Is Organic Agriculture and Fair Trade Certification a way out of Crisis?

Evidence from Black Pepper Farmers in India

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Abstract

This article examines the impact of a joint organic and fair trade certification on productivity and material costs based on data collected from 277 smallholder black pepper farmers in India. We estimate a multinomial endogenous switching regression along with a counterfactual analysis to ascertain the effects of certification. Our results indicate that certified farmers have higher yields. Counterfactual study shows that conventional farmers can increase their yields by 35% with less than half the costs by venturing into organic and fair trade networks. Further, treatment and transitional heterogeneity effects reveal that a joint organic and fair trade certification has the strongest effect on productivity for the less successful farmers.

Keywords: impact evaluation, multinomial endogenous switching regression, organic farming, fair trade, India

JEL classification: Q01, Q19, Q37

1. Introduction

Global debates on sustainable agriculture have brought alternative farming systems like organic agriculture and fair trade to the forefront. While organic certification focuses on production methods, fair trade is concerned with agricultural marketing. Both these certified systems critique conventional agriculture and claim to follow eco-friendly cultivation and ethical aspects of trade respectively (RAYNOLDS 2000).

In the recent decades, organic and fair trade certification schemes have captured the willingness to buy of the environmentally conscious and morally motivated consumer; threatening to break out of its current niche markets. This is reflected in the worldwide sales of these products. The organic market witnessed a five-fold increase in revenues since 1999 and reached 72 billion USD in 2013 (FIBL and IFOAM 2015). Similarly, money spent on fair trade products increased 15% from 2012 to global sales of 5.5 billion euros in 2013 (FAIRTRADE INTERNATIONAL 2014). Moreover, many studies have reported that such certifications improve smallholder producer livelihoods (e.g. BACON, 2005; KLEEMANN and ABDULAI, 2013; PARVATHI and WAIBEL, 2015)

Yet, the principal objection towards certified systems like organic agriculture is low yields (DE PONTI et al., 2012). This is reinforced by SEUFERT et al. (2012) in their seminal paper wherein they find that organic yields are lower than conventional crop yields. On the contrary, PIMENTEL et al. (2005) argues that yields of organic and conventional crops are almost similar and organic crops perform better during droughts. Also, BADGLEY et al. (2007) suggests that not only can organic production feed the world but also that the current agricultural land base could eventually be reduced if such eco-friendly production methods were widely adopted.

But, crop yields depend on input costs of fertilizers and pesticides as pointed by BRUNELLE et al. (2015). Although, organic farming systems are traditionally known for its cheaper inputs (SEUFERT et al., 2012), many organic farmers increasingly buy organic fertilizers and pesticides making inputs expensive (VALKILA, 2009; BEUCHELT and ZELLER, 2011). However, many smallholder organic farmers may not be able to afford these costs. Hence, they may limit application of high cost organic inputs resulting in lower yields. Therefore, it is important to understand the impact of such certification systems on material input costs. Yet, only few studies compare organic and conventional in terms of input costs (e.g. TZOUVELEKAS et al., 2001; GÜNDOĞMUŞ, 2006; PIMENTAL et al., 2005; VALKILA, 2009)

Moreover, most of these studies on yield and material input costs do not control for selection bias. Besides, literature does not discuss in detail whether organic farmers also having a fair trade certification are better producers. Although fair trade is focused on agricultural trade aspects and labor conditions of workers, it does have the possibility to affect efficiency of the smallholders indirectly through its social standards (PARVATHI and WAIBEL, 2013). For example, the ease of credit access under fair trade schemes can help meet input costs (BACON, 2005). Therefore, a joint organic and fair trade certification can influence smallholder crop productivity. Nonetheless, these aspects are yet to be widely discussed in agricultural literature. Hence, our study attempts to build this gap in literature by examining whether a joint adoption of organic and fair trade certification can increase yield and reduce costs.

In this context, we study the black pepper crop in India which has been floating in troubled waters since 2003 (HEMA et al., 2007). The declining pepper yields along with soil fertility problems, pests, high input costs and fluctuating market prices has made black pepper farming unremunerative for domestic producers. Consequently, this pushed many smallholder black pepper farmers to venture into alternative system of agriculture like organic and fair trade. Hence this makes it an interesting case study to understand if certification systems can pave a way out of crisis.

Thus, the main objective of this article is to examine the impact of a joint adoption of organic and fair trade certification by smallholders on black pepper yields and material input costs. Also, methodologically this article contributes to the counterfactual analysis literature. We follow CATER and MILON (2005) and DI FALCO, VERONESI and YESUF (2010) and expand on their binary counterfactual model to assess base and transitional heterogeneity effects to a multinomial model. Results from the counterfactual analysis show that conventional farmers can increase yields at reduced costs by adopting joint organic fair trade certification. Heterogeneity effects indicate that a joint organic fair trade certification is most essential for those farmers who were less high-yielding when they ventured into certified farming systems.

The rest of this article is organized as follows. The next section presents the details of black pepper crisis in India. Section three describes the study area and certification system in the region. Section four discusses the methodology used followed by the results elaborately examined in section five. Section six concludes the paper with some policy recommendations.

2. Indian Black Pepper Crisis

Indian agriculture has the leading number of organic producers in the world of 650,000 (FIBL and IFOAM, 2015) and also has the third highest fair trade producers globally (FAIRTRADE INTERNATIONAL, 2014). Both these systems are predominantly gaining prominence in the Indian cash crop sectors like cotton, tea, coffee and most recently, in the spices sector.

Spices are an important part of Indian agriculture with an export value of more than 2 billion USD in 2012 (SPICES BOARD OF INDIA, 2012). The share of India in the international spices market is 25% and pepper contributes 8% to Indian exports in value terms (PARTHASARATHY et al., 2011). Today, India is going through a pepper scarcity wherein production fell from 80,000 tons in 2002 to 37,000 tons in 2013. The area under pepper cultivation has also declined 46% from 218710 ha in 2000 to 117760 ha in 2013 (SPICES BOARD OF INDIA, 2014). From being a leading exporter and producer of pepper in the world till 1999, India has started to import pepper to meet its domestic demand (JEROMI, 2007). Additionally, the average Indian black pepper yields are around 267 kg/ha whereas in China and Vietnam it is around 2000 kg/ha. These low yields are attributed to poor farm management, depletion of soil fertility and significant outbreak of pests and diseases. Moreover, increasing input costs to fight pests and diseases is making black pepper farming financially unviable (HEMA et al., 2007 and GAFOOR et al., 2007).

Also, the international black pepper market is confronted with fluctuating supply leading to unstable market prices. The sharp decline of black pepper prices in 2003-04 prompted the introduction of fair trade standards for this crop by the Fairtrade Labelling Organization (FLO) in 2005 (FAIRTRADE INTERNATIONAL, 2014). To improve soil fertility and increase black pepper production many smallholders shifted to organic agriculture (REGANOLD, ELLIOTT and UNGER, 1987). Some of these organic farmers also adopted fair trade certifications to expand their international market prospects and to combat price risks.

Hence, this pepper crisis in India provides us with an interesting case study to understand whether certified organic and fair trade systems can increase productivity, reduce costs and thereby help India tide over its pepper problems.

3. Study Area

Kerala state produces 80 - 90% of the total pepper production in India (SPICES BOARD OF INDIA, 2009). Pepper farming is the major source of income for around two million households in this region (HEMA et al., 2007). In Kerala, the mountainous region of Idukki district has the largest area under pepper cultivation and is also the largest black pepper producing district in the state (ESD, 2013). Hence, Idukki district is chosen as our study area.

In Idukki, the taluks[1] of Udumbanchola and Peerumedu were non-randomly selected as they grow majority of the pepper in the district. It also needs to be noted that both these regions share similar climatic conditions, rainfall and topography. A cross-section data from 277 smallholder black pepper households was collected in 2012. The data pertains to previous production year 2011.

A list of smallholder conventional pepper farmers were obtained from the agricultural office of Idukki district. With regard to certified farmers, the details were collected from a local non-government organisation (NGO) promoting organic agriculture and fair trade certification. Thereby, we have three farm management regimes namely, (1) conventional, (2) organic and (3) organic and fair trade. Hence, using stratified random sampling data was collected from 90 conventional, 98 organic and 89 joint organic and fair trade certified farmers resulting in a total sample of 277 farmers. We do not have an only fair trade certified black pepper farmers as such farmers in this region were large plantation holders with more than 10 hectares of land. The survey was focussed on smallholders who own less than 1 hectare of pepper area.

A household survey questionnaire was used to draw information on household characteristics, agricultural activities, off-farm employment, asset endowments and credit access. It was noted from the data that although pepper was the major crop produced, all surveyed farm households followed mixed cropping. Almost all farm households intercropped pepper with coffee and cardamom. The second major crop produced by conventional households was cardamom followed by coffee. While both the categories of certified households produced coffee as their second major crop followed by cardamom. Also, it was observed that in the data collected that there was no partial organic certification among organic and the joint organic and fair trade certified farmers. The entire land area was certified organic.

[1] Taluk is an administrative division of the district. It is like an entity of the local government and has certain fiscal and administrative powers over the villages and municipalities coming under its jurisdiction

3.1 Certification system in Idukki

The NGO operating in Idukki is primarily responsible for promoting eco-friendly and ethical agriculture in the district. The NGO is the driving force in creating awareness regarding these certification systems on large scale within Idukki district. It gained prominence in 2000s during the black pepper crisis in Idukki wherein soil fertility declined and the pepper crop in the region got heavily infected with pests. Many smallholder farmers became members of the NGO and wanted to convert to organic black pepper cultivation to improve soil fertility, reduce costs and increase productivity.

Although initially it was only restricted to organic certification it expanded into fair trade when Fairtrade Labelling organization (FLO) introduced fair trade standards for black pepper in 2005 to overcome the fluctuating market prices. Therefore since 2005 it has been promoting fair trade among its organic farming members. Some already certified organic farmers decided to venture into fair trade networks. These farmers started selling joint organic and fair trade certified black pepper from 2009 through the NGO. As the data pertains to production year 2011, we have farmers who have adopted organic certification over different points in time covering a decade, whereas the joint organic and fair trade certified farmers are from 2009.

The NGO provides free technical assistance and training in organic cultivation. It also advances the certification and inspection costs for organic and fair trade with a condition that all certified products should only be sold to the NGO. However, to recover the certification costs the NGO reduces the market price payments for organic and the joint organic and fair trade certified pepper.

Moreover a humus rich fertile soil is need for black pepper (SIVARAMAN et al., 1999). But, as the region already lacked soil fertility due to years of poor farm management practices, large amounts of manure and fertilizers was applied by all the categories of farmers. With regard to inputs used by certified categories, in line with certification requirements, the organic and the joint organic fair trade farmers used manure, bio fertilizers and bio pesticides. But as these were smallholders with less than 1 hectare of black pepper area, they did not have the means to produce sufficient quantities of compost on their own. Also there was shortage of labor in the region making hired labor expensive and maintaining compost costly. Thus, these farmers had to depend on buying organic manure, fertilizers and pesticides from outside the farm resulting in high material input costs.

Also, most certified farms, especially the joint certified farms had conventional pepper farms near them who used high amount of pesticides as the region was known for its pests and disease problems (HEMA et al., 2007). Hence the susceptibility of certified farmers, particularly the joint organic fair trade certified farmers being exposed to pests were high (ZEHNDER et al., 2007). However, the NGO assisted both the categories of certified farmers in adequate application of bio fertiliser and pesticides to improve soil fertility and reduce pests.

4. Methodology

The simplest method to model the impact of adoption on quantity of black pepper produced per hectare or input costs per hectare, is an ordinary least square regression, where two dummies denote organic (1 organic and, 0 otherwise) and joint organic and fair trade certification (1 joint organic and fair trade and, 0 otherwise). But this can lead to biased results as it treats adoption as exogenous whereas it could possibly be endogenous.

Hence, to account for endogeneity and self-selection bias, we apply a multinomial endogenous switching regression along with a counterfactual analysis following DI FALCO and VERONESI (2013) and TEKLEWOLD et al. (2013). It is a two-step model. First, we use a selection equation to correct for multinomial selection bias and use the selection correction terms generated from the multinomial logit model as generated regressors in the regression. Second, we implement a counterfactual analysis to estimate the yield and cost impact of certified farmers in case they were non-certified and vice-versa.

4.1Modelling selection and outcome equations

In this article, the farm household is confronted with no certification option and two certification options namely; organic and joint organic and fair trade. We define the chosen system of pepper farming of the household as: s = 1 if no certification is chosen or the household follows conventional farming, s = 2 if organic certified pepper farming is chosen and s = 3 if joint organic and fair trade certified pepper farming is practised. Hence, a household will choose a farming system 3 if this system helps in maximising yield and reducing costs over another farming system r (BOURGUIGNON, FOURNIER and GURGAND 2007). We state this in terms of a multinomial logit model as a selection equation following MCFADDEN (1973) in the first stage as described below:

$$\left(\begin{array}{c} probability\ of\ household\ h, \\ choosing\ farmimg\ system\ s\ over\ another\ system\ r \end{array}\right) = \frac{\exp(\beta s X h)}{\sum_{r=1,2}^{3} \exp(\beta r X h)} \qquad (1)$$

Then an ordinary least square regression (OLS) is estimated by including the selection correction terms calculated from the selection equation entering the OLS as generated regressors. We use the same multinomial selection equation that identifies the drivers of adoption of organic and fair trade certification by smallholder black pepper farmers for the yield and material input cost outcome regressions. However the explanatory variables used slightly vary between the yield and material cost outcome regressions.

Drawing from Dubin and MCFADDEN (1984) and BOURGUIGNON, FOURNIER and GURGAND (2007) and applying the Normalized Dubin McFadden (DMF 2) model, the multinomial selection corrected OLS yield and cost equation for the three management categories are:

$$P_{h1} = X_h\alpha_1 + \delta_1\Omega_1 + e_{h1} \qquad if\ P_{h1}^* > \max_{r\neq 1}(P_{hr}^*) \qquad (2a)$$

$$P_{h2} = X_h\alpha_2 + \delta_2\Omega_2 + e_{h2} \qquad if\ P_{h2}^* > \max_{r\neq 2}(P_{hr}^*) \qquad (2b)$$

$$P_{h3} = X_h\alpha_3 + \delta_3\Omega_3 + e_{h3} \qquad if\ P_{h3}^* > \max_{r\neq 3}(P_{hr}^*) \qquad (2c)$$

In the above equations (2a), (2b) and (2c), P_{h1}, P_{h2} and P_{h3} represent the dependent variable pepper quantity produced per hectare and material cost of inputs in logarithm form for each farming systems conventional, organic and joint organic and fair trade certified respectively. X_h refers to explanatory variables, δ_r refers to the covariance between the errors of the multinomial logit and the OLS model and Ω_r is the inverse mills ratio calculated from the probabilities estimated in equation (1). e_h is an error term with mean value zero following the DMF 2 model.

As using generated regressors can lead to heteroskedasticity, the standard errors are bootstrapped in the outcome regressions. Moreover, selection instruments based on falsification tests as suggested by DI FALCO, VERONESI and YESUF (2011) are included for the identification of the model. Falsification tests allow variables to be used as selection instruments if they affect the adoption of certification decision in the multinomial logit selection equation but not the yield or cost of black pepper produced by non-adopters or conventional farmers. Also, it needs to be noted that irrespective of the Independent of Irrelevant Alternatives (IIA) limitation of the multinomial logit model, BOURGUIGNON, FOURNIER and GURGAND (2007, p.199) state that “selection bias correction based on the multinomial logit model can provide a fairly good correction for the outcome equation, even when the IIA hypothesis is violated.”

4.2 Estimating and analysing counterfactual outcomes

In the second stage a counterfactual analysis is implemented to ascertain the yield and cost impacts of conventional farmers in case of certification and vice-versa drawing from CARTER and MILON (2005), DI FALCO and VERONESI (2013) and TEKLEWOLD et al. (2013) . For example, we ascertain the amount of black pepper quantity produced per hectare by organic farmers if they were conventional and vice-versa. Hence, as we have three farm management regimes, we have nine counterfactual cases as presented in table 1.

Cases (3)(3), (2)(2) and (1)(1) refer to actual log quantity produced per hectare and actual log material input costs per hectare for joint organic fair trade, organic and conventional farmers respectively. Cases (3)(2) and (3)(1) show counterfactual yield and cost outcomes for joint organic fair trade farmers in case they were only organic and conventional respectively. Similarly cases (2)(3) estimates counterfactual yield and cost outcomes for organic farmers in case they were also fair trade certified and (2)(1) calculates the yield and cost outcomes for organic farmers if they were conventional. Correspondingly, cases (1)(3) and (1)(2) computes counterfactual yield and cost outcomes for conventional farmers if they were joint organic fair trade certified and if they were only organic certified respectively.

We calculate ATT and ATU effects following HECKMAN et al. (2001). ATT is the average treatment effect on the treated. It shows the counterfactual difference in outcomes of joint organic fair trade farmers if they were organic as the difference between (3)(3) - (3)(2) and if they were conventional as the difference between (3)(3) - (3)(1). The counterfactual differential outcomes of organic farmers in case they were conventional is represented as (3)(3) – (3)(2). ATU refers to the average treatment effect on the untreated. It refers to the counterfactual outcomes of conventional farmers in case they were joint organic fair trade or only organic as (1)(3) - (1)(1) and (1)(2) - (1)(1) respectively. The counterfactual outcome of organic farmers in case they adopted fair trade is calculated as difference between (2)(3) - (2)(2).

Drawing from CARTER and MILON (2005) and DI FALCO, VERONESI and YESUF (2010), we expand their binary counterfactual analysis model to calculate heterogeneity effects to a multinomial context. This is to understand if for example farm households that were certified may have produced more than conventional households not because they were certified but because of unobservable characteristics like farming management skill and efficiency.

$BH_{3(A)}$ and $BH_{3(B)}$ denotes the base heterogeneity effects for the farm households that decided to adopt joint organic fair trade as the difference between {(3)(3) - (2)(3) } and {(3)(3) - (1)(3)} respectively. $BH_{3(C)}$ refers to the difference in base heterogeneity effects of organic and conventional farmers in case they were joint organic fair trade certified. It is calculated as the difference between {(2)(3) - (1)(3)}.

Likewise, $BH_{2(A)}$ and $BH_{2(C)}$ refer to BH effects for joint organic fair trade certified and conventional households in case they were organic as the difference between {(3)(3) - (2)(2)} and {(2)(2) - (1)(2)} respectively. $BH_{2(B)}$ denotes the BH effects of joint organic fair trade certified households and conventional households in case they were organic as the difference between {(3)(2) - (1)(2)}. Equally, $BH_{1(B)}$ and $BH_{1(C)}$ refer to the BH effect for conventional households in case they were joint organic fair trade certified and only organic certified as the difference between {(3)(1) - (1)(1) } and {(2)(1) - (1)(1)} respectively. Also $BH_{1(A)}$ estimates the BH effects for joint organic fair trade certified households and only organic certified households in case they were conventional as the difference between {(3)(1) - (2)(1)}

We also finally estimate Transitional Heterogeneity (TH) effects to investigate if the effect of certification on yield and cost is larger or smaller for farm households that were certified or for those who were conventional in the counterfactual case they were certified as the difference between ATT and ATU. TH_1 shows the difference between the ATT of joint organic fair trade farmers in case they were only organic and the ATU of organic farmers in case they were joint organic fair trade certified as (a) – (d). TH_2 shows the difference between the ATT of joint organic fair trade farmers in case they were conventional and the ATU of conventional farmers in case they were joint organic fair trade certified as (b) – (e). TH_3 shows the difference between the ATT of organic farmers in case they were conventional and the ATU of conventional farmers in case they were organic certified as (c) – (f).

5. Results

The definition of variables used in regression and its descriptive statistics are presented in table 2. Regarding household characteristics, we find that certified farmers are older but not necessarily better educated compared to conventional farmers. Almost 97% of smallholder farmers under the joint organic and fair trade regime have access to credit. This could be due to the fair trade principle of extending advance credits to producers when required. Off-farm income is less than 50% for all the categories of farmers indicating that these are predominantly agricultural households. Almost all the categories of households own livestock although certified farmers have more farm tools indicating that they may follow more mechanized agriculture than conventional farmers. Certified farmers also have a comparatively larger pepper area that may be conducive to mechanized farming using small farm tools. Regarding years of organic farming we find that organic farmers have been practicing eco-friendly agriculture for less than a decade whereas the joint certified category have been following organic methods of pepper cultivation for more than a decade.

The details like inputs used relate only to black pepper production. This helps to ensure that apart from differences in agricultural practices, both adopters and non-adopters are exposed to the same climatic factors and cropping period. This is to confirm that any differences in black pepper quantity produced are only due to the agricultural practice followed and not due to any other intervention.

The net revenue details from black pepper are presented in table 3. In terms of black pepper land the certified farmers have significantly larger land size compared to conventional farmers. The joint organic fair certified farmers are able to sell black pepper at a significantly better price in contrast to the other two categories. As found by BEUCHELT and ZELLER (2011) higher prices do not necessarily translate to high net revenues as yield and costs also play important roles.

Organic farmers have significantly higher yields even in comparison to the joint organic fair trade certified farmers. This could be because during the survey year there was a severe pest attack in the region. But, organic farmers who have been practicing organic farming for less than a decade but more than 5 years appear to have been more resistant against the pest attack. Also as most of the organic farms were surrounded by other organic pepper farms or conventional coffee and tea farms the intensity of attack was probably lower. Whereas, the joint organic fair trade farms were mostly surrounded by conventional pepper farms which increased their exposure to pest attack. Although, ALTIERI and NICHOLLS (2003) find that organic farming can lead to better plant resistance against pest, we find that the joint organic fair trade farmers who have been committed to organic for more than a decade (table 2) seem to have been less resistant to pests.

Literature is mixed regarding whether organic farming is associated with lower pest levels. CROWDER et al. (2010) based on potato field enclosure experiments claim that organic agriculture provides strong pest control and thereby lead to increased yields. But, they also suggest that these results may change outside field enclosures. On the contrary, MACFADYEN et al. (2009), find that there is no significant difference in pest control between organic and conventional agriculture among arable crops. Likewise, BENGTSSON et al. (2005) support the perception that pest damage is not different between organic and conventional farms. Our results indicate that organic farming with time may be less resistant to pest attacks and need more quantities of bio pesticides.

Also farmers need adequate fertilizers and manure to maintain yield levels. All categories of farmers spent more on manure than fertilizers because they have a greater influence in increasing soil biological activity and thereby nutrients in the soil as found by EDMEADES (2003). Conventional farm´s reduced consumption of manure and fertilizers in comparison to certified category do not necessarily point to low levels of nutrient requirements in chemical agriculture. It signifies the possibility that these farmers may not have the means to buy adequate quantities of these inputs to increase yields and hence maybe rationing fertilizer and manure application (DUFLO et al., 2009). This also indicates that conventional farmers who also have smaller farm size may be considerably poorer than the certified groups.

With regard to certified farmers, manure is an important ingredient to help improve soil quality in sustainable agriculture (KUMAR et al., 2005). As the joint organic fair trade farmers were facing severe pest attack they needed more manure to increase supply of nutrients to soil. But as our sampled farmers were smallholders, they did not have adequate capacity for producing sufficient quantities of own compost heaps (BRANCA et al., 2011). Hence, as most of this manure, bio fertilizers and bio pesticides were procured outside the farm it proved expensive and reduced net revenue from black pepper for the joint certified category.

Total labor days are almost the same for conventional and organic farmers compared to the joint organic and fair trade farmers indicating that the joint certified category may be relatively more mechanized than the other groups. Nevertheless, all the categories of farmers reported labor shortage and increasing labor costs as found in other studies like UEMATSU and MISHRA (2012). This made it increasingly difficult especially for the certified farmers to make sufficient quantities of own composting heaps, making them dependent on external farm inputs.

Overall, organic farmers have the highest net revenue in spite of receiving the lowest selling price per kilogram of pepper. This can be attributed to high yields and low costs of organic pepper. Nevertheless, the higher yields of certified farmers in comparison to conventional can be attributed to the technical support and training provided by the NGO. It has made the farmers in the region aware and knowledgeable on the workings of alternative agriculture.

5.1 Selection equation

We use Stata command selmlog13 following BOURGUIGNON et al. (2002) to implement our selection and outcome regressions. We use variables distance to market and attitude towards risk, soil fertility and food safety as selection instruments based on falsification tests. The Wald test on these variables shows that they are credible to be used as exclusion restrictions as they significantly and jointly affect the decision to adopt in the multinomial regression but does not jointly affect the quantity of pepper produced per hectare and input costs per hectare of conventional farmers[2].

The results of the multinomial logit selection equation are presented in table 4 with conventional farmers as the base category. Younger farmers but those with experience in farming choose certified organic systems as found in WHEELER (2008). Black pepper growers owning farm tools are more likely to opt for certified and alternative farming systems. Consistent with literature a larger farm size drives organic adoption (e.g. MUSARA, 2012; CHOUICHOM and YAMAO, 2010). Also, farmers as expected prefer to convert to organic systems when their pepper plants are younger in order to gain maximum benefits from certification. Shorter distance to market plays a significant role in farmer´s decision to venture into organic systems as this could directly translate to lower transportation costs (DADI et al., 2004). Also, if organic conversion is less risky, farmers are more likely to implement it.

With regard to joint organic fair trade certification even the less educated organic farmers decided to venture into fair trade schemes. Perhaps, this could be due to the awareness programs conducted by the

[2] Wald falsification test results will be provided on request

NGO in the study region. Also, having an off-farm income significantly affects adoption as it can help during organic conversion period when the yields are low as well as with certification costs. Similarly owning farm tools also significantly contributes towards farmers choosing joint organic fair trade certification schemes. As with organic farming larger farm size and distance to market plays a significant role in the joint implementation of organic and fair trade schemes. Also if the farmers believe in soil friendly and soil nurturing agriculture, they are more likely to choose joint organic and fair trade systems.

5.2 Yield effects

5.2.1 Outcome equation: Yield

We use the log-log specification of the dependent variable quantity of black pepper produced per hectare and input costs in logarithm form following the Akaike information criteria (AIC) (GREENE, 2008). The AIC for log-log model was the least at 778 while it was 799 for the log-linear model. The AIC for the linear model was 4913 and for the linear log model it was 5089.

The results of the yield multinomial endogenous outcome equation are depicted in table 5. Long labor hours significantly increases conventional as well as joint organic fair trade yield. However with time there is a possibility that yields from organic farming may significantly decline. Nonetheless, once organic farmers join fair trade this yield decline will not be significant. A larger pepper area also increases organic yield.

With respect to joint organic fair trade certification younger but experienced farmers are more productive. Also, a larger household size increases black pepper yield of the joint certified regime. As seen from table 2 the joint certified members had less hired labor and mostly relied on household labor supply. Owning farm tools also increases yield. Having access to off-farm income may reduce focus on farming to a hobby and therefore is negatively related to yield. Also as expected, as the age of the pepper plant increases it is likely to become less productive.

Also, all the selection correction terms are not significant indicating that venturing into organic and joint organic and fair trade certification systems will have the same yield impact on conventional farmers, if they choose to enter such certification systems as those farmers who have already implemented them.

5.2.2 ATT, ATU and Heterogeneity effects: Yield

The treatment and heterogeneity yield effects are presented in table 6 following the methodology described in table 1. Columns (3)(3), (2)(2) and (1)(1) show the actual log quantity produced per hectare by the joint organic fair trade certified, the organic certified and the conventional farmers respectively. All other columns depict counterfactual outcomes. Columns (a), (b) and (c) present ATT effects and columns (d) (e) and (f) show ATU effects. As we express the quantity of black pepper produced per hectare in log form, we can interpret the results in percentage (Amare et al., 2012).

ATT results show that the log yield of the joint certified organic fair trade farmers will significantly decline by 82% (column (b)) if they become conventional and by 103% (column (a)) if they drop fair trade certification. This confirms that those farmers who have chosen joint certification schemes have maximized their yield prospects through their farming strategy. In the case of organic farmers, ATT findings in column (c) indicate that their yield will fall by 68% if they start using chemical methods of farming.

With regard to the ATU results of conventional farmers, we find that conventional farmers will increase their yield by 35% and 70% (column (e), (f)) by choosing a joint organic fair trade and organic methods of farming respectively. This indicates that conventional farmers will benefit from certified farming systems.

The Base Heterogeneity results $BH_{3(A)}$, $BH_{3(B)}$ and $BH_{3(C)}$, indicate that organic farmers under the counterfactual setting of adopting fair trade certification will perform better than existing joint certified farmers and conventional farmers if they adopted joint organic and fair trade certification in terms of yield. However, their current yield will decline as pointed out by the ATU results in column (d) though not significantly.

$BH_{2(A)}$, $BH_{2(B)}$ and $BH_{2(C)}$ indicate that conventional farmers will gain the most if they venture into organic farming. They have some unobservable characteristics like faming skill that enable them to become more productive under the counterfactual setting in case they were organic. This is also confirmed by the ATU results in column (f).

$BH_{1(A)}$, $BH_{1(B)}$ and $BH_{1(C)}$ depict that organic and conventional farmers have some unobservable characteristics that make them better farmers in comparison to the joint certified category. It also highlights that choosing a joint organic and fair trade certification has benefited the joint certified farmers in terms of yield outcomes.

Transitional heterogeneity effect for TH_1 and TH_2 is positive indicating that the effects are significantly higher for the joint certified category in comparison to organic and conventional farmers respectively. Also, TH_3 is negative implying that the effect is smaller for organic farmers in comparison to conventional farmers though not significant.

Overall, these results indicate that certified farming increases yield. Also, it needs to be noted that there are some important sources of heterogeneity that makes the joint certified farmers less productive under the counterfactual settings, in case they were organic or conventional. Hence, by opting for the joint certified farming system they seem to have made the right decision in terms of yield performance.

5.3 Cost effects

5.3.1 Outcome equation: Cost

We use the log-log model as it had the least AIC of 1320 compared to other linear functional forms. The dependent variable is the log cost of material inputs per hectare which includes expenses on manure, fertilizers and pesticides consisting of insecticide and fungicide. The results of the cost outcome equation presented in table 7 shows that the cost of inputs of conventional pepper farming decreases with plant age. Also applying insecticides increase costs as expected. With regard to organic farming, having access to farm tools significantly lowers expenses on bio fertilisers and bio pesticides. With increasing years of organic farming costs are likely to increase. It is significant for the joint organic fair trade as they have been practicing organic farming longer in comparison to the organic category. Overall, these results indicate that a significant increase in costs for all the categories of farmers is due to manure expenses.

With regard to the selection correction terms, similar to the yield outcome equation, almost all of them are not significant. This implies that choosing organic and joint organic fair trade networks will have the same impact on input costs for conventional farmers, if they opt for organic or joint organic fair trade certification respectively. However, this is not the case for conventional farmers if they choose organic as the selection correction term of conventional farmers under organic certification is significant. This suggests that if conventional farmers choose organic, cost effects may not be the same as current organic farmers.

5.3.2 ATT, ATU and Heterogeneity effects: Cost

The material cost treatment and heterogeneity effects are depicted in table 8 following table 1. Similar to yield effects, column (3)(3), (2)(2) and (1)(1) show the actual log material input costs per hectare by the joint organic fair trade certified, the organic certified and the conventional farmers respectively. All other columns depict counterfactual outcomes. Columns (a), (b) and (c) present ATT effects and columns (d) (e) and (f) show ATU effects. As we also express input costs per hectare in log form, we interpret the results in percentage (Amare et al., 2012).

ATT results show that the costs of the joint certified organic and fair trade farmers will significantly increase by 81% (column (b)) if they become conventional. However if they opt out of fair trade and retain organic their costs will decline (column (a)). This could be because as joint certified farmers have been practicing organic for a longer time period, with increasing years of practicing organic their yields may decline and to maintain their yields they need to invest more in manure, bio fertilizers and pesticides. In the case of organic farmers, ATT findings in column (c) indicate that their costs will fall by 120% if they start using chemical methods of farming. It indicates that bio fertilizers and pesticides if bought from outside can be expensive.

With regard to the ATU results of conventional farmers, we find that conventional farmers can decrease their costs by choosing organic (column (f)) and significantly decrease costs by 150% (column (e)) by choosing a joint organic fair trade certification. This denotes that conventional farmers will benefit from certified farming systems but more so from a joint organic fair trade certification in terms of cost reduction. With regard to organic farmers, the ATU results indicate that their costs may increase if they venture into fair trade networks and it is currently favorable for them if they remain organic.

The Heterogeneity results $BH_{3(A)}$, $BH_{3(B)}$ and $BH_{3(C)}$, show that conventional farmers under the counterfactual setting of adopting joint organic fair trade certification will perform better than existing joint certified farmers and organic farmers if they adopted joint organic fair trade certification. Hence, it is conducive for conventional farmers to choose a joint organic fair trade certification if they want to decrease their costs of inputs.

$BH_{2(A)}$, $BH_{2(B)}$ and $BH_{2(C)}$ indicate that conventional farmers will also gain if they venture into organic farming. However as indicated by the ATT results they will have a further significant decrease in costs if they venture into a joint organic fair trade system.

$BH_{1(A)}$, $BH_{1(B)}$ and $BH_{1(C)}$ depict that organic and conventional farmers have some unobservable characteristics that make them better farmers in comparison to the joint certified category. It also highlights that choosing a joint organic and fair trade certification has benefited the joint certified farmers to reduce costs to a certain extent.

Transitional heterogeneity effect for TH_1 is positive indicating that the effects are significantly higher for the joint certified category in comparison to organic farmers. It is also higher in comparison to conventional farmers though not significant (TH_2). Also, TH_3 is positive implying that the effect is larger for organic farmers in contrast to conventional farmers

To sum up, base heterogeneity results show that conventional farmers have some unobservable characteristics that enable them to produce at lower input costs in comparison to the other two groups even under a counterfactual setting. Also the positive transitional heterogeneity effects indicate that both the categories of certified farmers have chosen strategies that have helped them to minimize costs in comparison to a counterfactual setting.

6. Conclusions

The objective of this study was to examine whether a joint organic and fair trade certification can provide a light at the end of the tunnel. In this context, we investigated whether organic and fair trade systems can help to increase black pepper yields and lower material input costs to combat domestic pepper crisis in

India. We use a cross-sectional household survey data of 277 smallholder black pepper farmers in Kerala, India to examine yield and cost effects of certification. We apply a multinomial endogenous switching regression that controls for selection bias along with a counterfactual analysis expanded to include heterogeneity effects to investigate certification impacts.

The main finding is that, contrary to conventional expectations, organic farming can increase yields and if combined with fair trade can also reduce costs. An interesting finding as revealed by the counterfactual analysis is that organic and fair trade adoption by conventional farmers would lead to higher yield gains and cost savings compared to the loss of organic and joint organic fair trade farmers had they not adopted their respective certifications. This suggests that both the categories of certified farmers, organic and the joint organic fair trade farmers have chosen agricultural strategies that would maximize their quantity of black pepper produced per hectare. Both these categories of farmers would have been less productive under a counterfactual setting.

A key outcome of this article based on heterogeneity analysis is that the impact of certification on yield and material cost is larger for the joint organic and fair trade certified farmers implying that joint organic fair trade certified agriculture is more essential for those farm households who have less competence to produce. Therefore, joint organic fair trade certification can be used as a farming strategy by vulnerable households to close the gap with more productive smallholder households.

Furthermore, overall results combining yield and costs effects indicate that conventional farmers can increase yields and reduce material input costs if they adopt a joint organic and fair trade certification. These yield results are in line with RUBEN and FORT (2012), VALKILA and NYGREN (2009) and BARHAM et al. (2011) and cost effects similar to VALKILA (2009) and BOLWIG et al. (2009). The major lesson learnt is that although organic black pepper farming in the initial years is resistant to pests and helps in increasing yields nevertheless with time it may become less resistant to pest attack leading to increasing input costs to maintain yields. Although conventional wisdom dictates that organic farming will build up the ecosystem with natural control and resilience, it is possible as suggested by PIMENTAL (1993) and PIMENTAL et al. (2005) that pest control under organic farming may be crop dependent and certain crops may be more susceptible to pests under chemical free agriculture. KLONSKY and TOURTE (1998) argues that although conventional and organic farms have the same amount of pests, organic farmers are better able to control diseases using biological pest control and bio pesticides. Also, organic farming increases the use of bio fertilizers manure and bio pesticides (KLEEMANN and ABDULAI, 2013). As the inputs when procured from outside the farm can be expensive, smallholder organic farmers with an added fair trade certification may be better equipped to meet these expenses with improved access to credit facilities under fair trade networks. Hence, conventional farmers may witness a moderate increase in yields and significant reduction in material input costs, as bio pesticides may be cheaper than synthetic, if they venture into joint organic fair trade regimes in the long run. Also, the yield increase and cost decline among certified producers can be perhaps attributed in this study to the technical assistance and guidance on alternative agricultural systems provided by the NGO.

Therefore, we submit that a joint organic fair trade certified agriculture does have the potential to help India increase its pepper productivity. Nevertheless, it is possible that certain crops are more suitable for organic cultivation than others (SINKKONEN, 2002). Therefore, crop specific studies may give different results. But farmers should have adequate knowledge of unconventional methods of farming and accessibility to necessary training and support to make organic and fair trade schemes a success for any crop.

These findings are also relevant for designing effective strategies and programmes to promote certified organic and fair trade management regimes in other developing countries. Developing policies can be crucial in promoting implementation of such sustainable practices that help in increasing yield at reduced input costs. Furthermore, developing joint organic and fair systems as a strategy for the less productive farmers can play a critical role towards contributing to food security in the less developed world.

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Table 1: Counterfactual Analysis: Treatment and Heterogeneity Effects

	Farm Management Regimes	(3) **OFT**	(2) **ORG**	(1) **CO N**	**ATT**	
(3)	**OFT**	$E(P_{h3} \mid P_h = 3) = X_h\alpha_3 + \delta_3 g_3$	$E(P_{h2} \mid P_h = 3) = X_h\alpha_2 + \delta_2 g_3$	$E(P_{h1} \mid P_h = 3) = X_h\alpha_1 + \delta_1 g_3$	(a) *OFT to ORG* (3)(3) - (3)(2)	(b) *OFT to CON* (3)(3) - (3)(1)
				$E(P_{h1} \mid P_h = 2) = X_h\alpha_1 + \delta_1 g_2$		(c) *ORG to CON* (2)(2) - (2)(1)
(2)	**ORG**		$E(P_{h2} \mid P_h = 2) = X_h\alpha_2 + \delta_2 g_2$		**ATU**	
		$E(P_{h3} \mid P_h = 2) = X_h\alpha_3 + \delta_3 g_2$			(d) *ORG to OFT* (2)(3) - (2)(2)	
(1)	**CON**	$E(P_{h3} \mid P_h = 1) = X_h\alpha_3 + \delta_3 g_1$	$E(P_{h2} \mid P_h = 1) = X_h\alpha_2 + \delta_2 g_1$	$E(P_{h1} \mid P_h = 1) = X_h\alpha_1 + \delta_1 g_1$	(e) *CON to OFT* (1)(3) - (1)(1)	(f) *CON to ORG* (1)(2) - (1)(1)
	Heterogeneity Effects	$BH_{3(A)} = (3)(3) - (2)(3)$	$BH_{2(A)} = (3)(2) - (2)(2)$	$BH_{1(A)} = (3)(1) - (2)(1)$	TH (ATT - ATU)	
		$BH_{3(B)} = (3)(3) - (1)(3)$	$BH_{2(B)} = (3)(2) - (1)(2)$	$BH_{1(B)} = (3)(1) - (1)(1)$	$TH_1 = (a) - (d)$ $TH_2 = (b) - (e)$ $TH_3 = (c) - (e)$	
		$BH_{3(C)} = (2)(3) - (1)(3)$	$BH_{2(C)} = (2)(2) - (1)(2)$	$BH_{1(C)} = (2)(1) - (1)(1)$		

Note: OFT: Organic and Fair Trade, ORG: Organic, CON: Conventional, ATT: Average Treatment Effect on the Treated, ATU: Average Treatment Effect on the Untreated, BH: Base Heterogeneity and TH: Transitional Heterogeneity
Source: Adapted from Di Falco et. al. (2011), Modified

Table 2: Descriptive Statistics of Variables used in Regression

Variable Name	Description	Total Sample (277)		Conventional (90)		Organic (98)		Organic and Fair Trade (89)	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
Household characteristics									
Age	age of the household head in years	52.602	11.417	50.944	11.364	52.214	10.937	54.707	11.785
Years of schooling	education of the household head in years	9.090	3.211	9.411	3.331	9.755	3.022	8.033	3.054
Farm experience	farm experience of the household head in years	31.791	12.848	28.744	12.091	32.836	11.959	33.719	14.063
Total household Size	total number of members of the farm household	4.335	1.401	4.367	1.433	4.357	1.262	4.281	1.522
Dependency ratio	the total household members below 15 and above 65 divided by the rest of the household members	0.414	0.510	0.400	0.520	0.464	0.489	0.374	0.523
Access to credit	dummy = 1 if household had access to credit	0.877	0.328	0.822	0.384	0.846	0.361	0.966	0.181
Have off-farm income	dummy = 1 if household had access to off-farm income	0.357	0.480	0.356	0.481	0.316	0.467	0.404	0.493
Assets									
Have livestock	dummy = 1 if household has livestock	0.628	0.484	0.611	0.490	0.571	0.497	0.707	0.457
Have farm tools	dummy = 1 if household has farm tools	0.577	0.494	0.222	0.418	0.734	0.443	0.764	0.426
Pepper details									
Quantity produced per ha	black pepper quantity produced per hectare in kg in logarithm	6.141	1.177	5.569	1.262	6.563	1.198	6.254	0.781
Pepper area	Farm area of pepper in hectares	0.428	0.448	0.276	0.304	0.419	0.271	0.590	0.635

Plant Age	age of the black pepper plant in years	11.418	6.115	14.822	5.982	8.857	4.818	10.797	5.998
Years of organic farming	years practicing certified organic pepper farming	6.133	5.411	-	-	6.887	3.847	11.505	2.684
Input costs									
Manure material cost per ha	cost of manure used per ha in logarithm	6.248	5.091	2.623	3.725	6.711	4.672	9.404	4.410
Other material cost per ha	cost of other inputs used per ha in logarithm	1.627	3.324	1.257	2.979	0.229	1.322	3.539	4.213
labor use	total labor (family + hired labor) use per hectare in days in logarithm	4.225	1.005	4.327	1.257	4.481	0.818	3.839	0.775
Selection instruments									
Distance to market	logarithm of distance from the farm to point of sale in km i.e. market for conventional farmers and NGO for certified farmers	3.486	4.631	5.427	7.459	2.544	1.625	2.514	1.450
Attititude towards risk	dummy = 1 if farmer is risk loving	0.642	0.480	0.744	0.438	0.561	0.498	0.629	0.487
Attitude towards soil fertility	dummy = 1 if farmer believes in soil and environment friendly farming	0.234	0.424	0.100	0.301	0.173	0.380	0.438	0.498
Attitude towards food safety	dummy = 1 if farmer believes in producing safe food without the use of chemicals	0.238	0.426	0.144	0.353	0.255	0.438	0.314	0.466

Note: SD refers to standard deviation
Source: Own calculation based on household survey 2012

Table 3: Net Revenue from Black Pepper

Particulars	**Conventional**	**Organic**	**Conventional - Organic** (Mean Difference)	**Organic and Fair Trade**	**Conventional - Organic and Fair Trade** (Mean Difference)	**Organic - Organic and Fair Trade** (Mean Difference)
Pepper area (in ha)	0.276	0.419	- 0.143***	0.590	- 0.314***	- 0.171**
Average price /kg (in INR)	366.233	264.469	101.764***	387.348	- 21.115***	- 122.879***
Yield	642.933	1644.194	- 1001.261**	699.427	- 56.494	944.767**
Gross revenue / ha (in ´000 INR)	233.47	413.28	- 179.81*	267.45	- 33.98	145.83*
Variable costs						
Manure / ha (in ´000 INR)	3.01	22.97	- 19.96***	118.76	- 115.75***	- 95.79***
Fertiliser /ha (in ´000 INR)	0.15	0.12	0.03	3.42	- 3.27*	- 3.30*
Pesticides						
Insecticide /ha (in ´000 INR)	3.25	0.01	3.24	3.77	- 0.52	- 3.76*
Fungicide / ha (in ´000 INR)	0.05	0.01	0.04	0.60	- 0.55	- 0.59
Total material input cost/ha (in ´000 INR)	6.46	23.11	-16.65**	126.55	-120.09***	-103.44***
Total labor days /ha	143.745	144.974	-1.229	62.805	80.940***	82.169**
Family labor days	132.487	132.917	-0.430	56.984	75.503***	75.933**
Hired labor cost (in ´000 INR)	10.83	8.58	2.25	5.11	5.72	3.47
Total variable cost (in ´000 INR)	17.29	31.69	- 14.40*	131.66	- 114.37***	- 99.97***
Net revenue from black pepper / ha (in ´000 INR)	216.18	381.59	- 165.41	135.79	80.39	245.80***

Note: ***, ** and *significance at 1%, 5% and 10% respectively. Material inputs of certified farmers refer to bio fertilizers and bio pesticides.
Source: Own calculation based on household survey 2012

Table 4: Multinomial Logit Regression – Selection Equation

Base Category - Conventional famers	Organic	Organic and Fair Trade
Household Characteristics		
Age	- 0.064 *	- 0.065
	(0.035)	(0.053)
Years of schooling	- 0.111	- 0.386 ***
	(0.088)	(0.105)
Farm experience (years)	0.068 ***	0.047
	(0.026)	(0.043)
Total Household size	- 0.102	- 0.334
	(0.191)	(0.211)
Dependency ratio	0.502	0.549
	(0.501)	(0.589)
Credit access (yes = 1)	- 0.370	0.680
	(0.479)	(0.770)
Have off farm income (yes = 1)	0.704	0.961 *
	(0.433)	(0.498)
Production Assets		
Have livestock (yes = 1)	- 0.276	0.325
	(0.406)	(0.480)
Have farm tools (yes = 1)	2.104 ***	3.034 ***
	(0.447)	(0.517)
Pepper Plant Details		
Pepper area in ha	1.932 *	3.113 ***
	(1.120)	(1.187)
Age of the pepper plant (years)	- 0.138 ***	- 0.056
	(0.032)	(0.038)
Selection instruments		
Market distance in km (log)	- 0.945 ***	- 1.111 ***
	(0.317)	(0.333)
Attititude towards risk	- 0.808 *	- 0.814 *
	(0.423)	(0.464)
Attitude towards soil fertility	0.796	2.009 ***
	(0.640)	(0.677)
Attitude towards food safety	0.632	0.386
	(0.552)	(0.651)
Constant	4.033 *	4.405 *
	(2.085)	(2.290)

Wald test on selection instruments (χ^2)	19.99 ***	24.03 ***
Number of Observations	277	
log pseudolikelihood	-195.26087	
Pseudo R2	0.3578	

Note: Robust standard errors clustered at panel level in parenthesis. ***significant at 1%, **significant at 5% and * significant at 10% level

Source: Own calculation based on household survey 2012

Table 5: Multinomial Endogenous Switching Regression - Yield Outcome equation

Base Category - Conventional famers	Conventional	Organic	Organic and Fair Trade
Dependent Variable	Log of quantity produced cost per ha		
Household Characteristics			
Age	0.042	0.013	- 0.028 **
	(0.029)	(0.018)	(0.012)
Years of schooling	- 0.001	0.061	0.027
	(0.081)	(0.059)	(0.048)
Farm experience (years)	- 0.035	0.001	0.022 *
	(0.026)	(0.016)	(0.011)
Total Household size	- 0.023	0.077	0.134 *
	(0.126)	(0.088)	(0.079)
Dependency ratio	0.100	0.282	0.061
	(0.346)	(0.275)	(0.221)
Credit access (yes = 1)	0.471	- 0.112	0.048
	(0.435)	(0.347)	(0.840)
Have off farm income (yes = 1)	0.103	- 0.080	- 0.540 ***
	(0.395)	(0.275)	(0.196)
Production Assets			
Have livestock (yes = 1)	0.052	- 0.260	0.176
	(0.413)	(0.304)	(0.200)
Have farm tools (yes = 1)	0.597	0.023	0.550 **
	(0.543)	(0.453)	(0.255)
Pepper Plant Details			
Pepper area in ha	0.262	1.078 *	0.211
	(0.854)	(0.562)	(0.222)
Age of the pepper plant (in years)	0.043	- 0.010	- 0.046 **
	(0.040)	(0.028)	(0.021)
Years practising organic farming		- 0.067 **	- 0.013
		(0.030)	(0.040)
Input Expenses			
Manure material costs (log)	0.000	- 0.005	0.002
	(0.040)	(0.034)	(0.020)
Other material costs (log)	- 0.007	- 0.132 *	- 0.000
	(0.061)	(0.079)	(0.017)
Total labor days per ha (log)	0.383 *	1.139 ***	0.208 *
	(0.212)	(0.171)	(0.123)

Selection Bias Correction terms			
_m1 (δcon)	0.532	- 0.022	- 1.486
	(1.093)	(1.337)	(1.196)
_m2 (δorg)	-0.826	- 0.019	0.214
	(2.023)	(0.609)	(1.007)
_m3 (δoft)	3.047	- 0.832	- 0.427
	(2.803)	(1.523)	(0.586)
Constant	1.617	- 0.226	5.697 ***
	(2.383)	(1.395)	(1.312)

***significant at 1%, **significant at 5% and * significant at 10% level
Source: Own calculation based on household survey 2012

Table 6: Yield Effects from Counterfactual Analysis

	Farm Management Regimes	(3) **OFT**	(2) **ORG**	(1) **CO N**	**ATT**	
					(a) OFT to ORG	**(b) OFT to CON**
(3)	**OFT**	6.254 (0.060)	5.222 (0.109)	5.434 (0065)	1.032 *** (0.205)	0.820 *** (0.070)
						(c) ORG to CON
				5.876 (0.065)		0.687 *** (0.070)
(2)	**ORG**		6.563 (0.096)		**ATU**	
					(d) ORG to OFT	
		6.454 (0.058)			- 0.109 (0.073)	
					(e) CON to OFT	**(f) CON to ORG**
(1)	**CON**	5.927 (0.093)	6.273 (0.122)	5.569 (0.064)	0.358 *** (0.112)	0.704 *** (0.085)
	Heterogeneity Effects	$BH_{3(A)}$: - 0.200 ** (0.083)	$BH_{2(A)}$: - 1.341 *** (0.145)	$BH_{1(A)}$: - 0.442 *** (0.092)		
		$BH_{3(B)}$: 0.327 ** (0.111)	$BH_{2(B)}$: - 1.051 *** (0.164)	$BH_{1(B)}$: - 0.135 (0.091)	TH (ATT - ATU) TH_1 : 1.141 *** (0.090) TH_2 : 0.462 *** (0.133) TH_3 : - 0.017 (0.110)	
		$BH_{3(C)}$: 0.527 *** (0.110)	$BH_{2(C)}$: 0.290 * (0.155)	$BH_{1(C)}$: 0.307 *** (0.091)		

Note: CON – conventional, ORG – organic and OFT – organic and fair trade. Standard errors in parenthesis.
***significant at 1%, **significant at 5% and * significant at 10% level (Follows table 1)
Source: Own calculation based on household survey 2012

Table 7: Multinomial Endogenous Switching Regression - Cost Outcome equation

Base Category - Conventional famers	Conventional	Organic	Organic and Fair Trade
Dependent Variable	Log of material inputs per ha		
Household Characteristics			
Age	0.067	0.008	0.165
	(0.062)	(0.022)	(0.086)
Years of schooling	0.154	- 0.016	- 0.060
	(0.155)	(0.069)	(0.250)
Farm experience (years)	- 0.039	- 0.004	0.008
	(0.059)	(0.018)	(0.079)
Total Household size	0.011	- 0.071	0.328
	(0.295)	(0.113)	(0.406)
Dependency ratio	0.725	0.299	0.612
	(1.002)	(0.266)	(0.829)
Credit access (yes = 1)	- 1. 110	0.441	0.379
	(0.980)	(0.434)	(5.093)
Have off farm income (yes = 1)	- 0.534	0.343	- 0.146
	(0.898)	(0.321)	(1.025)
Production Assets			
Have livestock (yes = 1)	- 0.429	- 0.024	- 1.398
	(0.821)	(0.297)	(0.960)
Have farm tools (yes = 1)	- 0.802	0.656 *	1.727
	(1.372)	(0.353)	(1.425)
Pepper Plant Details			
Pepper area in ha	- 1.669	- 0.590	1.893
	(2.378)	(0.807)	(1.154)
Age of the pepper plant (in years)	- 0.212 **	- 0.016	0.150
	(0.101)	(0.030)	(0.103)
Years practising organic farming		0.050	0.291 *
		(0.046)	(0.166)
Input Expenses			
Use manure (yes = 1)	8.195 ***	11.943 ***	9.597 ***
	(0.901)	(0.291)	(1.854)
Use fertilizer (yes = 1)	4.267	1.078	0.553
	(4.865)	(0.689)	(0.816)
Use insecticide (yes = 1)	3.715 **	0.248	2.376
	(1.615)	(0.589)	(1.468)
Use fungicide (yes = 1)	- 0.427	- 0.830	- 0.570
	(2.370)	(0.515)	(0.934)
Total labor days per ha (log)	0.030	0.165	0.492

	(0.343)	(0.326)	(0.625)
Selection Bias Correction terms			
_m1 (δcon)	1.774	- 2.653	- 2.564
	(2.683)	(1.654)	(6.254)
_m2 (δorg)	11.157 **	- 0.462	- 4.697
	(5.626)	(0.674)	(5.210)
_m3 (δoft)	- 6.950	- 1.271	- 0.256
	(7.129)	(1.836)	(3.043)
Constant	0.293	- 4.617 **	-12.281 *
	(4.335)	(1.840)	(6.693)

***significant at 1%, **significant at 5% and * significant at 10% level
Source: Own calculation based on household survey 2012

Table 8: Cost Effects from Counterfactual Analysis

	Farm Management Regimes	(3) OFT	(2) ORG	(1) CO N	ATT	
					(a) OFT to ORG	**(b) OFT to CON**
(3)	**OFT**	9.379 (0.442)	8.181 (0.454)	10.194 (0.505)	1.198 *** (0.223)	- 0.815 * (0.442)
						(c) ORG to CON
				4.780 (0.482)		1.207*** (0.308)
					ATU	
(2)	**ORG**		5.987 (0.574)		**(d) ORG to OFT**	
		6.549 (0.522)			0.562 ** (0.183)	
					(e) CON to OFT	**(f) CON to ORG**
(1)	**CON**	0.555 (0.575)	1.721 (0.639)	2.062 (0.494)	- 1.507 *** (0.324)	- 0.341 (0.319)
	Heterogeneity Effects	$BH_{3(A)}$: 2.830 *** (0.684)	$BH_{2(A)}$: 2.194 ** (0.731)	$BH_{1(A)}$: 5.414 *** (0.699)	TH (ATT - ATU)	
		$BH_{3(B)}$: 8.824 *** (0.725)	$BH_{2(B)}$: 6.460 *** (0.783)	$BH_{1(B)}$: 8.132 *** (0.707)	TH_1 : 0.636 ** (0.288) TH_2 : 0.692 (0.548) TH_3 : 1.548 *** (0.444)	
		$BH_{3(C)}$: 5.994 *** (0.776)	$BH_{2(C)}$: 4.266 *** (0.860)	$BH_{1(C)}$: 2.718 *** (0.690)		

Note: CON – conventional, ORG – organic and OFT – organic and fair trade. Standard errors in parenthesis. ***significant at 1%, **significant at 5% and * significant at 10% level. (Follows table 1)
Source: Own calculation based on household survey 2012