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# Sustainability standards, gender, and nutrition among smallholder farmers in Uganda

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**Abstract**

*Sustainability standards are gaining in importance in global markets for high-value foods. While previous research has shown that participating farmers in developing countries may benefit through income gains, nutrition impacts have hardly been analysed. We use survey data from smallholder coffee farmers in Uganda – certified under Fairtrade, Organic, and UTZ – to analyse impacts on food security and dietary quality. Estimates of instrumental variable models and simultaneous equation systems show that certification increases calorie and micronutrient consumption, mainly through higher incomes and improved gender equity. In certified households, women have greater control of coffee production and monetary revenues from sales.*

*Keywords* — private standards, smallholder farmers, nutrition impact, gender, Uganda

JEL codes — I32; L15; O12; Q13; Q17

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# Sustainability standards, gender, and nutrition among smallholder farmers in Uganda

## 1. Introduction

Global food systems are undergoing a rapid transformation, with high-value market segments, private standards, and certification schemes gaining in importance (Berdegué et al., 2005; Reardon & Timmer, 2012). This transformation is partly driven by changing consumer preferences resulting from rising incomes, urbanization, and growing concerns for food safety and environmental and social consequences of agricultural production (Mergenthaler, Weinberger, & Qaim, 2009; Narrod et al., 2009). To address these concerns, various sustainability standards were introduced. In rich and emerging countries, market shares of products with sustainability labels are growing. Especially for high-value foods imported from developing countries – such as coffee, tea, cocoa, or tropical fruits – voluntary sustainability standards like Fairtrade, Organic, UTZ, or Rainforest Alliance are increasingly used for product differentiation (Henson & Humphrey, 2010; Holzapfel & Wollni, 2014). Many of these standards involve smallholder farmers. Hence, this trend towards "sustainable consumption" in rich countries may contribute to poverty reduction and rural development in poor countries.

There is a growing body of literature looking at the impact of sustainability standards on smallholder farmers in developing countries. Many of these studies have analysed the effects of participating in Fairtrade and Organic certification schemes for producers of coffee (Arnould, Plastina, & Ball, 2009; Bolwig, Gibbon, & Jones, 2009; Blackman & Naranjo, 2012; Jena et al., 2012; Ruben & Fort, 2012; Chiputwa, Spielman, & Qaim, 2015), cocoa (Jones & Gibbon, 2011), and tropical fruits (Ruben, 2008; Kleemann, Abdulai, & Buss, 2014). Most of these studies have analysed impacts in terms of output price levels and farm profits, some have also looked at household income and poverty. While the concrete results differ, and the specific institutional context plays an important role, a general conclusion is that smallholder farmers can indeed raise their income levels through participation in sustainability certification.

One question that has received much less attention in the existing literature is whether sustainability standards can also help to improve food security and nutrition among smallholder farmers. Undernutrition is still a widespread problem in many developing countries, and a large proportion of the undernourished people are smallholder farmers. Against this background, it is critical to better understand the linkages between agriculture and nutrition and to include nutrition dimensions into impact evaluation of agricultural programs (Hoddinott, 2012; Haddad, 2013; IFPRI, 2014). So far, little is known about the nutrition impacts of the food system transformation in developing-country farm households (Gomez & Ricketts, 2013). Income gains resulting from participation in high-value markets may contribute to improved nutrition. However, there is also evidence that agricultural commercialization can change gender roles within the farm household, often resulting in a lower share of the income being controlled by women (von Braun and Kennedy, 1994; Njuki et al., 2011). Since women tend to spend more on food and healthcare than men (Hoddinott & Haddad, 1995; Quisumbing & Maluccio, 2003), this shift in income control towards male household members might possibly lead to negative effects for dietary quality and nutrition.

We are aware of only one study that has looked into the effects of sustainability standards on food cosumption in farm households with a quantitative approach: using data from a small sample of farmers in Kenya, Becchetti & Costantino (2008) showed that Fairtrade certification is positively associated with food expenditures and dietary quality. Becchetti & Costantino (2008) used a relatively simple dietary quality index, and they did not analyze the causal chain behind the observed differences in diets between certified and non-certified households. Other studies looked at gender effects of standards, yet without linking these to dietary or nutrition outcomes (Utting-Chamorro, 2005; Lyon, Bezaury, & Mutersbaugh, 2010; Maertens & Swinnen, 2012). Some of the sustainability standards consider the promotion of gender equity as an important element (Lyon et al., 2010), which may have implications for income control and nutrition.

We contribute to this literature by analysing the nutrition impacts and impact pathways of sustainability standards among smallholder farmers in Uganda, where undernutrition is a sizeable problem. In particular, we use data from a comprehensive survey of smallholder coffee growers. In addition to uncertified farmers as a control group, the sample contains farmers who are certified under three different sustainability standards, namely Fairtrade, Organic, and UTZ. We use detailed food recall data to analyse impacts on household calorie and micronutrient consumption. Instrumental variable models are employed to control for possible selection bias. We also develop and estimate simultaneous equation systems to better understand causal chains, with a particular emphasis on income and gender effects.

## 2. Methodology

### *2.1 Measuring nutrition*

To analyse nutrition impacts of sustainability standards, we first need to identify appropriate indicators of nutrition. The most precise indicators of nutritional status are clinical measures (e.g., blood samples) and anthropometric data (Masset et al., 2012, IFPRI, 2014). However, clinical and anthropometric measures are less suitable to assess patterns of food security and dietary quality, which is what we concentrate on here. To analyse dietary patterns, data from household food consumption recalls are frequently used, which can be converted to calorie and nutrient values using food composition tables (Ecker & Qaim, 2011; Fiedler et al., 2012). We follow this approach and use calorie consumption levels to assess food security.

Furthermore, we use the consumption of important micronutrients to assess dietary quality. Micronutrient consumption is also a good proxy for dietary diversity, because fruits, vegetables, and animal products contain larger quantities of micronutrients than typical staple foods. We focus on iron, zinc, and vitamin A, because deficiencies in these micronutrients cause large public health problems in developing countries (Stein et al., 2008; IFPRI, 2014).

Details of the household survey are provided further below. Here, we only describe how the food consumption data were collected and used to derive the nutrition indicators. We conducted a food recall, asking survey respondents to report quantities of all foods consumed by the household during the last 7 days from own production, purchases, or any other source. To increase the accuracy of the responses, the food recall was carried out with the person in the households responsible for food preparation. The survey questionnaire included a breakdown of over 100 different food items. The reported food quantities consumed were converted to edible portions. These edible portions were then converted to quantities of calories and micronutrients, using recent food composition tables for Uganda (Hotz et al., 2012).

To enable comparison across households of different size and composition, consumption levels at the household level were divided by the number of adult equivalents (AE) living in each household. We define a food-secure household as one whose calorie consumption per AE is greater than or equal the minimum daily requirement of 2400 kcal for adult men. The recommended dietary threshold levels used for the three micronutrients are 18.27 mg/day/AE for iron, 15 mg/day/AE for zinc, and 625 μg RE/day/AE for vitamin A (FAO, WHO, & UNU, 2001).

While using household food consumption data has advantages to assess food security and dietary quality, the approach also has a few limitations (Bouis, 1994; de Haen, Klasen, & Qaim, 2011; Fiedler et al., 2012). First, by using a single 7-day recall we cannot account for seasonal variation in food consumption. The timing of our survey was shortly after the main harvest season, so that consumption levels may be somewhat higher than during other times of the year. Second, we are not able to account for intra-household food distribution. Third, the 7-day recall data measure consumption levels, which are only a proxy for actual food and nutrient intakes. Food wasted in the household or portions given to guests or fed to pets cannot always be fully accounted for, which may result in overestimated consumption levels. However, while these issues reduce the accuracy of the dietary assessments, they are unlikely to bias the impact estimates systematically, because they apply equally to certified and non-certified households.

*2.2 Modelling nutrition impacts*

We want to evaluate the impact of farmer participation in sustainability-oriented certification schemes on household nutrition. For this purpose, we start with a reduced-form model as follows:

$$N_i = \alpha_0 + \alpha_1 C_i + \alpha_2 X_i + \varepsilon_1, \quad (1)$$

where, $N_i$ is the nutrition indicator. In different regressions, we use household consumption of calories and micronutrients per AE as indicators of food security and dietary quality, as explained above. $C_i$ is the certification treatment variable, which we define in two different ways: (i) We use a treatment dummy that takes a value of one for certified farm households and zero otherwise. (ii) We use a continuous treatment variable measuring the number of years that a farm households has been certified already (duration); for non-certified households this variable takes a value of zero. $X_i$ is a vector of farm, household, and contextual variables that may influence nutrition, such as asset ownership, characteristics of the household and the household head, and infrastructure conditions. $\varepsilon_1$ is a random error term.

To evaluate whether certification has an impact on household nutrition, we are particularly interested in the coefficient $\alpha_1$. A positive and significant coefficient would imply that certification contributes to improved nutrition and vice versa. However, one problem in estimating equation (1) is that $C_i$ is likely endogenous. We use a sample where farm household decided themselves whether or not to participate in a certification scheme. It is possible that this decision is systematically correlated with unobserved factors that also influence nutrition, in which case the estimated treatment effect would suffer from non-random selection bias. We deal with this problem by using an instrumental variable (IV) approach. The challenge is to identify a valid instrument that is correlated with the treatment variable but uncorrelated with the nutrition outcomes.

Following Wollni & Zeller (2007), who analysed welfare effects of farmer participation in specialty markets for coffee in Costa Rica, we use altitude of the farm as an instrument for $C_i$. Altitude has an influence on coffee quality (Decazy et al., 2003; Avelino et al., 2005). Since coffee quality matters for exporters in certified markets, certification is correlated with farm altitude. On the other hand, altitude has no direct influence on household nutrition. One might expect that coffee quality may influence sales prices and incomes also in non-certified markets. However, altitude differences in our sample are relatively small; most farms are located within a range of 1100-1300 m above sea level. Coffee sales prices and household incomes of non-certified farms are not correlated with altitude, so that the conditions for a valid instrument are fulfilled.

### *2.3 Modelling impact pathways*

The reduced-form model in equation (1) is useful to analyse whether sustainability certification has an impact on household nutrition, but it cannot explain impact pathways. We hypothesise that participation in certification affects nutrition primarily through two pathways, namely through effects on income and gender roles within the household. Concerning the income pathway, several studies have shown that sustainability standards like Fairtrade and Organic can contribute to significant income gains through price premiums, reduced risk, and, in some cases, positive productivity effects (Arnould et al., 2009; Bolwig et al., 2009; Jena et al., 2012; Ruben & Fort, 2012). Holding other things constant, income gains are likely to improve food security and dietary quality.

Concerning the gender pathway, certification may also affect the roles of men and women within the household and thus food availability and nutrition. Previous research showed that agricultural commercialization is often associated with women in farm households losing control of production and income (von Braun & Kennedy, 1994; Njuki et al., 2011; Fischer & Qaim, 2012). However, sustainability standards explicitly try to strengthen women's role, so that loss of income control may possibly be prevented. For example, the promotion of gender equity and ensuring that women's work is properly valued and equally rewarded is one of the ten key principles of the Fairtrade standard (Fairtrade, 2009). Similarly, the UTZ code of conduct promotes policies of non-discrimination and gender equity by providing gender training and awareness programs to its members and extension workers (UTZ, 2009). A few studies show that sustainability standards improve women's incomes, autonomy, and access to information and cooperative networks (Riisgaard et al., 2009; Lyon et al., 2010; Bassett, 2010).

To formally analyse the two impact pathways, we develop a system of simultaneous equations as follows:

$$N_i = \beta_0 + \beta_1 I_i + \beta_2 G_i + \beta_3 X_i + \varepsilon_2 \quad (2)$$

$$I_i = \theta_0 + \theta_1 C_i + \theta_2 Y_i + \varepsilon_3 \quad (3)$$

$$G_i = \omega_0 + \omega_1 C_i + \omega_2 Z_i + \varepsilon_4 \quad (4)$$

$$C_i = \gamma_0 + \gamma_1 A_i + \gamma_2 L_i + \varepsilon_5 \quad (5)$$

where $N_i$ is the nutrition indicator of household $i$, as defined above, $I_i$ is per capita income, and $G_i$ is gender, which we measure in terms of a dummy that takes a value of one when revenue from coffee sales is controlled by a male household member. We hypothesise that income and gender are both endogenous and influenced by certification $C_i$, as shown in equations (3) and (4). $C_i$ is also endogenous, so that in equation (5) we use farm altitude, $A_i$, as a valid instrument. $X_i$, $Y_i$, $Z_i$, and $L_i$ are vectors of socioeconomic controls that are expected to influence nutrition, income, gender, and certification. $\varepsilon_2$, $\varepsilon_3$, $\varepsilon_4$, and $\varepsilon_5$ are random error terms that may be correlated. We employ a mixed-process maximum likelihood procedure to estimate this system of simultaneous equations (Roodman, 2011).

## 3. Data and descriptive statistics

### *3.1 Farm household survey*

We carried out a structured survey of coffee-producing households in Uganda between July and September 2012. For the selection of households to be interviewed, we used a multi-stage sampling procedure. At first, we contacted the main coffee associations in Uganda to obtain lists of existing farmer cooperatives, including information on their location, the number of cooperative members, and certification details. Based on these lists and visits to many of the locations, we purposively selected three cooperatives for inclusion in the study. These cooperatives have similar agro-ecological and infrastructure conditions. All three are located in the Central Region of Uganda; two of them in Luwero District, and the third in Masaka District. In all three cooperatives, farmers produce only Robusta coffee. Luwero and Masaka are among the top four districts that account for over 50% of Uganda's Robusta coffee production.

All three selected cooperatives had acquired UTZ certification around the year 2007; two of them had added a second certification scheme shortly thereafter. At the time of the survey, one cooperative had only UTZ; the second had UTZ plus Fairtrade, and the third had UTZ plus Organic certification. Farmers have to be member of a cooperative to participate in the certification schemes, but not all members of the three cooperatives actually participated in certification. Hence, all three cooperatives comprise certified and uncertified farm households, based on individual household decisions whether or not to participate in the certification schemes. Cooperative management provided us with lists of all members, including details on the location of each farm household and their participation in certification schemes. In each cooperative, we randomly selected two parishes, and in each parish, we randomly selected three villages. In these villages, we randomly selected households for the interviews.

In total, we interviewed 271 certified households. Of these, 108 households were certified under UTZ and Fairtrade, 101 under UTZ and Organic, and 62 only under UTZ. In addition to these certified households, we randomly selected a control group of 148 non-certified farm households in the same villages. Some of these control households were cooperative members while others were not. The total sample size is 419.

All farm households in the sample were interviewed with a structured questionnaire by a small team of local enumerators that were carefully selected, trained, and supervised by the researchers. The questionnaire covered all economic activities of households with a detailed breakdown for coffee production and marketing. Table 1 shows descriptive statistics of sampled households, disaggregated by certification status.

We find a few significant differences between certified and non-certified households. The heads of certified households are older and have longer experience with coffee cultivation. Certified farmers also have more land and larger houses, measured in terms of the number of rooms. They are located closer to all-weather roads than non-certified farmers and have slightly higher incomes. We proxy income by per capita expenditure levels, which is considered a better indicator of household living standard in the development economics literature. As explained above, we use altitude as an instrument for certification status. Certified farms are located in somewhat lower altitudes than non-certified farms. This difference is statistically significant but relatively small in magnitude.

*Table 1 about here*

### *3.2 Gender roles in coffee production*

To assess gender roles in the coffee-producing households, survey respondents were asked to identify who in the household is the primary decision-maker for coffee production activities – such as weeding, input use, and harvesting – and who controls the revenues from coffee sales. The decisions were categorised as being made by (i) the male household head, (ii) the female spouse or female household head, or (iii) jointly by male and female household members.

The lower part of Table 1 shows descriptive statistics for these gender role responses. In certified households, women have significantly more control of coffee production activities and revenues than in non-certified households. In 56 per cent of the certified households, women control coffee revenues either alone or together with a male household member (Figure 1). This is a first indication that certification may have a positive influence on women's empowerment, although this comparison is not yet proof of causality.

*Figure 1 about here*

To further examine potential effects of sustainability certification on gender roles, we analyse the relationship between the duration of being certified and gender control of coffee production and revenues in Figure 2. This is possible with the cross-section survey data, because households in the sample were certified at different points in time. The longer households have been certified, the less likely it is that males alone control coffee production and revenues. This supports the hypothesis that certification contributes to profound behavioural changes towards gender equity in participating households.

*Figure 2 about here*

*3.3 Household nutrition by certification*

Next, we compare nutritional indicators between certified and non-certified households. Table 2 shows levels of consumption, deficiency, and depth of deficiency for calories, iron, zinc, and vitamin A. The numbers confirm that food insecurity and micronutrient malnutrition are widespread problems among coffee farmers in Uganda, affecting more than 40 per cent of the households. Notable differences are observed between certified and non-certified households. Certified households have higher mean calorie and micronutrient consumption levels. They also have lower levels of nutritional deficiencies. Whether or not these differences can be interpreted as causal effects of certification will be analysed in the next section.

*Table 2 about here*

## 4. Econometric results

*4.1 Impact of certification on nutrition*

We start this analysis by specifying and estimating the reduced-form model in equation (1). In separate regressions, we use the consumption of calories, iron, zinc, and vitamin A per AE as dependent variables. Certification is used as the treatment variable on the right-hand side, together with a vector of controls. As control variables, we include gender, age, and education of the household head, household size, and infrastructure conditions, which may all affect nutrition. Furthermore, we include two asset variables – farm size and number of rooms in the house – as proxies for household wealth. Wealth may be influenced by certification, which could lead to issues of reverse causality. We use values lagged by five years, thus referring to 2007 (the other values refer to 2012 when the survey was conducted). Most households in the sample were not certified before 2007; hence, we reduce possible issues of reverse causality.

As explained above, we specify the treatment variable in two different ways, as a certification dummy and as a continuous variable measuring the number of years that a farm household has been certified. Table 3 shows the estimation results for the models with the certification dummy. These estimates are based on an IV estimator, using farm altitude as instrument for certification. For comparison, OLS results are shown in Table A1, whereas first-stage results of the IV models are shown in Table A2 in the Appendix. The Durbin-Wu-Hausman test statistics are significant for all models, suggesting that the IV models are preferred due to the endogeneity of the certification dummy.

*Table 3 about here*

The results in Table 3 show that certification has a positive and significant effect on the consumption of calories, iron, and zinc. Controlling for other factors, certified households consume 541 kcal more per AE and day, which implies a 19 per cent increase over mean consumption levels of non-certified households. Certified households also consume 7.3 mg/AE more iron and 5.1 mg/AE more zinc, representing increases relative to non-certified households of 35 per cent and 48 per cent, respectively. Also for vitamin A, we observe a positive effect of certification, although this coefficient is not statistically significant. These results suggest that participation in sustainability certification improves food security and dietary quality among coffee farmers in Uganda. This is similar to what has been shown for horticultural farm households in Kenya by Becchetti & Costantino (2008), who had used simpler measures of dietary quality.

The results in Table 4 use the same reduced-form models, but now with the duration of certification as a continuous treatment variable. Also for these models, the Durbin-Wu-Hausman test statistics suggest that the IV estimator is preferred over OLS. As can be seen, each additional year that a household is certified increases the consumption of calories and all three micronutrients. In these models, the effect for vitamin A is significant as well. It appears that certification does not only lead to a one-time positive shift, but to steady improvements in nutrition, which may be related to induced behavioural changes within the coffee-producing households.

*Table 4 about here*

*4.2 Impact pathways*

Results from the reduced-form models revealed that sustainability certification and the duration of certification are both positively associated with higher calorie and micronutrient consumption in coffee-producing households. We now turn to the analysis of possible impact pathways, estimating the simultaneous equation system shown in equations (2) to (5). Again, we use two different treatment variables, namely the certification dummy and the duration of certification as a continuous variable. The main results for the dummy specification are summarised in Table 5 (full results are shown in Table A3 in the Appendix).

The first two rows in Table 5 show how household expenditure (income) and gender roles affect calorie and micronutrient consumption. Each additional UGX (Ugandan shilling) of daily per capita expenditure increases calorie consumption by 0.306 kcal/AE; that is, an additional 1000 UGX (about 0.38 US$) increases calorie consumption by 306 kcal per day. Per capita expenditure levels also have a positive impact on iron and zinc consumption, whereas the effect for vitamin A is not statistically significant. Other studies with data from rural households in Africa have also shown that vitamin A consumption is often less responsive to income changes than iron or zinc consumption (Ecker & Qaim, 2011). On the other hand, gender roles within the household have a significant effect on all nutrition indicators, including vitamin A. If a male household member controls the revenue from coffee sales (as compared to female or joint control), calorie consumption is reduced by 664 kcal, equivalent to 23 per cent of mean calorie consumption levels. Iron, zinc, and vitamin A consumption are also reduced considerably through male control of coffee revenues. This is consistent with the literature showing that men and women often spend income on different types of goods, as discussed above (Hoddinott & Haddad, 1995; Quisumbing & Maluccio, 2003).

*Table 5 about here*

The other rows in Table 5 show that certification significantly affects household expenditure (income) and gender roles, confirming the two main hypothesised impact pathways. Per capita expenditure levels and women's empowerment are positively influenced through certification. When a household is certified, the probability that a male alone controls coffee revenues is reduced by 0.66. This is a very strong effect that may be explained by two factors. First, as discussed above, some of the sustainability standards promote gender equity through special training, awareness building, and other gender mainstreaming activities. Second, certified coffee production with stricter standards increases the demand for labour, so that female household members become increasingly involved in the coffee crop. More female labour spent on coffee production seems to improve women's bargaining power and their influence on decision-making.

Table 6 summarises the results for the simultaneous equation system using the duration of certification as continuous treatment variable (full results are shown in Table A4 in the Appendix). These estimates are consistent with the findings so far. Each additional year that a household is certified increases per capita expenditures by about 500 UGX per day and reduces the probability of male revenue control by 0.09. These results point at learning effects of producing successfully in certified markets and at a positive trend towards women empowerment.

*Table 6 about here*

## 5. Conclusions

Global food systems are undergoing a rapid transformation, with voluntary sustainability standards and certification schemes gaining in importance. Smallholder farmers in developing countries may potentially benefit from such standards. Previous research had analysed impacts of smallholder participation in sustainability-oriented certification schemes in terms of output prices, profits, and incomes. Impacts on household nutrition have hardly been evaluated. We have addressed this shortcoming, using survey data from smallholder coffee farmers in Uganda who participate in Fairtrade, Organic, and UTZ certification schemes. Our contribution to the existing literature is twofold. First, we have analysed impacts on household food security and dietary quality, building on various indicators constructed from comprehensive food consumption data. Second, we have developed and estimated systems of simultaneous equations to analyse impact pathways with a particular focus on income and gender roles within farm households. The approaches developed may also be useful for impact evaluation in other contexts, thus contributing to the broader research direction on agriculture-nutrition linkages.

The empirical results suggest that sustainability standards in the coffee market have positive impacts on food security and dietary quality for smallholder farmers in Uganda. Controlling for other factors, participation in the certification schemes has increased household consumption of calories, iron, and zinc by 19 per cent, 35 per cent, and 48 per cent, respectively. In terms of impact pathways, we have shown that sustainability certification increases household incomes and improves gender equity. Both these factors contribute to improved nutrition.

The gender effects are particularly noteworthy. Agricultural commercialization often contributes to women losing control of farm production and revenues, sometimes with negative marginal effects for household nutrition. The reason is that women tend to spend a greater share of their income on family nutrition and health than men. Our results demonstrate that this loss of female control can be prevented and even reversed when measures to promote gender equity are integrated into market linkage initiatives. Sustainability standards vary in their concrete measures and approaches, but their codes of conduct generally emphasise zero tolerance to discrimination, marginalisation, and unfair treatment of family members and workers employed on certified farms.

In addition to the structured survey that we implemented, we conducted several focus group discussions with certified and non-certified farmers, separately for men and women. These discussions confirm the results from the quantitative analysis. Spouses of male farmers often stated that intra-household gender relations have changed indeed through certification; many had received training courses on coffee production, marketing, and gender issues. Cooperatives with certification are also hiring more women as extension workers and foster equal representation of women in the leadership structure. In some cases, payments for coffee delivered to the cooperative are only made if both spouses are present. This improves transparency and women's involvement in decisions on how to spend the income. The econometric results suggest that women's empowerment further increases with the duration of certification, pointing at positive and profound behavioural changes.

Of course, the results from certified coffee farmers in Uganda should not simply be generalized. Nevertheless, we cautiously conclude that sustainability standards can contribute to improved livelihoods of smallholder farm households, including higher incomes, better nutrition, and improved gender equity. One shortcoming of our analysis is that it builds on cross-section data, so that not all possible biasing factors may be eliminated completely. Follow-up research with panel data may help to further increase the robustness of the results on impacts, impact pathways, and impact dynamics.

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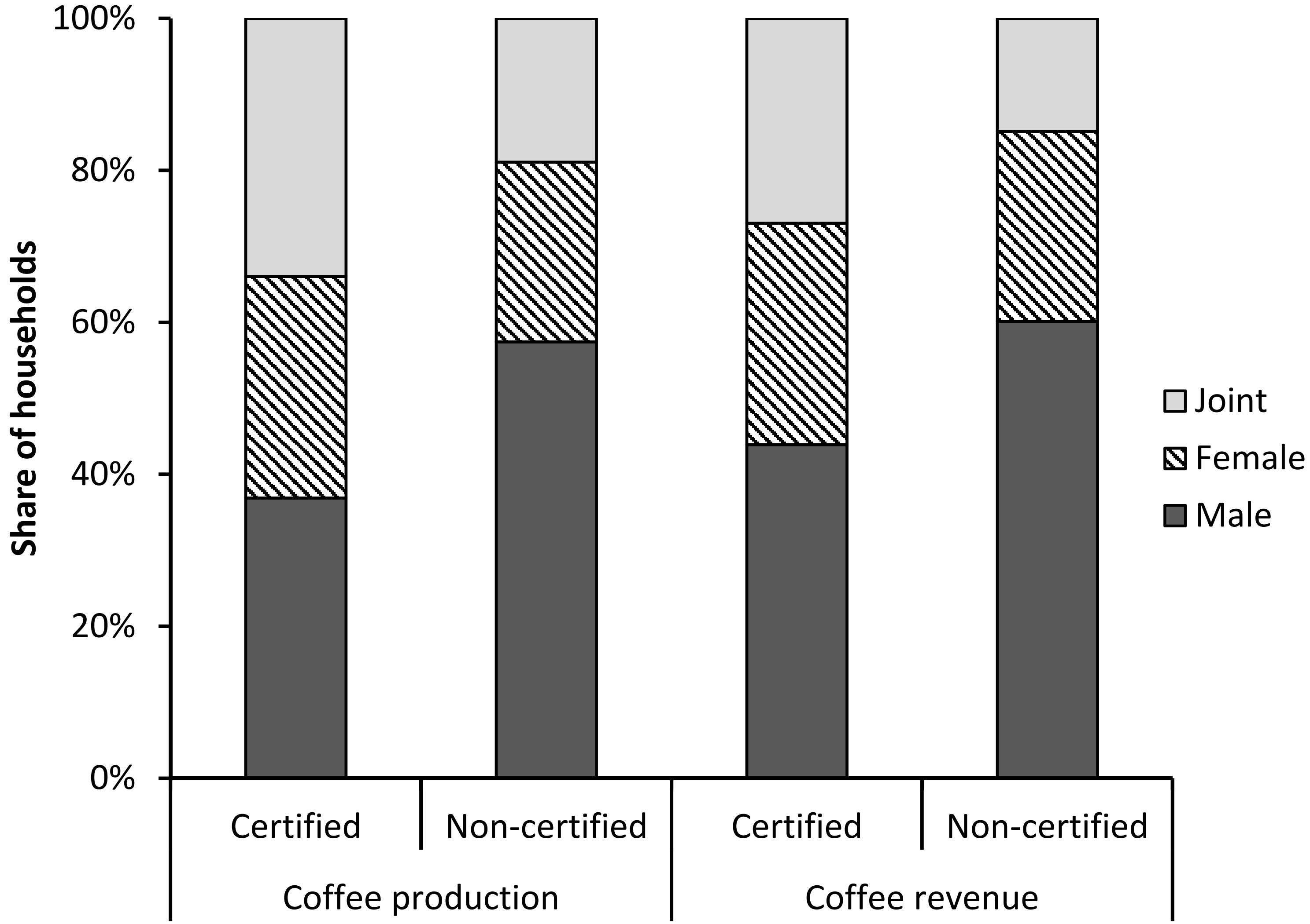


**Figure 1.** Male and female control of coffee production and revenues in certified and non-certified households

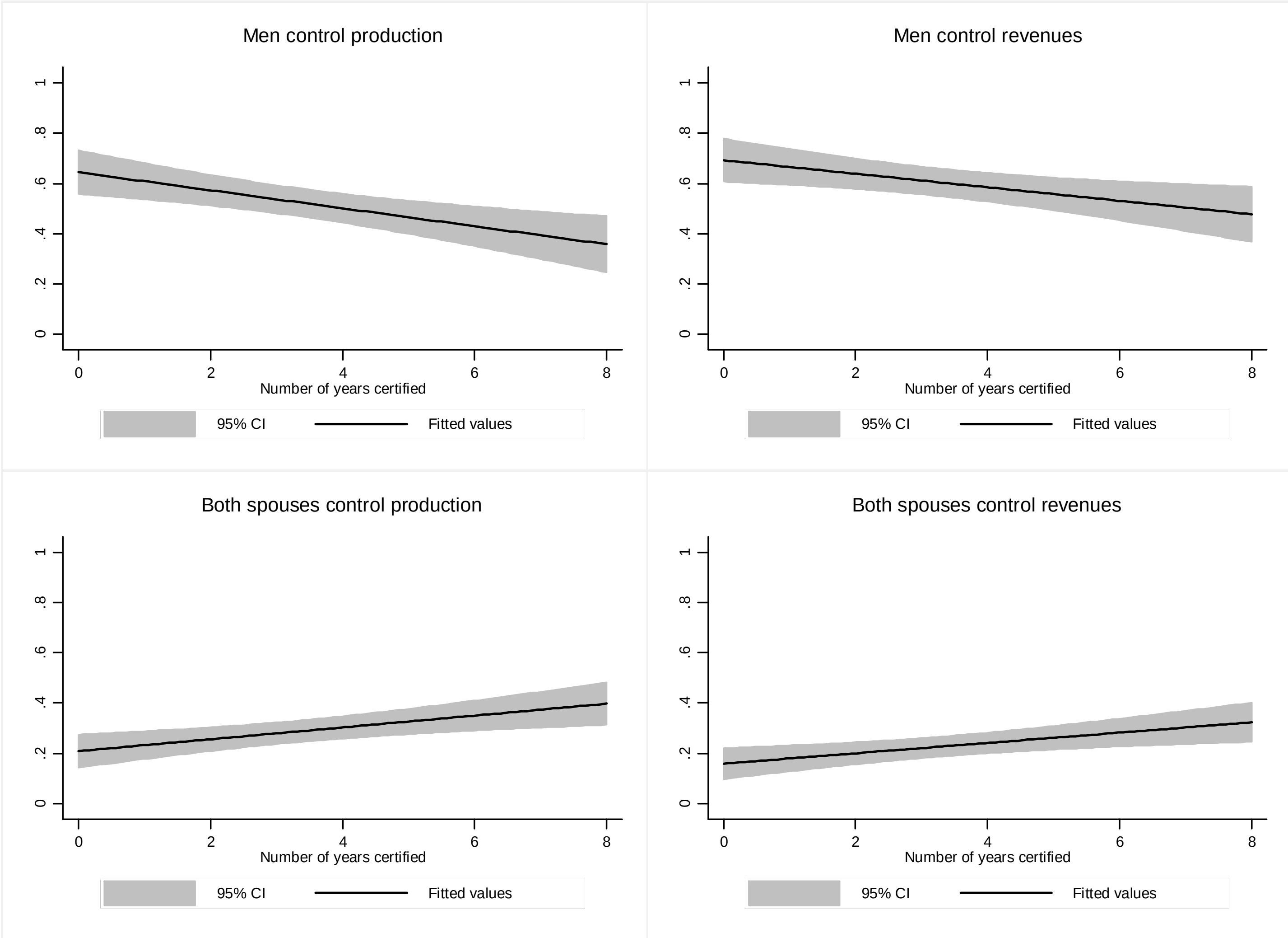


**Figure 2.** Relationship between duration of certification and gender control of coffee production and revenues

Note: Fitted values are predictions based on simple linear regressions with proportion of male control or both spouses as dependent variable and number of years certified as independent variable (CI, confidence interval). Zero years represent non-certified farmers.

**Table 1.** Summary statistics by certification status

| | Non-certified (N=148) | | Certified (N=271) | | Difference |
|---|---|---|---|---|---|
| | Mean | S.D. | Mean | S.D. | |
| ***Farm and household characteristics*** | | | | | |
| Male household head (dummy) | 0.791 | 0.408 | 0.738 | 0.441 | |
| Age of household head (years) | 47.378 | 15.444 | 55.432 | 12.816 | *** |
| Education of household head (years) | 6.534 | 3.329 | 6.590 | 3.785 | |
| Cell phone ownership (dummy) | 0.750 | 0.434 | 0.775 | 0.418 | |
| Household size (AE) | 4.848 | 2.930 | 5.360 | 2.683 | |
| Number of rooms in house | 4.128 | 1.481 | 4.613 | 1.508 | ** |
| Years growing coffee | 16.662 | 12.745 | 26.786 | 15.590 | *** |
| Total land owned (acres) | 4.533 | 3.296 | 6.220 | 4.702 | *** |
| Number of rooms in house (5 years ago) | 3.757 | 1.519 | 4.557 | 2.237 | *** |
| Per capita expenditure per day (UGX) | 3176.39 | 1582.18 | 3579.32 | 1821.21 | * |
| Total land owned 5 years ago (acres) | 4.344 | 3.496 | 5.995 | 5.287 | *** |
| Farm altitude (m) | 1210.03 | 47.698 | 1168.85 | 71.652 | *** |
| Distance to all-weather road (km) | 18.793 | 15.401 | 14.998 | 8.307 | ** |
| ***Control of coffee activities*** | | | | | |
| Male controls production (dummy) | 0.574 | 0.496 | 0.369 | 0.483 | *** |
| Male controls revenue (dummy) | 0.601 | 0.491 | 0.439 | 0.497 | ** |

Notes: UGX, Ugandan shillings; AE, adult equivalent; S.D., standard deviation. Differences in mean values are tested for statistically significant differences; *, **, *** denote significance at 10 per cent, 5 per cent, and 1 per cent level, respectively.

**Table 2.** Household calorie and micronutrient consumption

| | Non-certified (N=148) | | Certified (N=271) | | |
|---|---|---|---|---|---|
| | Mean | S.D. | Mean | S.D. | Difference |
| ***Calories*** | | | | | |
| Daily consumption (kcal/AE) | 2867.710 | 1408.336 | 3151.453 | 1353.307 | * |
| Prevalence of deficiency (%) | 0.439 | 0.498 | 0.354 | 0.479 | |
| Depth of deficiency (%) | 0.289 | 0.204 | 0.217 | 0.148 | * |
| ***Iron*** | | | | | |
| Daily consumption (mg/AE) | 20.722 | 10.770 | 23.266 | 11.324 | * |
| Prevalence of deficiency (%) | 0.486 | 0.502 | 0.395 | 0.490 | |
| Depth of deficiency (%) | 0.344 | 0.225 | 0.248 | 0.152 | *** |
| ***Zinc*** | | | | | |
| Daily consumption (mg/AE) | 10.661 | 5.974 | 12.263 | 6.392 | * |
| Prevalence of deficiency (%) | 0.784 | 0.413 | 0.745 | 0.436 | |
| Depth of deficiency (%) | 0.460 | 0.220 | 0.379 | 0.192 | *** |
| ***Vitamin A*** | | | | | |
| Daily consumption (μg RE/AE) | 1203.388 | 1218.732 | 1266.426 | 1148.831 | |
| Prevalence of deficiency (%) | 0.358 | 0.481 | 0.303 | 0.460 | |
| Depth of deficiency (%) | 0.455 | 0.276 | 0.437 | 0.269 | |

Notes: AE, adult equivalent; S.D., standard deviation; RE, retinol equivalent. Differences in mean values are tested for statistically significant differences; *, **, *** denote significance at 10 per cent, 5 per cent, and 1 per cent level, respectively.

**Table 3.** Impact of certification status on calorie and micronutrient consumption

| | Calorie consumption (kcal/AE) | Iron consumption (mg/AE) | Zinc consumption (mg/AE) | Vitamin A consumption (μg RE/AE) |
|---|---|---|---|---|
| Certified (dummy) | 540.909* | 7.274*** | 5.137*** | 441.029 |
| | (327.795) | (2.418) | (1.217) | (307.128) |
| Male household head (dummy) | -140.605 | -1.656 | -0.295 | -140.829 |
| | (149.889) | (1.265) | (0.727) | (142.071) |
| Age of household head (years) | 6.347 | 0.030 | 0.015 | -0.379 |
| | (5.248) | (0.043) | (0.024) | (4.960) |
| Education of household head (years) | -30.377* | -0.325** | -0.189** | -37.720** |
| | (18.165) | (0.153) | (0.088) | (17.217) |
| Household size (AE) | -201.577*** | -1.388*** | -0.758*** | -33.124 |
| | (22.849) | (0.192) | (0.110) | (21.651) |
| Number of rooms (5 years ago) | 55.714* | 0.119 | -0.141 | 25.484 |
| | (32.243) | (0.270) | (0.155) | (30.542) |
| Total land owned 5 years ago (acres) | 8.465 | 0.003 | 0.086 | -3.292 |
| | (13.929) | (0.117) | (0.067) | (13.193) |
| Distance to all-weather road (km) | 12.603** | 0.123** | 0.078*** | -0.426 |
| | (5.914) | (0.049) | (0.028) | (5.593) |
| Constant | 3227.684*** | 24.106*** | 11.863*** | 1420.629*** |
| | (327.200) | (2.758) | (1.583) | (310.105) |
| Observations | 419 | 419 | 419 | 419 |
| Log likelihood | -3789 | -1781 | -1540 | -3762 |
| Wald Chi-squared | 105.60 | 83.70 | 82.61 | 16.22 |
| Durbin-Wu-Hausman chi-squared | 4.01* | 7.19*** | 15.57*** | 4.70** |

Notes: AE, adult equivalent; RE, retinol equivalent. Coefficients are shown with robust standard errors in parentheses. *, **, *** denote significance at 10 per cent, 5 per cent, and 1 per cent level, respectively.

**Table 4.** Impact of certification duration on calorie and micronutrient consumption

| | Calorie consumption (kcal/AE) | Iron consumption (mg/AE) | Zinc consumption (mg/AE) | Vitamin A consumption (µg RE/AE) |
|---|---|---|---|---|
| Number of years certified | 111.421* | 1.530*** | 1.202*** | 105.236* |
| | (58.189) | (0.519) | (0.302) | (56.897) |
| Male household head (dummy) | -111.271 | -1.248 | 0.045 | -110.718 |
| | (164.769) | (1.404) | (0.812) | (167.292) |
| Age of household head (years) | 6.591 | 0.033 | 0.012 | -0.713 |
| | (4.945) | (0.042) | (0.025) | (5.104) |
| Education of household head (years) | -27.347 | -0.284 | -0.160 | -35.228** |
| | (19.916) | (0.176) | (0.105) | (16.489) |
| Household size (AE) | -205.155*** | -1.439*** | -0.805*** | -37.346* |
| | (25.976) | (0.232) | (0.140) | (21.170) |
| Number of rooms (5 years ago) | 64.004* | 0.230 | -0.068 | 31.655 |
| | (38.022) | (0.359) | (0.175) | (28.794) |
| Total land owned 5 years ago (acres) | 6.520 | -0.025 | 0.057 | -5.891 |
| | (15.166) | (0.122) | (0.083) | (9.816) |
| Distance to all-weather road (km) | 10.822* | 0.100* | 0.064** | -1.559 |
| | (5.773) | (0.051) | (0.029) | (4.907) |
| Constant | 3179.127*** | 23.422*** | 11.257*** | 1366.514*** |
| | (336.352) | (2.895) | (1.670) | (370.882) |
| Observations | 419 | 419 | 419 | 419 |
| Wald Chi-squared | 76.98 | 54.19 | 49.48 | 16.54 |
| Durbin-Wu-Hausman chi-squared | 5.351** | 8.005*** | 15.84*** | 5.048** |

Notes: AE, adult equivalent; RE, retinol equivalent. Coefficients are shown with robust standard errors in parentheses. *, **, *** denote significance at 10 per cent, 5 per cent, and 1 per cent level, respectively.

**Table 5.** Impact pathways of certification status on calorie and micronutrient consumption

| | Calorie consumption (kcal/AE) | Iron consumption (mg/AE) | Zinc consumption (mg/AE) | Vitamin A consumption (μg RE/AE) |
|---|---|---|---|---|
| ***Effect on nutrition*** | | | | |
| Per capita expenditure per day(UGX) | 0.306*** | 0.002*** | 0.002*** | 0.045 |
| | (0.034) | (0.000) | (0.000) | (0.034) |
| Male controls revenue (dummy) | -664.215*** | -6.525*** | -2.346** | -557.335*** |
| | (198.861) | (1.687) | (0.930) | (198.880) |
| ***Effect on p.c. expenditure (UGX)*** | | | | |
| Certified (dummy) | 4513.056*** | 4521.814*** | 4546.756*** | 4496.279*** |
| | (544.917) | (544.884) | (544.798) | (544.950) |
| ***Effect on male control (dummy)*** | | | | |
| Certified (dummy) | -0.657*** | -0.669*** | -0.680*** | -0.661*** |
| | (0.127) | (0.127) | (0.127) | (0.128) |
| ***Effect on certified (dummy)*** | | | | |
| Farm altitude (m) | -0.001*** | -0.001*** | -0.001*** | -0.001*** |
| | (0.000) | (0.000) | (0.000) | (0.000) |

Notes: UGX, Ugandan shillings; AE, adult equivalent; RE, retinol equivalent. Coefficients are shown with standard errors in parentheses. Only main variables of interest are shown. Full results are presented in Table A3 in the Appendix. *, **, *** denote significance at 10 per cent, 5 per cent, and 1 per cent level, respectively.

**Table 6.** Impact pathways of certification duration on calorie and micronutrient consumption

| | Calorie consumption (kcal/AE) | Iron consumption (mg/AE) | Zinc consumption (mg/AE) | Vitamin A consumption (μg RE/AE) |
|---|---|---|---|---|
| ***Effect on nutrition*** | | | | |
| Per capita expenditure (UGX) | 0.310*** | 0.002*** | 0.002*** | 0.043 |
| | (0.034) | (0.000) | (0.000) | (0.034) |
| Male controls revenue (dummy) | -665.098*** | -6.573*** | -2.409*** | -557.986*** |
| | (198.959) | (1.688) | (0.930) | (198.909) |
| ***Effect on p.c. expenditure (UGX)*** | | | | |
| Number of years certified | 500.387*** | 501.219*** | 508.781*** | 497.385*** |
| | (81.421) | (81.420) | (81.396) | (81.408) |
| ***Effect on male control (dummy)*** | | | | |
| Number of years certified | -0.090*** | -0.093*** | -0.095*** | -0.089*** |
| | (0.020) | (0.020) | (0.020) | (0.020) |
| ***Effect on years certified*** | | | | |
| Farm altitude (m) | -0.012*** | -0.012*** | -0.012*** | -0.012*** |
| | (0.002) | (0.002) | (0.002) | (0.002) |

Notes: UGX, Ugandan shillings; AE, adult equivalent; RE, retinol equivalent. Coefficients are shown with standard errors in parentheses. Only main variables of interest are shown. Full results are presented in Table A4 in the Appendix. *, **, *** denote significance at 10 per cent, 5 per cent, and 1 per cent level, respectively.

## Appendix

**Table A1.** Impact of certification on calorie and micronutrient consumption (OLS results)

| | Calorie consumption (kcal/AE) | Iron consumption (mg/AE) | Zinc consumption (mg/AE) | Vitamin A consumption (µg RE/AE) |
|---|---|---|---|---|
| Certified (dummy) | 283.117* | 2.658** | 1.644** | -0.749 |
| | (147.263) | (1.187) | (0.671) | (136.665) |
| Male household head (dummy) | -149.478 | -1.815 | -0.415 | -156.034 |
| | (160.556) | (1.316) | (0.729) | (160.079) |
| Age of household head (years) | 8.430* | 0.068* | 0.043** | 3.191 |
| | (4.675) | (0.038) | (0.022) | (4.629) |
| Education of household head (years) | -29.014 | -0.301* | -0.171* | -35.384** |
| | (19.870) | (0.170) | (0.100) | (16.120) |
| Household size (AE) | -198.464*** | -1.332*** | -0.716*** | -27.789 |
| | (24.359) | (0.204) | (0.117) | (19.401) |
| Number of rooms (5 years ago) | 61.838 | 0.229 | -0.058 | 35.979 |
| | (38.536) | (0.350) | (0.161) | (26.737) |
| Total land owned 5 years ago (acres) | 11.278 | 0.053 | 0.124 | 1.529 |
| | (14.868) | (0.117) | (0.081) | (9.716) |
| Distance to all-weather road (km) | 10.580* | 0.087* | 0.051* | -3.892 |
| | (5.817) | (0.051) | (0.027) | (4.927) |
| Constant | 3258.140*** | 24.652*** | 12.275*** | 1472.821*** |
| | (325.108) | (2.628) | (1.446) | (359.014) |
| Observations | 419 | 419 | 419 | 419 |
| Log likelihood | -3574.6 | -1567.8 | -1329.4 | -3548.1 |

Notes: AE, adult equivalent; RE, retinol equivalent. Coefficients are shown with robust standard errors in parentheses. *, **, *** denote significance at 10 per cent, 5 per cent, and 1 per cent level, respectively.

**Table A2.** First-stage results with farm altitude as instrument for certification status

| | Certified (calorie model) | Certified (iron model) | Certified (zinc model) | Certified (vitamin A model) |
|---|---|---|---|---|
| Farm altitude (m) | -0.008*** | -0.008*** | -0.009*** | -0.008*** |
| | (0.001) | (0.001) | (0.001) | (0.001) |
| Male household head (dummy) | 0.011 | 0.024 | 0.032 | 0.029 |
| | (0.173) | (0.174) | (0.173) | (0.174) |
| Age of household head (years) | 0.025*** | 0.026*** | 0.026*** | 0.025*** |
| | (0.005) | (0.005) | (0.005) | (0.005) |
| Education of household head (years) | 0.048** | 0.050** | 0.053** | 0.047** |
| | (0.022) | (0.022) | (0.021) | (0.022) |
| Household size (AE) | 0.012 | 0.013 | 0.013 | 0.012 |
| | (0.025) | (0.025) | (0.025) | (0.026) |
| Number of rooms (5 years ago) | 0.221*** | 0.215*** | 0.216*** | 0.218*** |
| | (0.052) | (0.052) | (0.052) | (0.052) |
| Total land owned 5 years ago (acres) | 0.014 | 0.013 | 0.010 | 0.013 |
| | (0.019) | (0.019) | (0.019) | (0.019) |
| Distance to all-weather road (km) | -0.021*** | -0.021*** | -0.021*** | -0.021*** |
| | (0.006) | (0.006) | (0.006) | (0.006) |
| Constant | 7.755*** | 8.051*** | 8.522*** | 7.758*** |
| | (1.378) | (1.361) | (1.348) | (1.355) |
| Observations | 419 | 419 | 419 | 419 |
| Log likelihood | -3789.4 | -1780.9 | -1540.0 | -3762.1 |
| Chi-squared | 105.6 | 83.70 | 82.61 | 16.22 |

Notes: AE, adult equivalent; RE, retinol equivalent. Coefficients are shown with robust standard errors in parentheses. *, **, *** denote significance at 10 per cent, 5 per cent, and 1 per cent level, respectively.

**Table A3.** Impact pathways of certification status on calorie and micronutrient consumption

| | Calorie consumption (kcal/AE) | Iron consumption (mg/AE) | Zinc consumption (mg/AE) | Vitamin A consumption (µg RE/AE) |
|---|---|---|---|---|
| ***Nutrition outcomes*** | | | | |
| Per capita expenditure per day(UGX) | 0.306*** | 0.002*** | 0.002*** | 0.045 |
| | (0.034) | (0.000) | (0.000) | (0.034) |
| Male controls revenue (dummy) | -664.215*** | -6.525*** | -2.346** | -557.335*** |
| | (198.861) | (1.687) | (0.930) | (198.880) |
| Age of household head (years) | 10.990*** | 0.078** | 0.052*** | 2.425 |
| | (4.177) | (0.036) | (0.019) | (4.157) |
| Education of household head (years) | -50.154*** | -0.475*** | -0.293*** | -35.948** |
| | (16.678) | (0.142) | (0.078) | (16.600) |
| Household size (AE) | -143.113*** | -0.984*** | -0.429*** | -26.626 |
| | (21.302) | (0.181) | (0.099) | (21.203) |
| Constant | 2822.138*** | 22.227*** | 8.979*** | 1612.469*** |
| | (330.871) | (2.813) | (1.544) | (329.669) |
| ***Per capita expenditure per day(UGX)*** | | | | |
| Certified (dummy) | 4513.056*** | 4521.814*** | 4546.756*** | 4496.279*** |
| | (544.917) | (544.884) | (544.798) | (544.950) |
| Male household head (dummy) | 797.429*** | 797.627*** | 799.837*** | 794.281*** |
| | (249.419) | (249.419) | (249.415) | (249.413) |
| Age of household head (years) | -35.859*** | -35.935*** | -36.183*** | -35.728*** |
| | (8.738) | (8.738) | (8.737) | (8.738) |
| Education of household head (years) | 56.040* | 55.985* | 55.627* | 56.194* |
| | (30.261) | (30.261) | (30.260) | (30.261) |
| Household size (AE) | -247.584*** | -247.686*** | -248.186*** | -247.360*** |
| | (37.944) | (37.944) | (37.944) | (37.944) |
| Total land owned (acres) | -7.789 | -7.909 | -7.582 | -7.413 |
| | (24.496) | (24.494) | (24.487) | (24.494) |
| Constant | 2779.785*** | 2779.556*** | 2777.872*** | 2781.876*** |
| | (525.447) | (525.447) | (525.446) | (525.446) |
| ***Male controls revenue (dummy)*** | | | | |
| Certified (dummy) | -0.657*** | -0.669*** | -0.680*** | -0.661*** |
| | (0.127) | (0.127) | (0.127) | (0.128) |
| Age of household head (years) | 0.002 | 0.002 | 0.002 | 0.002 |
| | (0.002) | (0.002) | (0.002) | (0.002) |
| Education of household head (years) | 0.016** | 0.016** | 0.016** | 0.016** |
| | (0.007) | (0.007) | (0.007) | (0.007) |
| Household size (AE) | 0.001 | 0.001 | 0.001 | 0.001 |
| | (0.009) | (0.009) | (0.009) | (0.009) |
| Constant | 0.703*** | 0.704*** | 0.704*** | 0.703*** |
| | (0.124) | (0.124) | (0.124) | (0.124) |
| ***Certified (dummy)*** | | | | |
| Farm altitude (m) | -0.001*** | -0.001*** | -0.001*** | -0.001*** |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| Male household head (dummy) | -0.194*** | -0.194*** | -0.194*** | -0.192*** |
| | (0.049) | (0.049) | (0.049) | (0.049) |
| Age of household head (years) | 0.008*** | 0.008*** | 0.008*** | 0.008*** |
| | (0.002) | (0.002) | (0.002) | (0.002) |
| Education of household head (years) | 0.015** | 0.015** | 0.015** | 0.015** |
| | (0.006) | (0.006) | (0.006) | (0.006) |
| Household size (AE) | 0.014* | 0.014* | 0.014* | 0.014* |
| | (0.008) | (0.008) | (0.008) | (0.008) |
| Total land owned 5 years ago (acres) | 0.006 | 0.006 | 0.006 | 0.006 |
| | (0.004) | (0.004) | (0.004) | (0.004) |
| Number of rooms (5 years ago) | 0.030*** | 0.029*** | 0.028*** | 0.030*** |
| | (0.009) | (0.009) | (0.009) | (0.009) |
| Distance to all-weather road (km) | -0.003* | -0.003* | -0.003 | -0.003* |
| | (0.002) | (0.002) | (0.002) | (0.002) |
| Constant | 1.275*** | 1.290*** | 1.322*** | 1.289*** |
| | (0.361) | (0.361) | (0.361) | (0.361) |

Notes: UGX, Ugandan shillings; AE, adult equivalent; RE, retinol equivalent. Coefficients are shown with standard errors in parentheses. *, **, *** denote significance at 10 per cent, 5 per cent, and 1 per cent level, respectively.

**Table A4.** Impact pathways of certification duration on calorie and micronutrient consumption

| | Calorie consumption (kcal/AE) | Iron consumption (mg/AE) | Zinc consumption (mg/AE) | Vitamin A consumption (µg RE/AE) |
|---|---|---|---|---|
| ***Nutrition outcomes*** | | | | |
| Per capita expenditure per day(UGX) | 0.311*** | 0.002*** | 0.002*** | 0.044 |
| | (0.034) | (0.000) | (0.000) | (0.034) |
| Male controls revenue (dummy) | -659.761*** | -6.499*** | -2.397*** | -549.158*** |
| | (199.044) | (1.689) | (0.930) | (198.984) |
| Age of household head (years) | 10.991*** | 0.078** | 0.052*** | 2.463 |
| | (4.177) | (0.036) | (0.019) | (4.157) |
| Education of household head (years) | -50.710*** | -0.482*** | -0.298*** | -35.922** |
| | (16.677) | (0.142) | (0.078) | (16.599) |
| Household size (AE) | -142.338*** | -0.974*** | -0.421*** | -26.709 |
| | (21.301) | (0.181) | (0.099) | (21.201) |
| Constant | 2803.677*** | 21.998*** | 8.847*** | 1610.003*** |
| | (330.895) | (2.813) | (1.543) | (329.662) |
| ***Per capita expenditure per day(UGX)*** | | | | |
| Number of years certified | 591.266*** | 592.245*** | 600.202*** | 587.966*** |
| | (82.935) | (82.934) | (82.907) | (82.918) |
| Male household head (dummy) | 714.522*** | 714.580*** | 719.767*** | 710.541*** |
| | (239.115) | (239.116) | (239.111) | (239.103) |
| Age of household head (years) | -19.381** | -19.423** | -19.755*** | -19.274** |
| | (7.658) | (7.658) | (7.658) | (7.658) |
| Education of household head (years) | 93.798*** | 93.792*** | 93.605*** | 93.817*** |
| | (28.501) | (28.501) | (28.501) | (28.501) |
| Household size (AE) | -240.304*** | -240.403*** | -241.317*** | -240.005*** |
| | (36.177) | (36.177) | (36.176) | (36.177) |
| Total land owned (acres) | -2.615 | -2.617 | -2.645 | -2.117 |
| | (23.894) | (23.892) | (23.881) | (23.890) |
| Constant | 2636.900*** | 2636.446*** | 2629.927*** | 2640.669*** |
| | (501.673) | (501.673) | (501.670) | (501.669) |
| ***Male controls revenue (dummy)*** | | | | |
| Number of years certified | -0.097*** | -0.100*** | -0.102*** | -0.096*** |
| | (0.020) | (0.020) | (0.020) | (0.020) |
| Age of household head (years) | 0.000 | 0.000 | 0.000 | 0.000 |
| | (0.002) | (0.002) | (0.002) | (0.002) |
| Education of household head (years) | 0.010 | 0.010 | 0.010 | 0.010 |
| | (0.007) | (0.007) | (0.007) | (0.007) |
| Household size (AE) | 0.001 | 0.001 | 0.002 | 0.001 |
| | (0.009) | (0.009) | (0.009) | (0.009) |
| Constant | 0.736*** | 0.737*** | 0.738*** | 0.736*** |
| | (0.123) | (0.123) | (0.123) | (0.123) |
| ***Number of years certified*** | | | | |
| Farm altitude (m) | -0.010*** | -0.010*** | -0.011*** | -0.010*** |
| | (0.002) | (0.002) | (0.002) | (0.002) |
| Male household head (dummy) | -1.136*** | -1.134*** | -1.130*** | -1.124*** |
| | (0.288) | (0.288) | (0.288) | (0.288) |
| Age of household head (years) | 0.033*** | 0.033*** | 0.033*** | 0.033*** |
| | (0.009) | (0.009) | (0.009) | (0.009) |
| Education of household head (years) | 0.064* | 0.065* | 0.066* | 0.064* |
| | (0.037) | (0.037) | (0.037) | (0.037) |
| Household size (AE) | 0.086* | 0.086* | 0.085* | 0.086* |
| | (0.045) | (0.045) | (0.045) | (0.045) |
| Total land owned 5 years ago (acres) | 0.033 | 0.031 | 0.034 | 0.032 |
| | (0.025) | (0.025) | (0.025) | (0.025) |
| Number of rooms (5 years ago) | 0.157*** | 0.154*** | 0.147*** | 0.158*** |
| | (0.056) | (0.056) | (0.056) | (0.056) |
| Distance to all-weather road (km) | -0.006 | -0.006 | -0.006 | -0.008 |
| | (0.009) | (0.009) | (0.009) | (0.009) |
| Constant | 12.933*** | 13.105*** | 13.303*** | 13.019*** |
| | (2.220) | (2.219) | (2.219) | (2.216) |

Notes: UGX, Ugandan shillings; AE, adult equivalent; RE, retinol equivalent. Coefficients are shown with standard errors in parentheses.
*, **, *** denote significance at 10 per cent, 5 per cent, and 1 per cent level, respectively.