DEPARTMENT OF FOOD AND RESOURCE ECONOMICS
UNIVERSITY OF COPENHAGEN

IFRO Working Paper

Organic Farming and Happiness
A Path Analysis

Ghislain B. D. Aïhounton
Arne Henningsen

2024 / 01

IFRO Working Paper 2024 / 01

Organic Farming and Happiness: A Path Analysis

Authors: Ghislain B. D. Aïhounton, Arne Henningsen

JEL-classification: D60, I31, O13, Q12, Q18

Published: December 2024

See the full IFRO Working Paper series here:
https://ifro.ku.dk/english/publications/ifro_series/working_papers/

Department of Food and Resource Economics (IFRO)
University of Copenhagen
Rolighedsvej 23
DK 1958 Frederiksberg DENMARK
https://ifro.ku.dk/english/

Organic Farming and Happiness: A Path Analysis

Ghislain B. D. Aïhounton and Arne Henningsen

December 2, 2024

Abstract

While price premiums incentivise farmers to engage in organic farming, these premiums are frequently insufficient to compensate for lower yields, resulting in no monetary benefits from adopting organic farming. This study goes beyond purely monetary outcomes and investigates how organic farming is related to both monetary and non-monetary outcomes, including farmers' general life satisfaction or 'happiness'. We use data collected from organic and conventional cotton growing households in Benin and employ Structural Equation Modelling in order to investigate the pathways through which organic farming is related to happiness. Our findings indicate that organic farming is positively associated with happiness through farmers' improved (self-reported) health and increased satisfaction with their work as well as through a direct relationship between organic farming and happiness. While a negative association between organic farming and income exists, it only reduces the overall positive relationship between organic farming and happiness to a very limited extent. Thus, our results show that non-monetary outcomes may be important drivers of the adoption of sustainability standards as well as relevant measures of farmers' welfare when evaluating policies and programmes.

Keywords: Organic farming, happiness, life satisfaction, non-monetary measures of wellbeing, income, farm households.

JEL Codes: D60, I31, O13, Q12, Q18.

1 Introduction

Organic farming and other sustainability standards are becoming increasingly important in global markets for high-value agricultural products. The implementation of standards whose aim is to promote sustainable farming practices can be particularly important in developing countries, where agro-chemicals are frequently handled improperly (Damalas and Abdollahzadeh, 2016; Sheahan et al., 2017; Sharifzadeh et al., 2019) so that they harm human health and the environment (Ecobichon, 2001; Asfaw et al., 2010; Hu et al., 2015; Sheahan et al., 2017). Numerous studies have investigated the impact of adopting organic farming and other sustainability standards on monetary welfare indicators such as profit, income, and poverty amongst smallholder farmers in developing countries (e.g., Bolwig et al., 2009; Kleemann et al., 2014; Ayuya et al., 2015; Chiputwa et al., 2015; Parvathi and Waibel, 2016; Froehlich et al., 2018). These studies have obtained positive estimates (e.g., Bolwig et al., 2009; Kleemann et al., 2014; Ayuya et al., 2015; Chiputwa et al., 2015; Parvathi and Waibel, 2016), negative estimates (e.g., Beuchelt and Zeller, 2011; Froehlich et al., 2018), and insignificant estimates (e.g., Uematsu and Mishra, 2012; Vellema et al., 2015) in terms of the welfare effect. Recently, economists and sociologists have shown interest in subjective indicators of well-being, thereby acknowledging the limitations of monetary outcomes in policy evaluation (Dolan and Metcalfe, 2012; Dedehouanou et al., 2013; Constanza et al., 2014; Delsignore et al., 2021).

For decades, research on agricultural household models (e.g., Lopez, 1984; Strauss, 1986; de Janvry et al., 1991) has emphasised that farm households maximise utility rather than monetary outcomes. Later, behavioural economists showed that individuals in general (not only farm households) make decisions based on their individual psychological views, e.g., to maximise their personal satisfaction (see Camerer et al., 2004).[1] Given the importance of non-monetary values such as utility or satisfaction, relying only on monetary outcomes may lead to ineffective policies (Fehr and Falk, 2002), and may overestimate the utility derived from consumption and underestimate the associated dis-utilities (Hirschauer et al., 2015). The dissatisfaction with purely monetary measures of welfare has led to the integration of happiness[2] in current economic welfare studies (Frey, 2018). Therefore, an increasing number of studies are analysing welfare questions with a subjective well-being approach instead of common income-based measures (e.g., Dedehouanou et al., 2013; Mzoughi, 2014; Huang et al., 2016; Maass et al., 2016; Woo and Kim, 2018; Sabillon et al., 2022). Subjective well-being measures offer the advantage of encompassing both monetary and non-monetary outcomes and, thus, provide a more comprehensive representation of human well-being compared to purely monetary measures (e.g., Powdthavee, 2007).

To our knowledge, in the extensive literature that explores the overall welfare effects of organic farming, no studies examine the role of mediating factors, i.e., the mechanisms through which organic farming affects subjective outcomes such as happiness. The study by Mzoughi (2014) investigates the relationships between organic farming and subjective well-being, revealing that organic farming is positively associated with life satisfaction. Furthermore, Mzoughi (2014) finds that subjective well-being is positively associated with income, profitability, job satisfaction, social recognition, and good health. However, this study neither analyses how these intermediate outcomes are related to organic farming nor through which mechanisms organic farming is related to happiness.

In this study, we explore several potential mechanisms through which organic farming could affect happiness. We do this by applying a path analysis—a variant of structural equation modelling (SEM)—considering a direct pathway as well as potential indirect relationships through farmers' income, health, satisfaction with their work, recognition of their work by the local community and their relationships with neighbours. In order to ensure high reliability and robustness of our results, we apply a wide variety of model specifications, including specifications that control for unobserved heterogeneity by using a control

[1] The concept of satisfaction in behavioural economics is closely linked to the concept of utility in microeconomic theory.

[2] Following Mzoughi (2014), it is important to note that happiness, life satisfaction, and subjective well-being are used interchangeably to align with the terminology commonly found in the economic literature.

variable that indicates the household's willingness to pay (WTP) for adopting organic or conventional farming (Verhofstadt and Maertens, 2014; Bellemare and Novak, 2017; Ruml and Qaim, 2021; Aïhounton and Henningsen, 2024).

Our analysis reveals that organic farming is negatively associated with farmers' income, while it is positively associated with farmers' (self-reported) health and their satisfaction with their work. Moreover, we identify four pathways through which organic farming is associated with happiness. Organic farming is associated with increased happiness through a direct pathway as well as through improved health and higher satisfaction with their work, while it is, to a very limited extent, linked to decreased happiness through lower income. We find the the local community's recognition of farmers' work and the farmers' relationships with neighbours to be significantly and positively related to happiness. However, these two variables do not significantly mediate indirect relationships between organic farming and happiness because they are not significantly related to organic farming. Our findings provide fresh insights into the returns associated with organic farming, illustrating that non-monetary outcomes may play a more significant role in elucidating the benefits of organic certification for smallholder farmers in developing countries than monetary outcomes.

The remainder of the paper is structured as follows. Section 2 conceptually discusses the relationship between organic farming and happiness. Section 3 describes the methodology of the paper, while section 4 presents and discusses our findings. Finally, Section 5 summarises the paper, suggests some policy implications and discusses the limitations of the study.

2 Organic farming and happiness

There is increasing recognition that economic indicators alone are insufficient for examining welfare differences across individuals. This is grounded in the notion that individuals' welfare is influenced by factors other than their income and wealth (Ferrer-i Carbonell, 2005; Graham, 2005; Kahneman and Krueger, 2006). In light of this recognition, there has been a notable expansion in the use of subjective indicators of well-being such as, for example, happiness (Powdthavee, 2007; Kahneman and Deaton, 2010; Dedehouanou et al., 2013; Perez-Truglia, 2020). In studies of happiness, individuals evaluate their overall state of well-being or their satisfaction with specific domains of their lives using either single-item or multiple-item questions with numeric scales (Powdthavee, 2007).

Studies have shown that subjective well-being is shaped by various factors including income, wealth, employment, social capital, health (Stutzer and Frey, 2012; Howley et al., 2017), personality traits, and socio-demographic characteristics (Howley et al., 2017). Hence, several rationales can explain why the adoption of organic farming may be linked to happiness. For instance, it can be expected that the adoption of organic farming affects farmers' income, health, work satisfaction, work recognition, relationships with neighbours, and other aspects of life that influence happiness (Mzoughi, 2014). In the following, we discuss how the adoption of organic farming may affect farmers' happiness through each of these potential pathways.

Income The economic effects of adopting organic farming are multifaceted. On the one hand, adopting organic farming has the potential to increase income by reducing costs connected to intermediate inputs such as pesticides and fertilisers and by obtaining premium prices for organic products (Bolwig et al., 2009; Bachmann, 2012; Vasile et al., 2015). On the other hand, organic farming often results in lower yields. Therefore, the price premiums and the reduced costs due to fewer intermediate inputs may not offset the lower yields and increased workload which are linked to organic farming, thereby leading to reduced income (Beuchelt and Zeller, 2011; Uematsu and Mishra, 2012; Delbridge et al., 2013; Chiputwa et al., 2015; Vellema et al., 2015; Giuliani et al., 2017; Froehlich et al., 2018; Aïhounton and Henningsen, 2024). Given that income is typically positively associated with happiness, it may be expected that the adoption of organic farming could negatively or positively influence farmers' happiness (Mzoughi, 2014).

Health By adopting organic farming practices and, thus, avoiding synthetic inputs, organic farmers can safeguard their health. The health benefits associated with sustainability standards such as GlobalGap have been documented (Asfaw et al., 2010), and a transition to organic farming is expected to reduce the adverse health effects of chemical inputs (Aïhounton et al., 2021), thereby positively influencing happiness.

Work satisfaction Organic certification offers farmers opportunities to attend specialised agronomic training, avoids contamination of the environment with synthetic pesticides, strengthens social equity by providing economic opportunities to women (Assogba, 2014; Sodjinou et al., 2015; Jouzi et al., 2017; Nath and Athinuwat, 2021), and ensures premium prices, which indicates consumers' higher appreciation of organic produce compared to conventional produce. These benefits of organic farming have the potential to make participating farmers proud and more satisfied with their work. Additionally, the relative autonomy in terms of accessing inputs and services in organic farming compared to conventional farming, where expensive inputs are often obtained on credit, may enhance work satisfaction (e.g., Rickson et al., 1999). Work satisfaction has generally been positively associated with improved happiness (Diener and Tay, 2017).

Work recognition Farmers often judge their overall life satisfaction based on how well they are respected and recognised by other farmers (Russell and Bewley, 2013). On the one hand, the more widespread presence of weeds, increased pest damage, and lower yields often seen on organic fields (Leifeld, 2016) may result in organic farmers' receiving less positive feedback for their farming from conventional farmers within traditional farming communities. On the other hand, organic farmers may get praise from farmers and others for strictly adhering to organic regulations and, therefore, for protecting the environment and reducing health hazards. Some studies have highlighted the role of work recognition in boosting individuals' self-esteem (Ariely et al., 2008; Mzoughi, 2014), which may in turn enhance life satisfaction.

Relationships to neighbours Given that organic farming strictly prohibits the use of synthetic inputs, neighbours of organic farmers may appreciate the environmental protection and experience reduced exposure to agrochemicals. Thus, adopting organic farming may be endorsed by some neighbours and, thus, may enhance organic farmers' relationships with neighbours (Mzoughi, 2014). However, the adoption of organic farming may also negatively affect relationships with neighbours. For instance, specific distances are required between organic and conventional fields to prevent the contamination of organic crops with chemical inputs used in conventional farming, which can lead to conflicts between organic farmers and conventional neighbouring farmers. Having good relationships with neighbours may promote happiness (Powdthavee, 2008).

Other pathways In addition to affecting farmers' happiness through income, health, work satisfaction, work recognition, and relationships with neighbours, the adoption of organic farming may affect their happiness through other pathways or even directly. For instance, organic farmers may feel a strong alignment with their personal convictions by employing organic farming practices, which can lead to improved life satisfaction (Mzoughi, 2014). For some farmers, organic farming symbolises a lifestyle in harmony with the environment, which may provide a profound source of happiness.

3 Methodology

3.1 Data sources

We use cross-sectional data collected from farm households that grow organic or conventional cotton in Benin. The locations cover the three districts Kandi, Glazoué, and Péhunco to ensure regional diversity, the presence of organic cotton farmers, and diversity in terms of experiences with organic farming. While Kandi and Glazoué are pioneer locations for organic farming in Benin, organic farming has been introduced in Péhunco more recently.[3] The selection of households for the survey was conducted in three steps. In the first step, we selected the villages in which our household survey had been conducted. We did this by collecting village-level data (e.g., type of road, presence of primary school, number of households, number of cotton farmers, total quantity of cotton produced in the village, whether there are organic cotton farmers in the village, etc.) for all villages in the three selected districts from the municipalities and the communal offices of agriculture. We used these data to select 75 villages, which were split into three categories. As organic cotton was grown in only 25 villages in the three districts, we selected all of them to ensure that we would have a sufficiently large number of organic cotton farmers in our sample. We used genetic matching to select 25 "conventional" villages which only have conventional cotton production but which are otherwise similar in terms of village-level characteristics to the 25 "organic" villages.[4] Finally, we used a search algorithm to select a third group of 25 villages to obtain a representative sample of all cotton-producing villages in our study locations (based on the village-level data). As the NGOs that support organic farming in Benin selected the villages in which they promoted organic farming not randomly but intentionally, the organic villages differ on average from the conventional villages. Our sampling procedure has the advantage that we can compare households with organic and conventional cotton farming, respectively, in comparable villages by using only households from the first group and second group of villages, and that we can use a representative sample by using observations from all three groups of villages.

Having selected 75 villages, the second step of our sampling procedure consisted of conducting a household census in all selected villages. We collected information on the cotton production method (i.e., organic cotton farming, conventional cotton farming, or no cotton farming), phone number, and location of each household.

In the third step of our sampling procedure, we randomly selected households from the lists obtained in the previous step. We aimed to sample around 1400 households in the three districts with about 70% of conventional cotton growing households and 30% organic cotton growing households in each of the three districts. However, this was not possible in the district of Péhunco due to its small number of organic cotton growing households. The sampling intensities for organic cotton growing households were 75%, 100%, 55%, while those for conventional cotton growing households were 8%, 11%, and 8% in Kandi, Péhunco, and Glazoué, respectively. These sampling intensities were used to determine the number of organic cotton growing households and the number of conventional cotton growing households that were selected in each of the 75 selected villages.

In total, 1361 households were randomly surveyed. After eliminating households that were producing both organic and conventional cotton, non-certified organic cotton growing households (i.e., households with less than three years of experience in organic farming as certification requires a three-year transition period and organic cotton growing households that had recently violated some certification requirements),

[3] At the time of data collection, cotton was the only agricultural product with an established organic market. Since price premiums were unavailable for other organic products, virtually all organic farmers in our study area grew cotton. However, while price premiums were limited to cotton, to achieve organic certification, organic farming principles had to be applied across the entire farm, not just on the cotton plots.

[4] In order to keep the wording as simple and as clear as possible, we denote the 25 villages in which both organic and conventional cotton is grown as "organic villages", while we denote the villages in which only conventional cotton is grown as "conventional villages."

households with missing values in crucial variables such as household composition and type of cotton farming, the final sample that we used in our analyses consisted of 1242 households of which 221 and 1021 produced organic and conventional cotton, respectively.

The data were collected through face-to-face interviews from March to May 2018. We gathered demographic and socioeconomic data, agricultural production data, and subjective measures of well-being measured in the following five dimensions: farmer's overall life satisfaction ('happiness'), self-reported health, work satisfaction, work recognition, and relationship with their neighbours; each of these five measures on a scale from zero to ten.[5]

3.2 Base model specification

We conduct a path analysis to explore the relationships between organic farming and happiness, considering several potential pathways. This method is a variant of Structural Equation Modelling (SEM) that does not include latent variables and allows for the examination of complex relationships among observed variables. SEM is known for its ability to simultaneously test theories containing multiple equations with interdependent relationships, estimate parameters for relationships between theoretical constructs, and assess behavioural science theories (Sanchez, 2013; Kline, 2016). SEM uses a path diagram and a system of linked regression-style equations to capture complex and dynamic relationships within a web of observed and unobserved variables and to estimate parameters for relationships between theoretical constructs (Gunzler et al., 2013). Unlike regression models, SEM explores both direct and indirect relationships among variables (Civelek, 2018; Baudron et al., 2019) and assesses the structure of the model and its parameters using observed data (McCune et al., 2002). As we aim to quantify the pathways that explain the relationship between organic farming and happiness, path analysis within the SEM framework is the most suitable method for this study as it allows for the investigation of both direct relationships and indirect relationships through mediators.

As discussed in Section 2, we hypothesise five indirect pathways from the adoption of organic cotton to happiness, namely through income, health, work satisfaction, work recognition, and relationships with neighbours as well as a direct pathway that may also capture indirect pathways through mediators that we do not consider in our analysis. Adding control variables, our model specification is graphically illustrated in Figure 1.

This model specification can also be described mathematically:

$$Y_i = \alpha_6 + \beta_6 \, D_i + \delta_6' \, x_{i6} + \sum_{k=1}^{5} \lambda_k \, M_{ik} + u_{i6} \tag{1}$$

$$M_{ik} = \alpha_k + \beta_k \, D_i + \delta_k' \, x_{ik} + u_{ik}; k = 1, \ldots, 5, \tag{2}$$

$$(u_{i1}, \ldots, u_{i6})' \sim N(\mathbf{0}, \Sigma) \tag{3}$$

where Y_i is the outcome variable (i.e., happiness) for household i, D_i is a dummy variable indicating whether household i is engaged in organic farming, $x_{ik}; k = 1, ..., 6$ are six vectors of control variables, $M_{ik}; k = 1, \ldots, 5$ are the five mediators (i.e., income, health, work satisfaction, work recognition, and relationships to neighbours), $u_{ik}; k = 1, \ldots, 6$ are the error terms, $N(\cdot)$ indicates a multivariate normal distribution, $\mathbf{0}$ is a vector of six zeros, and $\Sigma = [\sigma_{mn}]$ is a symmetric positive semi-definite six-times-six covariance matrix. This model is estimated by the maximum likelihood method, where $\sigma_{m6} = \sigma_{6m}; m =$

[5] Specifically, we asked the household head the following set of questions: (a) overall, how satisfied are you (individually) with your life? (from not satisfied 0 to 10 fully satisfied), (b) overall, describe the level of your (individually) health (from 0 very bad to 10 very good), (c) overall, how satisfied are you (individually) with your work (from not satisfied 0 to 10 fully satisfied), (d) overall, describe how recognised your (individually) work is by the local community in the village (from not recognised 0 to 10 fully recognised), and (e) overall, describe how satisfied you are (individually) with your relationship with your neighbours (from not satisfied 0 to 10 fully satisfied). We denote the answers to these questions as happiness, health, work satisfaction, work recognition, and relationship with neighbours, respectively.

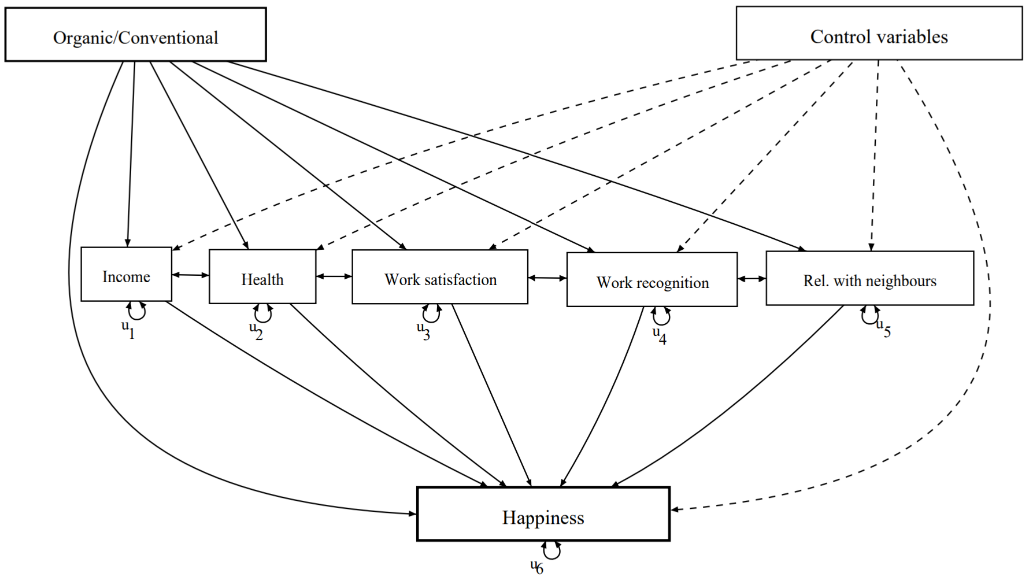

Figure 1: Detailed model specifications

Notes: "Rel." abbreviates "relationship". The box "Control variables" consolidates all control variables given that the inclusion of a separate box and paths for each control variable would excessively clutter the figure. Solid lines represent the relationships between organic farming, the mediators, and happiness, while dashed lines indicate the inclusion of control variables in the equations for happiness and the mediators. Curved double-arrows are used to denote error terms u. Our model specification takes into account a potential correlation of the error terms u_1, u_2, u_3, u_4, and u_5, while it is assumed that the error term u_6 is uncorrelated to the other five error terms. This figure was created using the web application developed by Mai et al. (2023).

$1, \ldots, 5$ are restricted to zero for identification, while all other covariances are freely estimated (e.g., De Stavola et al., 2015; Botha et al., 2018).[6]

In equation (1), the coefficient β_6 represents the direct relationship between organic farming and happiness. In equation (2), the coefficient β_k captures the relationship between organic farming and the k's mediator. The coefficient λ_k in equation (1) portrays the relationship between the kth mediator and happiness Y_i. Consequently, $\beta_k \lambda_k$ encapsulates the indirect relationship between organic farming and happiness through the kth mediator, while $\beta_6 + \sum_{k=1}^{5} \beta_k \lambda_k$ represents the total relationship between organic farming and happiness.

If we want to interpret the estimated relationships between organic farming, the mediators, and happiness as causal effects, we have to assume that organic farming (D_i) is unrelated to all six error terms ($u_{ik}; k = 1, \ldots, 6$) and that all five mediators ($M_{ik}; k = 1, \ldots, 5$) are unrelated to the error of the outcome equation (1), i.e., u_{i6}, i.e., we would rely on a selection-on-observables identification strategy. As this is an unachievable assumption in our empirical study with observational data, we interpret our estimation results as relationships rather than causal effects.

In order to ensure that our estimated relationships are as close as possible to causal effects, we add sets of control variables ($x_{ik}; k = 1, \ldots, 6$), which minimise the relationship between the error terms ($u_{ik}; k = 1, \ldots, 6$) and the explanatory variables (particularly D_i and in equation (1) also $M_{ik}; k = 1, \ldots, 5$). We chose the control variables based on the existing literature on happiness (e.g., Botha et al., 2018) and our own considerations about the situations of the farm households in our study region and the specification

[6] We transform variables with very right-skewed distributions by the log transformation (if all values are strictly positive) or by the inverse hyperbolic sine (IHS) transformation (if the variable has zero and/or negative values) in order to obtain variables with narrower ranges and distributions that are less skewed, which usually contributes to fulfilling the assumptions of regression models (e.g., heteroscedasticity) and makes the regression results more robust to extreme values and outliers (Wooldridge, 2016, p. 172). As the IHS transformation is not invariant to units of measurement, we use the method suggested by Aïhounton and Henningsen (2021) to identify the most suitable unit of measurement of the cotton income (see Tables C.1 and C.2 in Appendix C).

of our path analysis. Table A.1 in Appendix A describes which sets of control variables ($x_{ik}; k = 1, \ldots, 6$) we use in each of the six equations of our path analysis. We hypothesise that several factors including the household head's agricultural experience, distance to the village centre, distance to the nearest market, proximity to health facilities, and access to safe water may each exert distinct influences on happiness and/or its associated mediators. For instance, households with access to safe water sources are expected to have better health, which could potentially lead to greater happiness. Proximity to the village centre can affect relationships to neighbours in various ways, e.g., compared to people living on the outskirts, people living in the village centre are more likely to encounter a wider range of individuals in addition to their neighbours when they step outside, which can affect relationships to neighbours. Proximity to health facilities may correlate with improved health outcomes, which in turn could enhance overall happiness levels. Furthermore, households situated closer to the nearest market may experience higher income levels and increased work satisfaction due to easier access to markets for selling crops. Additionally, proximity to markets may facilitate the purchase of nutritious foods, which may potentially improve health and overall happiness.

In order to facilitate the interpretation of the economic significance of the estimated associations and to make the magnitudes of the estimated associations comparable across the different mediators, we present the associations between organic farming and the mediators as well as the indirect, direct, and total associations between organic farming and our outcome variable (happiness) in terms of Cohen's d (Cohen, 1988), i.e., we normalise the estimated associations by dividing them by the standard deviation of the respective mediator or by the standard deviation of the outcome variable, respectively. A Cohen's d equal to 0.5 is considered to be a medium effect size and indicates in our case that organic farming is associated with a change of 0.5 standard deviations of the mediator or outcome, while a Cohen's d equal to 0.2 or 0.8 is considered to be a small or large effect size, respectively (Cohen, 1988). Similarly, we present the associations between the mediators and the outcomes in terms of standardised coefficients, i.e., the estimated coefficients multiplied by the standard deviation of the respective mediator and divided by the standard deviation of the outcome variable. A standardised coefficient of, say, 0.5 indicates that a change in the mediator by one standard deviation is associated with a change in happiness by 0.5 standard deviations. As the calculations of Cohen's d and the standardised coefficients are just proportional transformations of the estimated coefficients or associations, we calculate the standard deviations of Cohen's d and of the standardised coefficients by applying the same proportional transformations to the estimated standard deviations.

Due to the design of our sampling strategy, we obtain a sandwich-type covariance matrix of the estimated coefficients, so that our standard errors are robust to clustering at the village level.

3.3 Alternative model specifications

In addition to our base model specification described above, we consider several alternative model specifications to explore how different model specifications affect the estimated relationships. The alternative model specifications deviate from the base model specification in the following aspects:

- In order to minimise the correlation between our 'treatment' variable (D_i) and the error terms ($u_{ik}; k = 1, \ldots, 6$), we control for potential unobserved variables that affect farmers' expectations of the advantages and disadvantages of organic farming and, thus, their participation in organic farming, as inspired by Verhofstadt and Maertens (2014), Bellemare and Novak (2017), Ruml and Qaim (2021), and Aïhounton and Henningsen (2024). We call this additional control variable 'WTP' as it proxies farmers' willingness to pay for adopting organic or conventional farming (Aïhounton and Henningsen, 2024). The WTP variable is obtained in our survey by asking each respondent "which type of cotton farming do you think gives you and your household, in general, a better life?". The question should be answered on a 7-point Likert scale with 1 = organic much better, 2 = organic somewhat better, 3 = organic slightly better, 4 = about the same, 5 = conventional slightly better, 6 = conventional somewhat better, 7 = conventional much better (see Aïhounton and Henningsen, 2024). We use the answer to this question to control for unobserved factors such as soil type, environmental conditions, and the respondent's personality, personal views, skills, and attitudes that affect the decision to adopt organic farming and might also affect happiness directly or through the mediators.

- In our base model specification, we use the income from cotton farming as mediator for income. As adopting organic cotton farming might also affect income from other sources (e.g., from other crops, livestock farming or off-farm activities), we estimate alternative specifications with (a proxy of) total household income instead of income from cotton farming as mediator for income. As our data set does not include information on all income-generating activities of all household members, we calculate a proxy of total household income by dividing the revenue from cotton farming by the share of cotton income in total household income, which was obtained as a response to the question "What is the share of cotton income of total household income?" (see Aïhounton and Henningsen, 2024, for details). We call this proxy of total household income "household revenue". While using income from cotton farming has the advantages of being closely related to the adoption of organic cotton farming and of being easy to precisely measure, using household revenue has the advantage of providing a more holistic measure of the household's economic financial situation, which acknowledges the diversity of rural households' income sources.

- In our base model specification, we use the household's wealth, measured as the monetary value of household assets, as a control variable because wealth likely has a positive impact on happiness and it may also influence the adoption of organic farming. However, as the adoption of organic farming may influence income and changes in income may in the long run influence the accumulation or depletion of wealth, we estimate alternative model specifications, where we use wealth as a mediator instead of as a control variable. Given that we cannot exclude the possibility that both the base model specification with wealth as control variable and the alternative specification with wealth as mediator are misspecified, we estimate additional model specifications in which wealth is neither used as control variable nor as mediator.

- While we use all observations (from all three groups of villages) in our base model specification, we conduct additional estimations with only observations from "organic" villages and villages that are similar to "organic" villages, i.e., removing observations from villages that are dissimilar to the "organic" villages (see Section 3.1 for details). While our base model specification has the advantage of using a dataset obtained from households in a representative sample of villages, this alternative specification has the advantage of including only households that are located in similar villages and, thus, have more homogeneous external conditions.

With two different specifications regarding the WTP variable, two different specifications of the income variable, three different specifications regarding modelling the household assets, and two different specifications regarding the choice of observations, we have in total 24 different combinations of specifications that we estimate. This structured approach allows for a thorough examination of how our results respond to changes in the model specification, thereby enabling the clear communication of the uncertainty of our results that is caused by uncertainty about the optimal model specification (not only caused by sampling uncertainty, which is captured in the standard errors) and a nuanced understanding of the relationships between organic farming and happiness.

4 Results[7]

4.1 Descriptive statistics

Table 1 summarises the descriptive statistics of the variables in our dataset, along with tests for significant differences between conventional cotton growing households and organic cotton growing households. The majority of the households in our sample has a male head, with a significantly higher share of female heads in organic cotton growing households (14%) than in conventional cotton growing households (5%). Household heads generally have a very low level of education, with on average only one to two years of schooling. Household size is often considered a proxy for labour availability, and the average household size is on average slightly above seven members both for organic and conventional cotton growing households. Several further characteristics of the household head and the household do not statistically significantly differ between organic cotton and conventional cotton growing households. However, compared to conventional cotton growing households, organic cotton growing households have significantly lower values of household assets, while they have on average a greater distance to the village centre and health facilities and a lower proportion of them are located in a village with access to a tarmac road, indicating that they are located more remotely. While conventional cotton growing households own on average around 14 ha land, organic cotton growing households own on average a slightly smaller land area (10.6 ha) with this difference being highly statistically significant. Although the difference in land ownership is rather moderate economically, organic cotton growing households cultivate cotton on average on less than half the area (1.64 ha) compared to conventional cotton growing households (3.87 ha). This is likely due to the significantly higher labour demand and wider crop rotation of organic cotton farming compared to conventional cotton farming.

Organic cotton growing households report statistically significantly higher happiness (life satisfaction), better health, higher work satisfaction, greater recognition for their work, and better relationships with neighbours compared to their conventional counterparts with the largest differences being in health and work satisfaction. However, in terms of economic outcomes, conventional cotton growing households tend to have a much higher cotton income and household revenue than organic cotton growing households.

4.2 Relationship between organic farming and the mediators

Table 2 presents our estimates of the relationships between organic farming and the mediators.[8] The results of all 24 estimations reveal a strong negative and highly statistically significant association between organic farming and income with organic farming being associated with a decrease in income of around one half to three quarters of the standard deviation of the income. We obtain this result regardless of whether income is measured as cotton income or as household revenue. In contrast, we do not find a clear association between organic farming and household assets.

In all 24 estimations, organic farming is statistically significantly associated with a moderate increase in farmers' self-reported health by around 0.37 standard deviations. Additionally, organic farming exhibits a positive association with work satisfaction in all 24 model specifications. This association is small and statistically insignificant in the 12 model specifications that do not include WTP as control variable. When using WTP to control for unobserved heterogeneity, we find that organic farming is associated with a highly statistically significant and substantial increase in work satisfaction of around 0.6 standard deviations.

[7]The empirical analyses were performed with the statistical software "R" (R Core Team, 2024) using the add-on packages "lavaan" (Rosseel, 2012) for the path analyses, "DescTools" (Signorell, 2024), "lmtest" (Zeileis and Hothorn, 2002), and "moments" (Komsta and Novomestky, 2022) for the grid-search procedure described in Aïhounton and Henningsen (2021) as well as "stargazer" (Hlavac, 2022) and "xtable" (Dahl et al., 2019) for creating tables.

[8]More detailed regression results are presented in Appendix B.

Table 1: Descriptive statistics

	All	sd	Convent.	Organic	Diff.	P-value
Household head						
Age (years)	42.46	11.56	42.06	44.31	2.25	0.020
Sex (1=male)	0.93	0.25	0.95	0.86	-0.09	<0.001
Years of education	1.37	2.87	1.34	1.52	0.18	0.433
Exper. in agric. decision making (years)	18.83	10.20	18.58	19.98	1.40	0.093
Household						
Household size	7.31	3.49	7.38	7.01	-0.36	0.177
Dependency ratio	0.41	0.21	0.41	0.42	0.01	0.650
Land cultivated with cotton (ha)	3.47	3.19	3.87	1.64	-2.23	<0.001
Total land owned (ha)	13.38	11.68	13.99	10.58	-3.41	<0.001
Household assets (million FCFA)	2.31	4.85	2.43	1.75	-0.68	0.006
Distance to village center (km)	2.77	5.36	2.59	3.62	1.04	0.022
Distance to closest market (km)	3.23	4.22	3.22	3.27	0.05	0.901
Tarmac road	0.35	0.48	0.30	0.57	0.27	<0.001
Water Deprivation	0.35	0.48	0.34	0.37	0.03	0.437
Distance to health facility (km)	4.06	4.53	3.88	4.90	1.03	0.018
Outcome and mediators						
Happiness	6.52	1.51	6.45	6.84	0.38	<0.001
Cotton income (1000 FCFA)	541.21	729.56	590.74	312.36	-278.38	<0.001
Cotton income (IHS, million FCFA)	0.44	0.48	0.48	0.28	-0.19	<0.001
Household revenue (1000 FCFA)	2249.79	2609.56	2488.12	1148.70	-1339.42	<0.001
Household revenue (log, 1000 FCFA)	14.21	0.93	14.36	13.54	-0.82	<0.001
Health	6.45	1.57	6.33	7.01	0.67	<0.001
Work satisfaction	6.57	1.59	6.47	7.04	0.57	<0.001
Work recognition	6.25	1.51	6.20	6.49	0.29	0.020
Relationship to neighbours	6.40	1.52	6.34	6.71	0.37	0.002
District						<0.001
Kandi	0.57	0.50	0.53	0.74	0.22	
Pehunco	0.24	0.43	0.28	0.03	-0.25	
Glazoué	0.20	0.40	0.19	0.23	0.04	
Observations	1242		1021	221		

Notes: Columns 'All', 'Convent.', and 'Organic' present the mean values of all observations, households growing conventional cotton, and households growing organic cotton, respectively. Column 'sd' presents the standard deviations (of all observations). Column 'Diff.' presents the differences in the mean values between households growing conventional cotton and households growing organic cotton. Column 'P-values' presents P-values of two-sample t-tests for equality of mean values of continuous variable and P-values of Pearson's χ^2-tests for equal proportions of categorical variables.

Finally, organic farming exhibits neither a statistically nor an economically significant association with the recognition of their work by the local community or their relationships to neighbours. Overall, these results imply that the adoption of organic farming is negatively associated with income and positively associated with self-reported health and work satisfaction.

4.3 Relationship between the mediators and happiness

The estimates of the relationships between the mediators and happiness are presented in Table 3. The results indicate that when using cotton income as income variable, the relationship between cotton income and happiness is statistically insignificant and even very close to zero. However, in the 12 model specifications that use household revenue as income variable, household revenue is statistically significantly and positively associated with happiness, although the magnitude of this association is rather small with an increase in household revenue by one standard deviation being associated with an increase in happiness by less than 0.1 standard deviations. All eight model specifications that use household assets as mediator indicate a positive association between household assets and happiness, although this association is also rather small with an increase in household assets by one standard deviation being associated with an increase in happiness of less than 0.1 standard deviations. Furthermore, it is statistically significant (at 10% level) in only five of the eight model specifications (when using a larger sample, consisting of households from all villages).

Self-reported health is positively associated with happiness across all 24 model specifications with very similar magnitudes across all 24 model specifications. An increase in self-reported health by one standard

Table 2: Associations between organic farming and mediator variables

WTP	Income Var.	HH Assets	Villages	Income	HH assets	Health	Work satisf.	Work recog.	Neighbours
No	Cotton Inc	Control	All	−0.44(0.11)***		0.37(0.14)***	0.23(0.14)	0.09(0.22)	0.10(0.23)
No	Cotton Inc	Control	Sim	−0.46(0.12)***		0.37(0.15)**	0.23(0.15)	0.04(0.21)	0.07(0.23)
No	Cotton Inc	No	All	−0.45(0.11)***		0.36(0.14)***	0.22(0.14)	0.07(0.22)	0.08(0.23)
No	Cotton Inc	No	Sim	−0.46(0.12)***		0.37(0.15)**	0.22(0.15)	0.03(0.21)	0.07(0.23)
No	Cotton Inc	Mediator	All	−0.45(0.11)***	−0.12(0.09)	0.36(0.14)***	0.22(0.14)	0.07(0.22)	0.08(0.23)
No	Cotton Inc	Mediator	Sim	−0.46(0.12)***	−0.03(0.09)	0.37(0.15)**	0.22(0.15)	0.03(0.21)	0.07(0.23)
No	HH Revenue	Control	All	−0.76(0.14)***		0.37(0.14)***	0.23(0.14)	0.09(0.22)	0.10(0.23)
No	HH Revenue	Control	Sim	−0.75(0.14)***		0.37(0.15)**	0.23(0.15)	0.04(0.21)	0.07(0.23)
No	HH Revenue	No	All	−0.77(0.14)***		0.37(0.14)***	0.22(0.14)	0.07(0.22)	0.08(0.23)
No	HH Revenue	No	Sim	−0.75(0.14)***		0.37(0.15)**	0.22(0.15)	0.03(0.21)	0.07(0.23)
No	HH Revenue	Mediator	All	−0.77(0.14)***	−0.12(0.09)	0.37(0.14)***	0.22(0.14)	0.07(0.22)	0.08(0.23)
No	HH Revenue	Mediator	Sim	−0.75(0.14)***	−0.03(0.09)	0.37(0.15)**	0.22(0.15)	0.03(0.21)	0.07(0.23)
Yes	Cotton Inc	Control	All	−0.50(0.12)***		0.37(0.19)*	0.62(0.19)***	−0.03(0.27)	−0.05(0.28)
Yes	Cotton Inc	Control	Sim	−0.50(0.13)***		0.36(0.21)*	0.55(0.21)***	−0.13(0.27)	−0.10(0.30)
Yes	Cotton Inc	No	All	−0.49(0.12)***		0.38(0.19)**	0.63(0.19)***	−0.02(0.27)	−0.04(0.28)
Yes	Cotton Inc	No	Sim	−0.49(0.13)***		0.37(0.21)*	0.56(0.21)***	−0.12(0.27)	−0.09(0.30)
Yes	Cotton Inc	Mediator	All	−0.49(0.12)***	0.19(0.11)*	0.38(0.19)**	0.63(0.19)***	−0.02(0.27)	−0.04(0.28)
Yes	Cotton Inc	Mediator	Sim	−0.49(0.13)***	0.15(0.12)	0.37(0.21)*	0.56(0.21)***	−0.12(0.27)	−0.09(0.30)
Yes	HH Revenue	Control	All	−0.50(0.16)***		0.37(0.19)*	0.62(0.19)***	−0.03(0.27)	−0.05(0.28)
Yes	HH Revenue	Control	Sim	−0.56(0.16)***		0.36(0.21)*	0.55(0.21)***	−0.13(0.27)	−0.10(0.30)
Yes	HH Revenue	No	All	−0.48(0.16)***		0.38(0.19)**	0.63(0.19)***	−0.02(0.27)	−0.04(0.28)
Yes	HH Revenue	No	Sim	−0.54(0.17)***		0.37(0.21)*	0.56(0.21)***	−0.12(0.27)	−0.09(0.30)
Yes	HH Revenue	Mediator	All	−0.48(0.16)***	0.19(0.11)*	0.38(0.19)**	0.63(0.19)***	−0.02(0.27)	−0.04(0.28)
Yes	HH Revenue	Mediator	Sim	−0.54(0.17)***	0.15(0.12)	0.37(0.21)*	0.56(0.21)***	−0.12(0.27)	−0.09(0.30)

Notes: The values in this table indicate Cohen's d, i.e., the estimated coefficients divided by the standard deviation of the respective mediator. Thus, a value of, say, 0.5 indicates that organic farming is associated with an increase in the mediator by 0.5 standard deviations. Each row presents the results of a different model specification, where columns 1–4 indicate the model specifications; 'HH' abbreviates 'household'; 'Income' indicates the income from cotton farming (IHS-transformed) if column 'Income Var.' is 'Cotton Inc' or approximate total monetary revenue of the household (log-transformed) if column 'Income Var.' is 'HH Revenue'; 'Health' indicates the farmers' self-reported health; 'Work satisf.' indicates their satisfaction with their work; 'Work recog.' indicates the perceived recognition of their work in the local community; 'Neighbours' indicates their satisfaction with their relationships with neighbours. '*', '**', and '***' indicates statistical significance at 10%, 5%, and 1% level, respectively.

deviation is associated with an increase in happiness of 0.25–0.26 standard deviations. Work satisfaction and work recognition are also positively associated with happiness across all 24 model specifications. An increase in work satisfaction by one standard deviation is associated with a substantial increase in happiness of 0.41–0.46 standard deviations, while an increase in work recognition by the local community of one standard deviation is associated with a notable increase in happiness of 0.15–0.18 standard deviations. Finally, we find a positive association between the relationship with neighbours and happiness with a small but very stable magnitude across all 24 model specifications. An improvement in the relationship with neighbours of one standard deviation is associated with a small increase in happiness of 0.05–0.08 standard deviations of happiness. This association is statistically significant (at 10% level) in 18 of the 24 model specifications (with statistical insignificance for smaller samples when observations from similar villages only are included).

Our results indicate that all of our mediators—income, wealth, health, work satisfaction, work recognition, and relationship with neighbours—are positively associated with happiness. Of these factors, health, work satisfaction and work recognition by the local community are the most important, while monetary factors—income and wealth—are much less related to happiness.

4.4 Indirect, direct, and total relationships

The estimated indirect, direct and total relationships between organic farming and happiness are summarised in Table 4. When using cotton income as income variable, we do not find an economically or statistically significant indirect relationship through income. However, when we use household revenue as income variable, we find a small indirect negative association between organic farming and happiness through income in that organic farming is related to a decline in happiness of 0.03–0.06 standard deviations through lower income. When considering household assets as mediator, we do not find an economically or statistically significant indirect relationship through household assets in any of the eight relevant model specifications.

In all 24 estimations, we find a statistically significant (at the 10% level) positive relationship between organic farming and happiness through self-reported health. This indirect association is very stable across all model specifications but rather small (0.09–0.10 standard deviations). All 24 model specifications indicate a positive indirect relationship between organic farming and happiness through work satisfaction. While this indirect relationship is rather small (0.09–0.11 standard deviations) and statistically insignificant in the 12 model specifications that do not include WTP as control variable, we find a statistically significant (at 5% level) and moderately large positive indirect relationship (0.22–0.27 standard deviations) when using WTP to control for unobserved heterogeneity. Regardless of the model specification used, no economically or statistically significant indirect association is found between organic farming and happiness through work recognition or relationships with neighbours.

Thus, income, self reported health, and work satisfaction mediate the indirect association between organic farming and happiness. In total, organic farming is indirectly associated with an increase in happiness of 0.13–0.37 standard deviations. However, due to partly counteracting indirect relationships (income negative, health and work satisfaction positive), the total indirect relationship is small in some of the model specifications and statistically significant (at 10% level) in only six of the 24 model specifications.

The direct relationship between organic farming and happiness is positive in all 24 model specifications. In the 12 model specifications that include WTP, the direct relationship between organic farming and happiness is small (0.01–0.09 standard deviations) and statistically insignificant, while this direct relationship is moderately large (0.26–0.36 standard deviations) when using the WTP variable to control for unobserved heterogeneity.

Table 3: Associations between mediator variables and happiness

WTP	Income Var.	HH Assets	Villages	Income	HH assets	Health	Work satisf.	Work recog.	Neighbours
No	Cotton Inc	Control	All	0.00(0.03)		0.25(0.03)***	0.46(0.05)***	0.15(0.03)***	0.06(0.03)*
No	Cotton Inc	Control	Sim	0.02(0.03)		0.25(0.03)***	0.43(0.06)***	0.16(0.04)***	0.05(0.03)
No	Cotton Inc	No	All	0.01(0.03)		0.25(0.03)***	0.46(0.06)***	0.15(0.03)***	0.06(0.03)*
No	Cotton Inc	No	Sim	0.02(0.03)		0.25(0.03)***	0.44(0.06)***	0.17(0.04)***	0.05(0.04)
No	Cotton Inc	Mediator	All	0.00(0.03)	0.08(0.03)**	0.25(0.03)***	0.46(0.05)***	0.15(0.03)***	0.06(0.03)*
No	Cotton Inc	Mediator	Sim	0.02(0.03)	0.06(0.04)*	0.25(0.03)***	0.43(0.06)***	0.16(0.04)***	0.05(0.03)
No	HH Revenue	Control	All	0.07(0.03)**		0.25(0.03)***	0.45(0.05)***	0.15(0.03)***	0.06(0.03)**
No	HH Revenue	Control	Sim	0.08(0.03)**		0.25(0.03)***	0.43(0.05)***	0.17(0.04)***	0.05(0.03)
No	HH Revenue	No	All	0.08(0.03)***		0.25(0.03)***	0.45(0.05)***	0.15(0.04)***	0.07(0.03)**
No	HH Revenue	No	Sim	0.09(0.03)***		0.25(0.03)***	0.43(0.05)***	0.17(0.04)***	0.06(0.03)
No	HH Revenue	Mediator	All	0.07(0.03)**	0.07(0.03)**	0.25(0.03)***	0.45(0.05)***	0.15(0.04)***	0.06(0.03)**
No	HH Revenue	Mediator	Sim	0.08(0.03)**	0.05(0.04)	0.25(0.03)***	0.43(0.05)***	0.17(0.04)***	0.05(0.03)
Yes	Cotton Inc	Control	All	0.01(0.03)		0.25(0.03)***	0.43(0.05)***	0.16(0.04)***	0.07(0.03)**
Yes	Cotton Inc	Control	Sim	0.02(0.03)		0.26(0.03)***	0.41(0.05)***	0.17(0.04)***	0.06(0.03)*
Yes	Cotton Inc	No	All	0.01(0.03)		0.25(0.03)***	0.43(0.05)***	0.16(0.04)***	0.07(0.03)**
Yes	Cotton Inc	No	Sim	0.03(0.03)		0.26(0.03)***	0.41(0.05)***	0.18(0.04)***	0.06(0.03)*
Yes	Cotton Inc	Mediator	All	0.01(0.03)	0.06(0.03)**	0.25(0.03)***	0.43(0.05)***	0.16(0.04)***	0.07(0.03)**
Yes	Cotton Inc	Mediator	Sim	0.02(0.03)	0.06(0.04)	0.26(0.03)***	0.41(0.05)***	0.17(0.04)***	0.06(0.03)*
Yes	HH Revenue	Control	All	0.05(0.03)**		0.25(0.03)***	0.42(0.05)***	0.16(0.04)***	0.07(0.03)**
Yes	HH Revenue	Control	Sim	0.07(0.03)**		0.26(0.03)***	0.41(0.05)***	0.18(0.04)***	0.06(0.03)*
Yes	HH Revenue	No	All	0.06(0.03)**		0.25(0.03)***	0.42(0.05)***	0.16(0.04)***	0.08(0.03)***
Yes	HH Revenue	No	Sim	0.08(0.03)***		0.26(0.03)***	0.41(0.05)***	0.18(0.04)***	0.06(0.03)*
Yes	HH Revenue	Mediator	All	0.05(0.03)**	0.06(0.03)*	0.25(0.03)***	0.42(0.05)***	0.16(0.04)***	0.07(0.03)**
Yes	HH Revenue	Mediator	Sim	0.07(0.03)**	0.05(0.03)	0.26(0.03)***	0.41(0.05)***	0.18(0.04)***	0.06(0.03)*

Notes: The values in this table indicate standardised coefficients, i.e., the estimated coefficients multiplied by the standard deviation of the respective mediator and divided by the standard deviation of the outcome variable (happiness). Thus, a value of, say, 0.5 indicates that an increase in the mediator by one standard deviation is associated with an increase in the outcome variable by 0.5 standard deviations. See further notes below Table 2.

Table 4: Indirect, direct, and total associations between organig farming and happiness

WTP	Income Var.	HH Assets	Villages	Income	HH assets	Health	Work satisf.	Work recog.	Neighbours	sum indirect	direct	total
No	Cotton Inc	Control	All	−0.00(0.01)		0.09(0.04)**	0.11(0.07)	0.01(0.03)	0.01(0.01)	0.22(0.14)	0.04(0.07)	0.25(0.13)*
No	Cotton Inc	Control	Sim	−0.01(0.01)		0.10(0.04)**	0.10(0.07)	0.01(0.04)	0.00(0.01)	0.19(0.15)	0.01(0.07)	0.21(0.14)
No	Cotton Inc	No	All	−0.00(0.01)		0.09(0.04)**	0.10(0.07)	0.01(0.03)	0.00(0.01)	0.20(0.14)	0.03(0.07)	0.23(0.13)*
No	Cotton Inc	No	Sim	−0.01(0.01)		0.09(0.04)**	0.10(0.07)	0.01(0.04)	0.00(0.01)	0.19(0.15)	0.01(0.07)	0.20(0.13)
No	Cotton Inc	Mediator	All	−0.00(0.01)	−0.01(0.01)	0.09(0.03)***	0.10(0.07)	0.01(0.03)	0.00(0.01)	0.19(0.14)	0.04(0.07)	0.23(0.13)*
No	Cotton Inc	Mediator	Sim	−0.01(0.01)	−0.00(0.01)	0.09(0.04)**	0.10(0.07)	0.01(0.04)	0.00(0.01)	0.19(0.15)	0.01(0.07)	0.20(0.13)
No	HH Revenue	Control	All	−0.05(0.02)**		0.09(0.04)**	0.10(0.07)	0.01(0.03)	0.01(0.02)	0.17(0.14)	0.09(0.07)	0.25(0.13)*
No	HH Revenue	Control	Sim	−0.06(0.02)**		0.10(0.04)**	0.10(0.07)	0.01(0.04)	0.00(0.01)	0.14(0.14)	0.06(0.07)	0.21(0.14)
No	HH Revenue	No	All	−0.06(0.02)***		0.09(0.03)**	0.10(0.07)	0.01(0.03)	0.01(0.02)	0.14(0.14)	0.08(0.07)	0.23(0.13)*
No	HH Revenue	No	Sim	−0.06(0.02)***		0.09(0.04)**	0.10(0.07)	0.01(0.04)	0.00(0.01)	0.13(0.15)	0.07(0.07)	0.20(0.14)
No	HH Revenue	Mediator	All	−0.05(0.02)**	−0.01(0.01)	0.09(0.03)***	0.10(0.07)	0.01(0.03)	0.01(0.01)	0.14(0.14)	0.09(0.07)	0.23(0.13)*
No	HH Revenue	Mediator	Sim	−0.06(0.02)**	−0.00(0.01)	0.09(0.04)**	0.09(0.07)	0.01(0.04)	0.00(0.01)	0.14(0.14)	0.06(0.07)	0.20(0.13)
Yes	Cotton Inc	Control	All	−0.00(0.01)		0.09(0.05)*	0.26(0.10)***	−0.00(0.04)	−0.00(0.02)	0.34(0.19)*	0.32(0.10)***	0.67(0.19)***
Yes	Cotton Inc	Control	Sim	−0.01(0.01)		0.09(0.05)*	0.23(0.10)**	−0.02(0.05)	−0.01(0.02)	0.28(0.20)	0.26(0.11)**	0.54(0.19)***
Yes	Cotton Inc	No	All	−0.01(0.01)		0.09(0.05)*	0.27(0.10)***	−0.00(0.04)	−0.00(0.02)	0.35(0.19)*	0.34(0.10)***	0.69(0.19)***
Yes	Cotton Inc	No	Sim	−0.01(0.01)		0.09(0.05)*	0.23(0.10)**	−0.02(0.05)	−0.01(0.02)	0.28(0.20)	0.27(0.11)**	0.55(0.20)***
Yes	Cotton Inc	Mediator	All	−0.00(0.01)	0.01(0.01)	0.09(0.05)*	0.27(0.10)***	−0.00(0.04)	−0.00(0.02)	0.37(0.18)**	0.32(0.10)***	0.69(0.19)***
Yes	Cotton Inc	Mediator	Sim	−0.01(0.01)	0.01(0.01)	0.09(0.05)*	0.23(0.10)**	−0.02(0.05)	−0.01(0.02)	0.29(0.20)	0.26(0.11)**	0.55(0.19)***
Yes	HH Revenue	Control	All	−0.03(0.01)*		0.09(0.05)*	0.26(0.09)***	−0.01(0.04)	−0.00(0.02)	0.32(0.18)*	0.35(0.10)***	0.67(0.19)***
Yes	HH Revenue	Control	Sim	−0.04(0.02)**		0.09(0.05)*	0.22(0.10)**	−0.02(0.05)	−0.01(0.02)	0.25(0.19)	0.29(0.11)***	0.54(0.19)***
Yes	HH Revenue	No	All	−0.03(0.01)**		0.09(0.05)*	0.27(0.09)***	−0.00(0.04)	−0.00(0.02)	0.32(0.18)*	0.36(0.10)***	0.69(0.19)***
Yes	HH Revenue	No	Sim	−0.04(0.02)**		0.09(0.05)*	0.23(0.10)**	−0.02(0.05)	−0.01(0.02)	0.25(0.19)	0.30(0.11)***	0.55(0.20)***
Yes	HH Revenue	Mediator	All	−0.03(0.01)*	0.01(0.01)	0.09(0.05)*	0.26(0.09)***	−0.00(0.04)	−0.00(0.02)	0.34(0.18)*	0.35(0.10)***	0.69(0.19)***
Yes	HH Revenue	Mediator	Sim	−0.04(0.02)**	0.01(0.01)	0.09(0.05)*	0.23(0.10)**	−0.02(0.05)	−0.01(0.02)	0.26(0.19)	0.29(0.11)***	0.56(0.19)***

Notes: The values in this table indicate Cohen's d, i.e., the estimated indirect, direct, or total association divided by the standard deviation of the outcome variable (happiness). Thus, a value of, say, 0.5 indicates that organic farming is associated with an increase in happiness by 0.5 standard deviations. Columns 4–9 indicate the indirect associations through the respective mediators, while column 'sum indirect' indicates the sum of these indirect associations; See further notes below Table 2.

Summing up all indirect relationships and the direct relationship, we obtain the total relationship between organic farming and happiness, which is positive and moderate to large in all 24 model specifications (0.21–0.69 standard deviations) and statistically significant (at 10% level) in 18 of the 24 model specifications (thereof statistically significant at 1% level in 12 of the 24 model specifications).

5 Conclusion

A growing body of literature analyses the effects of sustainability standards such as organic farming on the economic outcomes of smallholder farmers in developing countries with a mix of positive, negative and insignificant results. As several studies show that the adoption of organic farming decreases farmers' income (Beuchelt and Zeller, 2011; Uematsu and Mishra, 2012; Chiputwa et al., 2015; Vellema et al., 2015; Giuliani et al., 2017; Froehlich et al., 2018), the question is what benefits farmers gain from farming organically and, thus, why these farmers adopt organic farming in spite of lower incomes. Therefore, our study extends beyond monetary outcomes and explores how organic farming is related to various non-monetary indicators of wellbeing. We use path analysis, a variant of Structural Equation Modelling (SEM), to empirically analyse how organic farming is related to farmers' life satisfaction—often briefly denoted as 'happiness'—through various monetary and non-monetary intermediate outcomes. To the best of our knowledge, our study is the first that examines the associations between organic farming and a range of monetary and non-monetary outcomes as well as the indirect, direct, and total relationships between organic farming and happiness.

Our empirical research uses data collected from both organic and conventional cotton growing households in Benin. Our findings indicate that organic farming is negatively associated with income, while it is positively associated with farmers' self-reported health and their work satisfaction. However, we find neither a negative nor a positive association with the recognition of their work by the local community or their relationships with neighbours. Furthermore, our findings confirm those of Mzoughi (2014) who show that farmers' happiness is positively associated with both monetary (income) and non-monetary (good health, work satisfaction, work recognition, relationship with neighbours) indicators of well-being. Our mediation analysis suggests that organic farming enhances happiness through improved health and increased work satisfaction, along with a direct relationship between organic farming and happiness. The negative association between organic farming and income slightly reduces the positive relationship with happiness, but only to a limited extent.

Consistent with Mzoughi (2011) and Mzoughi (2014), our results highlight the importance of non-monetary factors in explaining farmers' perceptions of the welfare effects of adopting organic farming and, thus, their choice between conventional and organic farming. Non-monetary returns may even be more important to farmers than monetary returns. This may also explain the results of the descriptive analysis of Mourão et al. (2019), which finds that organic farmers tend to view themselves as happy with their lives, exhibiting an optimistic and positive attitude regardless of their economic or social concerns. Thus, it is essential to consider non-monetary outcomes in scientific analyses of both the adoption of organic farming and the effects of adopting organic farming.

Future studies could address some limitations of our study. For instance, obtaining data on non-monetary indicators of subjective well-being at multiple times rather than just once could give more reliable measurements as these factors likely fluctuate during the day, month, and year. Using panel data collected over multiple time points could further enhance the robustness of our findings. Finally, while we can only analyse relationships, using RCTs could facilitate the estimation of causal effects.

Acknowledgments

The authors gratefully acknowledge the financial support of the Ministry of Foreign Affairs of Denmark (Grant: 14-02KU). The authors would also like to express their gratitude to Epiphane Sodjinou, Roch Mongbo, Anne Floquet, and Jacob Afouda Yabi for their technical support with data collection and to Awudu Abdulai, Miet Maertens, and Mariéve Pouliot for their valuable comments and suggestions on earlier drafts of this paper. Of course, the authors take full responsibility for any remaining errors.

References

Aïhounton, G., Henningsen, A., and Trifkovic, N. (2021). Pesticide handling and human health: Conventional and organic cotton farming in Benin. *IFRO Working Paper 2021/06 Department of Food and Resource Economics, University of Copenhagen, Denmark.*

Aïhounton, G. B. and Henningsen, A. (2024). Does organic farming jeopardize food security of farm households in Benin? *Food Policy*, 124:102622.

Aïhounton, G. B. D. and Henningsen, A. (2021). Units of measurement and the inverse hyperbolic sine transformation. *The Econometrics Journal*, 24(2):334–351.

Ariely, D., Kamenica, E., and Prelec, D. (2008). Man's search for meaning: The case of Legos. *Journal of Economic Behavior & Organization*, 67(3-4):671–677.

Asfaw, S., Mithöfer, D., and Waibel, H. (2010). Agrifood supply chain, private-sector standards, and farmers' health: Evidence from Kenya. *Agricultural Economics*, 41(3-4):251–263.

Assogba, S. C.-G. (2014). *Représentations de l'environnement et adoption des pratiques durables de production par les cotonculteurs du Bénin.* PhD thesis, Gembloux Agro-Bio Tech Université de Liège, Gembloux, Belgium.

Ayuya, O. I., Gido, E. O., Bett, H. K., Lagat, J. K., Kahi, A. K., and Bauer, S. (2015). Effect of certified organic production systems on poverty among smallholder farmers: Empirical evidence from Kenya. *World Development*, 67:27–37.

Bachmann, F. (2012). Potential and limitations of organic and fair trade cotton for improving livelihoods of smallholders: Evidence from Central Asia. *Renewable Agriculture and Food Systems*, 27(2):138–147.

Baudron, F., Tomscha, S. A., Powell, B., Groot, J. C., Gergel, S. E., and Sunderland, T. (2019). Testing the various pathways linking forest cover to dietary diversity in tropical landscapes. *Frontiers in Sustainable Food Systems*, 3:97.

Bellemare, M. F. and Novak, L. (2017). Contract farming and food security. *American Journal of Agricultural Economics*, 99(2):357–378.

Beuchelt, T. D. and Zeller, M. (2011). Profits and poverty: Certification's troubled link for Nicaragua's organic and fairtrade coffee producers. *Ecological Economics*, 70(7):1316–1324.

Bolwig, S., Gibbon, P., and Jones, S. (2009). The economics of smallholder organic contract farming in tropical Africa. *World Development*, 37(6):1094–1104.

Botha, F., Wouters, E., and Booysen, F. (2018). Happiness, socioeconomic status, and family functioning in South African households: A structural equation modelling approach. *Applied Research in Quality of Life*, 13(4):947–989.

Camerer, C. F., Loewenstein, G., and Rabin, M. (2004). *Advances in Behavioral Economics*. Princeton University Press.

Chiputwa, B., Spielman, D. J., and Qaim, M. (2015). Food standards, certification, and poverty among coffee farmers in Uganda. *World Development*, 66:400–412.

Civelek, M. E. (2018). *Essentials of Structural Equation Modeling*. Lulu.com.

Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences*. Lawrence Erlbaum Associates, Hillsdale, NJ, USA, 2 edition.

Constanza, R., Kubiszewski, I., Giovannini, E., Lovins, H., McGlade, J., Pickett, K. E., Ragnarsdóttir, K. V., Roberts, D., De Vogli, R., and Wilkinson, R. (2014). Development: Time to leave GDP behind. *Nature*, 505(7483):283–285.

Dahl, D. B., Scott, D., Roosen, C., Magnusson, A., and Swinton, J. (2019). *xtable: Export Tables to LaTeX or HTML*. R package version 1.8-4, https://CRAN.R-project.org/package=xtable.

Damalas, C. A. and Abdollahzadeh, G. (2016). Farmers' use of personal protective equipment during handling of plant protection products: Determinants of implementation. *Science of the Total Environment*, 571:730–736.

de Janvry, A., Fafchamps, M., and Sadoulet, E. (1991). Peasant household behaviour with missing markets: Some paradoxes explained. *The Economic Journal*, 101(409):1400–1417.

De Stavola, B. L., Daniel, R. M., Ploubidis, G. B., and Micali, N. (2015). Mediation analysis with intermediate confounding: Structural equation modeling viewed through the causal inference lens. *American Journal of Epidemiology*, 181(1):64–80.

Dedehouanou, S. F., Swinnen, J., and Maertens, M. (2013). Does contracting make farmers happy? Evidence from Senegal. *Review of Income and Wealth*, 59:138–160.

Delbridge, T. A., Fernholz, C., King, R. P., and Lazarus, W. (2013). A whole-farm profitability analysis of organic and conventional cropping systems. *Agricultural Systems*, 122:1–10.

Delsignore, G., Aguilar-Latorre, A., and Oliván-Blázquez, B. (2021). Measuring happiness in the social sciences: An overview. *Journal of Sociology*, 57(4):1044–1067.

Diener, E. and Tay, L. (2017). A scientific review of the remarkable benefits of happiness for successful and healthy living. In *Happiness: Transforming the Development Landscape*, volume 6, pages 90–117. The Centre for Bhutan Studies and GNH, Thimphu, Bhutan.

Dolan, P. and Metcalfe, R. (2012). Measuring subjective wellbeing: Recommendations on measures for use by national governments. *Journal of Social Policy*, 41(2):409–427.

Ecobichon, D. J. (2001). Pesticide use in developing countries. *Toxicology*, 160(1-3):27–33.

Fehr, E. and Falk, A. (2002). Psychological foundations of incentives. *European Economic Review*, 46:687–724.

Ferrer-i Carbonell, A. (2005). Income and well-being: an empirical analysis of the comparison income effect. *Journal of Public Economics*, 89(5-6):997–1019.

Frey, B. S. (2018). *Economics of Happiness*. Springer, Cham, Switzerland.

Froehlich, A. G., Melo, A. S., and Sampaio, B. (2018). Comparing the profitability of organic and conventional production in family farming: Empirical evidence from Brazil. *Ecological Economics*, 150:307–314.

Giuliani, E., Ciravegna, L., Vezzulli, A., and Kilian, B. (2017). Decoupling standards from practice: The impact of In-house certifications on coffee farms' environmental and social conduct. *World Development*, 96:294–314.

Graham, C. (2005). Insights on development from the economics of happiness. *The World Bank Research Observer*, 20(2):201–231.

Gunzler, D., Chen, T., Wu, P., and Zhang, H. (2013). Introduction to mediation analysis with structural equation modeling. *Shanghai Archives of Psychiatry*, 25(6):390.

Hirschauer, N., Lehberger, M., and Musshoff, O. (2015). Happiness and utility in economic thought—or: What can we learn from happiness research for public policy analysis and public policy making? *Social Indicators Research*, 121(3):647–674.

Hlavac, M. (2022). *stargazer: Well-Formatted Regression and Summary Statistics Tables*. Social Policy Institute, Bratislava, Slovakia. R package version 5.2.3.

Howley, P., Dillon, E., Heanue, K., and Meredith, D. (2017). Worth the risk? The behavioural path to well-being. *Journal of Agricultural Economics*, 68(2):534–552.

Hu, R., Huang, X., Huang, J., Li, Y., Zhang, C., Yin, Y., Chen, Z., Jin, Y., Cai, J., and Cui, F. (2015). Long- and short-term health effects of pesticide exposure: A cohort study from China. *Plos One*, 10(6):e0128766.

Huang, J., Wu, S., and Deng, S. (2016). Relative income, relative assets, and happiness in urban China. *Social Indicators Research*, 126(3):971–985.

Jouzi, Z., Azadi, H., Taheri, F., Zarafshani, K., Gebrehiwot, K., Van Passel, S., and Lebailly, P. (2017). Organic farming and small-scale farmers: Main opportunities and challenges. *Ecological Economics*, 132:144–154.

Kahneman, D. and Deaton, A. (2010). High income improves evaluation of life but not emotional well-being. *Proceedings of the National Academy of Sciences*, 107(38):16489–16493.

Kahneman, D. and Krueger, A. B. (2006). Developments in the measurement of subjective well-being. *Journal of Economic Perspectives*, 20(1):3–24.

Kleemann, L., Abdulai, A., and Buss, M. (2014). Certification and access to export markets: Adoption and return on investment of organic-certified pineapple farming in Ghana. *World Development*, 64:79–92.

Kline, R. (2016). Principles and practice of structural equation modeling, 4th edit. New York, NY.

Komsta, L. and Novomestky, F. (2022). *moments: Moments, Cumulants, Skewness, Kurtosis and Related Tests*. R package version 0.14.1.

Leifeld, J. (2016). Current approaches neglect possible agricultural cutback under large-scale organic farming. A comment to Ponisio et al. *Proceedings of the Royal Society B: Biological Sciences*, 283(1824):20151623.

Lopez, R. E. (1984). Estimating labor supply and production decisions of self-employed farm producers. *European Economic Review*, 24(1):61–82.

Maass, R., Kloeckner, C. A., Lindstrøm, B., and Lillefjell, M. (2016). The impact of neighborhood social capital on life satisfaction and self-rated health: A possible pathway for health promotion? *Health & Place*, 42:120–128.

Mai, Y., Xu, Z., Zhang, Z., and Yuan, K.-H. (2023). An open-source WYSIWYG web application for drawing path diagrams of structural equation models. *Structural Equation Modeling: A Multidisciplinary Journal*, 30(2):328–335.

McCune, B., Grace, J. B., and Urban, D. L. (2002). *Analysis of ecological communities.* MjM software Design, Gleneden Beach, OR.

Mourão, I., Moreira, M. C., Almeida, T. C., and Brito, L. M. (2019). Perceived changes in well-being and happiness with gardening in urban organic allotments in Portugal. *International Journal of Sustainable Development & World Ecology*, 26(1):79–89.

Mzoughi, N. (2011). Farmers adoption of integrated crop protection and organic farming: Do moral and social concerns matter? *Ecological Economics*, 70(8):1536–1545.

Mzoughi, N. (2014). Do organic farmers feel happier than conventional ones? An exploratory analysis. *Ecological Economics*, 103:38–43.

Nath, T. D. and Athinuwat, D. (2021). Key factors of women empowerment in organic farming. *GeoJournal*, 86:2501–2520.

Parvathi, P. and Waibel, H. (2016). Organic agriculture and fair trade: A happy marriage? A case study of certified smallholder black pepper farmers in India. *World Development*, 77:206–220.

Perez-Truglia, R. (2020). The effects of income transparency on well-being: Evidence from a natural experiment. *American Economic Review*, 110(4):1019–1054.

Powdthavee, N. (2007). Economics of happiness: A review of literature and applications. *Chulalongkorn Journal of Economics*, 19(1):51–73.

Powdthavee, N. (2008). Putting a price tag on friends, relatives, and neighbours: Using surveys of life satisfaction to value social relationships. *The Journal of Socio-Economics*, 37(4):1459–1480.

R Core Team (2024). *R: A Language and Environment for Statistical Computing.* R Foundation for Statistical Computing, Vienna, Austria.

Rickson, R. E., Saffigna, P., and Sanders, R. (1999). Farm work satisfaction and acceptance of sustainability goals by Australian organic and conventional farmers. *Rural Sociology*, 64(2):266–283.

Rosseel, Y. (2012). lavaan: An R package for structural equation modeling. *Journal of Statistical Software*, 48(2):1–36.

Ruml, A. and Qaim, M. (2021). New evidence regarding the effects of contract farming on agricultural labor use. *Agricultural Economics*, 52(1):51–66.

Russell, R. and Bewley, J. (2013). Characterization of Kentucky dairy producer decision-making behavior. *Journal of Dairy Science*, 96(7):4751–4758.

Sabillon, B. H., Gerster-Bentaya, M., and Knierim, A. (2022). Measuring farmers' well-being: Influence of farm-level factors on satisfaction with work and quality of life. *Journal of Agricultural Economics*, 73(2):452–471.

Sanchez, G. (2013). PLS path modeling with R. Trowchez Editions. Berkeley.

Sharifzadeh, M. S., Abdollahzadeh, G., Damalas, C. A., Rezaei, R., and Ahmadyousefi, M. (2019). Determinants of pesticide safety behavior among Iranian rice farmers. *Science of the Total Environment*, 651:2953–2960.

Sheahan, M., Barrett, C. B., and Goldvale, C. (2017). Human health and pesticide use in Sub-saharan Africa. *Agricultural Economics*, 48(S1):27–41.

Signorell, A. (2024). *DescTools: Tools for Descriptive Statistics*. R package version 0.99.57.

Sodjinou, E., Glin, L. C., Nicolay, G., Tovignan, S., and Hinvi, J. (2015). Socioeconomic determinants of organic cotton adoption in Benin, West Africa. *Agricultural and Food Economics*, 3:1–22.

Strauss, J. (1986). The theory and comparative statics of agricultural household models: A general approach. In Singh, I., Squire, L., and Strauss, J., editors, *Agricultural Household Models: Extensions, Applications, and Policy*, pages 71–91. Johns Hopkins University Press, Baltimore.

Stutzer, A. and Frey, B. (2012). Recent developments in the economics of happiness: A selective overview. Discussion Paper 7078, Institute for the Study of Labor (IZA), Bonn.

Uematsu, H. and Mishra, A. K. (2012). Organic farmers or conventional farmers: Where's the money? *Ecological Economics*, 78:55–62.

Vasile, A. J., Popescu, C., Ion, R. A., and Dobre, I. (2015). From conventional to organic in Romanian agriculture–impact assessment of a land use changing paradigm. *Land Use Policy*, 46:258–266.

Vellema, W., Casanova, A. B., Gonzalez, C., and D'Haese, M. (2015). The effect of specialty coffee certification on household livelihood strategies and specialisation. *Food Policy*, 57:13–25.

Verhofstadt, E. and Maertens, M. (2014). Smallholder cooperatives and agricultural performance in Rwanda: Do organizational differences matter? *Agricultural Economics*, 45(S1):39–52.

Woo, M. and Kim, S. (2018). Does social capital always raise life satisfaction? A comparison of South Korea and Taiwan. *International Journal of Social Welfare*, 27(2):121–131.

Wooldridge, J. M. (2016). *Introductory Econometrics. A Modern Approach.* Cengage Learning, 6th edition.

Zeileis, A. and Hothorn, T. (2002). Diagnostic checking in regression relationships. *R News*, 2(3):7–10.

Appendix

A Control variables considered in the path analysis

Table A.1 presents the variables used in the path analysis.

Table A.1: Variables used in the model specification

Variables	Income	Household assets	Health	Work satis-faction	Work recog-nition	Relation-ship with neighbours	Life satis-faction
Gender of household head	X	X	X	X	X	X	X
Education of household head	X	X	X	X	X	X	X
Experience in agriculture	X	X	X	X	X	X	
Household size	X	X	X	X	X	X	X
Dependency ratio	X	X	X	X	X	X	X
Total land owned (log)	X	X	X	X	X	X	X
Household assets	X		X	X	X	X	X
Distance to village centre (asinh)	X	X				X	X
Distance to closest market (asinh)	X	X	X	X			X
Tarmac road	X	X					
Water deprivation			X				X
Distance to health facility (log)			X				X
District fixed effects	X	X	X	X	X	X	X
WTP-variable	(X)	(X)	(X)	(X)	(X)	(X)	(X)

B Detailed results of individual estimations

Table B.1: Mediation analyses results (No WTP, Cotton Inc, Control HH Assets, All Villages)

Outcome	Estimate	standard error	P-value
IDE: Cotton income	-0.00	0.02	0.89
IDE: Health status	0.14	0.05	0.01
IDE: Work satisfaction	0.16	0.10	0.12
IDE: Work recognition	0.02	0.05	0.69
IDE: Relationship with neighbors	0.01	0.02	0.70
Sum of indirect effects	0.33	0.21	0.12
Direct effect	0.05	0.10	0.59
Total effect	0.38	0.20	0.06

Table B.2: Mediation analyses results (No WTP, Cotton Inc, Control HH Assets, Sim Villages)

Outcome	Estimate	standard error	P-value
IDE: Cotton income	-0.01	0.02	0.48
IDE: Health status	0.14	0.06	0.01
IDE: Work satisfaction	0.15	0.10	0.14
IDE: Work recognition	0.01	0.05	0.86
IDE: Relationship with neighbors	0.01	0.02	0.77
Sum of indirect effects	0.29	0.22	0.18
Direct effect	0.02	0.11	0.87
Total effect	0.31	0.20	0.13

Table B.3: Mediation analyses results (No WTP, Cotton Inc, No HH Assets, All Villages)

Outcome	Estimate	standard error	P-value
IDE: Cotton income	-0.01	0.02	0.73
IDE: Health status	0.14	0.05	0.01
IDE: Work satisfaction	0.15	0.10	0.14
IDE: Work recognition	0.02	0.05	0.73
IDE: Relationship with neighbors	0.01	0.02	0.74
Sum of indirect effects	0.30	0.21	0.15
Direct effect	0.04	0.10	0.69
Total effect	0.34	0.20	0.08

Table B.4: Mediation analyses results (No WTP, Cotton Inc, No HH Assets, Sim Villages)

Outcome	Estimate	standard error	P-value
IDE: Cotton income	-0.02	0.02	0.38
IDE: Health status	0.14	0.06	0.01
IDE: Work satisfaction	0.15	0.10	0.15
IDE: Work recognition	0.01	0.05	0.88
IDE: Relationship with neighbors	0.01	0.02	0.78
Sum of indirect effects	0.29	0.22	0.20
Direct effect	0.02	0.11	0.88
Total effect	0.30	0.20	0.14

Table B.5: Mediation analyses results (No WTP, Cotton Inc, Mediator HH Assets, All Villages)

Outcome	Estimate	standard error	P-value
IDE: Cotton income	-0.00	0.02	0.89
IDE: Household assets	-0.01	0.01	0.31
IDE: Health status	0.14	0.05	0.01
IDE: Work satisfaction	0.15	0.10	0.14
IDE: Work recognition	0.02	0.05	0.73
IDE: Relationship with neighbors	0.01	0.02	0.74
Sum of indirect effects	0.29	0.21	0.16
Direct effect	0.05	0.10	0.59
Total effect	0.35	0.20	0.08

Table B.6: Mediation analyses results (No WTP, Cotton Inc, Mediator HH Assets, Sim Villages)

Outcome	Estimate	standard error	P-value
IDE: Cotton income	-0.01	0.02	0.48
IDE: Household assets	-0.00	0.01	0.74
IDE: Health status	0.14	0.06	0.01
IDE: Work satisfaction	0.15	0.10	0.15
IDE: Work recognition	0.01	0.05	0.88
IDE: Relationship with neighbors	0.01	0.02	0.78
Sum of indirect effects	0.28	0.22	0.20
Direct effect	0.02	0.11	0.87
Total effect	0.30	0.20	0.14

Table B.7: Mediation analyses results (No WTP, HH Revenue, Control HH Assets, All Villages)

Outcome	Estimate	standard error	P-value
IDE: HH Revenue	-0.08	0.03	0.02
IDE: Health status	0.14	0.05	0.01
IDE: Work satisfaction	0.16	0.10	0.12
IDE: Work recognition	0.02	0.05	0.69
IDE: Relationship with neighbors	0.01	0.02	0.70
Sum of indirect effects	0.25	0.21	0.24
Direct effect	0.13	0.11	0.22
Total effect	0.38	0.20	0.06

Table B.8: Mediation analyses results (No WTP, HH Revenue, Control HH Assets, Sim Villages)

Outcome	Estimate	standard error	P-value
IDE: HH Revenue	-0.09	0.04	0.01
IDE: Health status	0.14	0.06	0.02
IDE: Work satisfaction	0.15	0.10	0.14
IDE: Work recognition	0.01	0.05	0.86
IDE: Relationship with neighbors	0.01	0.02	0.77
Sum of indirect effects	0.22	0.22	0.32
Direct effect	0.10	0.11	0.39
Total effect	0.31	0.21	0.13

Table B.9: Mediation analyses results (No WTP, HH Revenue, No HH Assets, All Villages)

Outcome	Estimate	standard error	P-value
IDE: HH Revenue	-0.09	0.03	0.01
IDE: Health status	0.14	0.05	0.01
IDE: Work satisfaction	0.15	0.10	0.14
IDE: Work recognition	0.02	0.05	0.73
IDE: Relationship with neighbors	0.01	0.02	0.74
Sum of indirect effects	0.22	0.21	0.30
Direct effect	0.13	0.11	0.23
Total effect	0.35	0.20	0.08

Table B.10: Mediation analyses results (No WTP, HH Revenue, No HH Assets, Sim Villages)

Outcome	Estimate	standard error	P-value
IDE: HH Revenue	-0.10	0.03	0.00
IDE: Health status	0.14	0.06	0.01
IDE: Work satisfaction	0.14	0.10	0.15
IDE: Work recognition	0.01	0.05	0.88
IDE: Relationship with neighbors	0.01	0.02	0.78
Sum of indirect effects	0.20	0.22	0.36
Direct effect	0.10	0.11	0.37
Total effect	0.30	0.20	0.14

Table B.11: Mediation analyses results (No WTP, HH Revenue, Mediator HH Assets, All Villages)

Outcome	Estimate	standard error	P-value
IDE: HH Revenue	-0.08	0.03	0.02
IDE: Household assets	-0.01	0.01	0.33
IDE: Health status	0.14	0.05	0.01
IDE: Work satisfaction	0.15	0.10	0.14
IDE: Work recognition	0.02	0.05	0.73
IDE: Relationship with neighbors	0.01	0.02	0.74
Sum of indirect effects	0.22	0.21	0.30
Direct effect	0.13	0.11	0.22
Total effect	0.35	0.20	0.08

Table B.12: Mediation analyses results (No WTP, HH Revenue, Mediator HH Assets, Sim Villages)

Outcome	Estimate	standard error	P-value
IDE: HH Revenue	-0.09	0.04	0.01
IDE: Household assets	-0.00	0.01	0.75
IDE: Health status	0.14	0.06	0.01
IDE: Work satisfaction	0.14	0.10	0.15
IDE: Work recognition	0.01	0.05	0.88
IDE: Relationship with neighbors	0.01	0.02	0.78
Sum of indirect effects	0.21	0.22	0.34
Direct effect	0.10	0.11	0.39
Total effect	0.30	0.20	0.14

Table B.13: Mediation analyses results (WTP, Cotton Inc, Control HH Assets, All Villages)

Outcome	Estimate	standard error	P-value
IDE: Cotton income	-0.01	0.02	0.77
IDE: Health status	0.14	0.07	0.06
IDE: Work satisfaction	0.40	0.15	0.01
IDE: Work recognition	-0.01	0.06	0.91
IDE: Relationship with neighbors	-0.01	0.03	0.85
Sum of indirect effects	0.52	0.28	0.06
Direct effect	0.49	0.15	0.00
Total effect	1.01	0.29	0.00

Table B.14: Mediation analyses results (WTP, Cotton Inc, Control HH Assets, Sim Villages)

Outcome	Estimate	standard error	P-value
IDE: Cotton income	-0.02	0.02	0.41
IDE: Health status	0.14	0.08	0.09
IDE: Work satisfaction	0.34	0.15	0.02
IDE: Work recognition	-0.03	0.07	0.63
IDE: Relationship with neighbors	-0.01	0.03	0.74
Sum of indirect effects	0.42	0.30	0.16
Direct effect	0.39	0.17	0.02
Total effect	0.81	0.29	0.01

Table B.15: Mediation analyses results (WTP, Cotton Inc, No HH Assets, All Villages)

Outcome	Estimate	standard error	P-value
IDE: Cotton income	-0.01	0.02	0.63
IDE: Health status	0.14	0.07	0.05
IDE: Work satisfaction	0.41	0.15	0.01
IDE: Work recognition	-0.00	0.06	0.94
IDE: Relationship with neighbors	-0.00	0.03	0.89
Sum of indirect effects	0.53	0.28	0.06
Direct effect	0.51	0.16	0.00
Total effect	1.04	0.29	0.00

Table B.16: Mediation analyses results (WTP, Cotton Inc, No HH Assets, Sim Villages)

Outcome	Estimate	standard error	P-value
IDE: Cotton income	-0.02	0.02	0.33
IDE: Health status	0.14	0.08	0.08
IDE: Work satisfaction	0.35	0.15	0.02
IDE: Work recognition	-0.03	0.07	0.66
IDE: Relationship with neighbors	-0.01	0.03	0.77
Sum of indirect effects	0.43	0.30	0.15
Direct effect	0.40	0.17	0.02
Total effect	0.83	0.29	0.00

Table B.17: Mediation analyses results (WTP, Cotton Inc, Mediator HH Assets, All Villages)

Outcome	Estimate	standard error	P-value
IDE: Cotton income	-0.01	0.02	0.77
IDE: Household assets	0.02	0.01	0.11
IDE: Health status	0.14	0.07	0.05
IDE: Work satisfaction	0.40	0.15	0.01
IDE: Work recognition	-0.00	0.06	0.94
IDE: Relationship with neighbors	-0.00	0.03	0.89
Sum of indirect effects	0.55	0.28	0.05
Direct effect	0.49	0.15	0.00
Total effect	1.04	0.29	0.00

Table B.18: Mediation analyses results (WTP, Cotton Inc, Mediator HH Assets, Sim Villages)

Outcome	Estimate	standard error	P-value
IDE: Cotton income	-0.02	0.02	0.41
IDE: Household assets	0.01	0.01	0.25
IDE: Health status	0.14	0.08	0.08
IDE: Work satisfaction	0.35	0.15	0.02
IDE: Work recognition	-0.03	0.07	0.66
IDE: Relationship with neighbors	-0.01	0.03	0.77
Sum of indirect effects	0.44	0.30	0.14
Direct effect	0.39	0.17	0.02
Total effect	0.84	0.29	0.00

Table B.19: Mediation analyses results (WTP, HH Revenue, Control HH Assets, All Villages)

Outcome	Estimate	standard error	P-value
IDE: HH Revenue	-0.04	0.02	0.06
IDE: Health status	0.14	0.07	0.06
IDE: Work satisfaction	0.39	0.14	0.01
IDE: Work recognition	-0.01	0.06	0.91
IDE: Relationship with neighbors	-0.01	0.03	0.85
Sum of indirect effects	0.48	0.27	0.08
Direct effect	0.53	0.15	0.00
Total effect	1.01	0.29	0.00

Table B.20: Mediation analyses results (WTP, HH Revenue, Control HH Assets, Sim Villages)

Outcome	Estimate	standard error	P-value
IDE: HH Revenue	-0.06	0.03	0.02
IDE: Health status	0.14	0.08	0.09
IDE: Work satisfaction	0.34	0.15	0.02
IDE: Work recognition	-0.04	0.07	0.64
IDE: Relationship with neighbors	-0.01	0.03	0.74
Sum of indirect effects	0.37	0.29	0.20
Direct effect	0.44	0.17	0.01
Total effect	0.81	0.29	0.01

Table B.21: Mediation analyses results (WTP, HH Revenue, No HH Assets, All Villages)

Outcome	Estimate	standard error	P-value
IDE: HH Revenue	-0.04	0.02	0.03
IDE: Health status	0.14	0.07	0.05
IDE: Work satisfaction	0.40	0.14	0.01
IDE: Work recognition	-0.00	0.07	0.94
IDE: Relationship with neighbors	-0.00	0.03	0.89
Sum of indirect effects	0.49	0.28	0.08
Direct effect	0.55	0.16	0.00
Total effect	1.04	0.29	0.00

Table B.22: Mediation analyses results (WTP, HH Revenue, No HH Assets, Sim Villages)

Outcome	Estimate	standard error	P-value
IDE: HH Revenue	-0.06	0.02	0.01
IDE: Health status	0.14	0.08	0.08
IDE: Work satisfaction	0.34	0.15	0.02
IDE: Work recognition	-0.03	0.08	0.66
IDE: Relationship with neighbors	-0.01	0.03	0.77
Sum of indirect effects	0.38	0.29	0.20
Direct effect	0.46	0.17	0.01
Total effect	0.84	0.29	0.00

Table B.23: Mediation analyses results (WTP, HH Revenue, Mediator HH Assets, All Villages)

Outcome	Estimate	standard error	P-value
IDE: HH Revenue	-0.04	0.02	0.06
IDE: Household assets	0.02	0.01	0.12
IDE: Health status	0.14	0.07	0.05
IDE: Work satisfaction	0.40	0.14	0.01
IDE: Work recognition	-0.00	0.06	0.94
IDE: Relationship with neighbors	-0.00	0.03	0.89
Sum of indirect effects	0.51	0.27	0.06
Direct effect	0.53	0.15	0.00
Total effect	1.04	0.29	0.00

Table B.24: Mediation analyses results (WTP, HH Revenue, Mediator HH Assets, Sim Villages)

Outcome	Estimate	standard error	P-value
IDE: HH Revenue	-0.06	0.03	0.02
IDE: Household assets	0.01	0.01	0.27
IDE: Health status	0.14	0.08	0.08
IDE: Work satisfaction	0.34	0.15	0.02
IDE: Work recognition	-0.03	0.07	0.66
IDE: Relationship with neighbors	-0.01	0.03	0.77
Sum of indirect effects	0.40	0.29	0.18
Direct effect	0.44	0.17	0.01
Total effect	0.84	0.29	0.00

C Grid search for the optimal units of measurement of cotton income

Table C.1: Criteria to identify the optimal unit of measurement of cotton income in the happiness equation

scale factor	coef organic	coef cotton income	semi-ela cotton income	rSquared	pSquared	Kolmogorov-Smirnov	Shapiro-Wilk	Shapiro-Fancia	Anderson	Jarque-Bera	Pearson	kurtosis	skewness	Breusch-Pagan	RESET
10^{-9}	0.06	29.25	0.002	0.528	0.512	0.054	0.9843	0.984	4.84	143.18	69.74	4.11	-0.42	**50.62**	**6.12**
10^{-8}	0.06	2.92	0.002	0.528	0.512	0.054	0.9843	0.984	4.84	143.18	69.74	4.11	-0.42	50.62	6.12
10^{-7}	0.06	0.29	0.002	0.528	0.512	0.054	0.9843	0.984	4.84	143.09	**69.46**	4.11	-0.42	50.65	6.12
10^{-6}	0.05	0.01	0.001	0.528	0.512	0.053	0.9843	0.984	4.85	142.17	78.25	4.11	-0.42	51.16	6.16
10^{-5}	0.04	-0.02	-0.003	0.528	0.512	0.052	**0.9844**	**0.984**	**4.84**	**142.00**	87.15	**4.10**	-0.42	51.95	6.21
10^{-4}	0.04	-0.01	-0.002	0.528	0.513	0.052	0.9844	0.984	4.85	142.23	89.92	4.11	-0.42	51.92	6.20
10^{-3}	0.05	-0.01	-0.001	0.528	0.513	**0.052**	0.9843	0.984	4.86	142.29	84.17	4.11	-0.42	51.87	6.17
10^{-2}	0.05	-0.01	-0.001	0.528	**0.513**	0.052	0.9843	0.984	4.86	142.30	84.05	4.11	**-0.42**	51.83	6.15
10^{-1}	0.05	-0.00	-0.001	0.528	0.513	0.052	0.9843	0.984	4.86	142.32	82.03	4.11	-0.42	51.80	6.14
10^{0}	0.05	-0.00	-0.001	**0.528**	0.513	0.052	0.9843	0.984	4.86	142.33	81.35	4.11	-0.42	51.78	6.13

Notes: Column 'scale factor' indicates the scale factor applied to the cotton income, where, e.g., 10^0 indicates that the cotton income is measured in FCFA, while, e.g., 10^{-6} indicates that the cotton income is measured in million FCFA. Column 'coef organic' indicates the coefficient of the dummy variable for organic farming (indicating the direct relationship between organic farming and happiness). Column 'coef cotton income' indicates the coefficient of the IHS-transformed cotton income and 'semi-ela cotton income' is the semi-elasticity between cotton income and happiness calculated at the sample mean. All other column headings are criteria for choosing the optimal scale as described in Aïhounton and Henningsen (2021).

Table C.2: Criteria to identify the optimal unit of measurement of cotton income in the income equation

scale factor	coef organic	Semi-elasticity: Organic	rSquared	pSquared	Kolmogorov-Smirnov	Shapiro-Wilk	Shapiro-Fancia	Anderson	Jarque-Bera	Pearson	kurtosis	skewness	Breusch-Pagan	RESET
10^{-9}	-0.00	0.37	0.425	0.411	0.103	0.852	0.8489	31.700	25269.82	232.00	16.88	1.94	**127.06**	163.22
10^{-8}	-0.00	0.37	0.425	0.411	0.102	0.852	0.8491	31.680	25159.52	232.00	16.85	1.94	127.19	163.21
10^{-7}	-0.03	0.36	0.430	0.416	0.100	0.863	0.8604	29.943	17457.23	224.67	14.76	1.74	138.35	162.20
10^{-6}	-0.22	0.30	**0.486**	**0.474**	**0.054**	**0.960**	**0.9587**	**8.418**	**648.66**	**96.68**	6.33	**0.07**	164.59	108.80
10^{-5}	-0.55	0.21	0.480	0.469	0.072	0.951	0.9500	11.682	1016.27	116.24	**6.26**	-0.99	160.13	27.97
10^{-4}	-0.61	0.20	0.392	0.380	0.154	0.878	0.8772	50.773	4277.87	568.31	6.43	-1.40	300.39	5.78
10^{-3}	-0.58	0.21	0.334	0.321	0.220	0.816	0.8159	86.113	9100.85	1191.88	6.48	-1.56	349.65	1.20
10^{-2}	-0.56	0.21	0.302	0.289	0.255	0.779	0.7790	108.541	13347.75	1746.02	6.51	-1.63	363.77	**0.53**
10^{-1}	-0.53	0.22	0.284	0.269	0.276	0.757	0.7573	122.144	16488.40	2216.18	6.53	-1.67	369.16	0.98
10^{0}	-0.50	0.22	0.272	0.257	0.293	0.744	0.7436	130.886	18819.95	2491.28	6.54	-1.69	371.60	1.71

Notes: Column 'scale factor' indicates the scale factor applied to the cotton income, where, e.g., 10^{0} indicates that the cotton income is measured in FCFA, while, e.g., 10^{-6} indicates that the cotton income is measured in million FCFA. Column 'coef organic' indicates the coefficient of the dummy variable for organic farming (indicating the direct relationship between organic farming and Income). and 'Semi-elasticity: Organic' is the semi-elasticity of cotton income with respect to Organic. All other column headings are criteria for choosing the optimal scale as described in Aïhounton and Henningsen (2021).