The external costs of banana production: A global study

Research Report
Prepared for Fairtrade International

FAIRTRADE INTERNATIONAL

True Price™

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True Price is a social enterprise that aims to contribute to a circular and inclusive economy that creates value for all people by providing the information needed for such an economy. True Price helps organizations – multinationals, SMEs, NGOs, governments – quantify value and improve their economic, environmental and social impacts. True Price works directly with organizations by providing research services. In addition, True Price enables organizations to measure their impact by developing open source methods for impact measurement that are relevant, sound and inclusive.

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Acronyms

CLAC: Latin American and Caribbean Network of Fair Trade Small Producers and Workers
COSP: Cost of Sustainable Production
EXW: Ex Works
FAO: Food and Agriculture Organization of the United Nations
FTE: Full-time Equivalent
H&S: Health and Safety
HL: Hired Labour[1]
ILO: International Labour Organization
LCA: Lifecycle Analysis
SDG: Sustainable Development Goal
SP: Small Producers
SPO: Small Producer Organization
TEEB: The Economics of Ecosystems and Biodiversity

[1] With Hired Labour we refer to Fairtrade Plantations.

Glossary

Air pollution: environmental impacts caused by the release of harmful chemicals and particles into the air.
Child Labour: based on ILO Convention No.182 on the Worst Forms of Child Labour, which addresses work which, by its nature or the circumstances in which it is carried out, is "likely to harm the health, safety or morals of children"; and based on ILO Convention No.138 on the minimum age for admission to employment and work, which states that the minimum age "shall not be less than the age of completion of compulsory schooling and, in any case, shall not be less than 15 years".
Ecosystem: a community of living organisms interacting as a system in conjunction with their environment.
Externalities: costs imposed on society or benefits granted to society by the production, consumption or investment decisions of individuals, governments and business, for which they do not pay in the case of costs or are not compensated in the case of benefits (IMF, 2010).
Environmental costs: costs to society that arise through a direct effect on the environment.
EXW Price: the price a producer receives for goods under the agreement that the seller makes goods ready for pickup at the banana producer organization or banana plantation, by labelling and packing them. The buyer has to cover all subsequent expenses after product delivery, including loading the product into the ship. Such an agreement is the common price agreement for producers in the banana sector.
Forced Labour: based on ILO Convention No.29 which defines forced or compulsory labour as "all work or service which is exacted from any person under the menace of any penalty and for which the said person has not offered himself voluntarily".
FTE: a full-time equivalent, which is a unit of labour equal to the average number of working hours per year of a full-time worker in a country excluding overtime.
Impact: an effect of an activity that provides or leads to societal costs or benefits.
Harassment: Discriminatory, offensive, humiliating, intimidating or violent conduct in the workplace.
Land pollution: environmental impacts caused by the application of agricultural chemicals to the soil that are toxic to humans and/or ecosystems.
Living income: remuneration received for a standard work week by an entrepreneur in a particular place sufficient to afford a decent standard of living for the entrepreneur and her or his family, based on an average household composition. Elements of a decent standard of living include food, water, housing, education, health care, transport, clothing, and other essential needs, including provision for unexpected events (ISEAL, 2013).
Living wage: remuneration received for a standard work week by a worker in a particular place sufficient to afford a decent standard of living for the worker and her or his family, based on an average household composition. Elements of a decent standard of living include food, water, housing, education, health care, transport, clothing, and other essential needs, including provision for unexpected events (ISEAL, 2013).
Outlier: a data point that lies an abnormal distance from other values in a sample from a population (NIST/SEMATECH, 2012).
Sample: a subset of subjects that is representative of a population.
Social costs: costs that have a direct effect on the wellbeing of people.
Water pollution: environmental impacts caused by the run-off of fertilisers into freshwater bodies.

Executive summary

Currently, banana production has negative effects on the environment and society. This causes so-called external environmental and social costs that until now have been unknown and not captured in prices. At the same time, stakeholders demand more sustainability and transparency, which creates the necessity for businesses to internalize those external costs. Therefore, the banana sector faces a challenge of how to transition to more sustainable banana production with lower external costs.

To address this challenge, Fairtrade International commissioned True Price and Trucost to prepare a world first study on the external environmental and social costs of banana production in the major banana producing countries of Colombia, Dominican Republic, Ecuador and Peru. Social impacts covered in the study include labour issues such as underpayment, health and safety, overtime, social security, underage work, harassment, and forced labour. Environmental impacts covered include climate change, land occupation, water depletion, waste, and land, water and air pollution.

In partnership with Fairtrade International, True Price and Trucost gathered sector average data sourced from secondary literature, and expert opinions. In addition, they collected primary data on production inputs, working conditions, and environmental impacts from 15 Fairtrade plantations and 97 Fairtrade small producers across the four countries. This data was used to answer three research questions:

1. **What are the external social and environmental costs of the banana sector[2]?**

The average external costs of the banana sector are $ 6.70[3] per box of bananas. The most material social costs are insufficient wages and social security for workers, and insufficient income for small producers. The most material environmental costs are land occupation, water depletion and climate change. The social costs (60%) are greater than the environmental costs (40%) of banana sector production.

2. **How do the external costs of Fairtrade bananas compare to the external costs of the banana sector?**

In all four countries, Fairtrade producers have lower external costs than the sector benchmark. The average external costs of Fairtrade bananas are $ 3.65 per box, compared to the sector benchmark of $ 6.70 per box. Fairtrade producers still face challenges in terms of external costs, in particular in the Dominican Republic, but substantially less so than the sector. The social costs are considerably lower for Fairtrade producers than for the sector, whereas the environmental costs can be higher or lower depending on the country but are on average very similar to the sector benchmarks. As a result, the environmental costs are larger than the social costs for Fairtrade banana producers. The most important drivers of the difference between Fairtrade and sector bananas are the financial wages and social security for workers, yields, water consumption, and fertiliser application rates.

3. **What opportunities exist to reduce the external costs of the banana sector?**

The banana sector can learn from Fairtrade's practices, by improving drivers of social issues such as insufficient wages. At the same time, the sector can improve through a greater focus on environmental and social issues, and by encouraging the adoption of Fairtrade producer practices

[2] The banana sector includes both certified and non-certified banana producers.
[3] Note that with $ we refer to 2015 US Dollars.

that reduce external costs. Fairtrade and the banana sector can also learn from the practices of high-performing Fairtrade producers to improve their training and capacity building activities. One example is to balance yield increases with fertiliser, energy and water inputs to optimize production and reduce the environmental costs of land occupation, climate change and water depletion, while also improving producer livelihoods. Also, by investing in labour efficiency, the sector can reduce the social costs of insufficient wages and social security. Finally, Fairtrade itself can further improve its sustainable performance by reducing external costs in Dominican Republic, lowering climate change costs, reducing land occupation costs in case of expanding banana production, and by addressing insufficient income and wages through optimal use of the Fairtrade Premium.

Due to the innovativeness of this research and the nature of the data and the research methodology, there are certain limitations to the results presented in this study. For example, although the study analyses the differences between the sector benchmark and Fairtrade production, it does not measure the impact of Fairtrade certification over time and it does not provide for statistical comparisons between Fairtrade and non-certified producers. A broader discussion of the limitations is given in section 4.

To conclude, this global study provides a strong basis to improve the external costs of banana production. It shows that banana production has important social and environmental external costs, that Fairtrade banana producers have on average lower external costs, and that the whole sector can learn from well-performing producers on how to improve. These findings could help the sector to formulate a roadmap towards a sustainable banana sector by 2030.

Contents

1. Introduction

1.1. Context of this study

Banana is an economically important crop for many developing countries. It imposes, however, negative effects on the environment and on society, particularly in its cultivation and local processing phases (FAO World Banana Forum, 2016). These negative effects result in external environmental and social costs that are not captured in market prices but are ultimately paid by society, either directly or through losses in welfare. Increasingly, businesses, governments and NGOs are using information about the total impact of production, including external costs and benefits, to inform decision making (Deloitte, EY, PwC & True Price, 2014). Consumer demand for more sustainable bananas is also growing (ITC, 2015). However, a lack of awareness and transparency around external costs in the market, and how these relate to retail prices, poses a challenge to the sector becoming more sustainable (Sporleder et al. 2014; Guardian, 2014; 2016). At the same time, as organizations increasingly internalize external costs, the banana sector faces potential reputational risks which could affect sales. As such, there is a growing opportunity for the banana sector to transition to more sustainable production, reducing the negative effects on the environment and society while reducing its exposure to internalisation risks. The sector can maintain its licence to operate by self-organising around sustainability, so as to improve information flows on the most material impacts of banana production and on sustainable production best practices and improvements. In that way, the sector can improve programmes, investments and communication with stakeholders.

1.2. Definitions

A sustainable banana sector imposes no negative effects or external costs on society. These external costs, or 'externalities', are defined as costs imposed on society by the production, consumption or investment decisions of individuals, governments and business for which they do not pay (IMF, 2010). A classic example of a negative *environmental externality* is the emission of air pollution due to the burning of fossil fuels to produce electricity. The emission of air pollution is damaging to the communities living nearby - increasing healthcare costs and reducing life expectancy due to poor health - but the electricity producer may not fully pay these costs to the communities. In this way, the health damages caused by the emission of air pollution represent an external cost of electricity generation. An example of a negative social externality is the exposure of workers to health and safety risks. If workers do not wear sufficient protective clothing and equipment, they are exposed to a greater risk of occupational incidents and associated injuries. The cost of such incidents increases healthcare costs, which the producer may not fully pay, shifting the cost to the worker or to society more broadly. Another example is the provision of wages to workers that are insufficient to support a decent living, imposing negative effects on the wellbeing of the worker and their household.[4]

1.3. Purpose of this study

This study provides a measurement of the external costs of banana production and has three aims. Firstly, to identify the most material environmental and social costs of banana production and use this information to target strategic sustainability improvements in the sector. Secondly, to compare

[4] Certain interpretations of externalities do not classify 'insufficient wages' as an externality. Externalities are often linked to costs imposed to a third party who did not consent (Cornes & Sandler, 1996). Workers consented to their wage, and hence one could argue underpayment is not an externality. However, as the definition for this study specifically looks at the external costs of production and a decent living, this impact is classified as an externality. Firstly, because it affects the livelihood of families and when insufficient can result in costs paid for by society; and secondly, because the international labour market is imperfect and wages often do not reflect the actual value workers add.

the external costs of sector banana production systems with those of Fairtrade producers, to identify the best practices of the Fairtrade system that can help the sector to materially reduce its social and environmental costs. Finally, to identify the best practices of producers with superior social and environmental performances, which can then shape improvements to sustainable production standards as well as the training, capacity building and other support programmes offered by sustainable production organizations.

An indirect purpose of this study is to inform and facilitate the transition of the banana sector to more sustainable practices. To achieve this, it is important to increase transparency, as this will promote trust between buyers and sellers by reducing the ability of sellers to overstate the sustainability of their bananas. At the same time, increased transparency will facilitate market actors to make better informed decisions. A useful way of enhancing transparency in the market is through the quantification and monetization of external costs, as this makes it possible to express and compare all dimensions of sustainability in a common unit. Moreover, monetization of external costs allows actors to fully evaluate trade-offs and makes sustainability more accessible to the broader public and decision makers, who are not experts on all dimensions of sustainability.

1.4. Approach

To achieve the aforementioned aims, Fairtrade International commissioned True Price and Trucost to prepare a world first external cost account for banana production in the key markets of Colombia, Dominican Republic, Ecuador and Peru. In partnership with Fairtrade International, True Price and Trucost gathered sector average data sourced from secondary sources and expert opinions. Also, they collected data on production inputs, specific working conditions, and environmental impacts from 15 Fairtrade plantations and 97 Fairtrade small producers across four countries. Data and results were validated by local experts, including CLAC (Latin American and Caribbean Network of Fair Trade Small Producers and Workers). This data was used to produce an external cost account presented in this report.

Trucost and True Price adopted a seven-step process to develop the external cost account for banana production.

1. **Defining the scope:** the first step was to define the aims and scope of the analysis based on the objectives for the project and intended uses for the results. In this study, the scope of analysis was limited to activities related to the cultivation, processing and packing of banana and considered eight social cost indicators and seven environmental cost indicators.
2. **Defining the research design:** the second step was to define the research design including defining the data requirements, study populations, research samples and the sampling approach.
3. **Collecting the data:** the third step was to collect primary and secondary data using the research design and scope defined above. Secondary data was collected on banana sector production in Colombia, Dominican Republic, Ecuador and Peru via a review of available scientific literature and databases (See section 2.5 and chapter 6 for more literature used). Primary data on Fairtrade banana production was collected from 15 plantations and 97 small producers through surveys of producers and workers conducted via workshops in each of the four countries. A secondary data hierarchy was applied to give preference to secondary data published in peer reviewed publications and gathered recently in countries of interest.
4. **Validating the data and results:** the fourth step was to verify and validate the data collected and the impact results calculated from this data. Primary data was subjected to a data verification process, to ensure completeness and accuracy, and then a validation process to confirm data quality and suitability for inclusion in the research. During the verification of a survey among

farmers, for example, it was assessed whether they had completed the questionnaire correctly and whether the data gathered included any errors that could bias the results. During the validation of such a survey, the researchers looked at whether the data was plausible when compared to previous research on the same topic, and if it was consistent with the advice of local subject matter experts. Secondary data was subjected to the same data validation process. These processes allowed the data to be 'cleaned' before proceeding with the next step.

5. **Quantifying impacts and valuing external costs:** the fifth step was to quantify and value the impacts of banana production through a five-step process consisting of the quantification of inputs, outputs, outcomes and impacts, followed by monetization of the impacts. Monetized impacts were normalised per hectare and per box of bananas in preparation for the presentation and interpretation of the results.
6. **Interpretation and conclusions:** the sixth step was to interpret and draw conclusions from the impact and cost results.
7. **Development of strategic recommendations**: the final step was to develop strategic recommendations for the banana sector to take actions based on the findings of the external cost account and to improve external cost accounting methods for future studies.

1.5. Key results

The study was conducted with a focus on three research questions outlined below, as well as the key conclusions that can be drawn from the analysis of the external environmental and social costs of banana production. A more detailed presentation of the results can be found in Chapter 3.

1. **What are the external social and environmental costs of the banana sector[5]?**

The average external costs of the banana sector are $6.70[6] per box of bananas. The most material social costs are insufficient wages and social security for hired workers and insufficient income for small producers and their families. The most material environmental costs are land occupation, water depletion and climate change. The social costs (60%) are greater than the environmental costs (40%) of banana sector production.

2. **How do the external costs of Fairtrade bananas compare to the external costs of the banana sector?**

In all four countries, Fairtrade producers have lower external costs than the sector benchmark. The average external costs of Fairtrade bananas are $3.65 per box, compared to the sector benchmark of $6.70 per box. Fairtrade producers still face challenges in terms of external costs, in particular in the Dominican Republic, but substantially less so than the sector. The social costs are considerably lower for Fairtrade producers than for the sector, whereas the environmental costs can be higher or lower depending on the country but are on average very similar to the sector benchmarks. As a result, the environmental costs are larger than the social costs for Fairtrade banana producers. The most important drivers of the difference between Fairtrade and sector bananas are the financial wages and social security for workers, yields, water consumption, and fertiliser application rates.

What opportunities exist to improve the external costs of the banana sector?

[5] The banana sector includes both certified and non-certified banana producers.
[6] Note that with $ we refer to 2015 US Dollars.

The banana sector can learn from Fairtrade's practices, by improving drivers of social issues such as insufficient wages. At the same time, the sector can improve through a greater focus on environmental and social issues, and by encouraging the adoption of Fairtrade producer practices that reduce external costs. Fairtrade and the banana sector can also learn from the practices of high-performing Fairtrade producers to improve their training and capacity building activities. One example is to balance yield increases with fertiliser, energy and water inputs to optimize production and reduce the environmental costs of land occupation, climate change and water depletion, while also improving producer livelihoods. Also, by investing in labour efficiency, the sector can reduce the social costs of insufficient wages and social security. Finally, Fairtrade itself can further improve its sustainable performance by reducing external costs in Dominican Republic, lowering climate change costs, reducing land occupation costs in cases of expanding banana production, and by addressing insufficient income and wages through optimal use of the Fairtrade Premium**.** This requires finding the optimal balance between direct payments to farmers, wage increases, and investments that improve yields and labour productivity.

1.6. Conclusions and recommendations for the sector

The results of this study show that there is a significant potential for the banana sector to transition to a more sustainable model of production and reduce its social and environmental external costs. Furthermore, the results for Fairtrade producers show that it is possible to produce bananas with lower environmental and, especially, social external costs. The Fairtrade system therefore represents a possible model for a more sustainable banana sector globally.

Opportunities still exist, however, to improve the sustainability of Fairtrade producers by lowering their external costs. Particularly, the results highlight that subgroups of producers in each country show superior environmental and social performance compared to their peers and may serve as role models for best practice. Understanding the practices and processes that underpin this superior performance can help to enhance the standard setting and capacity building initiatives of Fairtrade and its partners.

The following plan is proposed to facilitate the transition to a more sustainable banana sector with greater transparency and reduced external costs:

1. Periodically establish sector benchmarks per country, facilitating informed policy decisions and enabling individual organizations to benchmark their sustainability performance. This would also provide a trusted source to address data gaps in future external costs studies.
2. Identify opportunities for collaboration to reduce external costs across the banana sector, for example based on the most material external costs of land occupation, climate change and insufficient income.
3. Form working groups with key stakeholders around specific external costs to define common goals and improvement programmes, preferably in existing pre-competitive platforms and governance structures.
4. Conduct research on how to reduce the external costs of the banana sector while simultaneously increasing benefits for producers and improving their livelihoods.
5. Implement improvement programmes based on the study findings to reduce the external costs of banana production.
6. Measure the effect of improvements on the social and environmental costs, by comparing external costs before and after implementation of the programme.

These recommendations underline the relevance of the Fairtrade Global Strategy 2016-2020. The study highlights the importance of making investments to improve wages and incomes in line with

the first goal of the strategy, which is to build benefits for producers and workers with a strong focus on Living Wage and Living Income. The second goal of the strategy focuses on deepening impact through services and programmes. This relates directly to the recommendations from this report to enable producers to increase productivity and labour efficiency and intensify good agricultural practices.

Moreover, with the above plan, the banana sector can also contribute to achieving the Sustainable Development Goals (SDGs), a 17-point global agenda for action adopted unanimously by all 193 member states of the United Nations and effective from January 1, 2016. In terms of transparency and external costs, the results of the plan can help shape the roadmap towards a sustainable banana sector by the SDG deadline of 2030. Essential for the success of achieving the roadmap is to measure the external costs of banana production and assess progress towards achieving the SDGs. In this way, the banana sector can show global leadership towards achieving the SDGs and form a model for other sectors that can contribute to sustainable development.

1.7. About this report

This report consists of the following five chapters:

1. **Introduction**
2. **Methodology and research design:** Chapter 2 describes the methodological approach adopted for this study including the definition of objectives, scoping, research design, and data verification and validation procedures. The methods used to quantify and monetize the environmental and social impacts of banana production are also described briefly and elaborated upon in the accompanying protocol report (Chapter 5 and 6).
3. **Results:** Chapter 3 summarises the results of the study, linking to the three key research questions, and considers opportunities to reduce the external costs of banana production through a series of subgroup analyses.
4. **Discussion:** Chapter 4 describes the key assumptions and limitations of the study and makes recommendations for future research and actions to help achieve a sustainable banana sector.
5. **Conclusions**: Chapter 5 outlines recommendations to support the vision for a sustainable banana sector, including future actions that can be taken over time to eliminate the negative externalities of banana production.

2. Methodology

2.1. Scope

The study assessed the external social and environmental costs of banana production by plantations and small producers in the major banana producing countries of Colombia, Dominican Republic, Ecuador and Peru. Small producers are defined as having less than 10 hectares (ha) of land. Producers that follow Fairtrade principles were compared to producers that do not.

The study considered the first steps in the supply chain of banana production in so far as they occur on the farm: cultivation and processing[7], including the washing and packing of bananas. The analysis is limited to environmental and social costs occurring during these phases and excludes any impacts upstream, such as the production of farm inputs, and downstream, such as transportation, marketing and consumption.

External costs were quantified by looking at a large set of social and environmental impacts of banana production. Social impacts refer to underpayment, health and safety, wages, overtime, and social security.[8] Environmental impacts are the material set of effects of banana production on the environment: climate change, land occupation, water depletion, waste, and land, water and air pollution (see Appendix 1 for the definitions of these impacts). To compare results, the total external costs are expressed in $ per box of bananas, where one box is equivalent to 18.14 kg of bananas.

2.2. Research design

This study was designed along three research questions:

1. What are the external social and environmental costs of the banana sector?
2. How do the external costs of Fairtrade bananas compare to the external costs of the banana sector?
3. What opportunities exist to reduce the external costs of the banana sector?

To answer these questions, the study assessed the external costs of a banana sector benchmark and Fairtrade certified banana producers in the four countries. Consequently, external cost data was required for the following groups:

- **Sector benchmark**: secondary data for the sector average banana producer in the four countries (See sections 2.5 and 6.2 for more on the benchmark and the literature used).
- **Fairtrade producers**: primary data from a statistically representative sample of Fairtrade certified banana producers in the four countries in 2015, supplemented with secondary data where necessary.

Note that this design does not allow for a statistical comparison between Fairtrade and non-Fairtrade producers, which would require primary data for non-Fairtrade producers, nor for an assessment of the impact of Fairtrade, which would require a difference-in-difference design with primary data for Fairtrade and non-Fairtrade producers over multiple years.

[7] In Peru, the processing phase was out of scope, as this is typically not done by the farm but by the Small Producer Organizations (SPOs). Also, services provided by the SPOs that contribute to the cultivation were out of scope, as those are done by workers hired by the SPO and not the farm. In the discussion, an estimate of the external costs of the cultivation and packing work provided by the SPO is provided.

[8] The questionnaire included questions about child and forced labour, including harassment. These aspects of data collection strictly followed Fairtrade Protection Policy and procedures.

Instead, this study establishes a sector benchmark and compares the external costs of Fairtrade with this benchmark. This innovative exploratory study is not intended to give a final verdict on the external costs of the sector; rather, it aims to provide a best possible estimate given the available data.

2.3. Sampling approach for Fairtrade producers

To compare the external environmental and social costs of the sector benchmark with those of Fairtrade banana production, data was collected from a sample of Fairtrade producers. A sample is a subgroup which is representative of the total population of interest. This study considered populations of small producers, plantation managers and plantation workers in the four countries.[9] The sample size required for representative results was based on a previous pilot study in 2015 commissioned by Fairtrade International on the external cost of banana production in Colombia. Consequently, producers were randomly chosen, with Fairtrade selecting plantations and CLAC selecting small producers and workers according to True Price and Trucost guidelines. See Table 1 for a summary of the samples used in the study.

Table 1: Summary of sample sizes used in external cost of banana production study

SAMPLE	COLOMBIA	DOMINICAN REPUBLIC	ECUADOR	PERU
Small producers surveyed	28	22	21	26
Plantation managers surveyed	8[10]	5	2[11]	NA[12]
Plantation workers surveyed	23	58	16	NA[9]

The population for the sector benchmark was defined as the average banana producer, large and small, in the same country as Fairtrade producers. No sampling was required as only secondary data was collected.

2.4. Sample characteristics of Fairtrade producers

Although the samples have been randomly selected, they are not fully homogeneous: random variation is intrinsic to random sampling and, in addition, there are differences in characteristics and practices across regions and countries.

In the sample for Colombia, none of the small producers or plantations are organic. For context, 3% of banana production in Colombia is organic, according to IISD (2011). Each of the small producers in the sample is located in the Magdalena region of the country, while most of the plantations are situated in Urabá, Antioquia.

In the sample for Dominican Republic, 50% of small producers and 60% of plantations are organic[13], compared to the country average of 28% organic (IISD, 2011). Plantations in the sample are relatively

[9] Due to practical and operational constraints small producer workers were excluded from the sample for this study.
[10] For the social cost analysis, 11 plantations were included as some of the workers in the sample were employed at plantations other than those in the sample.
[11] Data from one plantation was incomplete and was not included in the environmental cost analysis.
[12] Plantations were excluded from the Peru study because they are a relatively new phenomenon in the country, with little published data available. The recently certified plantation was unavailable to take part in the survey.

evenly spread across Monte Cristi (20%), Valverde (40%), Azua (20%) and Santiago (20%), while small producers in the sample are located in Monte Cristi (38%), Valverde (38%) and Azua (14%).[14]

In the sample for Ecuador, 67% of small producers and 100% of the plantations are organic, compared to the country average of 3% organic. All small producers and one plantation in the sample are located in El Oro, with one other plantation situated in Guayas.

In Peru, all farms in the sample are organic and this corresponds with the national numbers (IISD, 2011). Of these, 88% of the farms are located in Piura and 12% in Cajamarca.

2.5. Data collection

Fairtrade production data was collected through workshops held in 2016 with small producers, the directors of small producer associations and cooperatives, and with plantation managers and workers. The basis for data collection was a questionnaire on the external cost of banana production. Workers from Hired Labour were interviewed personally on human rights topics such as forced labour, child labour and harassment. Workers from SPOs, and children aged under 18 in HL and SPOs, were not interviewed personally. The small producer and plantations data was used as input for the social and environmental external impacts. For the social impacts of plantations specifically, a combination of data from plantation managers and workers was used. Refer to Appendix 2 for a detailed overview of the impacts that were covered by small producer, plantation manager and worker samples. The results of the questionnaire were recorded in a database in preparation for data verification and validation.

Minor gaps in primary data which were identified in otherwise complete producer questionnaires for specific indicators were addressed using the following conservative strategies:

- Producers were re-contacted where possible to clarify missing or ambiguous responses.
- Data collected from small producer organizations on pesticide and fertiliser use was used to fill gaps for these indicators for some small producers.
- Individual responses were excluded where the intention of the respondent was unclear or where insufficient information was provided to calculate an indicator value. For example, where a respondent provides the type and number of applications of a pesticide but not the quantity applied per application.
- Averages for all producers in the same country and producer type were used to fill gaps in the final external cost results when calculating the total production weighted average for all producers of each type.

Data for the sector benchmark was collected from reliable and applicable secondary sources. During the data collection, a data hierarchy was applied to give preference to country specific data from peer reviewed scientific journals and reports collected within the past five years. If this type of source was not available, data was sourced from non-peer reviewed studies or from the opinions of trusted experts. In case no reliable and applicable source was found, and secondary data was missing, it was assumed that the data point for the sector benchmark was equal to the value of Fairtrade producers. Since the results show that the external costs of Fairtrade production is lower than the sector

[13] Here, organic farms refer to those farms which are already certified organic or are working towards certification.,

[14] Note that in Dominican Republic, it is assumed that the locations of the 10% of small producers in the sample that cannot be identified are distributed similarly to the other producers.

benchmark, this is a conservative approach that most likely underestimates the external costs in the sector.

Key secondary sources for environmental data were life cycle assessment studies published in the Ecoinvent database and the World Food LCA Database. Notably, the mining of environmental data from a single source was preferred since indicators were likely to be interrelated, such as how increasing fertiliser or water input can increase yield, energy use and waste. Key secondary sources for social data included a LEI Wageningen UR study on Fairtrade certification in the banana hired labour sector (2016) a ILO study on Decent Work (2005), a study by Ministerio de Trabajo on the labour market in the Dominican Republic (2010), a report by SIPAE (Sistema de Investigación de la Problemática Agraria de Ecuador) on the working conditions at banana plantations in Ecuador (2011), and country-specific studies on labour statistics. Refer to chapter 6 on Literature for an overview of all the secondary sources used for data collection.

2.6. Data verification and validation

The quality and reliability of the external cost of production results depended on the quality of the underlying social and biophysical data used in the analysis. True Price and Trucost verified and validated the primary data collected from Fairtrade producers and the secondary data collected for the sector benchmark.

2.6.1. Data verification

Primary data was first screened to identify and correct any errors which had been made by the survey respondents due to the misinterpretation of the questionnaire or the instructions of the surveyor. Such errors - which included providing responses in incorrect units or in text where a numerical response was required - were flagged and clarified with the survey respondent where necessary. Care was taken to distinguish between non-responses and zero responses, particularly for questions relating to energy, pesticide and fertiliser use, where it is possible that producers may not use these inputs, or questions relating to maternity leave, where it is possible that producers in principle provide this to workers but potentially had no female workers who were pregnant. Once verified, all responses were normalised in the correct units in preparation for validation. For questions and data validation related to child labour, harassment and forced labour, the data protection policy applied by Fairtrade was strictly followed. Therefore, the data collected refers only to the answers obtained from the questionnaire; protected information could not be disclosed or used for the validation of this data.

Secondary data collected for the sector benchmark was screened using the same data hierarchy. This process helped to ensure that the best available data was used to represent the sector benchmark and to ensure a fair comparison between Fairtrade production and the benchmark. Where no secondary data was available for a given indicator in a given country, data from a similar country or an average of similar countries was used in some cases. Alternatively, for some indicators no difference between Fairtrade production and the sector benchmark was assumed. In these instances, primary data collected from Fairtrade producers was used as an estimate for the sector benchmark.

2.6.2. Data validation

The plausibility and likely robustness of primary data points collected from Fairtrade producers was validated both quantitatively and qualitatively. For quantitative validation, data that was collected from producers for key indicators was compared to reliable secondary benchmark data. For example, banana yields per hectare were compared with country average data from the FAO (FAOSTAT, 2016), water consumption data was compared with country average estimates from the Water Footprint Network (Mekonnen and Hoekstra, 2011), and labour intensities were compared to Cost of

Sustainable Production (COSP) Fairtrade data from previous years (Fairtrade, 2015). This process was necessarily subjective, and care was taken to avoid misinterpretation or exclusion of primary data points from Fairtrade producers unless there was a compelling case to do so. For example, reported data for a given indicator was included unless this was found to be 10 times greater or smaller than a reliable benchmark for that indicator.

The data collected from Fairtrade producers and the final external cost results were validated in a qualitative manner, in consultation with subject matter experts in each country. The extensive qualitative validation process was undertaken with CLAC to help identify unrealistic data points and identify suitable benchmarks against which the primary data could be compared. This validation process was completed separately for each study country and then for the final external cost results. Secondary data used to represent the sector benchmark was also subjected to the qualitative validation process to ensure its quality and reliability.

Even with every care taken in the collection of data and in the validation process, a set of social indicators could not be fully covered. The questionnaire was not applied to children and workers in SPOs below the age of 18, so there are no direct reports from children about their involvement in labour. The validation of this information was difficult since access was only open to data from Fairtrade where no major non-compliance was observed. It should also be noted that for events that occur with a low probability, it is possible that no cases were observed in a given sample.

2.6.3. Outlier detection and removal

Following the external cost analysis, the final results were screened to identify outlier producers that could bias the total external cost results. Potential outliers were detected by applying the following criteria:

- External social cost results that fell outside +/-1.5 times in the interquartile range were identified as potential outliers.
- External environmental cost results that were five times greater or less than the production weighted mean for each indicator were identified as potential outliers.

Potential outliers were excluded when the outlier was likely to be the result of an error which could not be corrected, or when the outlier had a material impact on the overall results. In the case of an outlier being detected for one data point, when the rest of the data points were sufficiently good, this data point was filled with average data from other producers. Outliers were only excluded in a limited number of cases to preserve the integrity of the data provided by Fairtrade producers.

2.7. Quantification

Social and environmental impacts were quantified using an extended set of indicators. These were quantified using collected data points and expressed per ton of bananas produced. For example, water use was expressed in litres per ton of bananas. In this way, the data was made comparable across producers and impact categories such that it can be monetized. Per box and per ton external costs were calculated based on the net sales of the respondent producer for primary data, or the average hectare in production for secondary data. For primary data, the quantity of banana produced but not sold was subtracted.

2.8. Monetization

After quantifying the key indicators, a social and environmental monetization method was applied to convert them into a social or environmental cost. Water depletion, for example, is expressed in

dollars per box of bananas. The monetization methods applied in this study have different guiding principles.

The principle guiding the monetization of social externalities, is to take an abatement cost approach to social impacts. The True Price method is based on benchmarks for a comprehensive set of social performance indicators that describe workers, work relations and health conditions at production sites. The benchmarks are based on norms specified by the International Labour Organization and other internationally recognized norms, in particular the ILO 1998 declaration on Fundamental Principles and Rights at Work, the Universal Declaration of Human Rights, and the United Nations 2011 Guiding Principles on Business and Human Rights. Deviations from the benchmark are then monetized based on the abatement cost.

The principle guiding the monetization of environmental externalities is that adverse impacts on the environment result in a loss of social welfare, which represents an external cost. These impacts include emissions of pollutants into water, air or soil, the depletion of finite resources, and the occupation of land. Trucost uses the principles of Life Cycle Assessment to quantify impacts on the environment and values them based on a combination of market and non-market monetization methods that calculate the cost to society of damages to the natural environment.

Finally, the sum of all monetized social and environmental impacts represents the external cost of banana production. The average external costs per producer type in each country were calculated by weighing the external costs of each individual producer in the sample by its respective Fairtrade sales. Similarly, the average external costs of each country were calculated by weighing the total Fairtrade sales by small producers and plantations with their respective average external costs.

For more background information on the monetization of externalities, see the TEEB Agri Food framework (2015). On environmental impacts specifically, see the Natural Capital Protocol (2015). For background information on social impacts, refer to the ILO Declaration on Fundamental Principles and Rights at Work and other core ILO Conventions. For information on the monetization of social impacts, refer to the Social Capital Protocol of the WBCSD (2017).

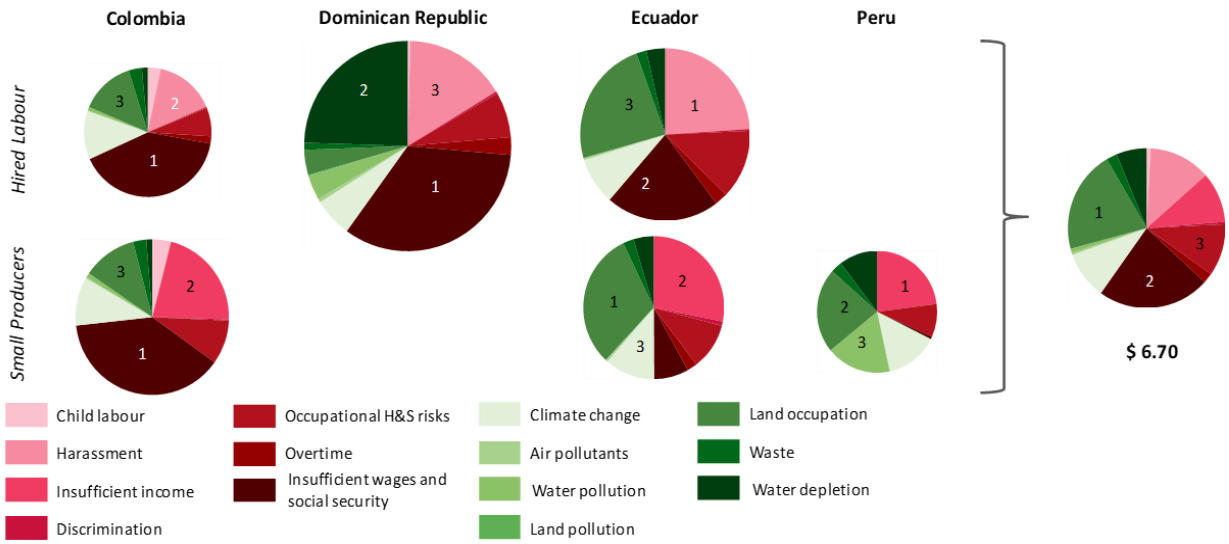
3. Results

3.1. The external costs of the banana sector

This section addresses research question 1: What are the external social and environmental costs of the banana sector? For this, plantations and small producers in the four countries are in scope. The banana sector is defined as the entire sector, encompassing certified and non-certified producers. The results represent an estimation of the external costs of the average box of bananas, calculated by dividing the total external costs of the sector in a country by the total production. All results in this report are expressed in 2015 US Dollars, unless explicitly mentioned otherwise.

The sector average external cost per box of bananas, weighted by total production across all four countries, was found to be $6.70 per box. The most material social costs are insufficient wages and social security for workers, and insufficient income for small producers. The most material environmental costs are land occupation, water depletion and climate change. The average social costs of $4.00 (60% of the external costs) are greater than the environmental costs of $2.70 (40%) of sector average banana production. Figure 1 shows how the external costs per box of bananas are highest for plantations in the Dominican Republic ($11.59) and lowest for small producers in Peru ($3.94)[15]. The large external costs for plantations in Dominican Republic are mostly driven by high costs of insufficient wages and social security (34% of their total external costs) and water depletion (24% of their total external costs).

[15] Note that the scope for Peru might not be fully comparable to that of the other countries, because the data collected in this study only covers labour hired directly by the producers and that in Peru it is common that small producer organizations (SPOs) provide (field and processing) labour as a service to the producers. Based on additional secondary data, the social costs related to this additional labour have been estimated at around US$0.68 per box. Hence, even when including this additional labour, bananas from Peru still have the lowest external costs at US$4.62 per box.



Total external costs

Costs per box of bananas		Colombia	Dominican Republic	Ecuador	Peru
Hired labour	Social costs	$3.50	$6.96	$4.69	NA
	Environmental costs	$1.63	$4.64	$2.96	NA
Small producers	Social costs	$4.67	NA	$2.70	$1.28
	Environmental costs	$1.70	NA	$2.70	$2.66

	Average
Social	$4.00
Environmental	$2.70

Top 3 largest external costs

Costs per box of bananas		Colombia		Dominican Republic		Ecuador		Peru	
Hired labour	1	Insufficient wages and social security	$2.07	Insufficient wages and social security	$3.90	Harassment	$1.83	NA	NA
	2	Harassment	$0.78	Water depletion	$2.84	Land occupation	$1.83	NA	NA
	3	Land occupation	$0.71	Harassment	$1.84	Insufficient wages and social security	$1.66	NA	NA
Small producers	1	Insufficient wages and social security	$2.45	NA	NA	Land occupation	$1.67	Insufficient income	$0.90
	2	Insufficient income	$1.37	NA	NA	Insufficient income	$1.52	Land occupation	$0.89
	3	Land occupation	$0.73	NA	NA	Climate change	$0.62	Water pollution	$0.69

Figure 1: Sector averages of external costs and top 3 largest external costs (in $) per box of bananas of hired labour[16] and small producers.[17]

The largest average environmental costs across all four study countries are land occupation, climate change and water depletion, representing 21%, 10% and 6% of the total external costs of production respectively:

- **Land occupation** by banana producers displaces the natural landscapes and ecosystem services that could otherwise have existed. Land occupation costs are thus a function of the ecosystem service value of average undisturbed landscapes in the banana producing regions of each country and the productivity of the producers (which differs significantly), since producers with higher yields require less land per box of banana produced. Average ecosystem service values are comparable in Colombia ($1,395 per hectare) and Peru ($1,711 per hectare) but are substantially lower in the Dominican Republic ($727 per hectare) and are highest in Ecuador ($3,126 per

[16] Hired labour refers to plantations.

[17] Note that no good data is available for non-Fairtrade small producers in the Dominican Republic, because the vast majority of small producers are Fairtrade certified. No good data for plantations is available in Peru, where plantations are a relatively new phenomenon.

hectare). Average per hectare yield also varies between producers, from a maximum of 1,975 boxes of bananas in Colombia to a minimum of 1,627 boxes in Ecuador for the sector and from 2,631 (Colombian plantations) to 1,434 (Dominican Republic small producers) for Fairtrade producers. Table 9 in appendix 5 gives a detailed overview of the drivers of land occupation.

- **Climate change** is driven by direct emissions from energy and fertiliser use, and indirect emissions of nitrous oxide from the soil. Direct emissions from energy and fertiliser use are linked to producer practices, namely the use of fuels and electricity and the use of organic and chemical nitrogen fertilisers. The nitrous oxide from the soil is the largest driver of the climate change costs, however, and is linked to the production area of the farm and therefore yield. More details on the drivers of climate change can be found in Table 8 in Appendix 5.
- **Water depletion** occurs due to the diversion of freshwater from surface and groundwater sources for use in irrigation and banana processing. The external costs of water depletion are determined by the scarcity of water in each country, and the amount of water consumed per box of bananas produced. Water depletion costs are highest in the Dominican Republic due to high water scarcity and consumption. Producers in Colombia are the most water efficient on average, followed by Ecuador and Peru. The external costs of water depletion show a large variability, mainly due to differences in water input. For more information, see Table 10 of Appendix 5.

Other environmental cost categories - such as air, land and water pollution, and waste - are relatively minor contributors to the external cost of banana production overall. However, there are significant variations in the use of fertiliser and pesticides, and in the production of waste between producers, and so there will likely be cases where the external costs associated with high impact producers could be reduced.

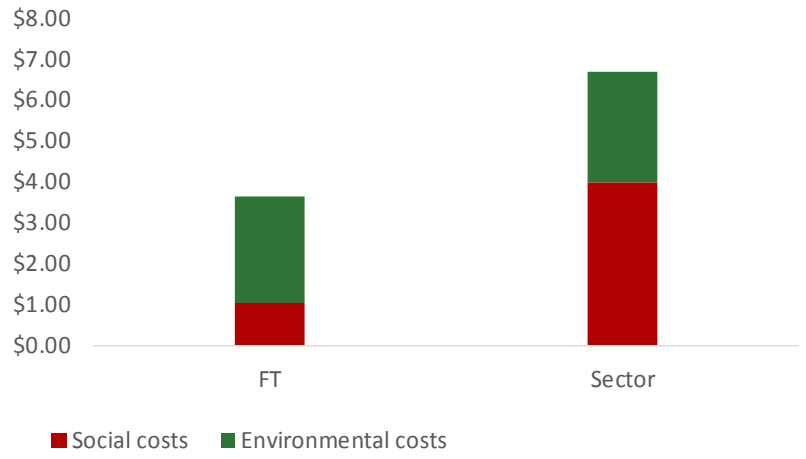
The largest social costs across all four study countries were found to be insufficient wages and social security for hired workers, and insufficient income for small producers and their families. Together, they amount on average to 33% of the total external costs. Other large external social costs are harassment and occupational health and safety risks, which respectively account for 13% and 11% of total external costs on average.

- **Insufficient wages and social security for workers and insufficient income for small producers** result from the difference between the living wage and the wage per worker, as well as the net producer income per household member of small producers. Food and housing are the largest contributors to the living wage across the four countries. Refer to Appendix 5 for an explanation and overview of the living income per country.
- **Harassment** of FTEs working on sector benchmark plantations could be either verbal or physical, and sexual or non-sexual.
- **Occupational health and safety risks** are mainly driven by the impact of non-fatal and fatal incidents. The total costs per box of bananas is larger for fatal incidents than for non-fatal incidents in every country, with percentages varying from 69% of total H&S costs in Colombia to 93% in Peru. The number of incidents per FTE can be found in Table 13 of Appendix 7.

A more detailed overview of the drivers and the exact costs of the most material impacts can be found in Appendix 5.

3.2. Fairtrade banana production vs. banana sector production

In this section, research question 2 is addressed: How do the external costs of Fairtrade bananas compare to the external costs of the banana sector? As shown in Figure 2, average external costs are lower for Fairtrade producers than for sector average producers at $3.65 and $6.70 per box of bananas respectively.



	Fairtrade	Sector
Social costs	$ 1.05	$ 4.00
Environmental costs	$ 2.60	$ 2.70

Figure 2: External costs per Fairtrade (Fairtrade) and sector average box of bananas[18]

On average, Fairtrade producers have lower social and environmental costs than sector benchmark producers. The average external costs across all producer types (weighted according to sales revenues) are 45% lower for Fairtrade producers than sector average producers, at $3.65 per box compared to $6.70 per box. Social costs are higher for the sector benchmark, mainly due to lower wages and less social security benefits given to workers, and the lower incomes of small producers. For Fairtrade plantations, the environmental costs are lower than the sector average in Colombia (due to lower land use and climate change costs) but higher in the Dominican Republic (due to higher water depletion and climate change costs). For Fairtrade small producers, environmental costs are lower in Colombia (due to lower land use costs), Peru (due to lower water pollution costs) and Dominican Republic (due to lower water depletion costs), but are higher in Ecuador (due to climate change and air pollution costs). It is important to note that in the samples surveyed in Ecuador and Dominican Republic, more producers were certified organic (or working towards organic certification) than on average in those countries.

Among plantations, Fairtrade producers have external costs which are 58% lower than the sector average ($3.09 vs $7.33 per box). For Fairtrade small producers, external costs are 29% lower than the sector benchmark ($3.99 vs $5.63 per box). Notably, these averages are heavily influenced by the results of Colombia, with a weight of around 75% of all plantations, and Ecuador, with a weight of around 80% of all small producers. Figure 3 shows that external costs of Fairtrade plantations in Colombia are less than one third of the external costs of the sector average plantations ($1.48 compared to $5.13). In Ecuador, Fairtrade small producers have external costs of $4.11, compared to $5.40 for the sector average.

[18] Note that the figures in this table have been rounded to 5 US dollar cents.

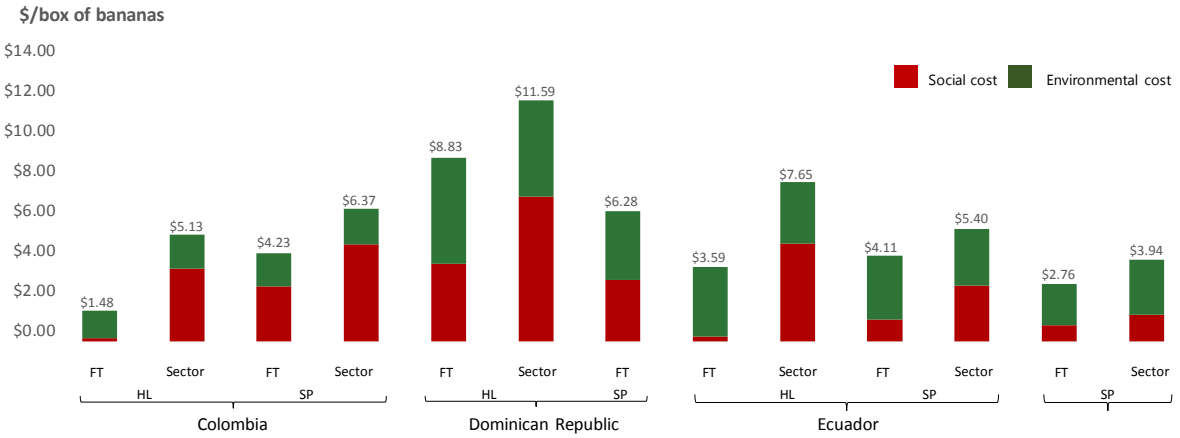


Figure 3: Social and environmental costs per box of bananas for Fairtrade and sector benchmark hired labour (HL[19]) and small producers (SP)

The contribution of environmental costs to the total external cost of Fairtrade producers (plantations and small producers) range from 57% in the Dominican Republic to 79% in Colombia. The contribution of environmental costs to the total external cost of banana sector producers is lower, between 31% (Colombia) and 68% (Peru), due to higher social costs in general.

The average external environmental costs are comparable for Fairtrade plantations and small producers at $2.19 and $2.84 per box respectively, and for sector plantations and small producers at $2.76 and $2.44 per box respectively. For both Fairtrade and sector benchmark banana producers, environmental costs are highest in the Dominican Republic due to a higher water use with comparable yields, and lowest in Colombia due to comparatively high yields but lower input use. Climate change costs are larger for Fairtrade producers, mainly due to higher energy and fertiliser input.

External social costs vary more than environmental costs across the four countries, for both Fairtrade producers and the sector benchmark. On average, they amount to $0.90 and $1.14 per box for Fairtrade plantations and small producers respectively, compared to $4.00 per box for the sector benchmark. The difference is due largely to the fact that Fairtrade producers have more often lower external costs due to underpayment, lack of social security and small producer underearning. This underlines the importance of Fairtrade's ongoing Wage Improvement Programme and Productivity Improvement Project.

A more detailed overview of the differences between the external costs and drivers of Fairtrade and the sector benchmark can be found in Table 2.

The external costs correspond on average to 71% of the reference price of a box of bananas for the sector benchmark, and 40% for Fairtrade producers, who also receive a higher price. As a reference price, the average EXW prices of the Fairtrade Minimum Price for organic bananas recorded in the 2015 COSP were used for Peru, Ecuador and the Dominican Republic, while the organic FOB price was

[19] Hired Labour refers to Fairtrade banana plantations.

used for Colombia.[20] Notably, the ratio of external costs to the reference price is lowest for Fairtrade plantations in Colombia and highest for sector benchmark plantations in Dominican Republic.

[20] The Fairtrade Minimum Prices were $10.35 (FOB) for Colombia, $9.60 (EXW) for Dominican Republic, $9.05 (EXW) for Ecuador and $8.55 (EXW) for Peru. Note these prices are a reference price, and not the empirical prices.

	Colombia				Dominican Republic			Ecuador				Peru	
Impact category	Fairtrade HL	Fairtrade SP	Benchmark HL	Benchmark SP	Fairtrade HL	Fairtrade SP	Benchmark HL	Fairtrade HL	Fairtrade SP	Benchmark HL	Benchmark SP	Fairtrade SP	Benchmark SP
Child labour	$0.00	$0.00	$0.17	$0.25	$0.03	$0.00	$0.05	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Forced labour	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Harassment	$0.00	$0.00	$0.78	$0.00	$0.02	$0.00	$1.84	$0.00	$0.00	$1.83	$0.00	$0.00	$0.00
Insufficient income	$0.00	$0.94	$0.00	$1.37	$0.00	$0.87	$0.00	$0.00	$0.48	$0.00	$1.52	$0.75	$0.90
Discrimination	$0.03	$0.01	$0.02	$0.02	$0.00	$0.03	$0.04	$0.02	$0.02	$0.03	$0.05	$0.00	$0.00
Occupational H&S risks	$0.05	$0.10	$0.37	$0.58	$0.13	$0.10	$0.81	$0.10	$0.01	$0.99	$0.57	$0.02	$0.35
Overtime	$0.01	$0.00	$0.09	$0.00	$0.21	$0.17	$0.31	$0.04	$0.13	$0.18	$0.12	$0.00	$0.00
Insufficient wages and social security	$0.08	$1.60	$2.07	$2.45	$3.36	$1.80	$3.90	$0.10	$0.42	$1.66	$0.43	$0.02	$0.03
Climate Change	$0.38	$0.69	$0.62	$0.64	$0.96	$0.79	$0.70	$0.93	$0.79	$0.68	$0.62	$0.58	$0.56
Air Pollutants	$0.01	$0.05	$0.01	$0.01	$0.26	$0.11	$0.07	$0.05	$0.06	$0.03	$0.02	$0.00	$0.00
Water Pollutants	$0.17	$0.04	$0.04	$0.06	$0.38	$0.50	$0.44	$0.00	$0.00	$0.00	$0.00	$0.02	$0.69
Land Pollution	$0.01	$0.00	$0.00	$0.00	$0.02	$0.00	$0.02	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Land Occupation	$0.63	$0.65	$0.71	$0.73	$0.49	$0.63	$0.45	$2.07	$1.85	$1.83	$1.67	$0.94	$0.89
Waste	$0.00	$0.00	$0.17	$0.18	$0.00	$0.00	$0.13	$0.00	$0.00	$0.15	$0.13	$0.03	$0.12
Water Depletion	$0.11	$0.16	$0.08	$0.08	$2.97	$1.27	$2.84	$0.28	$0.34	$0.27	$0.25	$0.38	$0.41
Total social	**$0.16**	**$2.65**	**$3.50**	**$4.67**	**$3.74**	**$2.97**	**$6.96**	**$0.25**	**$1.06**	**$4.69**	**$2.70**	**$0.80**	**$1.28**
Total environmental	**$1.32**	**$1.58**	**$1.63**	**$1.70**	**$5.08**	**$3.30**	**$4.64**	**$3.34**	**$3.05**	**$2.96**	**$2.70**	**$1.96**	**$2.66**
EXW price	$10.35	$10.35	$10.35	$10.35	$9.60	$9.60	$9.60	$9.05	$9.05	$9.05	$9.05	$8.55	$8.55

Table 2: External costs per impact ($ per box of banana) - all countries, hired labour (HL)[21] and small producers (SP)

[21] Hired labour refers to banana plantations.

In conclusion, the external costs of Fairtrade producers across all countries are likely to be lower than that of the sector benchmark. However, evidence from this study alone is insufficient to prove definitively (or statistically) that external costs of Fairtrade production are lower, due to the limitations of the research design and the lack of robust primary data on sector average producers. The results do allow for the identification of commonalities and differences between producers that do and do not follow sustainable production standards such as Fairtrade. Also, the study helps to better understand the key drivers of a sustainable production approach, which can inform strategic decisions for the whole sector. Furthermore, since conservative approaches were used in the selection and interpretation of sector average data used in this study, it is likely that the difference between Fairtrade and sector average external costs is underestimated. This finding may be confirmed through future studies of the external costs of banana production.

With reference to child labour, harassment and forced labour, the overall industry and Fairtrade figures might be underestimated due to some methodological choices, data access restrictions based on the Fairtrade Protection Policy, and the hidden nature of these practices. In terms of methodology, the study only collected data based on adults (above 18 years) and relied on secondary data from government and Flocert audits which may not have captured fully the "real value". Furthermore, cases of child and forced labour which were alleged and/or identified via the Fairtrade Protection Policy and which might have impacted the results, were not used in the data assessment. Finally, the hidden nature of these practices may mean that public documents covering these occurrences are limited. Not all national governments have publicly reported data on child and forced labour occurrences following ratification of the ILO relevant conventions. Therefore, the data collected and the secondary data used for the whole industry may underestimate the actual figures.

3.3. Potential for sustainable production improvements

In this section research question 3 is addressed: What opportunities exist to reduce the external costs of the banana sector?

Some of the recommendations for promoting sustainable production in this section are based on comparative subgroup analyses of Fairtrade producers. However, it is important to note that the small sample sizes have created a level of uncertainty around the results of subgroup analyses in this section. These should therefore be assumed as exploratory and can be further redefined by repeating surveys of Fairtrade producers in future years, and by increasing the available sample size to reduce uncertainty.

There is little uncertainty regarding the external social costs of occupational health & safety risk, overtime, and discrimination. Uncertainty is especially high for insufficient income of small producers and insufficient wages and social security of hired workers, mainly due to the high variability in data on the income of producers and the financial wage data of hired workers. Measurement limitations mean there is also uncertainty about forced labour, child labour and harassment; these are sensitive questions, prone to bias in answers, which were not asked of workers in most countries. In addition, for impacts that have a low frequency, measurement error is large in samples of limited size. For example, it may well be that no case is found of child labour in a given sample even if it is present with low probability.

Across all four study countries, water pollution and land pollution were the most uncertain external costs of production with the largest confidence interval ranges. These external cost categories, however, make only a minor contribution to the overall external cost per box of bananas. Uncertainty is also high for water consumption in plantations in the Dominican Republic and Colombia, due to the high variability in water input quantities among producers.

3.3.1 Potential improvements from learnings of Fairtrade banana producers

The banana sector can draw learnings from Fairtrade's sustainable practices to instigate change towards more sustainable production. The main difference in the external costs of Fairtrade and sector average producers stems from social costs, namely the cost of insufficient income for producers and the cost of insufficient wages and social security for hired workers.

The sector can easily adopt several improvements from Fairtrade practices through an increased awareness of social and environmental costs. For example, a greater focus on issues such as harassment or H&S risks, through strengthened policies on worker relations or investments in training and protective equipment, is one relatively accessible way to reduce the associated social costs.

Ultimately, the sector can improve by looking specifically at how its practices on social impacts differ from those of Fairtrade producers.

3.3.2 Potential improvements from high-performing Fairtrade banana producers

The banana sector, including Fairtrade, can learn from banana producers that perform well on sustainability[22]. External environmental costs can be reduced by analysing how high-performing producers optimize yields and adopt water efficiency measures. Additionally, the sector can improve external social costs by investing in labour productivity and labour conditions, which would positively affect yields, net producer income and worker income and benefits.

Reduce land occupation and climate change costs by optimizing yields

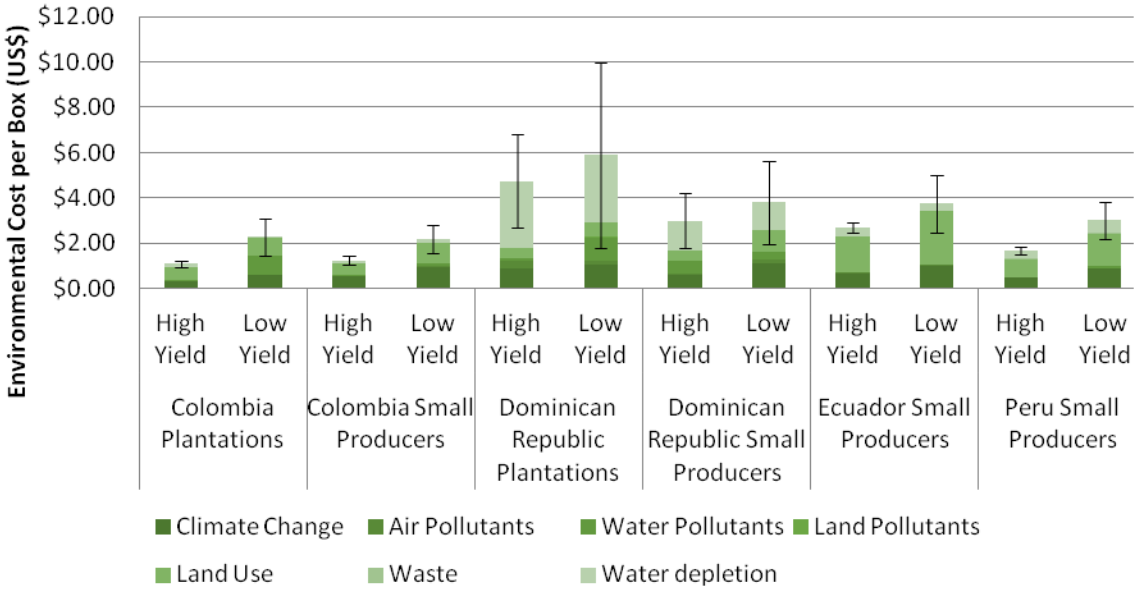
The banana sector could optimize yield by identifying strategies that are likely to deliver a net reduction in environmental costs per box of bananas. Such strategies could require increases in mechanisation (climate change), fertiliser use (water pollution) or irrigation (water depletion) and therefore the costs and benefits of yield optimization need to be carefully considered. While the degree of mechanisation in the study countries is typically low, mechanisation has been used in banana production to increase the efficiency of some practices (Cabrera et al, 2010; Goncalves and Kernaghan, 2014). These include:

- Soil tilling and weed removal at the beginning of each cultivation cycle;
- Spraying of pesticides from a vehicle as opposed to aerial or hand spraying;
- Clearing of pseudostems at the end of the cultivation cycle (this can also help to reduce the habitat for *Cosmopolites sordidus*, a common banana pest);
- Bunch harvesting; and
- Washing and processing of harvested bananas.

Where mechanisation of these practices increases banana yield or reduces losses, the overall productivity of the producer can be increased. The costs of land occupation and climate change are closely linked to productivity and can be reduced by minimising the area of land needed to produce one box of bananas. Yields reported by Fairtrade producers in Colombia and Peru exceed the five-year country average yield benchmark reported by the FAO (FAOSTAT, 2016), but fall short among producers in Ecuador and the Dominican Republic. This suggests that opportunities may exist to increase yields among producers in these countries at the same time as reducing their total environmental costs of production.

[22] In this study only data from Fairtrade producers was available, but lessons can be learned from all banana producers that perform highly on sustainability.

To explore this concept further, a subgroup analysis was conducted to compare the total environmental cost per box of bananas of high yield Fairtrade producers and low yield producers in all four countries.[23] As shown in Figure 4, the total environmental costs of high yield producers are between 19% (Dominican Republic plantations) and 52% (Colombia plantations) lower than their low yield counterparts. This suggests that it may be possible to increase yields among low yield groups without increasing environmental costs, even if additional inputs such as fertiliser, water and energy are needed. This is because any increase in air, land and water pollution, or in water consumption, could be offset by reductions in the two most important impact categories: land occupation and climate change. Repeating the external costs survey over time can provide more robust insight into the link between yield maximisation and total environmental costs, and it could reveal the break-even point at which the benefits of increased yield are offset by increases in other environmental cost categories.



	Colombia Hired Labour		Colombia Small Producers		Ecuador Small Producers		Dominican Republic Hired Labour		Dominican Republic Small Producers		Peru Small Producers	
	High Yield	Low Yield	High Yield	Low Yield	High Yield	Low Yield	High Yield	Low Yield	High Yield	Low Yield	High Yield	Low Yield
Yield (box/Ha)	2,779	1,956	2,801	1,800	2,012	1,458	1,701	1,139	1,749	909	2,172	1,305
Change in total environ-mental costs (%)	-52%		-43%		-29%		-19%		-21%		-45%	

Figure 4 Yield maximisation: Fairtrade producer subgroup analysis (Source: Fairtrade data)

Reduce the cost of water depletion through water efficiency

The banana sector could reduce the cost of water depletion without diminishing yields by optimising irrigation infrastructure and practices.

[23] High and low yield producers were defined as those producers with yields above or below the median for all Fairtrade producers of the same production system and country.

Water is an essential input to banana cultivation. It is also an input to the processing and packing of bananas for sale. However, there are diminishing returns in production where water inputs exceed the needs of the crop. According to the Water Footprint Network (Mekonnen and Hoekstra, 2011), banana production in Colombia, Dominican Republic and Ecuador consumes an average of 7.6 m^3, 11.6 m^3 and 5.4 m^3 of water per box of bananas (no data was available for banana production in Peru). These are all below the global average water requirements per box of bananas estimated by Mekonnen and Hoekstra at 12 m^3. Although water consumption reported by Fairtrade producers in Colombia, Peru and Ecuador is comparable to the Water Footprint Network benchmark, reported consumption in Dominican Republic is double that mark for Fairtrade plantations, and 3.7 times higher for small producers. This suggests that opportunities may exist to reduce water consumption in the Dominican Republic without compromising productivity.

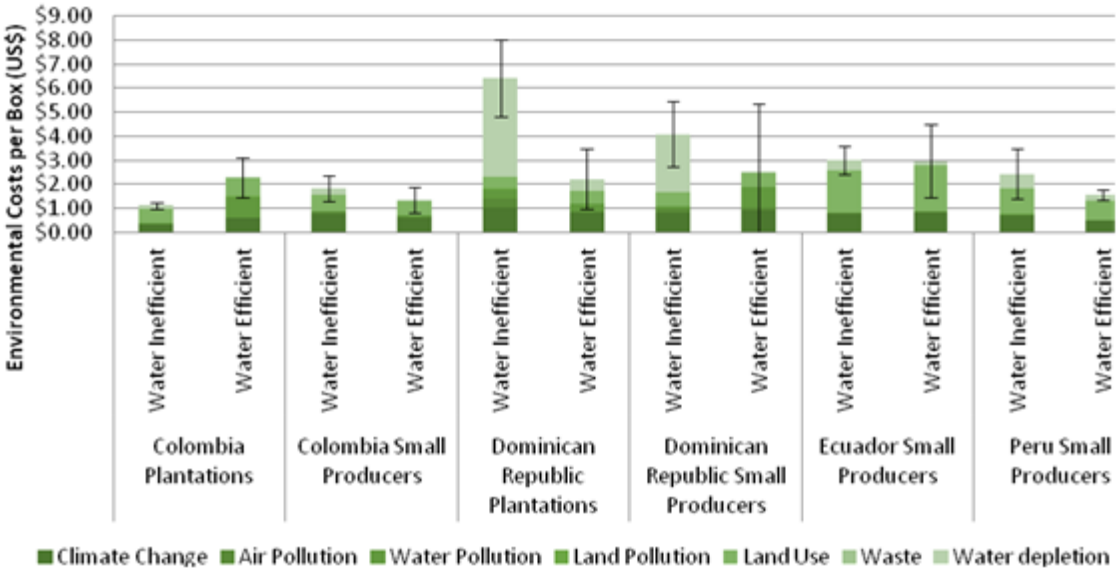
To explore this concept further, a subgroup analysis was conducted for Fairtrade producers in all four countries to compare the total environmental cost of water efficient producers (below median water consumption) and water inefficient producers (above median water consumption). Figure 5 shows that the total environmental costs of water efficient producers in Dominican Republic, Peru and Colombia (except plantations in Colombia) are between 2% and 65% lower than their water inefficient counterparts. This includes reductions of between 2% and 39% among small producers and 65% among plantations in Dominican Republic. The environmental costs of water efficient small producers in Ecuador are only marginally (2%) lower than their water inefficient counterparts due to relatively consistent water use per box of bananas across all producers in Ecuador. Water efficient small producers in Colombia and Peru exhibit lower total environmental costs while achieving increased yields. In Dominican Republic and Ecuador, yields for water efficient and inefficient small producers are approximately equivalent. This suggests that scope may exist for water inefficient producers to reduce their water use without compromising yield.

Contrary to expectations, total external costs among water efficient plantations in Colombia were found to be 106% higher than their water inefficient counterparts, due primarily to substantially lower yields of 1,956 boxes per hectare compared to 2,779 boxes per hectare. This finding highlights that important thresholds exist beyond which further reductions in water use may compromise crop productivity. Future surveys on water use and productivity among banana producers should focus on providing more robust insight into opportunities for water efficiency.

Previous studies of plantation and small banana producers have found up to 99% of water consumption in banana production occurs in the cultivation phase, with only a small contribution from the processing phase (Soil and More International, 2011; Zarate and Kuiper, 2013). Irrigation is a significant driver of the overall blue water footprint of banana producers in all four countries, where methods range from inefficient gravity irrigation where control over water volumes is limited, to more efficient sub-foliar spray, super foliar spray and drip irrigation practices (FAO, 2017). The FAO (2017) recommends a range of practices to help reduce water consumption in banana production, including:

- Optimising water inputs to crop requirements by using meteorological data to predict rainfall, and the measurement of soil moisture levels to consistently supply water throughout the growing cycle.
- Reducing water losses from drainage and evapotranspiration through the application of mulch or crop residues to the soil and the use of cover crops.
- Reducing the frequency of gravity irrigation (in countries where this is practiced) and replacing with frequent watering.

Approaches such as these may help to reduce the external costs of water depletion while also increasing the resilience of producers to water scarcity, which is expected to increase under future climate change. It is important to consider the economic, social and environmental context of each producer region when designing water efficiency strategies to ensure that these strategies can be implemented effectively. As such, it is important to engage with relevant experts and local stakeholders when designing future water efficiency programmes.



	Colombia Hired Labour		Colombia Small Producers		Dominican Republic Hired Labour		Dominican Republic Small Producers		Ecuador Small Producers		Peru Small Producers	
	Inefficient	Efficient	Inefficient	Efficient	Inefficient	Efficient	Inefficient	Efficient	Inefficient	Efficient	Inefficient	Efficient
Yield (box/Ha)	2,779	1,956	2,207	2,555	1,582	1,437	1,515	1,503	1,855	1,717	1,806	2,163
Change in total environmental costs (%)	+106%		-26%		-65%		-39%		-2%		-36%	

Figure 5 Water efficiency: Fairtrade producer subgroup analysis (Source: Fairtrade data).

Reduce the costs of insufficient income and wages by increasing productivity

The banana sector can reduce the costs of insufficient income for small producers and insufficient wages for hired workers by looking at ways to increase labour productivity. This would increase the income for the producer and create space for better benefits for workers. To explore this, a subgroup analysis was conducted to compare the net incomes and yields for the Fairtrade small producers with the 50% highest labour productivity and the 50% lowest labour productivity. Figure 6 shows that the 50% of Fairtrade small producers with the highest labour productivity have on average higher net incomes per ton bananas and yields in each country. This implies that labour productivity (FTE/ton bananas) is an important driver of the welfare of small producers and could therefore improve producer income. Increasing labour productivity in terms of hectares or output might have different effects on the change in both social and environmental external costs.

Ultimately, the external costs per FTE should also be monitored to ensure the social conditions of the workers improve. For example, an increase in labour productivity should be accompanied by an increase in wages in order to reduce the social externalities. Additional research on how the earnings of workers and producers are linked to production is required to identify the underlying drivers of this relation. This could also help to identify the best practices of small producers with high productivity that could be adopted by producers with low productivity. There are already various investments that small producers can make to enhance labour productivity, such as financial and in-kind benefits to encourage worker performance and attendance, and health and sanitary measures to prevent worker illness and absenteeism.

In tandem with addressing labour productivity it is also possible to reduce the cost of insufficient income for producers, for example by reducing production costs, using agricultural inputs more efficiently, and investing in higher productivity. As for the external costs of insufficient wages of employees, producers can make sure that increases in labour productivity and banana prices are reflected in increased wages, and they can give more attention to in-kind benefits such as housing, healthcare, and social security coverage for all workers, including casual workers. A tool like the Fairtrade Premium can play a role in reducing these costs, for example by providing in-kind compensation for workers in the short term, as is the case in Colombia. In the long term, investing in productivity can increase producer income which could in turn result in increased wages of workers, although this might also depend on other factors such as the preferences of the employers and the capacity of trade unions to negotiate better wages.

Although the current analysis is not sufficiently robust to claim the effects of these measures, it can contribute to the ultimate aim of further reducing the external social costs of banana production.

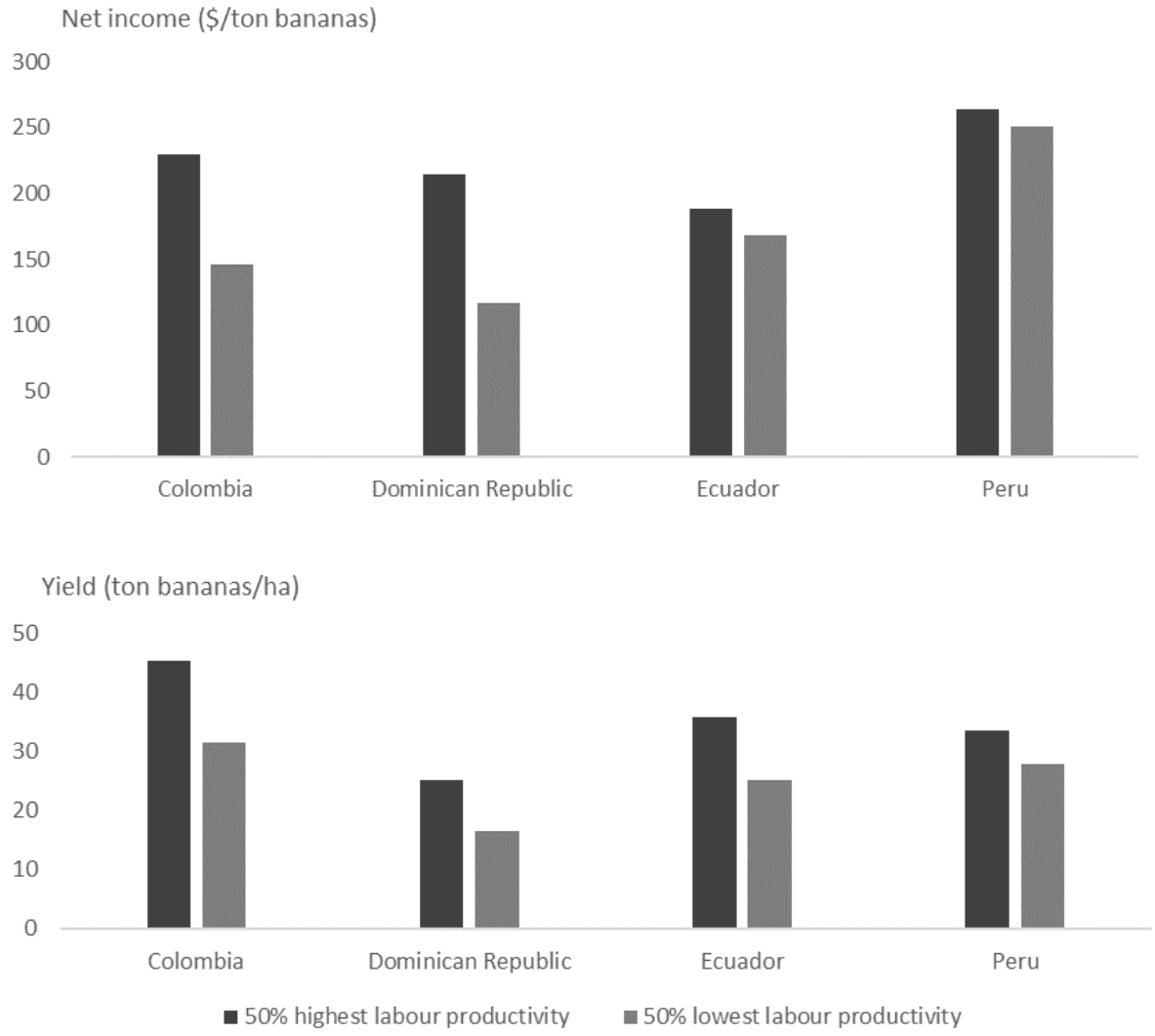


Figure 6: Subgroup analysis of the net income and yield of Fairtrade small producers with the 50% highest and 50% lowest labour productivity (ton bananas/FTE)

Reduce health and safety costs through training and personal protective equipment

Personal protective equipment (PPE) and health and safety training can reduce health and safety issues significantly. The data in this study was insufficiently diverse to be able to draw conclusions about health and safety cost reductions due to the use of PPE or training. This was mainly because almost all producers in the sample use PPE and train their workers, as this is part of the Fairtrade standard. In the future, primary data on agricultural practices of non-Fairtrade producers could be collected to see if there is a correlation between the use of PPE and the reduction of health and safety costs. Based on this it would also be possible to calculate the return on investment (ROI) in PPE or training, and the potential effect on the external cost of health and safety risks for banana producers.

3.3.3 Potential improvements for Fairtrade banana producers

Fairtrade banana producers can reduce their overall external costs through the adoption of better practices in Dominican Republic specifically, and more generally by reducing climate change costs, by targeting future expansion to minimizue land occupation impacts, and by optimizing insights into the use and benefits of the Fairtrade Premium.

Reduce the external cost of Fairtrade banana production in Dominican Republic

The external cost of Fairtrade banana production can be reduced by focusing efforts on production in Dominican Republic, where Fairtrade producers generate the largest external costs. There is potential for improvement by extrapolating best practices of Fairtrade producers in countries with lower external costs, for example the plantations in Colombia. These can inspire best practices around water use and water pollution, as well as financial wages for workers and social security conditions. Naturally, the application of practices in a country will depend highly on the national climatic and macroeconomic context. Additionally, the results show that practice changes regarding water use, water pollution and insufficient wages have large potential to reduce the external costs of Fairtrade producers in Dominican Republic (see Table 7 of Appendix V).

- **Water Use:** Water depletion costs per box of bananas in Dominican Republic for both plantations and small producers are substantially higher than in the other three countries. The subgroup analysis presented in the previous section suggests that it may be possible to reduce water depletion, and external environmental costs overall, without compromising yield by adopting the practices of water efficient producers more broadly. Producers in Peru and Ecuador have substantially lower water depletion costs and could serve as a model for water efficiency interventions for producers from Dominican Republic.
- **Water Pollution:** Water pollution costs are highest among plantations and small producers in the Dominican Republic due to excess fertilisation, both organic and chemical, beyond the requirements of the crop. Better optimising fertilisation regimes in Dominican Republic could aid in reducing water pollution costs while also reducing the financial burden of fertiliser purchases on producers.
- **Insufficient wages and social security:** The costs of insufficient wages could be reduced in various ways. The section below details the interaction between productivity improvements, income and wages.

Reduce the climate change costs of Fairtrade banana producers

Fairtrade can reduce the external costs of climate change by finding the right balance between minimising energy and fertiliser use without reducing productivity through insufficient fertilisation, irrigation, pest management or mechanisation. These types of practices are currently tested and implemented through the Productivity Improvement Program (PIP) of CLAC. Notably, in all countries the impact of indirect N_2O emissions from managed soil is the largest contributor to climate change costs, comprising 55-91% of the total (see Table 8 of Appendix 5). Emissions of N_2O from banana production were estimated in this study based on models defined by the IPCC (2006), taking account of fertiliser application and climatic conditions. Estimated N_2O emissions are therefore a function of the quantity of nitrogen applied to the field and the area of land occupied by the farm. Consequently, the estimated emission of N_2O in this study is linked to yield, with higher yields associated with lower N_2O emission costs per box of bananas. In practice, however, the rate of emission of N_2O may vary due to the specific characteristics of each producer. This rate can be influenced by a range of production practices associated with fertilisation rates, scheduling and methods; tillage, crop rotation and residue management practices; and water management (Sadghpour et al, 2016). Interventions targeting these practices could be the subject of future in-depth studies to reduce the external climate change costs of Fairtrade banana producers.

Reduce land occupation costs caused by the expansion of banana production on high ecosystem service value land

In this study the external costs of land occupation were based on the value of ecosystem services to society foregone due to the displacement of natural landscapes that could otherwise have existed on land occupied by banana producers. Ecosystem service value was assessed at the country level, taking a weighted average of the value of the mix of landscape types within the banana producing regions of each country. This allowed for comparison of the relative cost of land occupation between countries, and comparisons between producers in the absence of consistent (for all producers) and specific (by ecosystem type) data on the mix of ecosystems previously existing on each producer site. Trucost estimates of the average external cost of land occupation vary substantially among ecosystem types, and by extension, among regions within a country where the ecosystem mix is diverse. For example, the value of forest ecosystems ranges from a minimum of $121 per hectare for tropical dry forests, to $1,375 per hectare for tropical woodlands and $2,186 for tropical rainforests. Figure 7 highlights how this variation in land occupation cost by ecosystem type translates into variations in the average external costs per hectare at a provincial level in Ecuador.

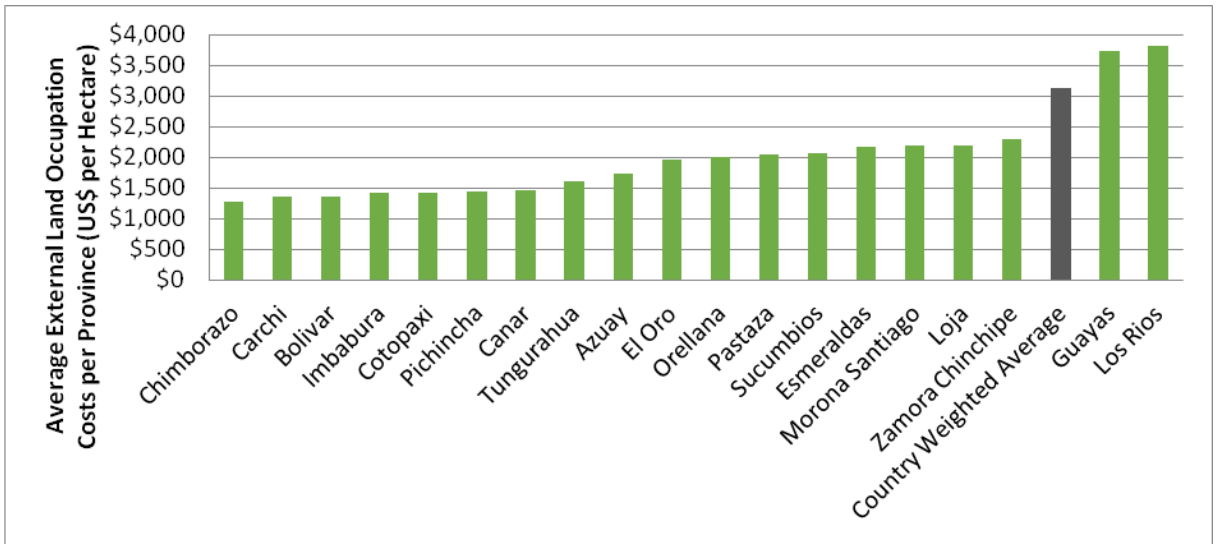


Figure 7 Variation in Average Land Occupation Costs per Province in Ecuador (Source: Trucost Analysis)

As shown, the country weighted average external cost of land occupation is $3,126 per hectare for the banana producing provinces of Los Rios (39%), El Oro (36%) and Guyas (25%) (Government of Ecuador; 2011), but ranges from slightly over $1,000 per hectare in Chimborazo province to almost $4,000 per hectare in Los Rios. Information on the relative external cost of land occupation across local regions within a country, or even between specific sites, could be used to inform the prioritisation of locations for future expansion of banana production into new areas. It may also be possible to use this information to minimise external environmental costs by identifying ecosystem or landscape types on which the expansion of banana production should be discouraged or prohibited. One example would be to discourage the clearing of tropical rainforest to enable the expansion of banana plantations, as this will result in a high land occupation cost. Of course, while not every region of each country will be equally suited to banana production, information on the costs of land occupation in each region could be considered as a factor in future expansion decisions.

Reduce the costs of insufficient wages and income through the Fairtrade Premium

Enhanced insight into the use of, and benefits generated by, the Fairtrade Premium can help to further understand the external social costs of Fairtrade banana producers.

One way in which the Premium may lead to the reduction of social external costs is by using it as a form of in-kind wage. The types of in-kind wage generated by the Fairtrade Premium include the value of benefits given to producers, hired workers and their families. For workers, these benefits include housing, education and healthcare. In this way, the wage gaps which drive the external costs of insufficient wages for hired workers can be reduced, as is the case in Colombia (refer to Figure 8, below). This is a direct and effective way to use the Premium in the short term.

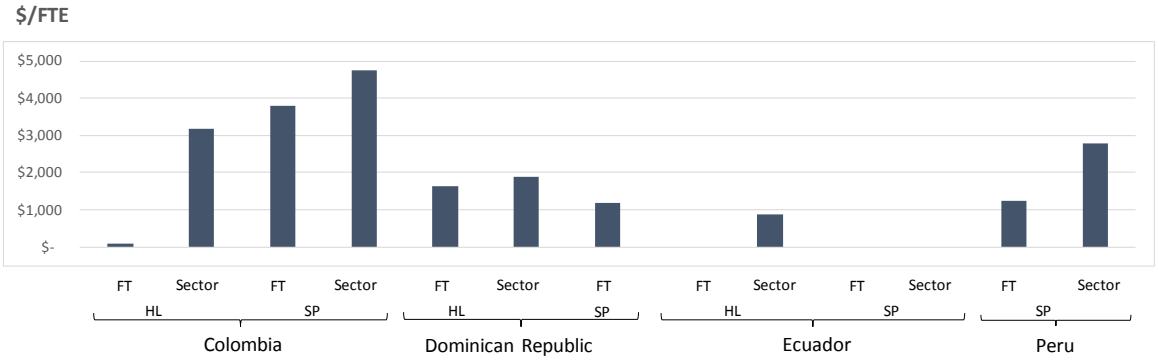


Figure 8 Wage gaps for hired workers in plantations (HL) and small producers (SP) ($/FTE/year), representing the gap between an annual living wage and an annual average wage

Another way in which the Premium can benefit producer household members is through initiatives that, in the short term, support household income (through access to education, health, certification and administrative benefits). In the long term, Premium income can be used for investments in productivity and labour efficiency. This would allow producers and workers to increase wages and income from banana sales over time and reduce their dependency on complementary Premium income for achieving the Living Wage and Income benchmarks.

Based on the current data, it appears that the Premium for workers in Colombia and Ecuador is mainly diverted to education and health benefits for workers, with around 30 to 35 $/FTE per year spent by small producers and around 355 to 420 $/FTE per year spent at plantations. As for direct benefits for the small producers, the Premium seems mainly targeted at productivity investments, ranging from 95 $/ha per year in Ecuador to 225 $/ha per year in Colombia. Investing the Premium in productivity interventions can result in higher production, revenues and net farm income, which in turn can be used to structurally increase household income and the wages of workers.

If future studies can record the value of in-kind benefits received from the Fairtrade Premium and provide more granular information on the types of benefits, it will be possible to assess even better under which conditions workers and producers receive better incomes through the investment of the Premium. With the right longitudinal data, the effectiveness of income investments can be assessed.

These findings can feed into Fairtrade's Wage Improvement project. By combining the living income and wages produced in this study with the actual wage and income data, the value of the benefits needed to close the gap for workers and producers, as well as the countries where this is most required, can be identified.

4. Discussion

The analysis of the external environmental and social costs of banana production by Fairtrade producers and the sector benchmark in the four countries generates interesting results that can be used to support the transition to a sustainable banana sector. The analysis can help the sector to take strategic decisions on sustainable production practices, by prioritizing interventions on material impacts, by adopting practices from sustainable producers, and by balancing trade-offs between and within economic, social and environmental impacts. Additionally, the study helps Fairtrade to further reduce its own external costs of banana production by comparing practices across countries and improving communication on the external costs of banana production. However, it is important to understand that the robustness of the results is linked to the key assumptions and limitations of the current study. Consequently, the results should be interpreted with care, and future research is required to refine the results and answer additional questions.

4.1. Key assumptions

When interpreting the results, it is important to consider the following key assumptions regarding the data on Fairtrade producers and the sector benchmark.

Firstly, some Fairtrade plantations did not report yield data. In those cases, an average of the per hectare yield of remaining plantations was used as a proxy. This affects the interpretation of the total results, which are expressed per box of bananas, and it can mean that specific plantations may have higher or lower than average yields, thereby reducing or increasing overall external costs. Also, using the average yield limits potential conclusions on the link between productivity and external costs, as there are differences among plantations on the relation between total production and key indicators such as the number of workers and financial wages.

Secondly, for some primary data it was difficult to interpret whether questions without a response reflected a data gap or a 'zero' value, for example paid overtime. As indicated in section 2.5, a conservative approach was taken to the benefits of Fairtrade certification, with the potential effect that filling data gaps with averages may overestimate the external costs of Fairtrade producers.

Thirdly, small producers were assumed to have no instances of forced labour or harassment, and no hired workers for supply chain phases other than cultivation. This means that the social external costs of small producers could be underestimated, which affects their comparability with plantations.

Fourthly, data for water and organic waste (crop residue) was reported inconsistently, as producers were asked about these indicators for the first time and they are relatively difficult to obtain or estimate. Therefore, water and crop residue quantities were estimated based on banana yield when not reported by the respondent. This might affect the reliability of the external cost of waste. It is recommended to include questions on these indicators in future studies to improve robustness.

Fifthly, where not reported by the survey respondents, the concentration and density of active ingredients in chemical pesticides was estimated based on a literature review. This could imply either an overestimation or an underestimation of the costs of air pollutants and climate change.

Sixthly, the information on harassment, forced labour and child labour was only collected from direct questions to adults aged over 18, workers in HL (no workers in SPOs) and to farmers and management in SPOs and HL. However, this did not consider the information collected on child and forced labour through the Fairtrade Protection Policy process, from children, and from workers in SPOs. Therefore, the data reported on these indicators did not consider information collected

through other source inputs which could affect the findings on these indicators. For detailed assumptions of the study, refer to Appendix 9.

4.2. Key limitations

There are three key limitations to the current study in terms of data quality, scope and reliability of results.

Firstly, the study did not include primary data on non-Fairtrade producers, limiting the comparability between external costs of the sector average and Fairtrade. The study used secondary sources which in many cases did not report explicit differences in data between certified and non-certified producers.

Secondly, the scope of the external costs analysis differed between producer types and countries. In Peru, packing and some cultivation activities are not done by the producer but by the SPO, and thus the Peru data is not fully comparable with that of the other countries. In addition, the cost of harassment and a lack of protective equipment for employees was out of scope for Fairtrade small producers, since hired workers in small farms could not be interviewed. This limits comparability across countries and producer types, and using the results should be done with care when prioritizing Fairtrade programmes and capacity building activities.

Thirdly, due to the nature of the data and the research methodology, there are certain limitations to the reliability of the results. The relatively small samples of Fairtrade producers - only two plantations in Ecuador were included, for example - affects the representativeness of results. In addition, the yields found for small producers are in the range of values found in the literature but arguably on the high end, which could be due to a higher response rate among more professional small producers. Also, the quality of primary data on certain impacts was limited due to low response rates or misinterpreted questions.

One challenge is to obtain reliable data for the intensity of labour. Producers, and especially small producers, do not always account in detail for the hours worked, and often data is collected per number of workers and not hours. Next to that, the data on the social and environmental costs for the sector benchmark was limited, partly because of the innovativeness of external cost analyses. That is, there was no distinction between the environmental costs of the sector benchmark for small producers and plantations in Peru and Ecuador, due to lack of specific secondary data. In addition, no data was available for the sector benchmark for banana smallholder production in Dominican Republic, which was then limited to plantations only. Consequently, it is not possible to perform a statistical test on the differences in the external cost between Fairtrade banana production and the sector benchmark (see section 4.1). At the same time, this difference is most likely underestimated.

Another limitation concerns the aforementioned assumptions made, and access to information on, issues related to child and forced labour, including sexual harassment.

In conclusion, when interpreting the results, it is important to keep in mind that there are limitations with respect to data quality, scope and reliability due to data availability. This reduces the robustness and comparability of some of the findings, therefore it is recommendable to interpret them carefully. See Appendix 10 for an overview of detailed limitations to this study.

4.3. Sensitivity analyses

There are two limitations for which it is worth quantifying their relevance on the results. This allows to assess whether conclusions could be compromised by these limitations.

Firstly, the results for the small producers in Peru exclude packing and cultivation work undertaken by the small producer organizations (SPOs). The data collected in this study only covers labour hired directly by the producers and in Peru it is common that producers outsource (field and processing) to Small Producer Organizations (SPOs). The study estimated the external costs including this additional packing and cultivation work based on data from a sample of six SPOs, provided by Fairtrade International. Although the sample had a smaller size and was less complete than the other data used in the study, it enabled an estimate of the total external costs for production and cultivation in Peru. The dataset used for the outsourced labour contains wages, working hours, labour intensity per hectare, maternity leave and paid annual leave of six SPOs in Peru. It contains average values per SPO.

Including the outsourced labour slightly increases the social costs of discrimination and occupational health & safety risks, and substantially increases the costs of insufficient wages and social security. Other impacts are not affected (See Table 3 below for an overview of the results). Note that including outsourced labour does not change the conclusions. For the benchmarks, the external costs of banana production in Peru is still the lowest of all systems and countries. Among Fairtrade small producers, the external costs of banana production remain smallest in Peru.

External costs Peru	Without outsourced labour		With outsourced labour	
Impact category	Fairtrade SP	Benchmark SP	Fairtrade SP	Benchmark SP
Discrimination	$0.00	$0.00	$0.00	$0.01
Occupational H&S risks	$0.02	$0.35	$0.03	$0.46
Insufficient wages and social security	$0.02	$0.03	$0.47	$0.59
Total social	$0.80	$1.28	$1.25	$1.96
Total environmental	$1.96	$2.66	$1.96	$2.66
Total	**$2.76**	**$3.94**	**$3.21**	**$4.62**

Table 3 - External costs (in $/box banana) for small producers in Peru excluding outsourced labour (as in the rest of this report) and including it. Values that are affected are highlighted in grey. SP=small producers

The second limitation for which a sensitivity analysis was conducted concerned the labour intensity of small producers in Dominican Republic and Ecuador. In these countries, the values obtained from primary data collection were lower than those for plantations, which is different from what several experts would have expected. It is difficult to verify these data points, as there is very little data on FTE/ha for these countries. Combining the data of Fairtrade International on workers/ha with expert opinion, estimates have been made of FTE/ha for these countries and the results using these alternative estimates have been computed. The table below shows that the external costs under these assumptions reduces the gap between the external costs of small producers and plantations. The overall conclusions remain unchanged. Given the absence of other reliable datasets on FTE/ha, a final verdict is difficult. This sensitivity analysis shows that caution should be exercised when comparing small producers and plantations, but that the conclusions of the report would also hold if labour intensities were closer to prior expectation.

	Values report							Values sensitivity analysis						
	Dominican Republic			Ecuador				Dominican Republic			Ecuador			
	Fairtrade HL	Fairtrade SP	Benchmark HL	Fairtrade HL	Fairtrade SP	Benchmark HL	Benchmark SP	Fairtrade HL	Fairtrade SP	Benchmark HL	Fairtrade HL	Fairtrade SP	Benchmark HL	Benchmark SP
Discrimination	-	0.03	0.04	0.02	0.02	0.03	0.05	-	0.05	0.04	0.02	0.04	0.03	0.08
Occupational H&S risks	0.13	0.10	0.81	0.10	0.01	0.99	0.57	0.14	0.15	0.92	0.10	0.02	0.99	0.89
Overtime	0.21	0.17	0.31	0.04	0.13	0.18	0.12	0.24	0.26	0.35	0.04	0.20	0.18	0.19
Insufficient wages and social security	3.36	1.80	3.90	0.10	0.42	1.66	0.43	3.79	2.86	4.40	0.10	0.66	1.66	0.67
Total social	**3.74**	**2.97**	**6.96**	**0.25**	**1.06**	**4.69**	**2.70**	**4.22**	**4.20**	**7.61**	**0.25**	**1.39**	**4.69**	**3.35**
Total environmental	**5.08**	**3.30**	**4.64**	**3.34**	**3.05**	**2.96**	**2.70**	**5.08**	**3.30**	**4.64**	**3.34**	**3.05**	**2.96**	**2.70**
External costs	**8.83**	**6.28**	**11.59**	**3.59**	**4.11**	**7.65**	**5.40**	**9.30**	**7.51**	**12.24**	**3.59**	**4.44**	**7.65**	**6.06**

Table 4 - External costs (in $/box banana) for Dominican Republic and Ecuador for the values in this report and the values of the sensitivity analysis. SP=small producers. The average labour intensity collected in this study is 1.33 FTE/ha for Dominican Republic HL, 1.13 FTE/ha for Dominican Republic SP, 1.16 FTE/Ha for Ecuador HL and 0.94 FTE/ha for Ecuador SP. The estimated values used in the sensitivity analysis are 1.5 FTE/ha for Dominican Republic HL, 1.6 FTE/ha for Dominican Republic SP, 1.16 FTE/ha for Ecuador HL and 1.25 FTE/ha for Ecuador SPO.

4.4. Interpretation of results

Based on the assumptions and limitations, the results corresponding to the three research questions can be interpreted with care.

Regarding research question 1, the results provide a robust indication about the size, proportionality and materiality of the external costs of sector benchmark banana production. Despite limitations in data quality for the sector benchmark, this finding is supported by the fact that materiality is similar within the external environmental and social costs for Fairtrade producers. At the same time, it is important to keep in mind that although on average the material costs are similar, there are differences across countries and producer types. For example, overtime and water consumption were large drivers of total external costs only in Dominican Republic. Also, given that some costs and producer types in certain countries were out of scope, comparability and generalization of findings are limited.

As for research question 2, the results show a substantial difference between the external costs of the sector benchmark producers and Fairtrade producers. It is not possible to establish a statistically significant difference between Fairtrade and non-Fairtrade production with the current methodology. In addition, care should be taken in drawing very specific conclusions from the data. Still, regarding the overall difference across the four countries included in this research, the data provides sufficient evidence to reasonably conclude that Fairtrade production is most likely different from the sector benchmark.

Regarding research question 3, the results helped to identify opportunities that the banana sector and Fairtrade can take to develop a more sustainable banana sector. It is important to keep in mind, however, that the underlying analyses of these improvements are often based on relatively small samples, which limits the extent to which robust conclusions can be drawn on the actual effects of the improvements. Additionally, the analyses were merely applied to Fairtrade producers, which limits the extrapolation of findings to the sector benchmark.

4.5. Future research

Fairtrade has made a first attempt to assess the external costs of the banana sector and has paved the way for the sector to take further steps towards transparency and external cost reduction. Based on the interpretation of the results, as well as the application potential of the current study, three key areas for future research in the banana sector can be identified:

1. Establishing a robust sector benchmark: A study on the external costs of the banana sector based on primary data, covering all major producing banana countries and producer types would provide a robust benchmark (or set of benchmarks) for the external costs of banana against which all producers could be compared. Such a study could help improve strategic priority setting and tailor interventions to specific impacts in specific countries. At the same time, it can provide insight into statistically significant differences between sector average and certified producers. This can be used for assessing progress on sustainable production.
2. Understanding best practice: An analysis of best practices by small and large banana producers and effects on productivity and profitability can help inform the design of capacity building and support programmes to raise the sustainability performance of producers.
3. Scaling sustainable intervention analysis: A study to assess the effect of sustainable production interventions while monitoring the external cost of the sector benchmark and increasing the sample size of the populations under study. This will lead to a more robust understanding of external cost improvements.

Together, these studies can support strategic prioritization, investment decisions and communication, and help shape a roadmap towards a sustainable banana sector by 2030.

5. Conclusion and recommendations for the sector

The results of this study show there is significant potential for the banana sector to transition to a more sustainable model of production and to reduce its social and environmental external costs. Furthermore, the results for Fairtrade producers show that it is possible to produce bananas with lower environmental and, particularly, social external costs. To this end, Fairtrade represents a possible model for a more sustainable banana sector globally.

Fairtrade banana production is not without external costs, and opportunities exist to further improve the sustainability of Fairtrade producers. Significantly, the results highlight that subgroups of producers in each country show superior environmental and social performance compared to their peers and may serve as role models for best practice. Understanding the practices and processes that underpin this superior performance can help to enhance the standard setting and capacity building initiatives of Fairtrade and its partners.

The following plan is proposed to facilitate the transition to a more sustainable banana sector with greater transparency and reduced external costs:

1. Periodically establish sector benchmarks per country, facilitating informed policy decisions and enabling individual organizations to benchmark their sustainability performance. This would also provide a trusted source to address data gaps in future external costs studies.
2. Identify opportunities for collaboration to improve external costs across the banana sector, for example, based on the most material external costs of land occupation, climate change and insufficient income.
3. Form working groups with key stakeholders around specific external costs to define common goals and improvement programmes, preferably in existing pre-competitive platforms and governance structures.
4. Conduct research on how to reduce the external costs of the banana sector while simultaneously increasing benefits for producers and their livelihoods.
5. Implement improvement programmes based on the findings to reduce the external costs of banana production.
6. Measure the effect of improvements on the social and environmental costs, by comparing external costs before and after implementation of the programmes.

With the above plan, the banana sector can also contribute to achieving the Sustainable Development Goals (SDGs), which took effect on January 1, 2016 and form a global agenda for action to achieve sustainable development by 2030. The sector can draw inspiration for this from Fairtrade, which has directly linked its mission to the SDGs through the overarching Goal 1 to end poverty. Fairtrade addresses various goals with its strategy, such as ending hunger (SDG 2), promoting decent work (SDG 8), ensuring sustainable consumption and production (SDG 12), and combating climate change (SDG 13). Specifically, the results of the plan in terms of transparency and external costs can help shape the roadmap towards a sustainable banana sector by 2030. Such a roadmap could start with defining a vision of a sustainable banana sector and translate into an action plan and goals to address the material external costs of land occupation (SDG 15), climate change (SDG 13), and insufficient income (SDG 1&8). Essential for the success of achieving the roadmap is to measure the impact of banana production and assess progress towards achieving the SDGs. In this way, the banana sector can show global leadership towards achieving the SDGs and form a model for other sectors that can contribute to sustainable development.

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7. Appendices

Appendix 1. External cost definitions

Table 5 Social cost definitions

SOCIAL COSTS	
Insufficient income	The cost of compensating producers that earn below a living income
Insufficient wages and social security	The cost of compensating hired workers that earn below a living income
Child labour	The social, health and economic cost of underage work
Forced labour	The social, health and economic cost of forced labour
Harassment	The health and economic cost of workplace bullying and sexual harassment
Occupational H&S risks	The health and economic cost of injuries and lacking prevention measures
Overtime	The cost of compensating hired workers for insufficiently paid overtime
Discrimination	The cost of compensating women for wage discrimination and no maternity leave

Table 6 Environmental cost definitions

ENVIRONMENTAL COSTS	
Water pollution	Health and ecosystem impacts, and economic costs of additional water treatment, associated with increased nutrient run-off into freshwater lakes and rivers
Climate change	The discounted future cost of impacts to health, agriculture and the economy due to the effects of climate change caused by greenhouse gas emissions
Air pollutants	The value of human health effects due to exposure to air pollutants
Land pollution	The value of ecosystem services and human health lost due exposure to toxic chemical and metals applied to land
Land occupation	The value of ecosystem services foregone through the displacement of natural ecosystems with alternative land uses
Waste	The value of impacts in all other categories associated with the disposal of wastes
Water depletion	The value of lost freshwater ecosystem services, water treatment costs and human health impacts due to the pollution of freshwater with nitrogen and phosphorus

Appendix 2. Detailed sampling results

Table 7 Impacts in scope for small producers, hired labour and hired workers that were surveyed

IMPACTS COVERED IN SURVEY	SMALL PRODUCERS	HIRED LABOUR	HIRED WORKERS IN PLANTATIONS
Environmental	X	X	NA
Child labour	X	-	X
Forced labour	-	-	X
Gender	X	X	X
Harassment	-	-	X
Overtime	X	-	X
Hired worker income	X	X	X
Farmer income	X	NA	NA
OHS	X	X	X

Note: environmental impacts covered in the survey were the same across the three samples.

Appendix 3. Quantification and monetization of external costs

Below follows an explanation of the quantification and monetization of environmental and social costs per external cost indicator.

- **Climate change** contributions are measured as the emission of greenhouse gases from energy use, emission of nitrous oxide (N_2O) from chemical and organic fertiliser use, and N_2O emissions due to natural land conversion to agricultural production. Costing consists of the discounted future cost of impacts to health, agriculture, and the economy due to the effects of climate change caused by greenhouse gas emissions.
- **Land occupation** is measured as the area of natural ecosystems that is displaced by agricultural land. Costing consists of the value of ecosystem services foregone through the displacement of natural ecosystems with alternative land uses.
- **Water depletion** is measured by the total input of freshwater per hectare from groundwater and surface water sources. Costing consists of the value of impairments to human health due to restricted water access for food production and sanitation, and the loss of ecosystem services due to water deprivation in natural ecosystems.
- **Land pollution** quantifies the application of active ingredients contained within chemical and organic fertilisers that are harmful to human and ecosystem health. Costing consists of the value of ecosystem services and human health lost due to exposure to toxic chemical and metal pollutants on land.
- **Water pollution** measures excess nitrogen and phosphorus in the form or chemical or organic fertilisers. Costings covers the value of lost freshwater ecosystem services, water treatment costs and human health impacts due to the pollution of freshwater with nitrogen and phosphorus.
- **Air pollution** quantifies the emissions of harmful air pollutants from fertiliser and energy use, such as Particulate Matter (PM_{10}), Nitrogen Oxides (NO_x), Sulphur Dioxide (SO_2), Ammonia (NH_3), and Non-Methane Volatile Organic Compounds (NMVOC). Costing consists of the value of human health impacts due to exposure to air pollutants.
- **Waste** is measured by the total amount of organic and non-organic waste generated and disposed by banana production. Costing covers the value of impacts in all other categories associated with the disposal of wastes.
- **Insufficient income, insufficient wages** and **social security** are measured by comparing the actual net income of small producers, and the wages and social security benefits received by workers, to a living wage. For a detailed explanation of the living wages refer to Appendix 7.
- **Child labour** is measured per child below the age of 12, 15 or 18, depending on whether the work is hazardous and/or physically intensive. Costing of child labour consists of costs for education, future income losses, and programmes to prevent child labour in the future.
- **Harassment** is measured per worker that has experienced physical, non-physical, sexual and/or non-sexual harassment. The costs include wages lost due to absenteeism, medical costs of mental health issues, costs of wellbeing loss due to mental health issues, and prevention costs.
- **Occupational health and safety** is measured per fatal or non-fatal occupational incident and per FTE that works without training, without personal protective equipment, or in an unsafe or unhealthy environment. The costing includes all medical costs not covered by an employer, costs of wellbeing loss due to incidents, and costs for prevention measures.
- **Overtime** is measured per FTE that works more than the legally allowed overtime hours, or that receives insufficient income for overtime hours. Costing includes lost income and interest.
- **Discrimination** refers to gender discrimination and is measured per FTE of female workers that receive no maternity leave or a lower income than male workers for the same occupational level. The costing consists of the wage gap including interest.

Appendix 4. Overview of external costs per producer type

Table 8: External costs ($ per box of banana) - all countries

Fairtrade	**Colombia**	**Dominican Republic**	**Ecuador**	**Peru**	**Production Weighted Average**
Environmental costs - HL	$1.31	$5.08	$3.34	NA	$2.19
Environmental costs - SP	$1.58	$3.30	$3.05	$1.95	$2.84
Share of environmental in Total External Costs	79%	57%	75%	71%	71%
Social costs - HL	$0.16	$3.74	$0.25	NA	$0.90
Social Costs - SP	$2.65	$2.97	$1.06	$0.80	$1.14
Share of social in Total External Costs	21%	43%	25%	29%	29%
Sector benchmark	**Colombia**	**Dominican Republic**	**Ecuador**	**Peru**	**Production Weighted Average**
Environmental costs - HL	$1.63	$4.64	$2.96	NA	$2.76
Environmental costs - SP	$1.70	NA	$2.70	$2.66	$2.44
Share of environmental in Total External Costs	31%	40%	49%	68%	40%
Social costs - HL	$3.50	$6.96	$4.69	NA	$4.57
Social costs - SP	$4.67	NA	$2.70	$1.28	$3.19
Share of social in Total External Costs	69%	60%	51%	32%	60%

Appendix 5. Key indicators of environmental external costs

		Colombia				Dominican Republic			Ecuador				Peru	
External Cost	**Biophysical Indicator**	**Fairtrade SP**	**Fairtrade HL**	**Benchmark HL**	**Benchmark SP**	**Fairtrade SP**	**Fairtrade HL**	**Benchmark HL**	**Fairtrade SP**	**Fairtrade HL**	**Benchmark HL**	**Benchmark SP**	**Fairtrade SP**	**Benchmark HL**
Climate Change	Electricity Consumption (kWh/Hectare)	1,502.4	337.5	NA	NA	0.0	27.2	2.5	47.5	2,986.7	9.8	9.8	0.0	9.8
	Gasoline Consumption (L/Hectare)	41.5	4.1	NA	NA	39.4	72.5	1.7	134.8	448.0	NA	NA	2.6	6.8
	Diesel Consumption (L/Hectare)	467.3	109.8	97.0	97.0	758.4	1,200.4	64.4	548.4	157.5	108.2	108.2	35.5	74.9
	Natural Gas Consumption (m3/Hectare)	2.0	0.0	NA	NA	0.0	0.0	NA	1.0	No Data	0.0	0.0	0.0	No Data
	LPG Consumption (L/Hectare)	NA	0.0	NA	NA	NA	3.5	NA	NA	NA	0.0	0.0	NA	No Data
	LPG Consumption (L/Hectare)	1.2	NA	NA	NA	NA	NA	NA	NA	NA	0.0	0.0	NA	No Data
Water	Water use (m3/Hectare)	15,932.6	17,600.6	8,610.3	8,610.3	33,403.2	65,791.9	65,791.9	9,971.4	8,500.0	9,308.0	9,308.0	17,606.4	21,711.1
Land Use	Yield (Box/Hectare)	2,381.5	2,631.5	1,974.7	1,909.4	1,433.9	1,535.9	1,626.9	1,816.4	1,818.6	1,712.2	1,872.9	1,983.6	1,928.9
Water Pollution	Nitrogen Application (Kg N/Hectare)	482.4	142.8	374.7	374.7	107.2	129.0	207.3	226.7	103.0	266.7	266.7	141.3	140.0
	Phosphorus Application (Kg P/Hectare)	15.3	22.3	39.2	39.2	25.0	23.7	35.8	12.0	7.0	1.4	1.4	102.1	210.0
Waste	Inorganic Waste (Kg/Hectare)	295.0	67.1	3,318.9	3,318.9	83.4	54.4	1,108.0	40.5	No Data	1,251.6	1,251.6	1,399.1	1,384.4

Table 9: Key indicators of most material environmental impacts

Table8: External climate change costs per country and producer type ($ per box of bananas)

	Colombia				Dominican Republic			Ecuador				Peru	
	Fairtrade HL	Fairtrade SP	Benchmark HL	Benchmark SP	Fairtrade HL	Fairtrade SP	Benchmark HL	Fairtrade HL	Fairtrade SP	Benchmark HL	Benchmark SP	Fairtrade SP	Benchmark SP
Climate Change ($/Box)	$0.38	$0.69	$0.62	$0.64	$0.96	$0.79	$0.70	$0.93	$0.79	$0.68	$0.62	$0.58	$0.56
from Energy	$0.02 (5%)	$0.11 (15%)	$0.02 (3%)	$0.02 (3%)	$0.19 (20%)	$0.17 ($21%)	$0.02 (3%)	$0.25 (27%)	$0.14 (17%)	$0.03 (4%)	$0.02 (4%)	$0.01 (1%)	$0.01 (3%)
from Fertiliser	$0.03 ($7%)	$0.14 (21%)	$0.11 (18%)	$0.12 (18%)	$0.07 (7%)	$0.19 (24%)	$0.08 ($12%)	$0.04 (4%)	$0.10 (12%)	$0.09 (13%)	0.08 (13%	$0.05 (8%)	$0.04 (8%)
from Managed Soil	$0.34 (88%)	$0.44 (64%)	$0.49 (79%)	$0.50 (79%)	$0.70 (73%)	$0.43 (55%)	$0.59 (85%)	$0.64 (69%)	$0.56 (70%)	$0.56 (83%)	$0.51 (83%)	$0.53 (91%)	$0.50 (90%)

Table 9 External land occupation costs per country and producer type ($ per box of bananas)

	Colombia				Dominican Republic			Ecuador				Peru	
	Fairtrade HL	Fairtrade SP	Benchmark HL	Benchmark SP	Fairtrade HL	Fairtrade SP	Benchmark HL	Fairtrade HL	Fairtrade SP	Benchmark HL	Benchmark SP	Fairtrade SP	Benchmark SP
Land Occupation ($/Box)	$0.63	$0.65	$0.71	$0.73	$0.49	$0.63	$0.45	$2.07	$1.85	$1.83	$1.67	$0.94	$0.89
Average Yield (Box/Ha)	2,381.5	2,631.5	1,974.7	1,909.4	1,433.9	1,535.9	1,626.9	1,818.6	1,816.4	1,712.2	1,872.9	1,983.6	1,928.9
Land Valuation ($/Ha)	$1,395				$727			$3,126				$1,711	

Table 10 External water depletion costs per country and producer type ($ per box of bananas)

	Colombia				**Dominican Republic**			**Ecuador**				**Peru**	
	Fairtrade HL	**Fairtrade SP**	**Benchmark HL**	**Benchmark SP**	**Fairtrade HL**	**Fairtrade SP**	**Benchmark HL**	**Fairtrade HL**	**Fairtrade SP**	**Benchmark HL**	**Benchmark SP**	**Fairtrade SP**	**Benchmark SP**
Water Depletion ($/Box)	$0.11	$0.16	$0.08	$0.08	$2.97	$1.27	$2.84	$0.28	$0.34	$0.27	$0.25	$0.38	$0.41
Water Input (m^3/Box)	6.7	6.7	4.4	4.5	23.3	42.8	40.4	4.7	5.5	5.4	5.0	8.9	11.3
Average Yield (Box/Ha)	2,381.5	2,631.5	1,974.7	1,909.4	1,433.9	1,535.9	1,626.9	1,818.6	1,816.4	1,712.2	1,872.9	1,983.6	1,928.9
Water Valuation ($/$m^3$)	$0.02				$0.07			$0.05				$0.04	

Appendix 6. Key indicators of social external costs

Table11: Key indicators of most material social impacts

Impact	Indicator	Colombia				Dominican Republic		
		Fairtrade SP	Fairtrade HL	Benchmark SP	Benchmark P	Fairtrade SP	Fairtrade HL	Benchmark HL
General	Total labour intensity (FTE/ha)	1.00	0.70	1.00	0.70	1.13	1.33	1.33
	Hired workers (%)	45%	100%	45%	100%	71%	100%	100%
	Family workers (%)	55%	0%	55%	0%	29%	0%	0%
	% permanent workers	46%	100%	46%	100%	64%	100%	100%
	% temporary workers	4%	0%	4%	0%	8%	0%	0%
	% non-contracted workers	50%	0%	45%	0%	28%	0%	0%
	Living income ($/FTE)	7861	7861	7861	7861	4950	4950	4950
Harassment	% FTEs that is verbally harassed	NA	0%	0%	13%	NA	0%	13%
	% FTEs that is physically harassed	NA	0%	0%	1%	NA	0%	1%
Insufficient income	Farmer income ($/FTE)	27,145	NA	23,027	NA	20,392	NA	NA
Occupational H&S risk	% workers without training	1%	0%	1%	0%	1%	0%	0%
	% workers working without PPE	0%	0%	3%	0%	1%	0%	0%
	Non-fatal incidents/FTE	0.24	0.10	0.12	0.10	0.09	0.06	0.06
	% workers entering the field within 4 hrs after aerial spraying	0%	0%	0%	0%	0%	15%	15%
Overtime	% workers working underpaid overtime	0%	84%	0%	22%	31%	57%	22%
	Average hours of overtime (hours/FTE)	0	40	0	350	62	112	112
Discrimination	% women without maternity leave benefits	0%	0%	0%	0%	0%	0%	0%
Insufficient wages	Financial wage hired workers excl. social security ($/FTE)	3677	5390	2875	3300	2436	3221	2016
	Financial wage hired workers incl. social security ($/FTE)	3974	6632	3060	4279	2723	3450	2071
	In-kind wage hired workers ($/FTE)	67	939	21	575	1,057	897	1,006
	% workers without paid sick leave	61%	15%	61%	8%	44%	49%	67%
	% workers without annual leave	52%	0%	62%	0%	20%	18%	0%
	% workers without employer paid social security	62%	0%	62%	0%	62%	36%	92%

Impact	Indicator	Ecuador				Peru	
		Fairtrade SP	Fairtrade HL	Benchmark SP	Benchmark HL	Fairtrade SP	Benchmark SP
General	Total labour intensity (FTE/ha)	0.94	1.16	0.94	1.16	0.75	0.75
	Hired workers (%)	59%	100%	59%	100%	0%	0%
	Family workers (%)	41%	0%	41%	0%	100%	100%
	% permanent workers	56%	100%	56%	100%	0%	0%
	% temporary workers	1%	0%	1%	0%	0%	0%
	% non-contracted workers	43%	0%	43%	0%	100%	100%
	Living income ($/FTE)	6,079	6,079	6,079	6,079	5,650	5,650
Harassment	% FTEs that is verbally harassed	NA	0%	0%	13%	NA	0%
	% FTEs that is physically harassed	NA	0%	0%	1%	NA	0%
Insufficient income	Farmer income ($/FTE)	16311	NA	5135	NA	11802	8324
Occupational H&S risk	% workers without training	0%	0%	4%	4%	0%	0%
	% workers working without PPE	0%	0%	2%	2%	0%	0%
	Non-fatal incidents/FTE	0.02	0.07	0.01	0.07	0.06	0.03
	% workers entering the field within 4 hrs after aerial spraying	0%	0%	0%	0%	0%	0%
Overtime	% workers working underpaid overtime	11%	77%	33%	48%	0%	0%
	Average hours of overtime (hours/FTE)	52	103	52	350	0	364
Discrimination	% women without maternity leave	0%	0%	0%	0%	0%	0%

	benefits						
Insufficient wages	Financial wage hired workers excl. social security ($/FTE)	6,567	5,246	6,567	4,143	4,404	2,867
	Financial wage hired workers incl. social security ($/FTE)	6,960	5,865	6,960	4,804	4,404	2,867
	In-kind wage hired workers ($/FTE)	607	1,018	358	1,018	0	0
	% workers without paid sick leave	36%	10%	36%	10%	NA	NA
	% workers without annual leave	100%	10%	100%	100%	NA	NA
	% workers without employer paid social security	38%	0%	38%	0%	NA	NA

Appendix 7. Living wage and living income

For each country, insufficient wages and social security and insufficient income impacts were determined by comparing actual income to a living income. A living income is defined as an income that provides a decent living to an average household.

A living wage is a specific type of living income that applies specifically to people working as employees. The living wage in a given country can be different from the living income, if, for example, some taxation (income tax for the living wage and profit tax for the living income) or social security arrangements are different for subordinate employment as opposed to self-employment. Note that in this study, the living income and living wage are defined in a holistic way, so that they are the same amount. The sources of income may differ – such as when self-employed people get the profits from their farm, while workers get salaries and government pensions – but the basic needs are the same for both groups. The assumption is that the effective tax rate for both groups is the same.

Estimations of a living income include:

(i) a basic living basket, comprising food, housing, clothing, transportation, ICT and healthcare costs
(ii) additional living costs to determine the net living basket, comprising education and savings costs
(iii) social security and tax expenses to determine gross living income.

The total living income is calculated for a full-time equivalent (FTE), based on the average number of persons per household that are part of the labour force in a country. An FTE is determined by the total hours of a person working every day in every week in a year, minus the public and paid holidays specified by law.

The living income method used builds upon the living wage method of Anker & Anker (2013), to enable determination of a living income based on national statistics instead of primary data; this is a benefit in cases where availability of primary data is limited. In addition, the method can be applied to determine a living income for self-employed people. The method takes a different approach for calculating the social security needs of individuals. Where Anker & Anker calculate the amount of social security expenses based on the social security tax paid to the state by employees, here the *actual* future income needs in case of retirement, unemployment and sickness are estimated, such that these needs will also be covered in the living income of self-employed people. Table 12 (below) provides an overview of the living wages for the four countries, which are used to measure the cost of insufficient wages and income.

Table 12: Living income in Colombia, Dominican Republic, Ecuador and Peru

		Living wage			
Items	**Unit**	**Colombia**	**Dominican Republic**	**Ecuador**	**Peru**
Food per household	USD p. hh	3281	2671	2699	2128
Housing per household	USD p. hh	3611	973	1912	3163
Clothing per household	USD p. hh	352	661	740	515
Transportation per household	USD p. hh	911	858	1415	1236
ICT per household	USD p. hh	284	235	462	237
Healthcare per household	USD p. hh	567	494	732	639
Basic living basket - household	USD p. hh	9006	5892	7960	7916
Education per household	USD p. hh	1315	118	322	149
Capacity building per household	USD p. hh	104	70	92	92
Savings/unforeseen expenses	USD p. hh	450	295	398	396
Net Living basket per household	USD p. hh	10875	6375	8772	8553
Household income from pensions	USD p. hh	-442	-283	-300	-317
Net Living wage per breadwinner	USD p. FTE	6979	4239	5584	4884
Retirement insurance	USD p. FTE	308	203	263	198
Unemployment insurance	USD p. FTE	467	423	171	136
Sick leave insurance	USD p. FTE	106	84	60	42
Gross Living wage	USD p. FTE	7861	4950	6079	5650

Note: p.p.: per person, p.hh.: per household, p. FTE: per FTE (average amount of FTE per country is: 1.49 in Colombia, 1.44 in Dominican Republic, 1.52 in Ecuador and 1.69 in Peru).

Note: tax rates are understood to be zero in all countries for the considered levels of income, except for Peru (8%), because this was the only country were the living income was above the relevant tax threshold. For this reason, the living basket insurance and the gross living wage are equal for Colombia, Dominican Republic and Ecuador.

Appendix 8. Uncertainty analysis of the external costs of Fairtrade producers

The overall robustness of the external costs of Fairtrade producers depends on the uncertainty of the results. The uncertainty is assessed by calculating the 95% confidence interval[24] for each impact (for example, insufficient income) and for each producer type (for example, small producer). In this way, it is possible to look deeper into the variability of results within the sample of producers from which primary data was collected.

Figures 9 and 10 show the confidence intervals for the environmental and social costs, which give a 95% certainty that the true population average will lie in that interval. Among the environmental costs, water pollution and land pollution were the most uncertain. Uncertainty is also high for water consumption in plantations in Colombia and the Dominican Republic due to the high variability in water input quantities among producers.

The most notable insight for social external costs is that the results on producer income and wages for workers are uncertain. This is both a result of the sample size and the actual fluctuation of underlying income and wage data across producers.

Member-specific data collection and large enough samples sizes are key to reducing the confidence interval. As the sector benchmark results were based on secondary data sources, an uncertainty analysis could not be carried out to assess variability among producers.

[24] The 95% confidence was based on the basic formula used by accepted statistical methods.

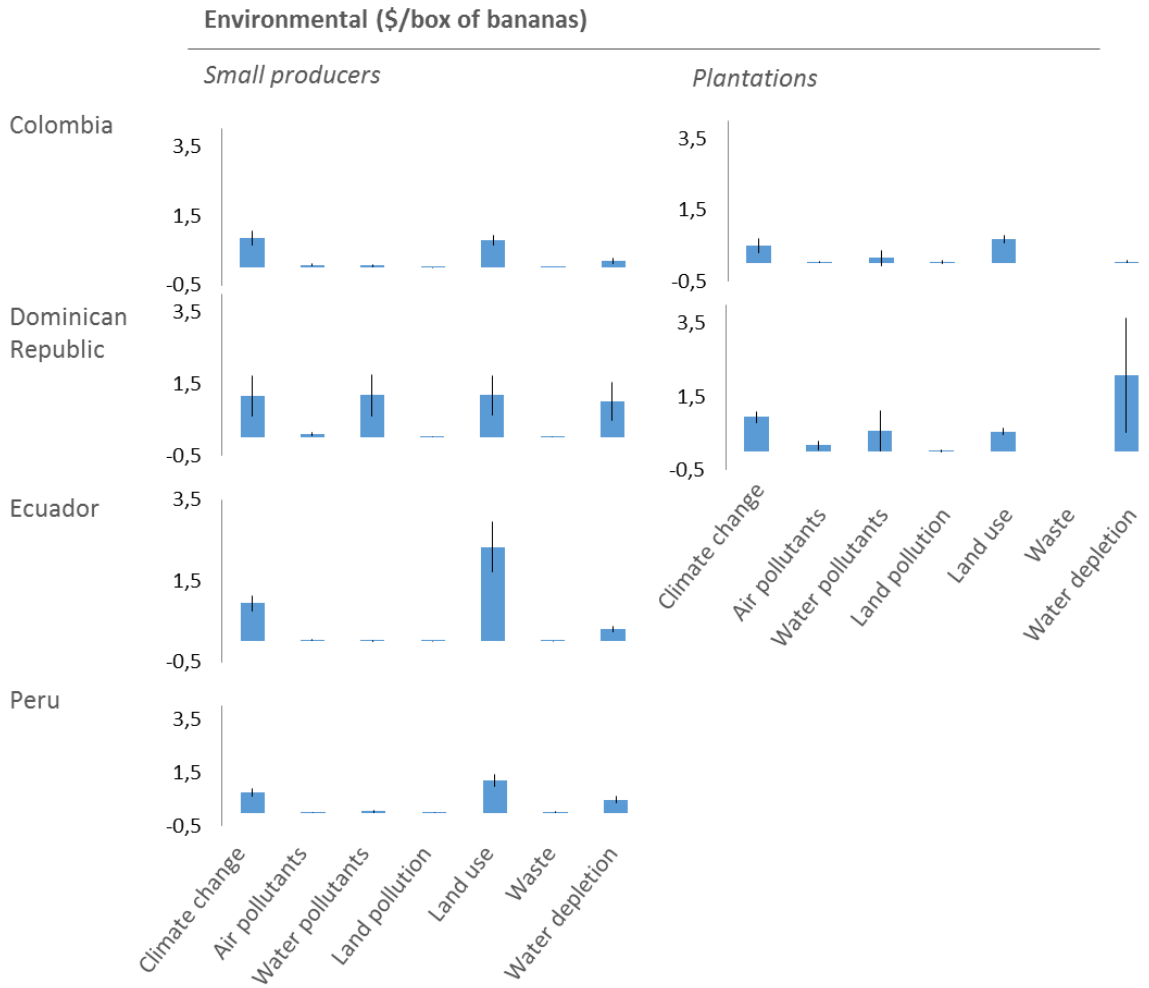

Figure 9: Uncertainty analysis with 95% confidence intervals of environmental impacts per country and per producer type

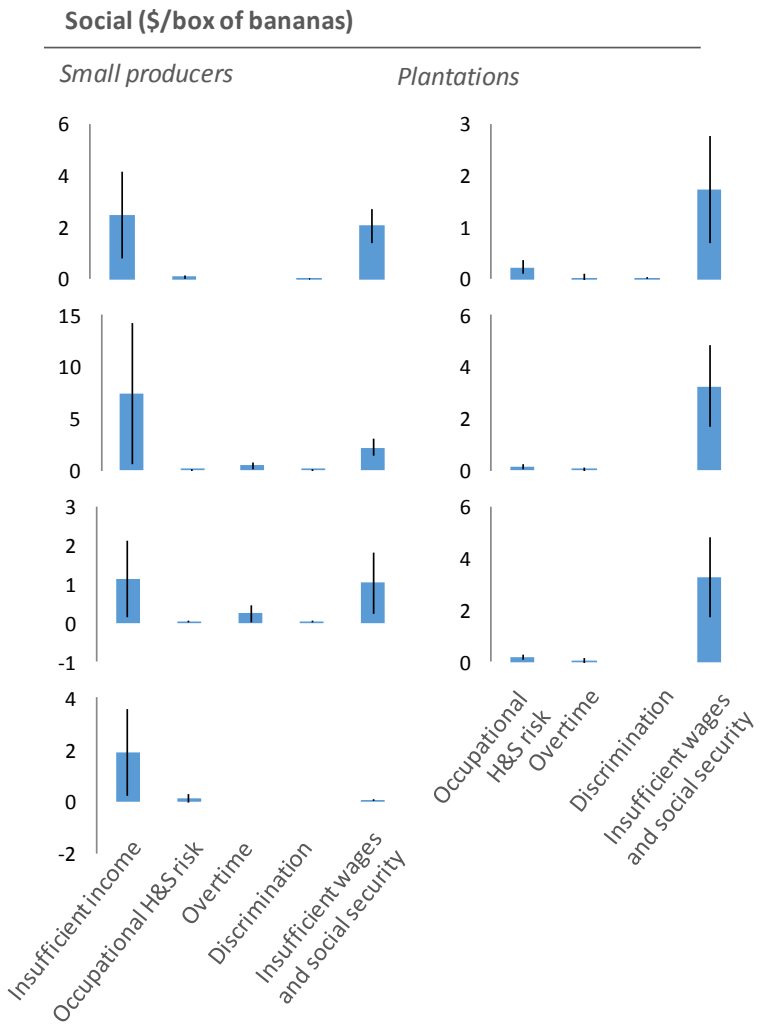

Figure 10: Uncertainty analysis with 95% confidence intervals of social impacts per country and per producer type

Appendix 9. Detailed assumptions

Social costs

Key assumptions related to the primary data, per country, per production level:

COUNTRY	PRODUCTION LEVEL	ASSUMPTION
Ecuador	Smallholders	In case social security contributions for smallholder producers were filled in as 100%, they were assumed to have the average social security contribution of plantations of 11.7%
Ecuador	Plantations	In case no normal pay was filled in, workers are assumed to receive a 150% overtime pay
Ecuador	Plantations	Due to data limitations, the gender income gap for cultivation workers is assumed the same as for processing workers
Ecuador	Plantations	Due to data limitations, the share of pesticide sprayers is based on average data from Colombia
Colombia	Smallholders	Data gaps on the share of workers receiving social security were filled with data on the average social security contribution of plantations, amounting to 20%
Colombia	Smallholders	Hired workers for loading are assumed to work one full day per week, without a contract
Colombia	Smallholders	Due to data limitations the share of pesticide sprayers is based on the average share of small producers in Ecuador and Peru
Colombia	Plantations	Overtime pay was assumed to be evenly distributed over Saturday and Sunday, respectively giving 125% and 175% overtime pay premium

Key assumptions related to the secondary data, per country:

COUNTRY	ASSUMPTION
All	Several assumptions have been made because of data gaps for the sector benchmark. The data hierarchy mentioned in section 2.4 has guided decisions on what secondary data to use for which impacts
All	Where no difference between Fairtrade and the benchmark activities could be proven, a conservative approach has been applied by setting the status of the sector benchmark equal to Fairtrade
All	To determine insufficient income for small producers of the sector benchmark, the same income distribution as for Fairtrade producers has been applied
All	All workers in the sector benchmark are assumed to work full-time, thereby assuming this includes thirteen public and seven paid holidays
All	Levels of child labour and forced labour in the sector benchmark are assumed equal to the levels of Fairtrade plantations
All	The average wage is assumed to reflect the average wage for male workers, in order to calculate the gender wage gap
All	Where data points were only available for permanent contract workers, these values are assumed for temporary workers and workers without a contract
All	Non-fatal occupational incidents are assumed to involve no permanent health damage in 95% of the cases, and permanent health damage in 5% of all instances (ILO, 2005)
All	Yields of the sector benchmark were corrected with the same production losses as indicated by the primary data of Fairtrade producers

Colombia	There are no workers without a contract
Colombia	There is no difference in paid overtime between workers with permanent and temporary contracts
Colombia	Children below the age of 18 that do hazardous work are aged 16 or 17
Colombia	The gender income gap data is based on data for one region with around 20,000 workers. This region is assumed to be representative for the Colombian banana sector
Colombia	Data related to overtime of permanent contracted workers is assumed to be equal to workers with other types of contracts
Colombia	Wages are calculated using the ratio between Fairtrade wages and wages in the sector benchmark, for permanent as well as for temporary contracts. Data from LEI Wageningen UR (2016) and Fairtrade primary data have been used for this purpose
Dominican Republic	Temporary workers have no paid holiday entitlement
Dominican Republic	There is no paid sick leave for non-contracted workers
Peru	Gross financial wage of workers without a contract and permanent contract workers are assumed equal
Peru	Net income for the sector benchmark is calculated based on the sales price of organic export bananas, from primary data of Fairtrade producers
Peru	The wage premium paid for overtime hours is assumed equal for women and men, and all contract types

Key assumptions related to the secondary data used for calculating the living wage:

ASSUMPTION
The average number of children per household in Dominican Republic and Peru is one child higher in rural than in urban areas, and so this was also assumed for Ecuador and Colombia. The number of children per household in rural areas is therefore estimated as the national average fertility rate plus one child
ICT costs are set at the lowest cost mobile phone plan provided by a local mobile phone provider
The current labour force is used as a proxy for the labour force in the past, in order to determine the share of 65+ adults that was part of the labour force and thus receive pension income
The average retirement age in the four countries is set at 65
The average age at which breadwinners start working is set at the legal minimum working age
The unemployment duration in a country scales proportionally with the OECD average ratio of unemployment duration and rate
The living income and living wage are the same due to the methodological assumption that self-employed entrepreneurs need to provide for their own social security.

Environmental costs

Key general assumptions related to the primary data:

ASSUMPTION
Some Fairtrade plantations did not report their yields. In these cases, an average of the per hectare yield of other plantations has been used as an estimate
Organic waste (crop residue) data was reported inconsistently. Crop residue quantities have been estimated based on the banana yield in case these quantities were not directly reported by the respondent
The use of organic pesticides with low risk of human and ecosystem health damage has not been

valued, thereby assuming no environmental costs of using these pesticides

Key assumption related to the secondary data:

ASSUMPTION
Due to gaps in country-specific data, an average of life cycle assessment data for banana production in Costa Rica, Colombia and Ecuador has been used to estimate selected indicators of the sector benchmark for Peru and Dominican Republic

Appendix 10. Detailed limitations per impact

IMPACT	LIMITATION
All impacts	The sector benchmark is estimated as the country average, which also includes a (small) share of Fairtrade producers
All impacts	Due to data gaps on plantations in Dominican Republic, most impact indicators are based on responses of only four plantations. Most indicators for Ecuadorian plantations are based on data from two plantations
Gender discrimination	Discrimination costs are calculated for employed women only. This implies that the lower the share of women in the labour force, the lower the gender-related costs. The underlying assumption is that women have equal access to work as men, which is not likely to reflect the true situation in the countries
Health and safety	Reliable data on fatal accidents rates in the banana sector is lacking. The only public source found on the banana sector concerns plantations in Costa Rica, and is outdated. The data from this source is averaged with ILO data at the agricultural sector level (not specifically on the banana sector). The two sources are considered to have similar reliability, however estimates of the two sources differ by a factor of ten
Health and safety	Incidents with H&S breaches are estimated by multiplying frequencies of H&S breaches and incidents. Indicators of H&S breaches are limited to pesticide spraying workers. This may underestimate the actual incidents with breaches, as workers not involved in pesticide spraying are excluded from the calculation
Harassment	Very reliable data on the frequency of harassment in Colombia, Peru and Ecuador is lacking and the data used is the best that could be obtained for this study. The national average frequency of harassment in the Dominican Republic is applied for all countries. This data point is not specific to the banana sector but comprises an average of all sectors.
Overtime	Secondary data on overtime indicators is lacking. Data on the average amount of working hours per week is sometimes applied as an alternative. However, this may hide overtime for part-time workers, the incidence of occasional overtime, and overtime of specific subgroups in the labour force. In other cases, overtime hours are based on anecdotal evidence. This may lead to both underestimation or overestimation of overtime impacts
Overtime	In many cases, it is difficult to distinguish between the extent to which overtime hours and overtime pay are taken into account in average working hours and average wage statistics. Here a conservative approach is applied, by assuming that overtime is not included in average working hours and wages. This may lead to an overestimation of overtime impact
Child labour	Due to lacking data on the incidence of child labour in the sector benchmark, primary data from Fairtrade producers has been used as an estimate. Since Fairtrade has active policies to prevent underage workers, this approach may underestimate the incidence of child labour in the sector benchmark
Insufficient income	In Peru many small producers indicated to receive a Fairtrade Premium, but did not provide the value of the premium they received. In these instances, the Fairtrade premium has been set at zero, which may overestimate the degree to which small producers have insufficient income

Insufficient income	The cost of living is, in some instances such as food, clothing, transport, and healthcare, based on *actual* expenditure data and not the *required* costs for a decent living
Insufficient income	Housing cost estimates are relatively uncertain. Due to limited data availability, housing costs are estimated based on the average cost of multiple sources and approaches, including actual expenditure data and food/housing cost ratios
Insufficient income	The household composition and unemployment rates are based on national averages, rather than averages for specific (rural) areas in the four countries
Insufficient income	Living wages are taxed at income tax rates, not corporate tax rates (also for family workers)
Insufficient income	Due to limited data availability on average sick days and average labour disability years, estimates are made based on data from the US and the Netherlands respectively
Social security	The average wage of temporary workers in Ecuador is based on the response of one worker
Soil pollution	Where data on the concentration and density of active ingredients in chemical pesticides were not reported by the respondents, these data were estimated based on available literature