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Organic and Geographical Indication Certifications' Contributions to Employment and Education

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Abstract: In this paper, we test to what extent Food Quality Schemes (FQS, including Geographical Indications and organic products) contribute to the social and economic sustainability of farmers and regions through employment and education. Through employment, FQS may counter the urban migration trend affecting rural regions, and help retain economic and social capital in the local region. Indeed, as FQS are often small and specialised sectors, the economic inefficiency of such businesses may translated into greater employment and social sustainability. Separately, by requiring a higher-level of quality and hence skills, FQS may encourage greater local educational attainment or skilled immigration. To test these propositions, we analyse the employment and educational outcomes of 25 FQS. Our results show that the FQS products examined have a 13% higher labour usage (labour-to-production ratio) compared to reference products, indicating that they provide greater employment. Additionally, wage levels are 32% higher in FQS compared to references.

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Despite providing greater employment and higher wages, profitability of FQS (i.e. how much turnover/profit is generated per employee) is nevertheless 32% higher for FQS compared to reference products, due to the ability to attract higher product prices. Finally, there is no clear link between FQS and greater (or lower) education attainment in the supply chain. Overall, our results suggest that FQS can provide a strong contribution to local employment, employee income and business profits, strengthening the social and economic sustainability of producers and regions.

Keywords: food quality schemes, social sustainability, employment, education, geographical indication, organic, alternative food, sustainable agriculture

1 Introduction

Organic and Geographical Indications (GIs, including Protected Designation of Origin [PDO] and Protected Geographical Indication [PGI]) schemes are two certifications that aim to address quality and sustainability issues in agro-food supply chains. Organic certifications focus on reducing and prohibiting the use of harmful chemicals to provide environmental and human health benefits, and in some cases intend to address social issues (Reganold and Wachter 2016; Seufert and Ramankutty 2017). GIs, a separate approach, originated to protect certain styles of regional produce (e.g. Parmigiano-Reggiano) by specifying permitted production locations and/or methods in order to provide higher product quality and economic and other benefits to particular regions and producers (Bowen and De Master 2011; Vandecandelaere et al. 2010). Both food quality schemes (FQS) continue to increase in popularity among consumers and producers, driven by interest in quality foods and ethical (environmental) values (e.g. Grunert and Aachmann 2016; Hughner et al. 2007; Rana and Paul 2017), and, for producers, economic benefits (e.g. Deselnicu et al. 2013; Reganold and Wachter 2016). However, while organic and GI certifications primarily seek to provide economic and/or environmental benefits, they also have important connections to social wellbeing.

Providing employment and encouraging upskilling are two key ways in which FQS might contribute to positive social outcomes for producers and communities. Certification, by requiring certain production standards and/or providing larger economic margins, may result in businesses employing greater numbers of people (Gerz and Dupont 2006; Seufert and Ramankutty 2017). Indeed, less economically efficient businesses may be more socially sustainable (or economically sustainable from an individual's perspective), if they need to employ more people to achieve the same outcomes as competitors. Similarly, by requiring higher levels of product quality and hence producer skills, FQS might encourage greater local educational attainment and skilled immigration, which can build social capital and political and civic engagement (Hillygus 2005; Schoon et al. 2010). Furthermore, such benefits are likely to flow on to local communities through, for example, increased discretionary income and, particularly for GIs, tourism (e.g. Suh and MacPherson 2007). Thus, FQS could provide a way of addressing critical rural issues including regional under-development, political disenfranchisement and urban migration.

In this paper, we examine whether and how FQS provide beneficial employment and educational outcomes, by comparing selected FQS products with standard or industrial products. After a literature review, four working hypothesis are proposed and tested. For this purpose, we analyse 25 FQS products and their conventional counterparts, and establish the level of employment they provide and the level of education of actors involved. Based on the level of labour use, we also estimate the extent that price premiums for FQS products are offset (or not) by employment costs. Our quantitative assessment provides evidence of the differences between FQS and conventional agriculture across organic and GI schemes and specific product types. We then provide a qualitative analysis of the key factors driving such differences.

2 Literature Review and Hypotheses

Both organic and GI FQS have been shown to generally require high levels of labour and so create more employment than conventional agriculture (e.g. Bouamra-Mechemache and Chaaban 2010; Finley et al. 2018; Gerz and Dupont 2006; Midler and Depeyrot 2019; Seufert and Ramankutty 2017; Török and Hazel 2018). FQS are also associated with increased cooperation between producers (Barjolle and Sylvander 1999; Bowen and De Master 2011; Charters and Spielmann 2014; Dentoni et al. 2012; Reganold and Wachter 2016) and, in cases, increased duration and stability of employment (e.g. Finley et al. 2018; Gerz and Dupont 2006). Notably, workers have a preference for working on organic farms due to reduced exposure to harmful agro-chemicals (Reganold and Wachter 2016; Seufert and Ramankutty 2017). Beyond individual producers, GIs in particular can provide flow-on employment benefits to the wider community through increased tourism (e.g. Suh and MacPherson 2007). However, critics note that positive social outcomes are not necessarily better in FQS, as they remain production focussed, and that certification can favour powerful commercial entities over providing benefits to farmers, workers and their communities (e.g. Besky 2014; Bidwell, Murray, and Overton 2018; Dumont and Baret 2017; Guy 2011).

In line with existing research, we propose:

Hypothesis 1: *FQS businesses will employ more people than businesses producing similar, non-certified products.*

The relationship between FQS and education, on the producer side, is more tenuous. For organic farms, some studies find that adopting organic farming is related to higher educational levels (Boncinelli et al. 2017; Geniaux et al. 2011; Koesling, Flaten, and Lien 2008), although other studies find no relationship (Goldberger 2011; Läppe and Kelley 2015). However, the influence of education in environmental agriculture is often highly dependent on how a producer's level of education is measured (Baumgart-Getz, Prokopy, and Floress 2012). In GIs, there has been very little examination of the connection between certification and education. In one case study, Suh and MacPherson (2007) found that the cooperative aspect of GIs also provided a way of increasing knowledge for farmers. Demographically, Filipović (2019); Vitrolles (2011) note that (proposed) GI producers had little education, limiting the advantages accruing to them from the GI, while Chethana et al. (2010) found that proposed coffee GI producers had high levels of education. However, in these three cases, these demographics predate GI certification, demonstrating that separating the cause and effect of education in FQS is also an important concern.

As the evidence for educational benefits arising from FQS remains limited, we develop our hypotheses from the argument that the higher quality products of FQS will require higher levels of skills and education. In the EU-27, our argument could be supported by the evidence of a considerable increase in the level of educational attainment of employees in agri-food sectors (agriculture, fishery, food and beverage) (Cedefop 2008). However, geographical differences remain very important: the lowest rates of educational attainment concern predominantly rural regions of Southern Europe (European Union 2013). Thus, it is important for decision-makers to understand and utilise approaches addressing educational deficits, which will provide significant social and other benefits. Formally, we propose that:

Hypothesis 2: *The educational level of people who work in FQS businesses will be higher than for those working in businesses producing similar, non-certified products.*

The provision of higher employment at higher educational levels, as we propose above, has further implications for the economics of FQS. In principle, employing more people would reduce the profit available to the business, as would providing higher wages to employees (due to higher education levels). However, this argument is in contradiction to the common assumption that FQS products are desirable, for industry, precisely because they are premium and so can attract greater profits to businesses and regions (e.g. Deselnicu et al. 2013; Reganold and Wachter 2016).

The economic impacts of FQS have attracted significant interest, yet findings remain conflicted. For organic products, there is evidence that certification or use of organic methods can improve overall profitability (Crowder and Reganold 2015; Reganold and Wachter 2016), however, this can be very context-dependant and in many cases economic losses may occur (Sahm et al. 2013; Seufert and Ramankutty 2017; Smith et al. 2020). For GIs, some studies show evidence of price premiums for certified products (Deselnicu et al. 2013; Gerz and Dupont 2006). However, to which products these accrue, and why, remains contested (e.g. certain Champagne wine (Haeck, Meloni, and Swinnen 2019) c.f. agricultural commodities (Deselnicu et al. 2013)), and there is significant variation in how consumers value PDO compared to PGI labels (Aprile, Caputo, and Nayga 2012; Deselnicu et al. 2013). Overall, there is little consistent nor strong evidence that GIs do in fact provide economic benefits for individual businesses, although they may still economically (and otherwise) support regional development (Török and Hazel 2018).

Thus, to link our earlier propositions on increased employment and educational levels to economic concerns, for both producers and employees, we propose:

Hypothesis 3: *People who work in FQS businesses will be paid more than people who work in businesses producing similar, non-certified products.*

Hypothesis 4: *FQS businesses will have higher profits than businesses producing similar, non-certified products.*

3 Materials and Methods

We analysed 25 FQS products and their conventional counterparts concerning three product sectors: vegetal (fruits/vegetables, cereal/bakery, coffee/tea); animal (meat, dairy); and seafood and fish. The value chain of each product can be described as a sequence of economic activities from the provision of specific inputs to primary production, transformation and marketing, up to the final sale of the product to the consumer. The set of enterprises (operators) that performs these functions include the input suppliers, the producers, processors, traders and distributors of the product. For each product, we retain two main "levels" of operators: primary production enterprises, termed "farm level", and transformation enterprises, termed "processing level". We do not take into account the distribution level, as the FQS and conventional products we compared are generally sold in retail stores offering a wide range of food products as well as fast-moving consumer goods. For this reason, it is very difficult to assess the contribution of the FQS and reference products alone on the characteristics of the retail stores. Products choice and methodology for the selection of reference and conventional products (Barczak et al. 2016), as well as the main data sources and collection methods (Arfini and Bellasssen 2019) are extracted from the Strength2Food project (funded by the EU's H2020 program).

3.1 Measurement

To examine our four hypotheses, we will make use of four measures, computed for 25 FQS products and their conventional counterparts, for farm and processing levels (see Section 3.3 for details). We will use two "labour intensity" measures to test if FQS businesses employ more people (Hypothesis 1) and have higher profits (Hypothesis 4) than businesses producing similar non-certified products. We will also use an educational attainment measure and a wage level measure to examine whether people working in FQS enterprises have a higher level of education (Hypothesis 2) and are better paid (Hypothesis 3).

3.1.1 Labour Intensity

In agricultural economics, the productivity and efficiency in agricultural and agri-food sectors is often analysed at sectoral and farm levels using measures of aggregate productivity or the productivity of individual factors of production (Latruffe 2010). For labour productivity, it is possible to measure the physical productivity, as the ratio between the area or the volume produced and the quantity of labour, or the economic productivity, as the ratio between the value add produced and the quantity of labour. An improvement or gain in productivity makes it possible to produce more efficiently, i.e. to produce as much using less financial or human capital, or more for the same cost. The decrease in employment resulting from an increase in productivity is offset by an increase in access to products (social benefit) resulting from the increase in volumes produced and the decrease in prices. As the objective of our paper is not to measure labour productivity but to analyse the social sustainability of FQS sectors, we use an adaptation of these two measures.

- The first one concerns labour intensity and answers to the question: "is the sector labour intensive and offers significant employment opportunities?" The labour intensity measure defines the amount of labour required in a production process. It is calculated as the number of workers required for a unit quantity of product. This makes it possible to measure the way in which agricultural and processing activity affects the labour market and in particular the direct effects on employment. Note that labour intensity differs according to the nature of the products (vegetable farming, field crops, livestock farming, etc.), the production model (intensive industrial agriculture, conventional agriculture, integrated farming, organic farming, etc.), and that labour requirements also vary over time (Nolte and Ostermeier 2017).
- The second measure is similar to the measure of economic productivity. However, rather than focussing on whether the sector is more profitable through using less human capital, we seek to determine whether FQS sectors are economically viable with a more intensive use of human capital.

To that end, the two employment measures are:

- Labour to production ratio: value number of annual work unit (L) per ton of product (Q). The labour use ratio indicator, calculated on the basis of output, reflects labour requirements for a unit of physical output (Just and Pope 2001).

$$LQ = \frac{L}{Q}$$

- turnover to labour ratio (TL): euros per annual work unit. The turnover-to-labour ratio, calculated on the basis of sales turnover (T) divided by number of annual work unit (L), reflects labour productivity.

$$TL = \frac{T}{L}$$

Labour inputs are estimated using units based on standardised figures, e.g. one annual work unit, for each person between 18 and 65 years who works full-time on the farm(s)/business unit(s). All forms of farm labour (farmers, hired employees and unpaid family workers) are included in the calculation. One annual work unit corresponds to the work performed by one person who is occupied on a full-time basis. Full-time means the minimum hours required by the relevant national provisions governing contracts of employment. If the national provisions do not indicate the number of hours, then 1800 h are taken to be the minimum annual working hours: equivalent to 225 working days of 8 h each. As the volume of labour is calculated on the basis of fulltime equivalent jobs, nobody can represent more than one AWU, even if someone works for more than the maximum number of hours defining full-time work in that country.

Sales turnover T is computed by multiplying the quantity of product sold Q and the sold price P (see Monier-Dilhan et al. in this issue). By assuming that $T = P * Q$, we obtain $TL = \frac{P}{LQ}$. The two measures labour-to-production and turnover-to-labour ratios are linked by the price of the product. We will discuss this relationship later when we introduce the indicators associated with LQ and TL that will allow us to compare quality products and conventional products.

Du to this assumption, it should be underlined that labour-to-production and turnover-to-labour ratios are linked by the price of the product

When firms produce several products, the following strategy was applied:

- First, we tested whether the share of the product of interest in the turnover of firms differed between FQS firms and their reference. If not, all labour was attributed to the product of interest. This overestimates the labour requirement, but does not bias the difference when the ratio is high and FQS and reference firms' structures are comparable in terms of production;
- Second, if the FQS and reference firms displayed differences in diversification, values from the literature were used to allocate labour between the different products of the firms.

3.1.2 Educational Attainment and Wage Level

The principal indicator is the educational level of people who work in the supply chain. This is based on the highest level of an educational programme the person has successfully completed, according to The International Standard Classification of Education (ISCED) 2011, the standard classification on educational attainment at the EU level. The expression 'level successfully completed' must be associated with obtaining a certificate or a diploma. At the European level, this indicator is used in several surveys.

The educational attainment indicator is computed by using the share of all jobs held by workers with:

- primary education or less and less than middle school degree (E^p);
- secondary education or equivalent and middle school degree or equivalent (E^s);
- short cycle tertiary education, post-secondary non tertiary education or equivalent (1 or 2 years after high school);
- bachelors or equivalent level, 3 or 4 years after high school;
- higher education or equivalent level, at least 5 years after high school (e.g. master degree, PhD).

When the data are not detailed for high education levels, the last three categories are regrouped into one category called tertiary education level or equivalent ($E^{t,l,m}$). The indicator is normalized as follow so that it is bounded by 0 and 1:

$$EA = \frac{0*E^p + E^s + 2*E^{t,l,m}}{2}$$

We also use a secondary indicator related to education, based on average wages. This measure takes into account, indirectly, the vocational education and level of workers' skills, complementing formal educational attainment. The indicator (W_j) is expressed as the average wages per annual work unit (€/AWU). The variables used to calculate agricultural income are not the same at farm and processing levels. At farm level, considering that the net result is often the income of unpaid family workers, we include the proportions of wages (π^w) and net result (π^r) in sales turnover (T). The net result is calculated by subtracting from the sales turnover the value of intermediate consumption, the consumption of fixed capital and production taxes, and adding the value of production subsidies (see Monier-Dilhan et al. in this issue).

$$WL = \frac{T*(\pi^w + \pi^r)}{L}$$

At the processing level, the numerator focuses only on wages:

$$WL = \frac{T*\pi^w}{L}$$

3.2 Material

3.2.1 Data Collection Strategy

The methodology presented above details the list of variables to be collected to construct four ratios (i.e. LQ, TL, EA, *WL*). From this list of variables, each coordinator, in charge of a case study (a selected FQS product), was responsible with their team for collecting the necessary information and related metadata (date, source, comments) for the FQS product and the conventional one (counterpart product) for farm and processing levels. In general, the data were obtained from primary surveys of businesses or business accountancy data. In some cases, they were supplemented by secondary information primarily obtained from regional or national statistical databases, or specifications or other documents describing the technical, regional and historical context of production. In most cases, the data was validated or supplemented with the help of local experts. The consistency of the data and calculation of the indicators was performed by an assigned indicator coordinator. In the event of inconsistencies (inappropriate measurement, unit issues, reference field, etc.), the product and indicator coordinators held meetings to identify the problem(s) and provide a solution: new information collection strategy, data correction, etc.

3.2.2 Products

The products selected for this paper are summarised in Table 1.

3.3 Data Analysis Strategy

For each case study and each measure (i.e. *LQ*, *TL*, *EA*, *WL*), we calculate 4 intermediate ratios:

- labour to production ratios: $LQ_{i,j,k}$
- turnover to labour ratios: $TL_{i,j,k}$
- educational attainment: $EA_{i,j,k}$
- wage level: $WL_{i,j,k}$

where:

$i = 1, \ldots, 25$; number of case studies (products);

j = *fqs*,*ref*; production methods for products of the case study *i (fqs = food quality schemes; ref = conventional method)*;

k = *farm*,*proc*; value chain levels of the product *j* of the case study *i (farm = farm level; proc = processing level)*;

3.3.1 Aggregated Farm and Processing Values

To assess the difference in "social performance" of the entire value chain, we first calculate aggregated values or value chain averages.

For three ratios (turnover to labour, educational attainment and wage level) the aggregated values are averages across the two chain values (farm and processing):

$$TL_{i,j} = \frac{TL_{i,j,farm} + TL_{i,j,proc}}{2}$$

$$EA_{i,j} = \frac{EA_{i,j,farm} + EA_{i,j,proc}}{2}$$

$$WL_{i,j} = \frac{WL_{i,j,farm} + WL_{i,j,proc}}{2}$$

For labour to production ratio, which is expressed on a per ton basis, the aggregated value is calculated cumulatively. For example, if one ton of cheese requires 10 tons of milk, the indicator sums the labour need to produce 10 tons of milk at farm level and the labour need to product one ton of cheese at processing level rather than averaging the quantity of labour of one ton of milk and one ton of cheese. Following a common practice in Life Cycle Assessment for value chain levels producing several co-products (Ayer et al. 2007; Cederberg and Stadig 2003; Eady, Carre, and Grant 2012), the aggregated value across the two chain values (farm and processing) for labour to production ratio is:

$$LQ_{i,j} = \frac{LQ_{i,j,farm}}{FPR_{\mathrm{i,j,farm}} \times (1 + VCP_{\mathrm{i,j,farm}})} + \frac{LQ_{i,j,proc}}{(1 + VCP_{i,j,proc})}$$

Final product ratio (*FPR*) is the amount of raw product at farm level (e.g. milk) necessary for one ton of final product (e.g. cheese), and *VCP* are the value of coproducts (e.g. meat) expressed as a percentage of the value of the main product (e.g. milk) at farm and processing levels.

3.3.2 Comparing FQS and Conventional Products

Our analytical approach is to compare, both globally and relatively, the performance of FQS products and similar, reference products that use non-FQS (conventional) production methods. Our approach supposes that there are broad similarities between the FQS sector and the conventional sector for a given product type of same nature, with the same level of processing, and produced in the same country. Our intent is to compare the distribution of the relative differences observed for similar products, rather than between products that significantly differ (e.g. by type or sector). In our analysis, the only major difference is the type of production: FQS or 'conventional'. With our available data, it is not possible to make more detailed comparisons between different products as they are very heterogeneous, both in terms of the nature of the products

Table 1: Selected products.

Case_study	Sector 3	Product	Country	FQS	Processed	Reference product
Comte cheese	Animal	Hard pressed cooked cheese from cow milk	France	PDO	Yes	National average from the cheese industry in France
Dalmatian prosciutto	Animal	Dry pork ham	Croatia	PDO	Yes	Conventional prosciutto made from pigs raised in Croatia
Gyulai sausage	Animal	Sausage	Hungary	PGI	Yes	Conventional (generic) sausage from Gyulai region (Hungary)
Organic pork	Animal	Ham?	Germany	Organic	Yes	Conventional pork from Germany
Organic yoghurt	Animal	Organic yoghurt from cow milk	Germany	Organic	Yes	Natural cow milk yoghurt (unflavored) from Germany
Parmigiano Reggiano cheese	Animal	Hard pressed cooked cheese from cow milk	Italy	PDO	Yes	Biraghi cheese (similar non-PDO cheese)
Sobrasada Porc Negre of Mallorca	Animal	Raw, cure saussage from pork meat	Spain	PGI	Yes	Conventional pigs from Spain
Lofoten stockfish	Seafood/ fish	Dried fish	Norway	PGI	No	Clipfish produced in More og Romsdal (Norway)
Organic salmon	Seafood/ fish	Salmon	Norway	Organic	Yes	Conventional salmon from Norway
Phu Quoc fish Sauce	Seafood/ fish	Fish sauce	Vietnam	PDO	Yes	Conventional fish sauce from Phu Quoc island (Vietnam)
Saint-Michel bay bouchot mussels	Seafood/ fish	Mussels produced on “bouchots”	France	PDO	No	Conventional Bouchot mussels (France)
Buon Ma Thuot coffee	Vegetal	Coffee	Vietnam	PGI	Yes	Conventional unsorted and sorted green coffee beans from Dak Lak province (Vietnam)
Organic rice from Camargue	Vegetal	Rice	France	Organic	Yes	Conventional rice from Camargue (France)
Doi Chaang coffee	Vegetal	Coffee	Thailand	PGI	Yes	Conventional coffee cherries and roasted coffee produced from Doi Pha Hee (Chiang Rai province, Thailand)
Kalocsai paprika powder	Vegetal	Paprika powder	Hungary	PDO	Yes	Conventional dried paprika from raw paprika produced abroad
Kastoria apples	Vegetal	Apple	Greece	PGI	No	Conventional apples produced by the cooperative Kissavos, in Agia, Greece
Kashubian strawberries	Vegetal	Strawberries	Poland	PGI	No	Conventional strawberries from Poland
Olive oil	Vegetal	Olive oil	Croatia	PDO	Yes	Conventional olives and conventional olive oil produced from Croatia
Opperdoezer Ronde potatoes	Vegetal	Early potato	Netherlands	PDO	No	Conventional fresh consumption potato from The Netherlands
Organic flour	Vegetal	Wheat flour	France	Organic	Yes	Conventional cereals from France
Organic pasta	Vegetal	Pasta	Poland	Organic	Yes	Conventional cereals from Poland
Organic raspberries	Vegetal	Frozen rapsberries	Serbia	Organic	Yes	Conventional raspberries from Serbia
Organic tomatoes from Emilia Romagna	Vegetal	Organic tomato	Italy	Organic	No	Conventional processed tomato from Northern Italy (Emilia Romagna region).
Thung Kula Rong-Hai Hom Mali rice	Vegetal	Rice	Thailand	PGI	No	Conventional rice seeds and paddy rice from the same TKR region (Thailand)
Zagora apples	Vegetal	Apple	Greece	PDO	No	Conventional apples produced by the cooperative Kissavos, in Agia, Greece

(e.g. animal or vegetable) and production characteristics (e.g. level of processing, size of production companies).

To control for heterogeneity (product specificities and geographical locations), we establish for each of the four ratios (*LQ*, *TL*, *EA and WL*) a relative difference between the value obtained for the FQS product and the value obtained by the counterpart product. For each case study i, we obtained four indicators (*ILQ*, *ITL*, *IEA and IWL*):

– labour to production indicator:

$$ILQ_i = \frac{LQ_{i,fqs} - LQ_{i,ref}}{LQ_{i,ref}}$$

If $ILQ_i > 0$ then FQS sector employs more people than conventional sector producing the same quantity of similar product.

– Turnover to labour indicator:

$$ITL_i = \frac{TL_{i,fqs} - TL_{i,ref}}{TL_{i,ref}}$$

If $ITL_i > 0$ then FQS sector has higher profits than conventional sector producing similar product.

Put in other words, the apparent labour productivity of the FQS sector is higher than that of the conventional sector. This result depends on the price premium of FQS product (see Monier-Dilhan et al., this issue). Indeed, considering that $TL_i = P_i/LQ_i$, ITL_i can be expressed as:

$$ITL_i = \frac{P_{i,fqs}/LQ_{i,fqs} - P_{i,ref}/LQ_{i,ref}}{P_{i,ref}/LQ_{i,ref}}$$

If we assume that $LQ_{i,fqs} = LQ_{i,ref}$, we find that $ITL_i > 0$ when $P_{i,fqs} > P_{i,ref}$.

– educational attainment:

$$IEA_i = \frac{IEA_{i,fqs} - IEA_{i,ref}}{IEA_{i,ref}}$$

If $IEA_i > 0$ then the educational level of people who work in FQS sector will be higher than for those working in conventional sector.

– wage level:

$$IWL_i = \frac{WL_{i,fqs} - WL_{i,ref}}{WL_{i,ref}}$$

If $IWL_i > 0$ then people who work in FQS sector are paid more than people who work in conventional sector.

In summary, for each ratio we have aggregated the values of the farm and processor levels. We therefore obtain one value for the FQS product and another for the reference product. Our indicators are based on the difference observed between FQS and reference over the 25 products.

To test our hypotheses, we first test the normality of the distribution of the values of the 25 products for each of the four indicators, using Shapiro-Wilk and quantile-quantile (QQ) graphs. All p-values are below our significance level ($\alpha = 0.05$). Thus, we reject the null hypothesis of the Shapiro-Wilk normality test that each of the samples belongs to normally distributed populations. Examination of the QQ curves confirms that our value samples are not normally distributed. Therefore, we use the signed Wilcoxon rank test (Salkind 2010) to test for differences between groups (usually, FQS and reference products), selected as it does not require the groups to be normally distributed, is relatively stable to outliers, and is adapted for small samples (at least five observations). Due to our small sample, we systematically generate exact *p*-values.

4 Results

4.1 Overall

Figure 1 shows box plot distributions of FQS performance relative to their reference products for the study sample, for each of the four indicators. The positive skew indicates that FQS products tend to outperform their references, with few exceptions. Each indicator has a median greater than zero, with a value of 32% (turnover to labour ratio and wage level), 14% (labour to production ratio) and 6% (educational attainment), while outlying values are all positive.

The bottom and top edges of the box indicate the intraquartile range (IQR), values between the first and the third quartiles. The line inside the box indicates the median value and the marker (lozenge) the mean value. The whiskers that extend from each box indicate the upper and lower fences (± 1.5 IQR), while circles indicate outliers beyond these bounds.

Table 2 shows the Wilcoxon test results for each indicator overall, showing that the differences between FQS medians and reference medians are statistically significant (in a positive direction, at the 0.05 level), except for the educational attainment indicator.

Tables 3–6 provide further detail on the performance of FQS for each indicator, including a breakdown by FQS and sector. In general, the differences revealed in this analysis are not statistically significant, which may be due to

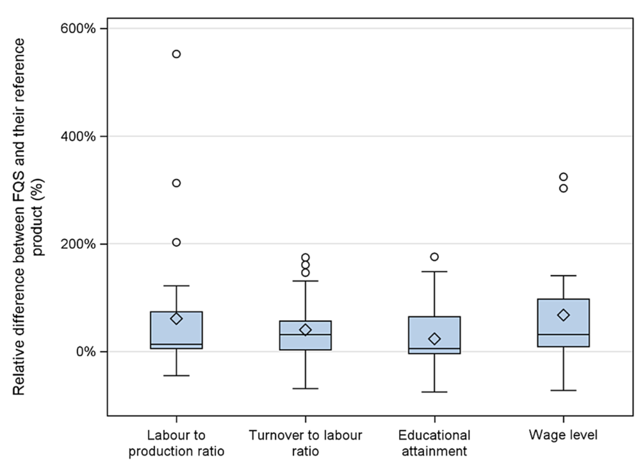

Figure 1: Food Quality Schemes performance distribution compared to reference products.

Table 2: Test results (signed Wilcoxon rank) for each indicator.

Variable name	Median	*p*-value	n
Labour to production ratio	14 %	0.0031	25
Turnover to labour ratio	32 %	0.0011	24
Educational attainment	6 %	0.0921	23
Wage level	32 %	0.0000	22

the relatively small sample size. Nevertheless, organic and PDO outperform PGI schemes, the only exception being PGI outperforming PDO for wage levels. PGI also exhibits more extreme positive and negative outliers, suggesting that PGI performance may be very case dependant. Differences between production sectors are less pronounced, with exceptions being low educational attainment for animal products, and lower wage levels for seafood products, compared to other FQS sectors.

4.2 Labour to Production Ratio

Table 7 and Figure 2 illustrate performance of FQS compared to reference products for a range of groupings. Across each grouping, FQS require more labour, with only five observations showing small negative differences. The differences are statistically significant for some groupings: PDO, the animal and combined animal and seafood sectors, and southern European countries.

Table 3: Performance distribution by category of FQS.

FQS	Labour-to-production ratio median [min, max] (#)	Turnover-to-labour ratio median [min, max] (#)	Educational attainment median [min, max] (#)	Wage level median [min, max] (#)
Organic	25 [−45; 122] (8)	35 [−10; 161] (8)	5 [−10; 76] (6)	70 [24; 141] (6)
PDO	33 [−22; 313] (9)	33 [−19; 147] (8)	6 [−4; 149] (9)	16 [2; 324] (8)
PGI	10 [−19; 552] (8)	21 [−69; 175] (8)	3 [−75; 176] (8)	37 [−72; 303] (8)

Table 4: Test results (Kruskal-Wallis *p*-values) between FQS categories.

Variable name	Organic vs. PDO	Organic vs. PGI	PDO vs. PGI
Labour to production ratio	0.6304	0.4746	0.1779
Turnover to labour ratio	0.6744	0.8781	0.8336
Educational attainment	0.6371	0.8422	0.6302
Wage level	0.0707	0.2704	0.5286

Table 5: Performance distribution by sector.

FQS	Labour-to-production ratio median [min, max] (#)	Turnover-to-labour ratio median [min, max] (#)	Educational attainment median [min, max] (#)	Wage level median [min, max] (#)
Animal	27 [2; 552] (8)	28 [−69; 161] (8)	−2 [−75; 6] (6)	29 [−72; 324] (7)
Vegetal	11 [−45; 313] (14)	32 [−19; 147] (13)	14 [−48; 176] (14)	51 [2; 303] (12)
Seafood/Fish	19 [6; 203] (3)	43 [−11; 175] (3)	12 [−44; 98] (3)	8 [4; 35] (3)

Table 6: Test results (Kruskal-Wallis *p*-values) between sectors.

Variable name	Animal vs. vegetal	Animal/seafood/fish vs. vegetal
Labour to production ratio	0.1172	0.1711
Turnover to labour ratio	0.9684	0.5430
Educational attainment	0.0206	0.0438
Wage level	0.9254	0.5097

Table 7: Performance distribution and test results (signed Wilcoxon rank *p*-values) for the labour to production ratio indicator (n/a shows where sample has fewer than five observations and *p*-value may be inaccurate).

Groups	n	Mean	Median	*p*-value
Organic	8	34%	26%	0.1953
PDO	9	74%	33%	0.0391
PGI	8	74%	10%	0.1406
Animal	7	108%	33%	0.0156
Seafood/fish	4	58%	13%	n/a
Vegetal	14	39%	11%	0.2606
Animal/seafood/fish	11	90%	22%	0.0010
Northern Europe	9	20%	14%	0.1641
Southern Europe	5	140%	33%	0.0625
Eastern Europe	7	64%	11%	0.2969
Southeast Asia	4	52%	11%	n/a

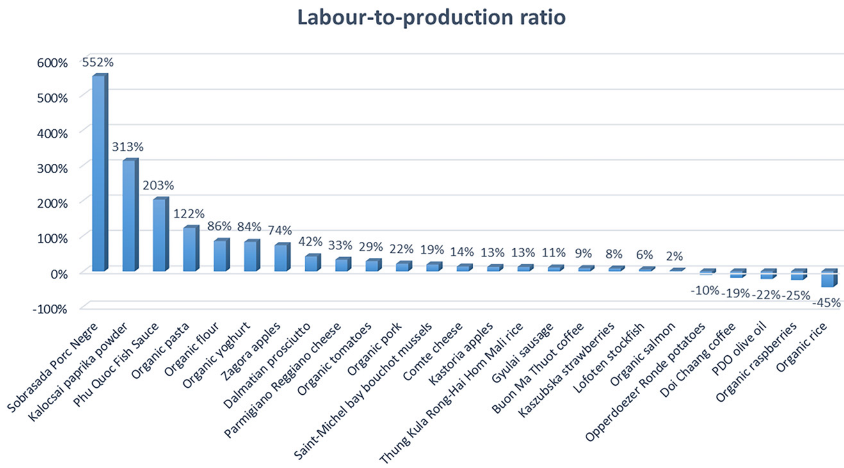

Figure 2: Distribution of relative differences between products and their references for the labour to production ratio indicator.

4.3 Educational Attainment

Table 8 and Figure 3 show the performance of FQS products compared to reference for educational attainment, for a number of groupings. In general, differences are small in magnitude and sometimes negative; they are also rarely statistically significant. However, the vegetal sector and southern European and southeast Asian countries show a relatively strong performance in relation to other categories.

Table 8: Performance distribution and test results (signed Wilcoxon rank *p*-values) for educational attainment indicator (n/a shows where sample has fewer than five observations, and *p*-value may be inaccurate).

Groups	n	Mean	Median	*p*-value
Organic	6	14%	6%	0.4375
PDO	9	31%	6%	0.0781
PGI	8	23%	3%	0.5703
Animal	5	−22%	−4%	0.3125
Seafood/fish	4	17%	6%	n/a
Vegetal	14	42%	15%	0.0269
Animal/seafood/fish	9	−5%	−1%	0.7422
Northern Europe	7	−3%	0%	0.8125
Southern Europe	5	52%	65%	0.1875
Eastern Europe	7	−2%	0%	1.0000
Southeast Asia	4	82%	100%	n/a

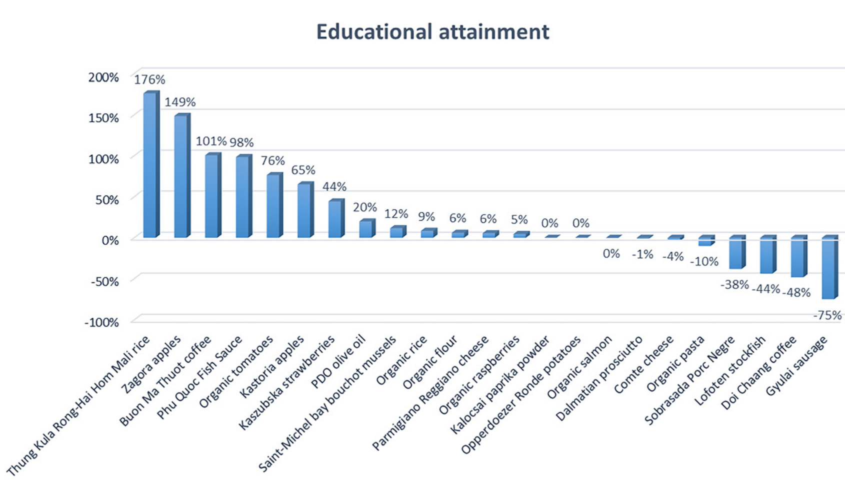

Figure 3: Distribution of relative differences between products and their references for the educational attainment indicator.

4.4 Wage Level

Table 9 and Figure 4 show the performance of FQS compared to reference products for the wage levels, for a range of groupings. Wage levels are consistently higher in across all groupings, and the differences are often statistically significant.

4.5 Turnover-to-Labour Ratio

Finally, Table 10 and Figure 5 show the performance of FQS compared to reference products for the turnover to labour ratio indicator, across a range of groupings. FQS have

Table 9: Performance distribution and test results (signed Wilcoxon rank *p*-values) for the wage level indicator (n/a shows where sample has fewer than five observations, and *p*-value may be inaccurate).

Groups	n	Mean	Median	*p*-value
Organic	6	77%	70%	0.0313
PDO	8	62%	16%	0.0078
PGI	8	68%	38%	0.0781
Animal	6	81%	56%	0.1563
Seafood/fish	4	19%	19%	n/a
Vegetal	12	78%	52%	0.0005
Animal/seafood/fish	10	56%	27%	0.0371
Northern Europe	7	40%	24%	0.0156
Southern Europe	5	40%	40%	0.3125
Eastern Europe	6	94%	70%	0.0313
Southeast Asia	4	113%	73%	n/a

Table 10: Performance distribution and test results (signed Wilcoxon rank *p*-values) for the turnover to labour ratio indicator (n/a shows where sample has fewer than five observations, and *p*-value may be inaccurate).

Groups	n	Mean	Median	*p*-value
Organic	8	52%	35%	0.0391
PDO	8	36%	33%	0.0781
PGI	8	33%	21%	0.1484
Animal	7	26%	24%	0.2188
Seafood/fish	4	92%	102%	n/a
Vegetal	13	32%	32%	0.0178
Animal/seafood/fish	11	50%	32%	0.0537
Northern Europe	9	74%	32%	0.0195
Southern Europe	5	29%	42%	0.4375
Eastern Europe	6	13%	9%	0.4688
Southeast Asia	4	20%	21%	n/a

consistently high performance, which is often statistically significant. The highest performance is found, unlike educational attainment, for northern European countries and the seafood sector.

5 Discussion

In the discussion that follows, we further analyse and contextualise our statistical results reported above. While in the statistical results we do not distinguish between farm and processing parts of the product value chain, below we selectively refer to monographic studies conducted on the products, or sometimes on other products, where the distinction between farm and processing levels is retained. In such cases, we sometimes use such distinctions in order to provide context and to confirm or moderate our aggregate statistical findings.

5.1 Hypothesis 1: Employment

Overall, FQS products examined in this paper have a higher labour-to-production ratio than their reference products, with a median difference of 14% across all products (Table 2). These figures indicate that FQS provide and require increase employment, relative to conventional products, in agreement with the existing literature (e.g. Bouamra-Mechemache and Chaaban 2010; Finley et al. 2018; Gerz and Dupont 2006; Midler and Depeyrot 2019; Seufert and Ramankutty 2017). In general, Hypothesis 1 is supported.

Figure 4: Distribution of relative differences between products and their references for the wage level indicator.

Distinct differences are in evidence between production sectors. For animal and seafood products, all FQS products examined require more labour than their conventional equivalents (Table 6). As can be seen in Figure 2, the observations are split between a low difference for three products (between 2 and 13% higher than the conventional reference), a moderate difference for two products (between 14 and 19%) and a high difference for six products (more than 22 % and up to 552% difference). The trend is much less obvious for the vegetal sector: five products out of 14 have a lower labour intensity than their reference (2/4 for PDOs, 1/5 for PGI and 2/5 for organic). The difference is moderate for four products out of 14 (between 8 and 13% higher than the conventional reference) and high for five products (between 29 and 313%). There is therefore a clear difference between sectors and a counterintuitive result for the vegetal sector, with some FQS products requiring less labour than their conventional counterparts.

Qualitatively, the products where FQS have lower labour requirements than conventional counterparts can be explained by the sectors' structure, and relevant technical attributes. When FQS sectors are highly integrated and managed by innovative actors (at farm and processing level), the organisational structures and technical investment can lead to lower labour requirements or higher efficiencies (e.g. in organic rice). This is related to, but distinct from, existing results showing increased cooperation between FQS producers (Barjolle and Sylvander 1999; Charters and Spielmann 2014; Reganold and Wachter 2016). However, these differences may not be equally distributed across the supply chain: the need for labour is generally greater at the farm level than the processing level. The second explanation concerns technical attributes of the products. In some cases, products may have a low overall labour requirement for seasonal reasons (e.g., Opperdoezer Ronde potatoes from the Netherlands need intensive work at harvest time but over a very short period). Other cases, such as organic products (e.g. organic rice of Camargue from France), have technical specifications that prohibit the use of herbicides or fungicides. In the event of, for example, severe weed infestation or problems with seed rot, conventional producers may mobilise labour to apply chemical treatments, which cannot be done for organic producers (Gauvrit and Schaer 2019).

5.2 Hypothesis 2: Educational Attainment

There are few clear trends for educational attainment in FQS. As can be seen in Figure 3, almost half of the observations (11/23 products) show low differences between FQS and conventional references (between –10 and 12%), eight have positive differences (between 20 and 176%) and four, clear negative differences (between –38% and –75%). This heterogeneity supports the small amount of existing work that shows that education in highly case or methodology dependant, and has no strong relationship with FQS overall (see Baumgart-Getz, Prokopy, and Floress 2012). In general, Hypothesis 2 is rejected.

However, there is a notable difference between the animal and seafood sectors, and the vegetal sector. For the nine products in the animal/seafood sectors, one is clearly positive (PDO Phu Quoc Fish Sauce 98%), five are neutral (3 PDO, one organic and one PGI, between –4 and 12% difference) and three clearly negative (all PGI, between –38% and –75%). For the vegetal sector seven products out to 14 are clearly positive (between 20 and 176%), six are neutral (between –10 and 9%) and one is clearly negative (–48%).

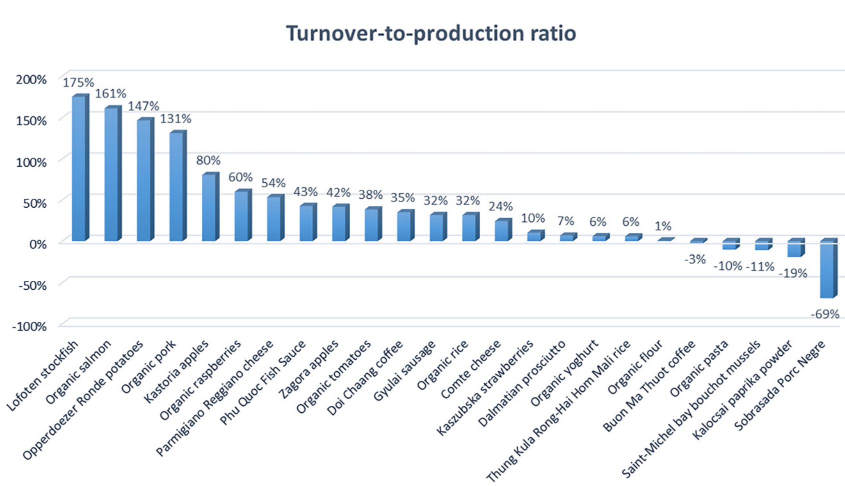

Figure 5: Distribution of relative differences between products and their references for the turnover to labour ratio.

Notably, cases with high education attainment performance are mostly found in less developed regions (e.g. Thailand, Southern and Eastern Europe), and/or in products that do not require significant processing. The two exceptions to this, the Doi Chang Coffee (Thailand) and Gyulai sausage (Hungary) products, is mainly due to differences in education at the processing level, where larger conventional sectors may employ more skilled worked for large-scale processing instead of manual work (Csillag and Török 2019; Lilavanichakul 2019). This suggests that FQS may encourage or reward upskilling in farms or regions where it is not the norm, providing a strong social sustainability benefits.

5.3 Hypothesis 3: Wage Levels

Wage levels are 32% higher in FQS compared to reference products, with superior performance in all but one observation (Table 2). While not the primary focus of this research, this is an important result indicating that FQS may provide significant economic (and hence social) benefits for employees (emphasising the findings in Barham et al. (2011) and Sellers-Rubio and Más-Ruiz (2014), and in contrast to Besky (2014)). Thus, Hypothesis 3 is supported.

The processing level of the supply chain in general shows the highest wage-related performance, which may indicate that FQS products require more specialised processing skills and hence higher wages (although it may also indicate that FQS use less labour or have higher turnover than reference products). For example, in the FQS Parmigiano Reggiano and Comté cheese the share of skilled cheese-makers among total processing firms' workforces are higher than for their reference products. There is also some indication of country-specific trends, such as high performance in Italy, which may be driven by the lack of a legislated minimum wage (i.e. reference products may require low skills and hence be paid very poorly; Nespoli 2019). There are also both high (processing level) and low performance (farm level) cases in Thailand (Lilavanichakul 2019; Napasintuwong 2019), indicating high inequalities between different levels of the supply chain, which may also be related to low minimum wages and skilled processing requirements.

5.4 Hypothesis 4: Business Profitability

Despite higher labour requirements per ton of product, FQS have a 32% higher turnover-to-labour ratio. Interestingly, this result means that the price premium of FQS (see Monier-Dilhan et al., this issue) more than offsets the higher labour intensity, resulting in greater turnover per labour unit (Table 2). Additionally, the few cases with a lower turnover to labour ratio than their conventional counterparts also have a very high labour to production ratio. This suggests that FQS will provide financial benefits for employees, except in extreme cases where there is very high labour usage and hence labour expenses. This supports existing research and strong arguments for the economic benefits of FQS (e.g. Deselnicu et al. 2013; Reganold and Wachter 2016). In general, Hypothesis 4 is supported.

The high turnover-to-production ratio for FQS is evident across all sectors: 20 out of 25 products outperform their references (Figure 5). The best performing cases (14 products between 24 and 175% higher than references) are principally FQS products that are highly valued by consumers, increasing their turnover compared to reference products (e.g. Lofoten stockfish, Parmigiano Reggiano cheese, Zagora apples and Comté cheese). This performance is maintained even when labour requirements are also high (labour-intensive specialty products) or similar to conventional production (efficient production and highly valued products). These products have strong recognition from consumers because of the products' identity and valued attributes (e.g. artisanal production, unique terroir), in part driven by the sectors' strategies. In a few cases, high turnover to labour performance is due to an integrated supply chain structures featuring large co-operatives or vertically integrated businesses, allowing efficiencies to be developed.

In six cases the difference between FQS and conventional products' turnover to labour ratios are low (between –3 and 10%). In four cases, the difference is more strongly negative (between –10% and –69%). Here, the differences are likely due to the size and integration of the sectors, as well as the intensity of work. The two FQS products with the most negative performance (Kaloscai paprika powder and Sobrasada Porc Negre) are also the two who have the highest difference in labour to production ratio. Underperformances may be reflective of small sectors in general, which have small territories and few producers and processors.

5.5 Limitations and Future Research

In order to put these results into perspective, we must mention some limitations related to the methodology:

1) the trends that appear by type of FQS are not necessarily to be interpreted as being related to the certification's intrinsic qualities. Although the analysis was designed

to isolate the effect of the certification, through the use of a reference product, it is not bullet-proof. For example, the lower turnover-to-labour and educational attainment ratios of the PGI products in the animal sector is likely less related to the PGI certification itself and more to the nature of the products (i.e. the size and integration of the channels), which are not necessarily representative of PGIs in general.

2) the collection of data and the reference used as a point of comparison. Although guidelines on both aspects have been followed, and the traceability of data and sources has been ensured, data collection was not conducted in a fully homogeneous manner across all products. Differences may therefore have emerged depending on the available data and the choices made regarding the reference product.
3) the level of education is only an approximation of the level of competence and training of the workforce in quality sectors. It does not necessarily take into account continuing, incomplete or informal education.

In future work, we suggest that further methodological development be undertaken, to address the issues we have raised above, and in particular to examining education, as other work shows educational performance may be highly dependent on measurement approaches (Baumgart-Getz, Prokopy, and Floress 2012). In addition, we encourage researchers to examine the question of wages and education in more detail. These areas are critically important for the social and economic sustainability of farms and regions, and so understanding to what extent, and why, FQS do (or do not) contribute to higher wages and educational outcomes would be of great value.

6 Conclusion

In this study, we examined the differences between 25 FQS and conventionally-produced reference products to assess the contribution of FQS to social sustainability, as measured through employment generation, educational attainment, business profitability and wage levels. The FQS examined show an overall higher labour usage compared to reference (conventional) products, indicating that they thus provide greater employment. In addition, the FQS provided higher wages for employees, in all cases except those with extremely high labour usage. FQS also demonstrated generally better financial performance (i.e. how much turnover/profit is generated per employee) compared to reference products. However, under-performing cases (i.e. low labour use) can be found across organic, PDO and PGI products. Combined, these results indicate that FQS can, for many products, provide substantial social and economic support to farmers, communities and regions.

Our analysis strongly supports the contention that that the higher labour requirements of FQS products (and hence higher employment generated) are offset, for the business, through increased profits. This is a frequently debated point in relation to FQS, especially Geographic Indications (e.g. Smith et al. 2020; Török and Hazel 2018). Here, we contribute by providing a comprehensive assessment of FQS compared to like products, including the labour costs, to address overall profitability. Additionally, while the higher employment associated with FQS is generally established, our analysis provides the first comprehensive indication that FQS generally provide higher wages, an important benefit, which nevertheless does not impact farms' profitability.

While we hypothesised a connection between FQS and educational attainment, we found no overall link between FQS and greater (or lower) education attainment of actors in the supply chain. However, cases with higher educational attainment compared to reference products occur more often in more marginalised (i.e. remote or poorer) regions and countries. This provides a first, broader indication that while FQS may not be associated with educational outcomes in general, there may be an important connection in areas where educational attainment is traditionally not high.

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