year
ac_total Total hours worked per year	-93.959		1935.493	Hours worked per year
ac1 Number of occupations in past year	0.007		2.019	Number of occupations (1+)
he_ag_rev Total revenue from non-coffee agriculture	682930.766	**	2655383.298	Indonesian Rupiah (1 USD = 14500 IDR)
ac_non_ag_wage Total earnings from non-agri. occupations	-624612.801		4131447.754	Indonesian Rupiah (1 USD = 14500 IDR)

*** If t-test significant at 1% (highly significant)
** if t-test significant at 5% (significant)
* if t-test significant at 10% (moderately significant)

Table 26. Impacts of RA on household labour allocation

Monetary measures of livelihood outcomes

While the average income of the RA group was reportedly lower, this was not significant and amounted to only around 26USD per year.

Outcome variable	Estimated effect	Significance	Mean of control	Units
hs_income total HH net income	-181821.548		1768575.914	Indonesian Rupiah (1 USD = 14500 IDR)
fp_totalincome Total HH annual income	-369584.986		19004413.739	Indonesian Rupiah (1 USD = 14500 IDR)
hs_income_congive Net HH inc per month, incl. in-kind given/rec'd	-176318.745		3943632.445	Indonesian Rupiah (1 USD = 14500 IDR)
he4 Remittances received in past year	14125.025		265564.655	Indonesian Rupiah (1 USD = 14500 IDR)
he2_top Total kg. given away (rice, durian, other veg.)	40.386		241.274	Kg
he2_21_kg Kilos of rice given away	32.692		190.955	Kg

*** If t-test significant at 1% (highly significant)
** if t-test significant at 5% (significant)
* if t-test significant at 10% (moderately significant)

Table 27. Impacts of RA on monetary measures of livelihood outcomes

Coffee and well being

There are no statistically significant differences between the RA and non-RA group in terms of attitudes towards coffee farming, subjective quality of life, and probability of being in poverty.

Outcome variable	Estimated effect	Significance	Mean of control	Units
sa1 Prospects for coffee farming in your region over the next five years? (1-5)	0.002		2.518	[1,5]
sa9 Overall quality of life for the HH in the last production year was (1-5)	0.010		2.493	[1,5]
PPI implied probability of poverty	1.775		17.996	[0,100]

*** If t-test significant at 1% (highly significant)
** if t-test significant at 5% (significant)
* if t-test significant at 10% (moderately significant)

Table 28. Impacts of RA on non-monetary measures of livelihood outcomes

Overall comments on RA Upgrading

Overall what we see is that offering RA-specific training focused on environmental and conservation practices to farmers who were already 4C certified and connected to an exporter, does not lead to drastic differences in outcomes after 2 years. Results on coffee practices, particularly on shade trees and production practices, are suggestive that the main focus of the RA trainings led to very moderate improvements in these practices. However, we largely do not see these behaviours translate into broader improvements in outcomes, other than a smaller decrease in yields per coffee tree between 2015 and 2017. However, the effects are small, and do not translate into broader economic or livelihood improvements. Given that the exporter in our study was not maintaining an active supply chain during the 2017 survey round, our assessment of RA impacts should be interpreted with some caution.

Farmer Attitudes towards Sustainability Programs in Southern Sumatra

Our farmer perceptions survey across South Sumatra and Lampung generated insights into household attitudes towards sustainability standards. The strongly firm-driven process of the 4C verification process in Sumatra meant that producer households generally perceive a top-down process with little understanding of what the 4C standard is, and what it is intending to achieve. Only half of all households were aware that they were listed as participating producers in a 4C program and most generally had little awareness regarding the 4C program and its aims (Table 29). From their perspective, households were enrolled in a training program delivered by the coffee firm through pre-existing farmer groups. As such, they thought of themselves as being part of a company "program".

Indicator	Response (%)
Aware of involvement with 4C? (implying they were aware that they were being trained as part of a VSS program)	50
Perceived a distinction between coffee company and 4C	16
Received training as a result of the program	97

Table 29. Aware of programs

Enrolled producers were generally very positive about the impacts of the program on their lives and their village communities, with many believing that the program had resulted in yield increases (Table 30).

Indicator	ALL Responses (%)
Perceived a positive impact on village as a result of the program	73
Perceived a positive impact on family as a result of the program	85
Perceived a yield increase following training	68

Table 30. Attitudes toward programs

Participating households generally felt that training in farm management was the most beneficial aspect of the training program, followed by marketing improvements and then financial management (Table 31).

Perceived Benefits of the Program	ALL Responses (%)
Training in farm management	91
Higher prices	87
Training in financial management	74
Training on environmental management?	67
Training in post-harvest management	26

Table 31. Perceived benefits of program

The overwhelmingly positive producer attitudes towards participation in the 4C program is somewhat at odds with the greater difficulty we otherwise had in detecting measurable improvements in coffee yields and coffee incomes in the Semendo study. We explain this outcome as a function of subjective producer perceptions of the program that helped develop social networks and social capital. What might otherwise be interpreted as insignificant or moderate improvements to coffee-related livelihood improvements by researchers using objective indicators are subjectively appreciated by producers as a significant departure from the very low levels of support previously provided to them. The quality of training was a significant improvement on previous government offerings and, even if they rarely applied all of the improved practices, they appreciated the choice it provided in terms of applying specific techniques to their particular livelihood portfolios.

Perhaps even more importantly, involvement in the program reinvigorated somewhat moribund farmer groups, thus enhancing both bonding social capital within the group and bridging social capital by establishing new social networks with external organisations (facilitated by the firms). As programs frequently anchored onto pre-existing producer groups, they could be seen to reinforce existing patronage relationships (between individual farmers and farmer group heads) in both negative and positive ways. Farmer group heads are key beneficiaries (and conduits) of both material assistance (tarpaulins, seedlings, fertilisers) and of training activities and comparative field trips to other coffee regions in Java and even Vietnam. This contribution to social capital, by strengthening group leadership and increasing frequency of group activity, was perceived to offer benefits beyond the life of the specific VSS intervention since the same network was found to attract further development assistance from NGOs, government and other corporate actors.

A fuller presentation of the results of the perceptions survey, and the apparent associations between VSS programs and social networks, is provided in Appendix G.

5. Discussion

The various components of this this study in Sumatra have presented a complex portrait of the livelihood impacts and poverty alleviation potential of sustainability standards. We detect contributions to poverty reduction from access to the 4C program provided by an international exporter, however perhaps not through the expected impact pathways. Furthermore, we observe several benefits to livelihoods in terms of improving resilience and developing social capital. We now discuss several of the key aspects from the study.

Sustainability Standards, Livelihood Change and Rural development

Voluntary sustainability standards are used as both a means of securing coffee supply by large coffee firms and a development intervention to address rural poverty and improve environmental management in the global south. Our ethnographic case-study approach in Semendo (detailed findings are presented in Appendix H) examined the interface between the sustainability program and broader livelihood trajectories and processes of rural development amongst coffee producers. From this perspective, it is difficult to identify a significant contribution from the standards program to this broader development landscape. The level of commitment required of producers (if all advised practices were implemented) appears incompatible with the particular way that coffee is embedded within local landscapes, livelihoods and poverty alleviation pathways. The sustainability standards tend to articulate a narrative of rural development underpinned by an assumption that agricultural modernisation is the preferred pathway out of poverty for rural households. As a result, we identify a risk that sustainability programs may be inadvertently encouraging household investment in a particular kind of agriculture, which might assist sustainability of supply for the exporter, but which is poorly aligned with prevailing processes of poverty alleviation.

The livelihood strategies of rural households living in Semendo have dynamically responded to wider changes in the institutional environment over the last hundred years. Traditional and conventional systems of agriculture, derived from swidden systems, are still favoured by most producers in Semendo as part of a diversified livelihood portfolio. At the same time, quality standards and training in good agricultural practices, which appear to represent modernisation, have been introduced by an international trading firm. There is an apparent conflict in the way coffee is embedded in Semendo livelihoods as a low risk, low maintenance cash crop, with the high input, focused production methods advocated by standards. An important exception to this is the increased planting of shade trees advocated by the programs, which appears well-suited to livelihood strategies and indeed resilience enhancing.

The sustainability program is attempting to encourage the diversion of (what is perceived to be) surplus labour towards coffee production, while producer livelihood decisions generally prioritise low-risk, low-input options. Many producers in Semendo are ambivalent towards the adoption of modern agricultural practices, and while the 4C program did encourage greater time allocation to coffee, this did not result in commensurate increases in coffee outcomes and coffee-related income. This ambivalence is particularly the case if they have already reoriented their livelihood strategy away from agricultural production through an off-farm poverty alleviation pathway. Coffee was often portrayed as a “fortress crop”, providing resilience in difficult times, but not necessarily a poverty alleviation pathway. Those participants who have the capacity to adopt good agricultural practices are those with available resources and capital, and these same individuals are also those best placed to exit agriculture as a means of poverty alleviation. The theories of change prodecued by standards

organisation, such as 4C, are therefore poorly aligned to the distinction between rural and agricultural livelihoods, and appear to systematically ignore the importance of off-farm income in rural communities, and the central role this often performs in poverty alleviation.

This is not to claim that the program in Semendo has not induced positive change. It has positively impacted price transparency, provided a mechanism for knowledge transfer through training, increased adoption of modern financial practices, encouraged the active participation in farmer groups, and has provided new income-earning opportunities within the community for select individuals. However, the particular way coffee production is embedded within livelihood strategies and landscapes across Semendo suggests that implementation of standards is unlikely to significantly contribute to poverty alleviation through the coffee farm itself. The impact on poverty is also marginal when assessed against the broader processes of development and the direct poverty alleviation programs instigated by the state (including conditional cash payments, infrastructure projects, universal health care provisions and educational scholarships).

Rather than expecting standards to result in poverty alleviation through intensified coffee production (as presented in several Theory of Change documents), these interventions should be more realistically considered as a means through which the livelihood capitals of producers can be supported and resilience enhanced. It provides greater options and assets for households, who will ultimately choose from a suite of different livelihood strategies available to them. In Semendo, however, it is unlikely to entail a wide-ranging shift towards intensified coffee farming.

Sustainability Standards and Inequality

It seems clear that the 4C program, as implemented in Semendo, tended to target better connected farmers, many of whom were already participating members of government-instigated farmer groups. Program implementers will understandably seek to leverage existing groups where possible to minimise costs, and this may mean that individuals not enrolled in existing groups are excluded. The process of enrolling farmers in both 4C and RA programs involved an initial audit by the company to assess their likelihood to successfully pass an external audit, such that “poorer” performing households were excluded at this point. In Sumatra, farmers cultivating coffee on community-forestry land were also systematically avoided by some exporters, which resulted in a further exclusion.

The geographic spread of sustainability programs is also revealing in that those areas closest to Bandar Lampung were enrolled initially, with the more remote areas of South Sumatra integrated later. At a higher scale, the decision of an exporter to progressively abandon Semendo and then Lampung as part of a corporate decision to concentrate their sourcing and sustainability programs in Vietnam is also important. Such decisions are based on a calculation of costs (of which accessibility and yields feature prominently) to obtain a particular volume of certified production from different regions.

Some individuals chose not to become involved in the standards programs or withdrew based on their perception that it was time-consuming and restrictive of their practices. This, however, was not a widespread sentiment. Overall, we do not believe that the program is likely to increase inequality in the community, which is largely a function of the limited overall

livelihood impacts of the program compared to other government-funded poverty-alleviation programs.

Sustainability Standards and Service Provision

The particular way that standards were introduced to farmers across southern Sumatra was intimately associated with the rollout of firm-initiated farmer training programs. The process of complying with the requirements of standards inevitably required firms to first invest in new farmer training programs on topics ranging from agronomic practices to post-harvest handling, quality control, environmental management and financial practices. For many firms, standards thus provided the initial impetus for direct service provision along their supply chain. Our observations of the varied degrees and quality of service provision offered by three different firms in southern Sumatra emphasised the difficulties of attributing outcomes and impact to standards specifically as distinct from outcomes and impact as result of the way different firms chose to roll-out programs linked to standards. These differences are clearly evident in Table 32, which (using data from the perceptions survey) shows the reported time spent in training to range from around 9 hours per year (Firm C) to 26 hours (Firm B). The quality of training, as reflected in respondents' responses to the extent of new information learnt (Table 33), also varies considerably, suggesting that farmer involved with Firm C developed very few new skills. Indeed, these findings also closely echo our impact evaluation studies. As such, it is difficult to assert that enhanced service delivery is necessarily inherent to sustainability standards, even if it is often associated with it.

Criteria	Coffee Company	All	A		B		C
	District		M	LB	T	LB	T
Frequency of training events per year		3.41	2.05	2.35	5.94	5.33	2.26
Total hours attending training per year		14.91	10.29	9.64	26.31	20.71	8.94

Note: A = Firm A; B = Firm B; C = Firm C; M = Muara Enem; LB = Lampung Barat; T = Tanggamus

Table 32: Attendance at Training (average hrs)

Response	Coffee Company	All	A		B		C
	District		M	LB	T	LB	T
None		1	1	4	0	1	0
A little		20	11	20	18	8	88
Much		71	81	72	68	82	12
A great deal		8	7	4	14	9	0

Note: A = Firm A; B = Firm B; C = Firm C; M = Muara Enem; LB = Lampung Barat; T = Tanggamus

Table 33: Perception of learning new information (%)

For the most part, however, farmers were appreciative of training programs, which were generally considered to be of superior quality to previous training programs offered through government channels. Firms were able to access international knowledge networks to prepare course training materials and, through the recruitment of ICS agronomists, offered access to a relatively interactive agricultural extension service. The social networks, and associated knowledge flows, resulting from implementation of standards therefore emerged in the study as an important outcome. It remains unclear, however, if the current system of audit-based standards is the most effective way to achieve this same outcome. Our study suggests that the most important potential benefits for producer livelihoods arise from the services provided to them by firms (including through enhanced social capital and access to markets). As such, it may be that the future orientation of standards may be to ensure service provision is occurring at the firm-level rather than compliance to prescribed practices at the farmer-level.

The shift away from monitoring farm practices towards a service delivery orientation appears to already be occurring. In Lampung, Rainforest Alliance is working with a major coffee manufacturer as a service provider of technical assistance for farmers unrelated to third-party certification. The metamorphosis of the 4C Association into the service-oriented Global Coffee Platform (with the Sustainable Coffee Platform for Indonesia – SCOPI – as a national service delivery platform), whilst the 4C standard was eventually sold off to MEO Carbon Solutions, similarly suggests a reorientation towards a fundamentally different approach to sustainability. In this context, it is possible to envisage the continued transformation of sustainability standards towards a model whereby service delivery by firms becomes the object of certification rather than auditing of farm practices. Under such a model, producers would be relieved of the burden of compliance, and would rather emerge as clients for whom services are to be provided.

We did not find evidence of financial services offered in association with the standards programs in Sumatra.

Sustainability Standards and Corporate Strategies

This study commenced in late 2014 at a time when firms appeared to be extending the geographic scope of standards into the more remote coffee-producing districts of southern Sumatra, thereby providing an opportunity to assess their roll-out across space. However, by 2018, conventional standards schemes appear to be on the retreat. Several firms in Sumatra reported strategies to move away from the use of third-party audited standards towards in-house sustainability programs. As expressed by one firm representative, “why should we keep paying for certification and auditor fees when we can just encourage farmers to adopt sustainability practices…….. most buyers don’t want certified product anyway”. This sentiment was widespread in Sumatra. Presumably, this is strongly influenced by the dominant end markets for Sumatran Robusta, where relatively few opportunities exist for product value-adding through certification marks.

The problem of certified produce being sold in conventional markets has been frequently remarked upon in the literature (Panhuysen & Pierrot, 2018; Grabs, 2018). Many of the firms we interviewed in Sumatra appeared committed to improving the sustainability of their supply chain, and a key aspect of this was improving livelihood outcomes for producers. However, a widespread scepticism was expressed towards whether standards were the best way to achieve this. It is difficult, at least in the southern Sumatra context, to claim that certification

and verification provide any additional market-related benefits to farmers beyond what could be provided through 'in-house' sustainability or training programs alone.

The introduction of standards was generally, but not always, associated with new (more direct) supply chain arrangements. The existence of price premiums at the farm-gate level (and many farmers did perceive some kind of premium linked to the sustainability program) appears to be driven by the specific corporate polices of firms rather than being driven by strong market demand for certified product. Our research has highlighted how it is often the interaction between standards and the institutional environment in producing regions, including firm-specific strategies, that determines impact. A much fuller discussion of this argument is provided in Appendix I. The example of the international exporter in Semendo suggests that sustainability programs can, however, be delinked from actual buying operations.

Indonesian Robusta coffee competes in the global market with Vietnamese coffee. While both regions are smallholder-dominated, farmers in Vietnam operate very different production systems with high inputs resulting in significantly higher yields. As a result, the costs for a firm to obtain a certain volume of "sustainable coffee" in Vietnam are reduced by dealing with far fewer farmers. This was part of the logic provided by an international trader we spoke with for concentrating their Robusta-sourcing operations in Vietnam rather than Indonesia. As such, this suggests that market forces alone are unlikely to be sufficient to extend the potential benefits of standards to new geographic regions.

Sustainability Standards and the State

Our research involved interviewing various representatives of the Indonesian Government, from local village heads and agricultural extension officers through to senior advisers and bureaucrats in the Ministries of Agriculture and Trade in Jakarta. Attitudes towards private sector sustainability standards varied considerably amongst different actors.

Locally, there was a general perception amongst government representatives that firm engagement was resulting in enhanced service delivery in terms of agricultural extension. At the provincial and national level, however, a more sceptical attitude towards standards became more prevalent amongst government stakeholders. At its most extreme, standards were perceived as rent-seeking mechanisms that allowed foreigners (audit firms, NGOs and coffee buyers) to extract financial benefits from the value chain by, in part, excluding local Indonesian firms. One *Bupati* (district head) expressed a perceived loss of sovereignty as foreign firms developed relationships directly with farmer groups and enforced rules of behaviour (i.e., compliance with standards). It should be noted that another *Bupati* we met expressed a feeling of gratitude that the private sector was investing in agricultural extension in his jurisdiction as this assisted his development program.

The specific interaction between institutional state actors and standards is an important factor determining the potential for livelihood improvements. The variable livelihood impacts resulting from sustainability programs reported in the literature to date can likely be explained as a function of the way standards interact with different institutional settings (refer to Appendix I for a fuller discussion).

Responding to twin concerns of local exporter marginalisation and increased foreign interference in rural Indonesia, the Ministry of Agriculture announced in 2014 that it would develop its own sustainable coffee standard (known as ISKopi). This followed the earlier

introduction of a similar standard for the palm oil sector (ISPO) in direct opposition to the (foreign-authored) Roundtable for Sustainable Palm Oil (RSPO) standard. However, by 2019, ISKopi had not eventuated and political will appears to be waning for the initiative. Given the enhanced level of training provision associated with standards across Sumatra, it would seem that improved collaboration with the government would help extend these potential benefits. Similarly, the interaction between environmental standards and the conservation challenges of forest clearing within the park were underappreciated by state actors who could leverage supply chain mechanisms to improve habitat protection.

Evaluating poverty impacts of sustainability programs: methodological reflections

Probably the most critical challenge we faced when attempting to evaluate the impacts of sustainability programs on producer livelihoods in Sumatra was the inherent difficulty of disentangling the effects of standards specifically from the effects of the way standards were implemented by different firms. There is a natural trade-off between our ability to carry out in-depth, internally-valid research in a specific setting, and our ability to disentangle to what extent what we see there is specific to a given implementer and their staff team, versus what is fundamental to standards. “Implementation quality” would have been difficult to measure, even if we had tried, as success of implementation can vary a lot based on contextual, institutional and other factors.

Somewhat relatedly, it was a challenge to even define “the standard” in the field. In many cases, farmers who our partners categorized as being part of the program were not aware of it themselves, or at least they would deny it when asked in the survey context. Part of this may be how the programs were delivered – often as “train-the-trainer” models whereby a lead farmer is expected to help facilitate the program in their farmer group, and some farmers may simply not be reached. There may also be some level of confusion in defining the program to farmers. Official language like “Rainforest Alliance,” “4C,” or “VSS,” is often unfamiliar to farmers. Strategies to use informal connections like the name of the implementer’s staff member working in the area is also somewhat imprecise, as that person may deliver other services and support outside the delivery of the standard. Hence this leads to a level of ambiguity in defining who are the recipients of the program. In practice, we generally define someone as a recipient if they are part of a farmer group that is considered to be in the program, even if an individual in that farmer group may have had very minimally impacted by the program.

Perhaps the most innovative component of the set of studies summarized in this report was the attempt to conduct a randomized control trial (RCT), which is largely unheard of globally as a tool for impact evaluation in the context of VSSs. RCTs are well-known to raise implementation challenges in the field, particularly in implementing and controlling randomization, and this study was no different. Without a high-quality partner “on the ground” like the Abdul Latif Jameel Poverty Action Lab (J-PAL Southeast Asia) it would have been impossible to implement the study. During high intensity periods, our research partners would be communicating weekly if not daily with partners in the field, to manage implementation. Even in spite of these efforts, and every effort of the partner exporter in Semendo, we had 5 out of 29 of the farmer groups selected for treatment in the RCT drop out of the RA program within 6 months of agreeing to join.

However, furthermore, a number of events over time raised significant challenges to our ability to run a long-term evaluation of sustainability standards. Our original plan was to carefully measure the evolution of impacts of a standard from launch through 2 and 4 years post-launch. However, in practice "the intervention" evolved significantly. These dynamics included:

1. Market dynamics. As discussed elsewhere in the report, there were significant changes to the Indonesian Robusta market over 2015-2017, with international export demand, particularly from remote regions, dropping drastically. While we saw hints of this in late 2014 and early 2015 as the study was under discussion, these trends really crystallized in 2017, and the full intervention we are considering was eventually pulled in Semendo by the exporter.
2. These market dynamics naturally drove changes in the intervention, as the exporter shut down a buying station, and then started to scale back sustainability activities. While we think that our 2017 midline results largely reflect a situation "as if" the exporter had continued according to the original plans, there is reason to question this, and these changes have affected our design of the follow-up 2019 survey round.
3. As discussed at length elsewhere in this report, we also observed a significant evolution in the appetite for standards in Indonesia. While it appeared that this momentum was starting to wane in late 2014 and early 2015 as we were seeking out partners for such a study, this trend only continued in the subsequent years, as export demand waned, and an increasing number of organizations moved to alternative models such as creating internal standards rather than utilizing third-party standards.

Altogether, these dynamic factors greatly reduced our ability to carefully track the uptake and impacts of standards over time, and refocused our work on a broader assessment of interaction with a particular standard in a particular location.

While management of (randomization of) the intervention was a great challenge, fortunately some of the other potential practical worries about fieldwork were less prevalent. We were largely successful in tracking farmers over time and had a relatively low attrition rate from our 2015 to our 2017 household survey in Semendo. This was in spite of the fact that some respondents were quite remote and could only be reached by enumerators traveling 1-2 hours on foot or alternative transport such as by bike. Farmers were quite open and willing to respond to 1-2-hour in-depth surveys, though fatigue about survey length is an important issue. However, given the surprising findings in our quantitative work, which tremendously benefited from the extra effort to collect a broad set of household behaviours and outcomes beyond the coffee farm, we wholeheartedly endorse this "livelihood-based" approach to measurement.

One of the classic challenges of carrying out agricultural studies is the measurement of yields. Agricultural crops are often harvested multiple times over a number of weeks or months, and farmers may not have tools available to precisely measure yields by weight, volume, etc. This can lead to very imprecise self-reports of yields, which are critical for measuring productivity. We had discussions about various ways to do more frequent measurement of yields (e.g., weekly, monthly), and there seemed to be some enthusiasm for this with the exporter, however there was a resistance to using monetary payments to provide incentives for reporting. In the end we were not able to implement any such system, and our yield measurements are purely recall-based measurements over long time periods (i.e., 1 year).

We also worked closely with the exporter to gain access to administrative data that the exporter was collecting. This included data on everything from participation in farmer group meetings for training, to sales to the buying station, to farmer group membership. Though the exporter did not have the most robust data collection system early on, and much of the information was collected on paper with uneven digitization, we have been able to make some use of the data. Embedding good data collection practices in interoperable, digital systems, on the part of implementers, could be a tremendous boon to research.

Beyond our attempt at an RCT, we also believe that our work in Semendo provides a promising example of taking a quasi-experimental approach to this research setting. While RCTs are considered the "gold standard" of identification and can add tremendous value in the right context, the right quasi-experimental design can go a long way in approximating an ideal RCT design. Quasi-experimental techniques in panel data and/or when the selection of farmers is well-understood (e.g., lending to techniques such as regression discontinuity) can be tremendously useful. If the right secondary data is available, quasi-experimental studies may allow for analysis at larger scale, to track dynamics over longer time horizons, and to generate research on shorter timelines without waiting for an intervention to take place. Such studies could also leverage emerging data sources such as high resolution satellite data.

6. Conclusions

Our study into the role of sustainability standards in poverty reduction across the southern Sumatra Robusta-producing regions has highlighted the multifaceted ways through which standards interact with local institutional environments. This makes it extremely difficult to claim, with any certainty, that implementation of the standard has directly reduced poverty in the coffee-producing community. Given the complex realities of agrarian change and poverty alleviation pathways within contemporary rural Indonesia, and the particular role performed by coffee within diversified livelihood strategies, it seems unlikely that standards for coffee production are directly resulting in substantial poverty reduction in Sumatra – at least not through improved coffee-related income. Importantly, however, this is not to claim that the standards programs we studied have not had beneficial outcomes. In many respects they have been beneficial for participating households and communities. However, it would appear to be overstating the reach of the programs to claim that they have been transformative of producer's lives.

The findings of this analysis broadly echo the results of the prior study based exclusively on the 2015 data: the program leads to improved household outcomes as measured in monetary terms. The mechanisms are also somewhat analogous – effects on the main coffee operation are mixed, though still much more promising in 2017, with some notable improvements in practices, most especially shade tree utilization and compliance with recommended labour practices. Overall improved monetary outcomes come as much from non-coffee activities as improvements on the coffee farm. In 2017, 4C farmers were working greater hours across all categories (coffee, non-coffee agriculture, non-agriculture), including on the coffee farm. So, we see higher earnings from all three categories, including coffee. However, if we monetize this own-labour time investment, it is less likely that we would observe superior earnings from the coffee operation.

It does appear that 4C farmers had their aspirations raised through engagement with the program. Perhaps engagement with the program leads to a greater sense of engagement with the market economy, motivating more work investment across multiple categories. Indeed, we also see higher remittance receipts. While our quasi-experimental methodology is quite robust to selection bias concerns, it is always possible that a time-variant, unobserved shock is creeping in to influence results. Whatever the case, we can conclude that involvement in this 4C program has led to improved livelihood outcomes in monetary terms. However, the specific pathway through which this improvement has occurred remains unclear as it does not appear to be exclusively a result of enhanced coffee-related income as expected under the theories of change.

Across southern Sumatra, but particularly in the Semendo region, coffee production is not generally viewed by rural households as a means for potential poverty alleviation. Instead, coffee production constitutes the backbone of livelihood resilience. It is a crop that provides a basic source of cash income when households have few other livelihood options. In this sense, coffee is critically important and may well be all that stands between a household and acute food insecurity during difficult times. However, households are unlikely to escape from poverty through coffee. This reality, we believe, has important implications for the impact pathways that can be expected from standards. The 4C program, as implemented in Semendo, appears to have contributed to a more resilient livelihood, but this does not necessarily mean it has lifted households out of poverty. We believe this is an important distinction, and one

that Standards Organisations, and others promoting the use of standards, should bear in mind when considering claims about impact – at least in smallholder sectors such as Indonesian coffee. It is telling that even when our quantitative analysis suggested improvements in income for 4C farmers, these were not a direct effect of enhanced coffee-related income.

We find that the most important change instigated by VSS programs in Sumatra has been the dramatically increased levels of investment by firms in farmer training programs. Even if some firms are now moving towards in-house sustainability programs and away from third-party standards, it was the standards that initially prompted this engagement. As a result, many farmers have become part of wider social and knowledge exchange networks, which are providing various opportunities for strengthening livelihoods.

Dependence on firm-driven support programs could, however, be a risky strategy for households. Standards are implemented along company supply chains that are inherently volatile, as highlighted by the wavering commitment of firms to sustainability standards in Sumatra and indeed the wholesale shifting of sourcing operations. The ephemerality of particular supply chains suggests that relying on standards to deliver development benefits would be unwise.

7. Recommendations

1. The livelihood impacts of standards, where we have seen them, are incremental rather than transformational. Poverty alleviation is a complex process and is probably beyond the capacity of supply chain standards and possibly even beyond a single commodity like coffee. Standards organisations may need to be more realistic about their capacity to induce transformational change in the lives of producers in developing countries, and to be careful about what claims they can make. For example, the effect of standards in Sumatra appears to be resilience-building but not necessarily poverty alleviating.
2. Livelihood strategies vary considerably across producing regions. To be beneficial for producer livelihoods, standards will need to develop mechanisms that promote agricultural technologies that are more adaptive to local needs (e.g., labour-reducing strategies appropriate to swidden systems in the case of Semendo).
3. Standards originally emerged to provide assurance to consumers about production conditions. However, in Sumatra at least, they have evolved to become important mechanisms for service-delivery to farmers (especially knowledge transfer). We suggest that efforts to enhance and emphasise this service delivery function should be prioritised as standards evolve further. This could involve further supporting the shift towards broader support platforms (e.g., SCOPI in Indonesia) and for the provision of service delivery by firms to become the primary focus of audits rather than farmer-level compliance. Given the apparent shift towards in-house systems of corporate sustainability, standards organisations may consider closer collaboration with firms that might involve the certification of firms or supply chains rather than producer units.
4. Interactions with government could be leveraged far more effectively to maximise livelihood impacts. Effective government engagement, however, can be resource-intensive for firms. As a result, nation-wide or region-wide platforms would appear to be the best mechanism to achieve this outcome. The apparent shift, reported by some stakeholders, towards “verified sourcing areas” or “landscape approaches” (a so-called jurisdictional approach) would demand a much higher degree of partnership with local administrations.

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Appendices

Appendix A. Research and implementation team – identification and qualifications

The Research Team consisted of the following individuals

- Jeff Neilson, University of Sydney - Overall Project Leader
- Bustanul Arifin, University of Lampung, Senior Project Advisor and Coordinator for the Perceptions Survey
- Russell Toth, University of Sydney - Leader of Quantitative Research Methodologies
- Joshua Bray, University of Sydney (PhD student) – Researcher for ethnographic studies Research Methods 2 and 3
- Manann Donoghue (Honours Student) - assisting with quantitative analysis of the 2015 data
- Hanung Ismono, University of Lampung, - Responsible for field work coordination and recruitment of student researchers at UNILA for ethnographic fieldwork and Coordinator for the Perceptions Survey
- Niken Sari, Indonesian Coffee and Cocoa Research Institute – soil scientist responsible for observation-based soil study in Semendo
- J-PAL Southeast Asia
    - Lina Marliani, Research Director and Executive Director. Supervision and Quality Control for Research Method 1.
    - Freida Sirergar, Senior Research Associate. Quality Control and research support for Research Method 1.
    - Alfariany Fatimah, Research Associate. Quality Control and research support for Research Method 1.
    - Masyhur Hilmy, Data analysis and report preparation.
    - Filbert Maynard, graduate intern. Quality control assistance and research support for Research Method 1.
    - Chaerudin Kodir, Data Manager. Data checking and management for Research Method 1.
    - Wisnu Harto, Research Associate. Data analysis for Method 1.
    - Nurzanty Khadijah, Research Manager. Oversight of data analysis for Method 1.
    - Lolita Moorena, Research Associate. Data analysis for Method 1.
    - Astuti Kusumaningrum, Research Manager. Oversight of data analysis for Method 1.
    - Nadia Setiabudi, Research Associate. Data analysis for Method 1.
    - Andrea Adhi, Research Director. Oversight of data analysis for Method 1.
- SurveyMETER

- Bondan Sikoki, Director. Survey instrument design, piloting, overall data collection management for Research Method 1.
- Muhammad Mulia, Field Manager. Field data method for Research Method 1.
- Various other staff (35+): supervisors, enumerators, data managers.

Appendix B: How the study methods address the Identified Research Questions

A mixed method approach was applied to address the various research questions. This meant that in some instances qualitative work was used to help interpret quantitative data, while elsewhere qualitative approaches were applied to directly respond to research questions. Below we briefly address how the quantitative research will contribute to the research questions raised in the ToR.

Primary Questions

1. What is the impact on farmer livelihoods (as affected through improved resource management, production levels, organisational capacity and business resilience) as a result of being involved in a 4C-verified production unit?

2. What is the additional impact on the livelihoods of farmers, currently part of a 4C-verified unit, if they become further certified to the Sustainable Agriculture Network / Rainforest Alliance coffee standard?

The quantitative research in Semendo was customized to address each of these two primary research questions in a precise and population-representative form, subject to the limitations that come with employing quantitative indicators to characterize changes in a complex system. These were addressed by collecting survey data on outcomes across a range of survey measures combined with the observation-based soil survey. Ethnographic work and interviews the helped to interpret these findings.

Secondary Questions

1. What is the relative impact of sustainability standards on poverty alleviation in the **broader context of livelihood change** and rural development processes currently occurring in southern Sumatra? What role does coffee and sustainability programs perform in developing household livelihood assets? What narratives do farmers adopt to present their experience of coffee, poverty alleviation and sustainability?

By evaluating the impacts of sustainability programs both on household behaviour and on household assets (at least those that can be quantitatively measured), Research Method 1 will be able to provide strongly suggestive evidence about the causal pathway from sustainability to behaviour to outcomes in terms of livelihood assets. This question will, however, also be primarily addressed through Research Method 2 (Village-based case studies).

2. What is the relationship between sustainability **standards and inequality** within the community? Do sustainability standards unintentionally target relatively better-off households? Are there any barriers that prevent the poorest households being involved in, or benefitting from, sustainability programs? Why do some farmers not become involved in sustainability programs?

Research Method 2 (Village Case Studies) will be the primary means through which these questions of inequality will be assessed, when used in conjunction with the detailed household data collected under Research Method 1.

3. What **services** (eg. training programs) are provided to farmers during the process of becoming involved in sustainability standards? How do farmers value these services? Who provides services to farmers and who finances this provision? What motivates the provision of these services?

Research method 1 will allow for the collection of population-representative data on outcomes such as farmers' valuation of the services, and this will be significantly scaled up and examined specifically under the much broader survey conducted under Research method 3. Motivations for the provision, and the quality, of training will be further analysed through Research methods 4 and 5.

4. What are farmer **perceptions of sustainability** standards and the processes associated with standards? What aspect of the standards do they consider the most beneficial to their well-being? How do perceived benefits compare with perceived costs of participation?

Research Method 1 will provide representative data on farmer well-being, and some indication of the perceived costs of participation (e.g., in terms of addition time investment and effort on the farm), with farmer perceptions explicitly assessed through Research Method 3.

5. Does certification and verification provide additional market-related benefits in Sumatra beyond 'in-house' sustainability or training programs alone? What are the **current market dynamics** within southern Sumatra for certified and verified coffee, and how are these conveyed to farm households? What factors are driving (or acting as a disincentive for) the adoption of sustainability standards by private sector firms in Sumatra?

Research method 5 (Key Stakeholder Interviews) will delve into the question of current market dynamics. Research method 1 will also provide suggestive evidence on other behaviours that may be connected to sustainability programs, and how that may be connected to market-related benefits.

6. What role is, and potentially could, **local government** be undertaking to maximise the benefits of sustainability programs for Sumatran coffee farmers?

Research method 1 and 3 will address the current extent of government programs and farmer perceptions of any such programs, while Research Method 5 will qualitatively explore possible supportive roles for government.

7. Are **producer groups** strengthened by certification, and do strengthened producer groups more successfully support smallholder farmers and their families? What are the intended and unintended **gender effects** (eg. role in household financial management) of the organisational development of farmers associated with sustainability standards?

Research Method 1 will be able to address this issue by collecting some data at the farmer group level, and the household level in terms of gender-based financial roles. Research method 2 will further tease out this dynamic through participant-observation. Although not

discussed in this research design, this topic is particularly amenable for further investigation through an associated research project at either Sydney or UNILA.

8. What **methods, techniques and indicators** are the most effective and appropriate to understand and evaluate the poverty impacts of sustainability programs?

Research Method 1 will provide a significant contribution to developing, testing and analysing a number of potential indicators. Furthermore we can correlate indicators with more objective measures of outcomes to connect measures to outcomes. As the first known randomized control trial study evaluating sustainability programs, this study will potentially provide a template to other research teams on designing and implementing such a study.

Appendix C. Bray, J. G. and Neilson, J. (2017). Reviewing the impacts of coffee certification programmes on smallholder livelihoods, *International Journal of Biodiversity Science, Ecosystem Services & Management*, 13 (1). 216-232.

This paper is available at:

https://www.tandfonline.com/doi/full/10.1080/21513732.2017.1316520

Appendix D. Details of experimental and quasi-experimental research designs.

Appendix E. Donoghoe, M., Hilmy, M., Neilson, J., Toth, R. 2018. Certification or Certainty? Impacts of 4C Certification on Coffee Smallholder Livelihoods.

This research paper can be accessed on the ISEAL website.

Appendix F. Summary statistical table of core and supplemental variables for midline report.

Appendix G. Bray, J.G., Arifin, B., Ismono, H. Neilson, J. (Forthcoming). Perception of sustainability standards among coffee farmers in southern Sumatra, Indonesia: implications for understanding social networks.

This paper has been made available on the ISEAL website

Appendix H. Bray, J. G. and Neilson, J. (2018). Examining the interface of sustainability programs and livelihoods in the Semendo highlands of Indonesia, *Asia Pacific Viewpoint.*59(3). P368-383.

This published paper can be accessed at:
https://onlinelibrary.wiley.com/doi/pdf/10.1111/apv.12205

A pre-print version is available on the ISEAL website

Appendix I. Bray, J. G. (2018). Institutional environments and the livelihood impacts of voluntary sustainability standards: A Village-based analysis from southern Sumatra's coffee sector, *Singapore Journal of Tropical Geography.* 40(2). 291-311.

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