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Full Research Article

The wellbeing of smallholder coffee farmers in the Mount Elgon region: a quantitative analysis of a rural community in Eastern Uganda

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Abstract. For many smallholder farmers in the Mount Elgon region of Uganda, Arabica coffee cultivation is the major income-generating activity. Although it is widely known that smallholder coffee farmers often live under conditions that barely assure their survival, research to date has failed to examine the composition and distribution of wellbeing within this group. In the present study, a composite indicator of wellbeing is created using information collected from interviews with 431 coffee-cultivating households to investigate wellbeing in the Mount Elgon region of Uganda. From results of an explorative Principal Components Analysis, the factors of trust, security, housing, and landholding, covering a total of ten indicators, provided a comprehensive measure of wellbeing, explaining 81.20% of the total variance. The results show substantial differences in wellbeing within the sub-counties of Bulegeni, Simu, and Namisuni, and even greater differences between these sub-counties. These differences are explained primarily by the physical wellbeing factors of housing and landholding. Efforts to improve the quality of housing, particularly in Namisuni and Bulegeni, for instance, by providing improved access to financial services, construction loans, or subsidized prices for bricks and other construction materials, as well as official land registration in all three sub-counties could improve the wellbeing of households in this area.

Keywords. Composite Indicator, Mount Elgon, smallholder coffee farmers, Uganda, wellbeing.

JEL Codes. I31, Q12, R21.

1. Introduction

Producing more than 38 thousand tons of Arabica coffee (in 2017/18), Uganda is among the most important Arabica coffee producers in the world (UCDA 2018). With around 1.3 million rural households (HH) engaged in coffee production, Uganda's coffee sector has high socioeconomic importance for the country (UBOS 2010). In most coffee cultivation areas, smallholder coffee farmers barely live above the subsistence level. In

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Uganda, extreme poverty affects more than 33% of the country's 39 million people, among them a large number of smallholder coffee farmers (BMZ 2016). However, only a few research projects have investigated the wellbeing of coffee farmers to date.

Most of the research to date dealing with the wellbeing of coffee farmers has measured the impacts of participation in specialty markets or cooperatives and focused on how certification programs affect specific aspects of coffee farmers' wellbeing (e.g., Ahmed and Mesfin 2017, Bacon *et al.* 2005, Ruben and Fort 2012). Even recent studies on coffee producers' wellbeing refer to concepts of wellbeing that have been challenged or developed further, or equate wellbeing with welfare. Ahmed and Mesfin (2017), for example, use the equivalent of consumption per adult as a wellbeing indicator. The analysis of a single dimension of wellbeing such as income or expenditure has been criticized by authors in other research fields including Decancq and Lugo (2012), who investigated inequality of wellbeing in Russia. Although some researchers have used questionnaires containing direct questions about farmers' wellbeing to assess the impacts thereof (e.g., Frank *et al.* 2011), these studies do not clarify how farmers themselves understand wellbeing. Other authors have used related terms, such as "quality of life" (see Bacon *et al.*, 2005), in their research on the impacts of participation in certification programs among coffee farmers in Nicaragua. However, results like those of Bacon *et al.* (2005) show that most coffee farmers (74% of the Nicaraguans surveyed) perceive their quality of life as independent of whether they are part of conventional or alternative trade networks, because "sales to alternative markets is not enough to offset the many other conditions that influence the quality of one's life" (Bacon 2005). Estoque *et al.* (2018) claim that wellbeing is a prerequisite for quality of life. As these diverse findings reflect, wellbeing is complex, usages of wellbeing and related terms differ widely, and research is still needed on the structure of wellbeing among HHs engaged in coffee farming. A better understanding of wellbeing will not only enable comparison between individuals within a given area or between groups of different coffee cultivation areas, but also provide the basis for better evaluation of certification programs or policy measures.

The high importance of wellbeing is widely recognized in other fields, and the research on wellbeing has been growing worldwide in recent decades (e.g., Suh *et al.* 1996, Kahnemann 1999, Allen 2001, Decancq and Lugo 2012, Keyes *et al.* 2002, Beaumont 2011, Seligman, 2011, Dodge *et al.* 2012). Disciplines including psychology, medicine, economics, and sociology have proposed different instruments for the measurement of wellbeing. One of the more recent and broadly applicable definitions is the one proposed by Dodge *et al.* (2012), who define wellbeing as "the balance point between an individual's resource pool and the challenges faced" in terms of physical, social, and psychological components of wellbeing. In other words: stable wellbeing exists "when individuals have the psychological, social and physical resources they need to meet a particular psychological, social and/or physical challenge" (Dodge *et al.* 2012). Hendry and Kloep (2002) developed this concept further. The so-called *lifespan model,* incorporates the idea that solving challenges successfully leads to development in the individual and/or environment, whereas failing to solve challenges impedes the solution of future challenges. Their model also assumes that success in meeting challenges depends on the resource pool individuals have. They conclude that research on wellbeing is not only crucial to adequately measure development; wellbeing is indeed also the prerequisite for development.

Adding the assumptions of the *lifespan model* to the theory of subjective wellbeing proposed by Headey and Waring (1992), who cite external forces as the precondition for change in the wellbeing balance, one could assume that external forces could lead to a positive or negative development in the wellbeing of individuals and groups. Humans could be faced with more challenging situations, for instance, in the environment. Considering the estimated decrease in the climatic suitability of most Ugandans' Arabica coffee cultivation areas, climate change could have a major impact on coffee farming (Damatta *et al.* 2012, Jassogne *et al.* 2012). Coffee farmers are already facing heightened environmental problems such as a higher occurrence of pests and diseases (UNDP 2012) and greater uncertainties regarding temperature and irrigation. Changing weather patterns are also expected to reduce coffee quantity and quality (e.g., Jassogne *et al.* 2012, UNDP 2012, Läderach *et al.* 2012). This will lead to lower income from coffee sales, which would also have a long-term impact on the resources' farmers have to devote to other aspects of their wellbeing. Considering the aforementioned difficulties, the Uganda Coffee Development Authority (UCDA) developed a program to counteract the challenges coffee farmers are facing. They state the ambitious aim of quadrupling Uganda's coffee production by 2040 by stabilizing coffee farmers' resources through measures such as workshops on coffee management and distribution of free coffee seedlings (UCDA 2019).

The present paper investigates the composition of wellbeing of HHs engaged in coffee farming based on data from 431 quantitative interviews. This investigation requires a definition of wellbeing that takes the coffee farmers' point of view into account as the basis for policy recommendations that will be able to improve coffee farmers' and their families' wellbeing. Using the definition of wellbeing formulated by Dodge *et al.* (2012), this paper proposes a composite indicator (CI) of wellbeing based on material wealth (physical component), the fulfillment of social needs (social component), and the fulfillment of basic psychological needs (psychological component), to enable the measurement of wellbeing in one of the three most important Arabica coffee cultivation areas of Uganda. Along with a better understanding of what wellbeing means to farmers, this paper uses a well-established CI for wellbeing and meaningful wellbeing indicators to test the hypotheses that (1) wellbeing is not equally distributed within and between sub-counties in the Mount Elgon region, and that (2) the physical wellbeing component shows a more substantial impact than the social and psychological components on the constitution of wellbeing among these HHs. Both assumptions were formulated based on the observation during previous field visits that the group under investigation is economically vulnerable and based on previous data showing high differences in income from coffee-selling activities. The results of this study show dependencies between different indicators of wellbeing and identify the impact levels of the various indicators. As such, they provide an important idea of how the living conditions of coffee-farming HHs are developing and are of high practical relevance for policy makers.

In the materials and methods section that follows this introduction, I provide information on the area in which the study was conducted, the sample and data collection, and the methodological background for the construction of the CI, and briefly explain the framework of the data analysis. In the results section, I present descriptive statistics on the wellbeing indicators and the construction and composition of the CI formula, and also provide insights into wellbeing on a factor level and an overview of the wellbeing distribu-

tion in this research area. In the final sections, I discuss potential policy implications of the findings for improving wellbeing and methodological limitations of the study.

2. Materials and methods

2.1 Study area

The study was conducted on the Western slopes of the Mount Elgon region, one of the three main Arabica coffee-producing regions in Uganda (Knutsdatter Formo and Padegimas 2012). For many farmers in the Mount Elgon region, Arabica coffee cultivation is the main source of income. In this region, Arabica varieties as Bugisu local, SL14, SL28, and KP423 are usually intercropped with bananas, beans, peas, ground nuts, vegetables, and shade trees like avocado and mango. It is estimated that 90% of coffee cultivation takes place on plots of less than 3 hectares (Chiputwa *et al.* 2015).

Data collection for this study took place in the Bulambuli district, which extends over about 809 km², reaches elevations of up to 1526 meters above sea level, and is divided into two counties, Elgon and Bulambuli County (NPHC 2014). Surveys were administered in Elgon County because 60.5% of its HHs were engaged in coffee farming, whereas coffee farmers in Bulambuli County only represented 2.2% of existing HHs (NPHC 2014). In Elgon county, the three sub-counties of Bulegeni, Simu, and Namisuni were chosen (Fig. 1).

Figure 1. Map of (b) South Uganda and (a) details of Bulambuli district with Bulambuli County (grey) and Elgon County (white) with the sub-counties Bulegeni (blue), Simu (turquoise), and Namisuni (orange).

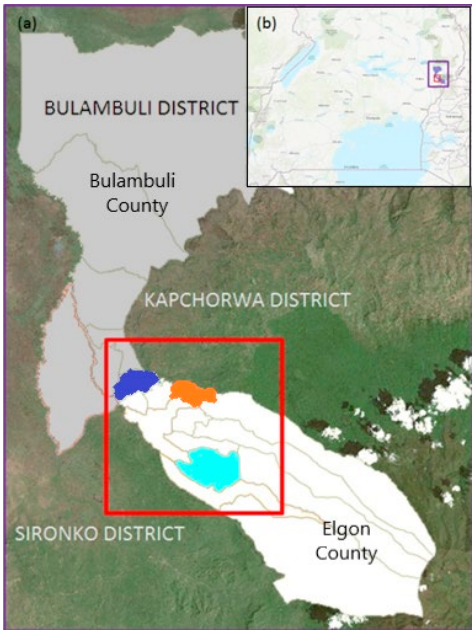


Table 1. Number of HHs participating in the study.

Sub-county	Participants HH survey
Bulegeni	156 (36.2%)
Simu	90 (20.9%)
Namisuni	185 (42.9%)
Total	431 (100%)

For data collection, 460 coffee-cultivating HHs were randomly selected and visited. The only prerequisite for participation in the study was that farmers were willing and that their HH was engaged in coffee cultivation activities. Of these 460 HH, 29 did not provide (sufficient) data for different reasons: HH heads were located but not available for an interview even on the third attempt, HH heads had died or were ill, or another person representing the HH head was unable to provide reliable answers. This left a final data set with completed questionnaires from 431 HHs (Table 1).

2.2 Sample description

Comparing the sample distribution with the average HH characteristics for the area in which the study was conducted, slight deviations in socio-demographic characteristics can be seen (Table 2). However, statistics on the area's population were either collected in 2012 (see NPHC 2014) or, for those from the most recent reliable source, only refer to the Mount Elgon region as a whole (UNHS 2018). Taking the high fertility rates in Uganda into account (5.4 children per woman in 2016), these deviations in sample characteristics can generally be accepted due to the broad similarity in socio-demographic trends (SUPRE 2018). As production of cash crops like coffee is usually male-dominated in rural areas of Sub-Saharan Africa, and only coffee farmers were included into the sample group, female-headed HHs are clearly underrepresented (e.g., Bolwig 2012, Doss 2002).[1] However, the data set can be considered largely representative for this research area, except for the small percentage of female-headed HHs and the larger number of people per HH in this study than in the statistics. Discrepancies in the data, particularly for the gender of the HH head, could not be excluded in the interpretation of the results.

2.3 Data collection

Data were collected as part of the project "Potential improvements for the income situation of smallholder coffee farmers in Mount Elgon, Uganda" developed and implemented by the Georg-August University of Göttingen, Germany, and the National Agricultural Research Organization (NARO) of Uganda.

The theoretical selection of relevant dimensions for the present study and context was conducted based on a literature review (Decancq and Lugo 2012, Dodge *et al.* 2012, among others) and on data from HH surveys implemented in the Mount Elgon region in 2015. The resulting framework was discussed with the local research team, consisting of five research assistants who had grown up in coffee-cultivating HHs in the area, in 2017. Based on that, questionnaire pre-tests were developed and implemented in the area to

[1] Only 20.7% of the female HH heads are married. The rest of the female HH heads are single (20.7%), divorced (10.3%), or widowed (48.3%), whereas only 1.5% of the male HH heads are widowed.

Table 2. Sample characteristics.

Quantitative data set		Bulegeni	Simu	Namisuni	Total	Research area
Number of HHs		n= 156	n= 90	n= 185	n=431	21,244 [1]
Gender of HH head	Male	94.2%	95.6%	93.5%	94.2%	81.4% [1]
	Female	5.8%	4.4%	6.5%	5.8%	18.6% [1]
Age of HH head	<18	0.0%	0.0%	0.0%	0.0%	1.0% [1]
	18-30	7.1%	11.1%	16.1%	11.7%	25.9% [1]
	31-59	60.3%	62.2%	65.0%	62.7%	53.9% [1]
	>60	32.7%	26.7%	18.9%	25.6%	19.2% [1]
Highest level of education for head of HH	Illiterate	3.9%	4.4%	2.2%	3.3 %	9.3% [2]
	Primary school	45.8%	41.1%	59.7%	50.7%	58.7% [2, 3]
	High school	44.4%	47.8%	34.3%	40.8%	27.8% [2, 4]
	College	3.9%	3.3%	2.8%	3.3%	8.2% [2, 5]
	University	2.0%	3.3 %	1.1%	1.9%	
People per HH	MD/SD	6.31/2.338	6.41/2.238	5.21/2.170	5.86/2.312	4.638/0.135 [2]
Coffee production is the main source of income		83.2%	93.3%	88.6%	87.7%	83.0% major economic activity is crop farming [2]

[1]Data for Elgon County from NPHC 2014.

[2]Data for Elgon Region from UNHS 2018.

[3]Sum from category: some primary and completed primary for the whole HH.

[4]Sum from category some secondary and completed secondary for the whole HH.

[5]Post-secondary and above for the whole HH.

evaluate the feasibility of the survey and to test the content and construct validity and reliability. After some revisions, the survey was finally successfully implemented in 431 coffee-cultivating HHs in the period from July to December 2018.

The final survey of the project comprised seven sections; (i) HH demographics, (ii) farm management system, (iii) access to information and extension material, (iv) general HH living conditions, (v) expected yield and income, (vi) community relations, and (vii) shortages and shocks experienced so far. Within five of these sections (ii-vi), a set of subdimensions comprising a total of 44 variable dimensions was developed to measure the wellbeing level of the HHs (Table 3).

Because of different levels of English proficiency in the population, the five local assistants (four male and one female) were trained to conduct an average number of five interviews per day in the local language Lugisu. For the time spent to complete the questionnaire (50 minutes on average), each farmer received compensation in the form of bookkeeping and small business management materials. After data cleaning, 431 interviews remained for data analysis.

Table 3. Structure of survey sections relevant to wellbeing.

Section of the survey	Dimensions
(ii) Farm management system	Area of land for agricultural activity in general, area of land for coffee cultivation, ownership of land, intercropping with other products, livestock, membership in farmer organizations, certification of coffee, farm management practices
(iii) Access to information and extension material	Main sources and interest in information on farm management, participation in meetings, workshops
(iv) General HH living conditions	Characteristics of the main house; toilet, wall material, floor material, roofing, source of lighting, cooking, source, distance and mode of treating drinking water, distance to village market, doctor/hospital, and school
(v) Expected yield and income, access to productive capital/credit	Yield, prices for coffee cherries and parchment coffee, expected income from coffee selling, other sources of income, labor input coffee production, loans, farm equipment, consumer durables, cellphone, bicycle, motorbike
(vi) Community relations	Safe from violence and crime, safe from economic disasters, level of happiness, most people can be trusted, most government officials can be trusted, local government considers concerns voiced by you, most people are willing to help, collaboration with other farmers, heterogeneity within the village, frequency of getting together with others

2.4 Methodical background for the construction of the CI for wellbeing

As pointed out in the introduction section, a CI was constructed for wellbeing based on HH material wealth (physical component), the fulfillment of social needs (social component), and the fulfillment of basic psychological needs (psychological component). In contrast to Dodge *et al.* (2012), the present paper does not investigate wellbeing at the individual level but at the HH level. The HH reflects a social construct, which leads to a high level of overlap in content between social and psychological indicators in the data set presented here (see Table 3). For the indicators that reflect the level of trust, for instance, a clear classification into either social or psychological categories cannot be made. Mistrust could reflect instability within the community, but it could also stem from fears of opportunistic behavior or from other psychological discomfort, especially when considering the economic vulnerability and dependency of the farmers in our sample group. Therefore, the social and psychological wellbeing indicators were merged into a "social-psychological" component.

To examine the fulfillment of social-psychological needs, only indicators dealing with the individual-level emotions and social interactions of farmers have been selected for the construction of the CI. All social-psychological wellbeing variables were measured with a five-point Likert scale ranging from 1 (not at all) to 5 (very much; the highest subjective wellbeing for that item), except for HH participation in meetings, workshops, and training over the last 12 months, which was measured with a binary survey question and represented as a population percentage. For the physical component, only variables that focus

on the measurable status of material wealth have been included in the analysis: indicators measuring the value of HH belongings or productive HH activities. The scales used here describe an objectively measurable condition, ranked by the status of wealth on the HH level, expressed in some cases by the number of items belonging to the HH, hectares of land, or construction materials for housing. Material for housing was ranked from reflecting low wealth (non-permanent materials like mud/soil for walls, earth for floors, and grass/banana leaves for roofing), mid-wealth status (semi-permanent materials like plaster for walls, wood for floors, and sheet metal for roofing) to high wealth (permanent materials like bricks for walls, cement for floors, and tiles for roofing) within the community[2].

Variables used for the construction of the CI were measured using different units and scales. To enable comparison within and between individual indicators and different scales, and to preserve the empirical distribution of the data, the indicators were standardized by computing z-scores (Santeramo 2015). For each individual indicator x_{qc}^{t}, the average $x_{qc=\bar{c}}^{t}$ and the standard deviation were calculated. A similar dispersion across indicators emerges when implementing into the normalization formula: $I_{qc}^{t} = \frac{x_{qc}^{t} - x_{qc=\bar{c}}^{t}}{\sigma_{qc=\bar{c}}^{t}}$

To explore whether the theoretically developed indicators of wellbeing are statistically well-balanced and whether the indicators are suitable for the underlying data structure, a principal component analysis (PCA) was performed.

Factors that meet the prerequisites of having eigenvalues larger than one and of individually contributing more than 10% to total explained variance are included in the CI for wellbeing. The square of factor loadings represents the proportion of total unit variance of the CI of wellbeing explained by the factor (JRCEC 2008).

Referring to Santeramo (2015), equal weighing does not only represent the weak assumption that all variables have the same importance; it may also induce double-counting bias because a higher number of variables in a subgroup leads to a higher weight of that subgroup. There are many weighing approaches preventing the conclusion that dimensions have similar importance, among them the PCA, which relies on data variability and variable correlation (JRCEC 2008, Nicoletti *et al.* 2000, Santeramo 2015). For the PCA-based approach of Nicoletti *et al.* (2000), the variance explained by the factor after varimax rotation could be used to calculate the weight of each factor if correlations between indicators are found.

$$\textit{Weight of the factor for the CI of wellbeing (Wq)} = \frac{\textit{Variance explained by the factor}}{\textit{Total variance of the four factors}}$$

The z-standardized scores used for the PCA were regressed for each factor, and the CI of wellbeing was calculated for each interviewed HH.

2.5 Data analysis

To compute the CI of wellbeing, I followed the methodological approaches described in the *Handbook on Constructing Composite Indicators*' of the Joint Research Centre of the

[2] The scales were developed based on estimated values of construction material quality within the community resulting from previous qualitative interviews.

European Commission to best fit the constitution of the data at hand (JRCEC 2008). SPSS Version 25 was used for tasks including to perform the required PCA for the construction of the CI of wellbeing. Pearson's correlation coefficient was used to check for correlations between individual indicators using the z-scores of the items. To assess whether sub-county had an influence on the indicators, factors, or the CI of wellbeing, a one-factor ANOVA was performed.

3. Results

3.1 Descriptive statistics of indicators

After testing all previously mentioned variables, only 19 wellbeing indicators were able to provide specific, measurable, accessible, relevant, and timely (SMART) information and fulfill the aforementioned selection criteria for wellbeing (FAO, 2013). Table 4 provides the categorization into components of wellbeing and descriptive statistics for absolute (not standardized) values of those indicators.

The social-psychological indicators with the highest scores (up to 4.56) are represented by the *willingness to help* and *intensity of collaboration with other farmers*. Whereas the *level of happiness* and *local government considers farmers' concerns* show means of approximately 3.7, *trust in government officials* shows a lower mean, and *trust in most people* represents the lowest level of satisfaction at 3.10. All social-psychological indicators show different means in different sub-counties. The lowest means for all trust-related indicators is in Bulegeni sub-county. Namisuni shows the highest mean for the indicators *local government considers farmers' concerns* and *trust in government officials*. Whereas Simu sub-county has the highest mean for *trust in most people*, it is also represented by the highest percentage (68.89%) of *HHs that have participated in meetings, workshops, and training* during the last 12 months.

The individual indicators for the physical component of wellbeing show a very high percentage of HHs (84.4% to 97.8%) with floor and wall materials consisting of earth (floors) and mud/soil (walls) that indicate the lowest level of welfare. In consequence, percentages for indicators showing mid-to high-valued housing materials are low (0.0% to 15.6%), which could also explain the presence of extreme values. HH access to belongings ranges from farm equipment, which nearly all HHs (97.45%) have access to, to *consumer durables* (mainly radio) (79.58%), *cellphone* (70.30%), *bicycle* (ranging from 37.78% to 7.03%) all the way down to *motorbikes,* which are only present in 8.35% of HHs. Only Namisuni is an exception, with a higher percentage of access to motorbikes than bicycles. For *landholding for agricultural activities* in general, the mean for the sample shows 0.95 ha, whereas the HH use on average 0.5 ha of their land for coffee cultivation. In Table 4, the wide range of landholding in Simu reveals differences in access to land within the sub-county. However, there is also evidence of a general trend of differences in all physical indicators (except from the indicator roofing material) between the sub-counties: Simu shows a higher percentage of higher values than other sub-counties. Bulegeni also shows a much lower wealth status than other sub-countries, directly followed by Namisuni.

Table 4. Descriptive statistics for the 19 wellbeing indicators.

Indicator		Bulegeni (n= 156)	Simu (n= 90)	Namisuni (n= 185)	Total (n=431)	Extreme values[1]
Social-psychological wellbeing component						
HH members participated in meetings, workshops, and training (last 12 months)		62.18%	68.89%	60.54%	62.88%	0
Trust in most people	Mean	3.08	3.17	3.09	3.10	0
	SD	1.56	1.50	1.54	1.53	
Trust in government officials	Mean	3.26	3.36	3.44	3.36	0
	SD	1.57	1.34	1.44	1.47	
Local government considers the farmers' concerns	Mean	3.61	3.71	3.77	3.70	0
	SD	1.38	1.38	1.30	1.35	
Willingness to help	Mean	4.56	4.04	4.06	4.24	0
	SD	1.09	1.52	1.49	1.39	
Intensity of collaboration with other farmers	Mean	4.06	3.97	4.31	4.15	0
	SD	1.49	1.42	1.49	1.35	
Economically secure	Mean	3.08	3.72	3.72	3.49	0
	SD	1.63	1.39	1.42	1.52	
Safe from violence and crime	Mean	3.87	3.27	3.32	3.51	0
	SD	1.16	1.60	1.69	1.52	
Level of happiness	Mean	3.85	3.77	3.68	3.76	0
	SD	1.20	1.45	1.40	1.34	
Physical wellbeing component						
Farm equipment belongs to HH		98.08%	98.89%	96.22%	97.45%	0
Consumer durables belong to HH		78.85%	86.67%	76.76%	79.58%	0
Cellphone belongs to HH		71.79%	81.11%	63.78%	70.30%	0
Bicycle belongs to HH		26.92%	37.78%	7.03%	20.65%	0
Motorbike belongs to HH		5.13%	13.33%	8.65%	8.35%	0
Wall material	Mud/soil	93.6%	84.4%	96.2%	92.8%	31
	Plaster	3.2%	3.3%	1.6%	2.6%	
	Brick	3.2%	12.2%	2.2%	4.6%	
Floor material	Earth	92.9%	84.4%	97.8%	93.3%	31
	Wood	0.6%	0.0%	0.0%	0.2%	
	Cement	6.4%	15.6%	2.2%	6.5%	
Roofing material	Grass/banana leaves	1.92%	0%	1.08%	1.16%	0
	Sheet metal	79.49%	93.33%	93.51%	88.40%	
	Tile	18.59%	6.67%	5.41%	10.44%	
Land used for coffee cultivation (ha)	Mean	0.46	0.77	0.39	0.50	26
	SD	0.48	0.99	0.42	0.62	
	Range	3.03	5.26	2.83	5.26	
	Min.	0.00	0.00	0.00	0.00	
	Max.	2.83	5.26	2.83	5.26	

Indicator		Bulegeni (n= 156)	Simu (n= 90)	Namisuni (n= 185)	Total (n=431)	Extreme values[1]
Land used for agricultural activity (ha)	Mean	0.91	1.32	0.80	0.95	24
	SD	0.81	1.29	0.61	0.88	
	Range	5.97	7.99	2.95	8.04	
	Min.	0.10	0.10	0.05	0.05	
	Max.	6.07	8.09	3.00	8.09	

[1]To ensure that all levels of wellbeing are included in the data analysis, these extreme values were not excluded.

3.2 PCA for the CI of wellbeing

A PCA was applied to these 19 variables. The best result of the PCA (shown in Fig. 2) was found for a four-factor solution that can explain 81.20% of the total variance (Kaiser-Meyer-Olkin Measure (KMO) = 0.681, Bartlett's Test of Sphericity Sig. =0.000) by including ten of the previously derived indicators.

The factor *trust* consists of the indicators *trust in most people*, *trust in government officials*, *local government considers the farmers' concerns* (Fig. 2). The factor *security* consists of the indicators *economically secure*, *safe from violence and crime,* and the *level of happiness*. The connection between happiness and security can be explained by citing one of the interviewed farmers: "[…] Well, to me, happiness is the state of being content with all the prevailing circumstances in life." For the physical component of wellbeing, the factor *housing* consists of *walls* and *floors*, whereas the factor *landholding* includes *land for agricultural activity* and *land for coffee cultivation.*

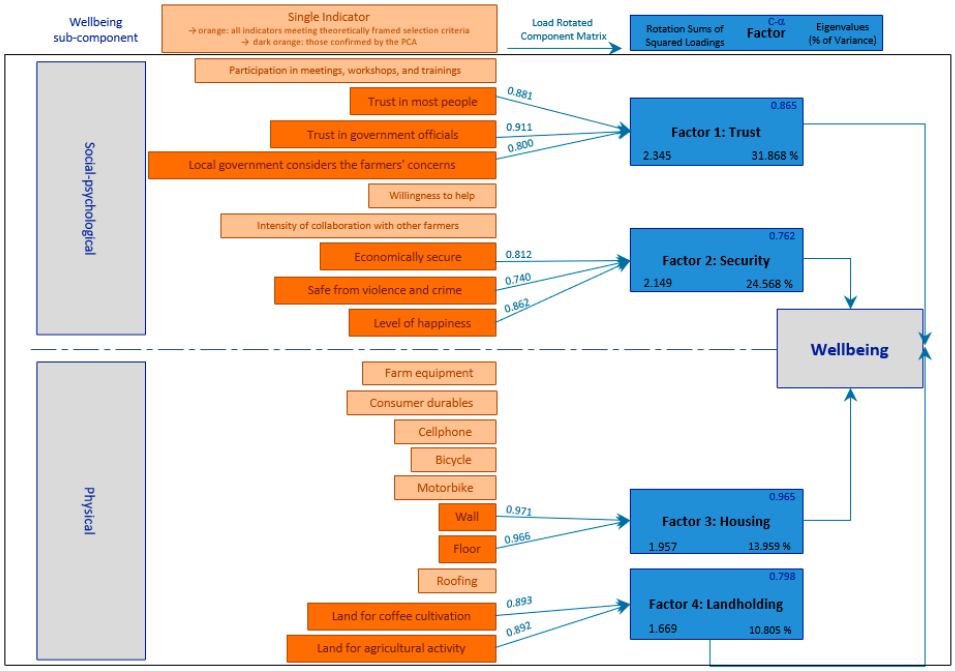
Testing the combination of the variables of the four-factor solution for reliability, the Cronbach's coefficient alpha (C-α) for the total internal consistency shows a value of 0.741, which is acceptable (Field 2009). Consequently, for the development of the CI of wellbeing, only the variables for the resulting factors *trust, security, housing,* and *landholding* are investigated further.

Factor 1 *(trust)* explains 31.868%, Factor 2 *(security)* explains 24.568 %, Factor 3 *(housing)* explains 13.959%, and Factor 4 *(landholding)* explains 10.805% of the total variance.

As a last step, the relationships between individual indicators are investigated and depicted in Table 5 in order to inspect whether correlations between indicators are present and to calculate the weight for each factor using the results of the PCA, as suggested by Nicoletti *et al.* (2000).

Correlation results yield a strong positive relationship between *trust in most people* and *trust in government officials* (corr=0.718**), between *local government considers the farmers' concerns* and *trust in most people* (corr=0.587**), and between *trust in government officials* and *local government considers the farmers' concerns* (corr=0.736**). For the indicators of the factor *security,* the positive relationship is not as strong. There is a positive relationship between *wall* and *floor* materials (corr=0.932**) and between *land used for agricultural activity* and *land used for coffee cultivation* (corr=0.480). In addition, all physi-

Figure 2. Summarizing the components of wellbeing, the indicators investigated, and the results ofthe principal component analysis (PCA).



Extraction method: principal component analysis; rotation method: varimax with Kaiser normalization, rotation converged in 5 iterations.
** highly significant P=0.01.

cal indicators have positive relationships with each other. Pearson's correlation indicates a relationship between *economically secure* and (a) *land for coffee cultivation* (corr=0.129**), (b) *land used for agricultural activity* (corr=-0.160**). Similar relationships between the *level of happiness* and the indicators of *landholding* are visible. Furthermore, all indicators of the factor *trust* show a highly significant (P≤0.01) positive correlation with the indicators of *security* and the *landholding* indicator *land used for coffee cultivation*. The perception of being *safe from violence and crime* correlates negatively with *land used for agricultural activity* (corr=-0.257**). Relationships between indicators of different factors can also be found, but their correlation is not strong (corr<0.5).

However, the correlations found between the individual indicators are strong enough to enable the calculation of weights of each factor by dividing the percentage of variance explained by the factor after varimax rotation by the total variance of all factors (JRCEC 2008). The results of the PCA, relevant for the construction of the CI of wellbeing, are shown in Table 6.

Previously indicated results from the PCA lead to the following formula for the CI of wellbeing:

Table 5. Pearson's correlation with z-scores of the ten single indicators.

Factor	Indicator	1	2	3	4	5	6	7	8	9	10
Trust	1.Trust in most people	1	0.718**	0.587**	0.152**	0.242**	0.211**	n.s.	n.s.	0.137**	n.s.
	2.Trust in government officials	**0.718****	1	0.736**	0.236**	0.309**	0.288**	n.s.	n.s.	0.146**	n.s.
	3.Local goverm. considers the farmers' concerns	**0.587****	**0.736****	1	0.363**	0.364**	0.389**	n.s.	n.s.	0.163**	n.s.
Security	4.Economically secure	0.152**	0.236**	0.363**	1	0.402**	0.589**	n.s.	n.s.	0.129**	-0.160**
	5.Safe from violence and crime	0.242**	0.309**	0.364**	0.402**	1	0.559**	n.s.	n.s.	n.s.	-0.257**
	6.Level of happiness	0.211**	0.288**	0.389**	**0.589****	**0.559****	1	n.s.	n.s.	0.117*	-0.244**
Housing	7.Wall	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	1	0.932**	0.338**	0.101*
	8.Floor	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	**0.932****	1	0.360**	0.102*
Landholding	9.Land used for coffee cultiv.	0.137**	0.146**	0.163**	0.129**	n.s.	0.117*	0.338**	0.360**	1	0.480**
	10.Land used for agricultural activity	n.s.	n.s.	n.s.	-0.160**	-0.257**	-0.244**	0.101*	0.102*	0.480**	1

*Significance for two-tailed correlation is P≤0.05, **Significance for two-tailed correlation is P≤0.01, Correlations of 0.5 and above are shown in bold.

Table 6. Variance explained by each factor and weight of each factor.

Factor	% of variance	Cumulative %	% of variance after varimax rotation	Weight of each factor
Trust	31.868	31.868	23.451	0.2888
Security	24.568	56.436	21.492	0.2647
Housing	13.959	70.395	19.567	0.2410
Landholding	10.805	**81.200**	16.689	0.2055

Extraction method: principal component analysis.
Weight of each factor = % of variance explained the factor after varimax rotation/total variance.

$$CI\ of\ wellbeing = (W_{Trust} * Trust) + (W_{Security} * Security) + (W_{Housing} * Housing) + (W_{Landholding} * Landholding)$$

Implementing the weights of each factor into the formula for the CI of wellbeing, the final CI formula is:

$$CI\ of\ wellbeing = (0.2888 * Trust) + (0.2647 * Security) + (0.2410 * Housing) + (0.2055 * Landholding)$$

3.2.1 Influence of sub-county on wellbeing

To test the first hypothesis, the first step is to conduct an investigation at the indicator level. The results of the one-factor ANOVA (shown in Table 7) confirm the hypothesis of an influence of the sub-county on the perception of being *economically secure*, and on all indicators of the physical components of wellbeing with P=0.000***. Assumptions are also confirmed by the one-factor ANOVA, with P=0.001*** for the influence of sub-county on being *safe from violence and crime*. For the other social-psychological indicators, no significant influence of sub-county could be found. However, these results should be interpreted carefully for *safe from violence and crime* (P=0.000***), *economically secure* (P=0.000***), *level of happiness* (P=0.000***), and *trust in local government officials* (P=0.011*) and for all physical indicators (P=0.000***) because Levene's test is undesirably significant, which means that homogeneity of variance cannot be assumed. In addition, the requirement for normally distributed data is not met according to the Kolmogorov-Smirnov (KS) Test (P = 0.000***).

However, to fully test the first hypothesis, I also examined to what extent this regional influence is also given for the factors. The results of the one-factor ANOVA (shown in Table 8) show a significant influence of sub-county on *housing* (P=0.004**) and on *landholding* (P=0.000***). The influence of sub-county on *trust* (P=0.858) and *security* (P=0.988) is not significant. However, due to the significance of Levene's Test for *housing* (P=0.000***), *landholding* (P=0.000***) and *security* (P=0.043*), these results should be interpreted carefully.

In the following section, I investigate factors after standardisation (z-score transformation). Using the previously specified formula for wellbeing, the wellbeing index shows a mean of 0.000 for the total group. Negative values for the CI show a lower wellbeing compared to the rest of the sample group. The greater the positive figure, the better the wellbeing relative to the mean of wellbeing index for all HHs. To better illustrate how the wellbeing distribution differs by sub-county, boxplots are provided in Fig. 3.

Regarding the wellbeing distribution between sub-counties, it can be seen that Simu has the highest mean (0.158), followed by Bulegeni (-0.026) and Namisuni (-0.055). The range indicates differences within the sub-counties: Namisuni has the lowest range (2.238), followed by Bulegeni (2.742), whereas Simu has the highest range (3.178) for the CI of wellbeing between HHs.

The last step is now to have a look at whether this relation is also evident for the overall wellbeing construct. Based on the ANOVA (Table 9), the influence of sub-counties on the wellbeing index is highly significant (P = 0.003**), but again, Levene's test is significant (P=0.006**), which points to the need for careful interpretation of this result.

Table 7. One-factor ANOVA for the influence of sub-county on the indicators of the social-psychological and physical wellbeing factors.

Factor	Indicator	Source	Partial SS	df	MS	F	P(>F)
Trust	Trust in most people	Between groups	0.475	2	0.238	0.101	0.904
		Within groups	1011.033	428	2.362		
		Total	1011.508	430			
	Trust in government officials	Between groups	2.955	2	1.477	0.684	0.505
		Within groups	924.020	428	2.159		
		Total	926.974	430			
	Local government considers the farmers' concerns	Between groups	2.289	2	1.144	0.631	0.533
		Within groups	776.101	428	1.813		
		Total	778.390	430			
Security	Economically secure	Between groups	41.164	2	20.582	9.229	0.000***
		Within groups	954.516	428	2.230		
		Total	995.680	430			
	Safe from violence and crime	Between groups	32.502	2	16.251	7.266	0.001***
		Within groups	957.220	428	2.236		
		Total	989.722	430			
	Level of happiness	Between groups	2.472	2	1.236	0.688	0.503
		Within Groups	768.948	428	1.797		
		Total	771.420	430			
Housing	Wall	Between groups	3.006	2	1.503	7.849	0.000***
		Within groups	81.959	428	0.191		
		Total	84.965	430			
	Floor	Between groups	4.346	2	2.173	9.197	0.000***
		Within groups	101.116	428	0.236		
		Total	105.462	430			
Landholding	Total hectares of land used for coffee cultivation	Between groups	9.109	2	4.555	12.448	0.000***
		Within groups	155.868	426	0.366		
		Total	164.978	428			
	Total hectares of land used for agricultural activity	Between groups	16.614	2	8.307	11.146	0.000***
		Within Groups	318.993	428	0.745		
		Total	335.606	430			

Table 8. One-factor ANOVA for the influence of sub-county on the factors trust, security, housing, and landholding.

Factor	Source	Partial SS	df	MS	F	P(>F)
Trust	Between groups	0.307	2	0.153	0.153	0.858
	Within groups	427.693	426	1.004		
	TotaI	428.000	428			
Securit y	Between groups	0.023	2	0.012	0.012	0.988
	Within groups	427.977	426	1.005		
	TotaI	428.000	428			
Housing	Between groups	11.080	2	5.540	5.661	0.004**
	Within groups	416.920	426	0.979		
	TotaI	428.000	428			
Landholding	Between groups	22.228	2	11.114	11.668	0.000***
	Within Groups	405.772	426	0.953		
	TotaI	428.000	428			

Number of observations = 431.

Figure 3. Bloxplots depicting the CI of wellbeing by sub-county.

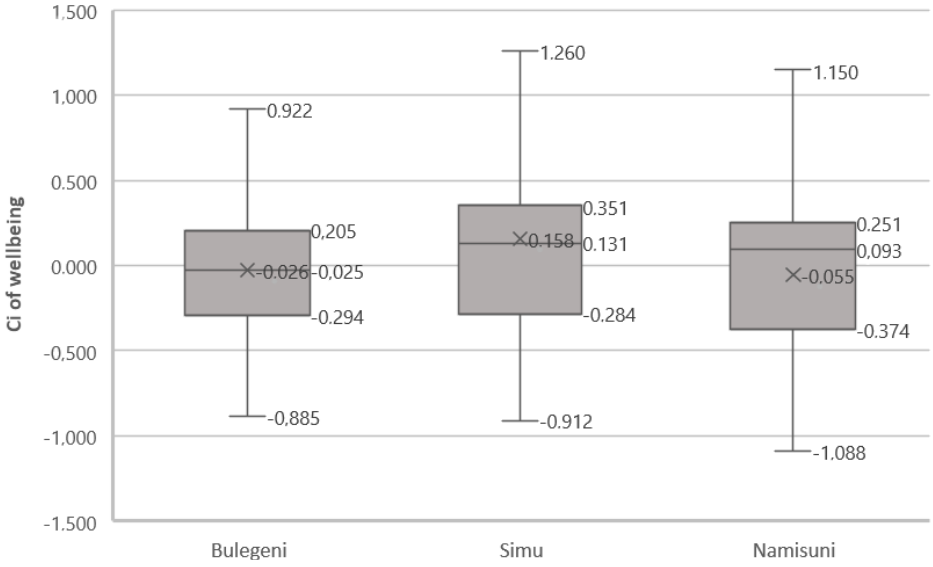


Table 9. One-factor ANOVA for the influence of sub-county on wellbeing index.

Source	Partial SS	df	MS	F	P(>F)
Between groups	2.923	2	1.462	5.891	0.003**
Within groups	105.696	426	0.248		
Total	108.619	428			

Table 10. Descriptive statistics for the four wellbeing factors (after z-score transformation).

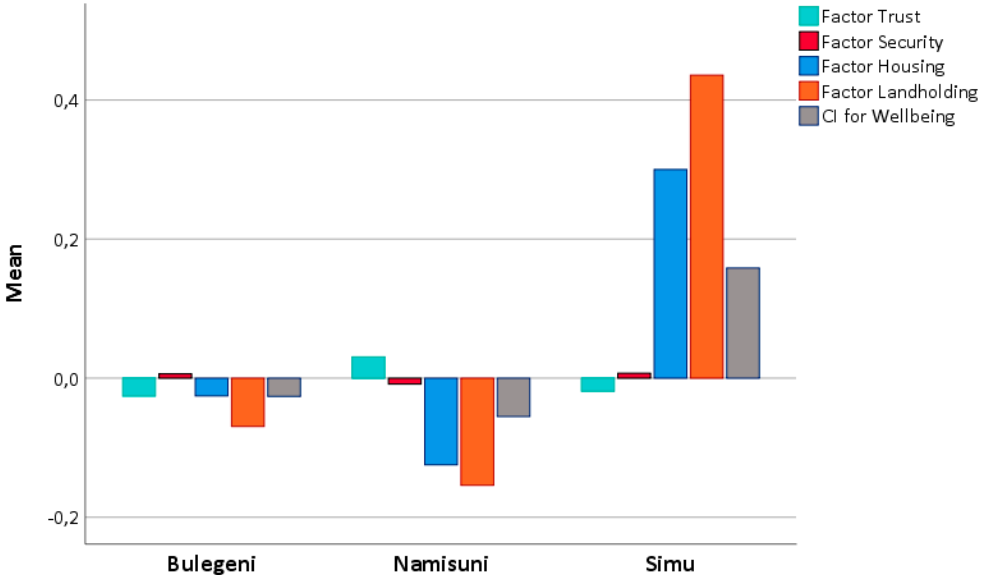
Component	Factor	Sub-county	N Valid	Mean	Median	SD	Variance	Range	Min	Max
Social-psychological	Trust	Bulegeni	156	-0.026	0.350	1.071	1.148	3.718	-2.189	1.528
		Simu	90	-0.019	0.219	0.953	0.909	3.462	-1.828	1.634
		Namisuni	185	0.031	0.311	0.964	0.930	3.810	-2.182	1.628
		Total	431	0.000	0.285	1.000	1.000	3.823	-2.189	1.634
	Security	Bulegeni	156	0.006	0.144	0.904	0.817	3.653	-2.077	1.576
		Simu	90	0.007	0.380	1.036	1.074	3.673	-1.936	1.737
		Namisuni	185	-0.008	0.289	1.062	1.127	3.828	-2.249	1.579
		Total	431	0.000	0.273	1.000	1.000	3.987	-2.249	1.737
Physical	Housing	Bulegeni	156	-0.026	-0.210	0.911	0.831	5.132	-0.885	4.247
		Simu	90	0.300	-0.236	1.490	2.221	5.953	-1.523	4.430
		Namisuni	185	-0.125	-0.221	0.708	0.501	5.467	-0.901	4.566
		Total	431	0.000	-0.221	1.000	1.000	6.089	-1.524	4.566
	Landholding	Bulegeni	156	-0.069	-0.332	0.839	0.703	6.170	-1.230	4.940
		Simu	90	0.4358	0.102	1.563	2.442	8.626	-1.632	6.993
		Namisuni	185	-0.154	-0.350	0.663	0.439	5.154	-1.636	3.518
		Total	431	0.000	-0.270	1.000	1.000	8.629	-1.636	6.993

3.2.2 Comparison of physical and social-psychological factors

To compare physical and social-psychological influences in a second step, I investigated z-standardized factors. Following the descriptive results shown in Table 10, the total range and the ranges per sub-county for z-scores of the social-psychological factors *trust* and *security* are < 4. The ranges of the z-scores of the factors *housing* and *landholding* of the physical component of wellbeing show greater (5.132 to 8.629) differences between minimum and maximum values of z-scores in total and for individual sub-counties. The physical component of wellbeing thus indicates greater variation and also a higher diversity in the percentage impact on wellbeing compared to the social-psychological component.

However, Figure 4 gives a more detailed explanation for the impacts of the individual factors on wellbeing by sub-county. It shows the means for all factors and the CI of wellbeing for the individual sub-counties and reveals that *landholding* has the strongest impact on wellbeing in all individual sub-counties, although this impact is negative (negative scores correspond to values less than the mean) in the sub-counties of Bulegeni and Namisuni. The means of the social-psychological factors *trust* and *security* are clearly smaller for all individual sub-counties, except for Bulegeni, where *trust* causes lower means for wellbeing of the HHs. With regard to the mean of total wellbeing, the results in Fig. 4 show that in Simu, the wellbeing score is the highest, followed by Bulegeni and Namisuni.

Figure 4. Means for the factors trust, security, housing, and landholding, and the CI of wellbeing for the sub-counties Bulegeni, Namisuni, and Simu (after z-score transformation).



4. Discussion

The findings presented here suggest that wellbeing can be explained mainly by the four factors *trust, security, landholding,* and *housing* quality, containing in total ten indicators divided into physical and social-psychological components that have different impacts on the wellbeing of individual HHs in the research area. In addition, an influence of the sub-county on wellbeing was found that can be explained primarily by the significant differences found for the physical factors *housing* and *landholding*.

The physical conditions of the HHs show that only a few have homes with plaster or brick walls, or wood or cement floors. This finding confirms those of the NPHC (2014), where only 6.6% of the interviewed HHs responded that their dwellings were constructed with permanent floor materials and 6.9% with permanent wall materials. The total mean for our sample group for *land used for agricultural activity* is 0.95 hectares, whereas the total mean for *land used for coffee cultivation* is about half that (0.5 ha). Other studies in the Mount Elgon region of Uganda found that the majority of their sample group had less than one hectare of land (e.g., Mugagga 2011). For both *land used for agricultural activity in general* and *land used for coffee cultivation*, the ranges of values for the area are up to ten times higher than the mean, which indicates wide disparity with regard to *landholding* in the community, especially in Simu.

The smaller means for the social-psychological factors could also be explained by the transformation into z-scores: Indicators with extreme values, such as those for *landholding,* have a greater effect on the CI, because indicators are converted to a common scale with a mean of zero and standard deviation of one. Here, extreme values were not excluded, because differences in hectares of land could not be ignored in cases where the main economic activity is farming. Nevertheless, it is widely accepted that landholdings are the major factor for HHs depending on agriculture. Even though the entire social-psychological component and also the individual factors *trust* and *security* do not significantly differ between sub-counties (quality of results from ANOVA were confirmed by Levene's and KS tests), the results still show a significant influence of the sub-county on the single indicators *economically secure* and *safe from violence and crime.*

The means for the final calculated CI of wellbeing indicate the highest wellbeing for the sub-county of Simu, followed by Bulegeni and Namisuni. The same order is found for the range of wellbeing within the sub-counties. To conclude, the results show differences in wellbeing within, and even greater differences in wellbeing between sub-counties, confirming the hypothesis stated at the outset.

Although there has been no direct research on wellbeing in the area under investigation here, findings reported by the NPHC (2014) also indicate differing levels of wealth in different sub-counties: for instance, the percentage of 6-12-year-old children not attending school is 17.6% in Bulegeni, 13.6% in Namisuni, and 12.9% in Simu. In addition, the percentage of 18-30-year-olds who are not in school and not working ranges widely, from the lowest in Bulegeni (8.7%), followed by Simu (12.5%), to the highest in Namisuni (27.1%). Looking at the percentage of people eating less than two times a day, Simu has the highest rate at 9.3%, followed by Namisuni at 7.2% and Bulegeni at 5.3% (NPHC 2014). In contrast to the results of the present paper, the findings of the NPHC (2014) do not clearly indicate distinct trends for the individual sub-counties.

The sub-counties investigated in this study do not border each other. Looking at the map of the sub-counties, it becomes clear that Namisuni and Bulegeni are closer to each other than to Simu. The geographical distances between the sub-counties correspond to similarities in the results of the wellbeing index, with sub-counties that are geographically closer showing more similar results. Further research should investigate whether geographic location really matters for wellbeing and whether there are other reasons that could explain the differences in physical wellbeing in different sub-counties. A possible explanation for the higher welfare in Simu could be the better access to roads, which enable faster and safer transport to the next town and could also lead to economic advantages. Another possible explanation could be better ecological conditions. It can be assumed that the presence of Sisiyi Falls in Simu could provide a more constant water source for crop cultivation or lessen the impact of droughts. This could lead to higher income from coffee selling or lower expenditures for food that has to be purchased in addition to self-sufficiency agriculture. Proving this assumption would require further investigation of the water sources in Bulegeni and Namisuni. Also, the *housing* quality parameter could explain the differences in wellbeing, because in Namisuni and Bulengeni, soils are too poor to make bricks, and transportation costs for bricks in both of these sub-counties with lower wellbeing far exceed the cost of the bricks themselves, whereas in Simu, the conditions for building a permanent house do not entail such high transaction costs. There could, however, be several other reasons for better physical wellbeing in Simu that should be included in further analyses. It might also be interesting to find reasons explaining the higher *trust* levels and the lower *security* perceptions in Namisuni than in the other sub-counties.

Nonetheless, several impacts of the data-driven development of the CI of wellbeing should be considered. Here, we interviewed the HH heads, who in our sample group are mainly men. Considering that based on their role within the HH, women are more likely to consider the wellbeing of the entire family, there might be differences in the indicators impacting wellbeing. A female perspective could be somewhat more representative of the wellbeing of the entire HH and might also consider more health or educational indicators, such as those found in the Women's Capabilities Index for Malawi developed by Greco (2018). Due to the widespread gendered division of labor in Uganda and the corresponding differences in men's and women's responsibilities for coffee-related tasks (Bantebya *et al.* 2014), it might be difficult to collect high-quality data from the HH heads' wives on questions about the economic or security level of the HH, realms that traditionally are the husband's responsibility. This issue does not have a major impact on the comparability within our sample group, but the higher number of male-headed HHs interviewed for this study compared to the research area reduces the representativeness of the results for the entire research area.

Nevertheless, the construction of a CI has the advantage of measuring wellbeing indirectly. Indirectly answered questions can lead to a lower impact of social desirability of the answers given by the farmers. It can further prevent low response quality due to different understandings of what complex terms like wellbeing mean. However, there are many different ways to construct a CI, starting with the definition of the term wellbeing, content-related selection criteria for indicators, the statistical analysis of reliability of indicators, all the way to the choice of a tool for measuring the weight of influencing factors. Even

if many indicators were involved here, indicators such as the HH head's health status or coffee productivity might be considered for further data collection. In the future, social and psychological components could be differentiated in more detail to provide an even better picture of what wellbeing means for the HHs investigated. Each individual step in constructing the CI influences how well the CI reflects wellbeing. Nevertheless, even the best choices in each step would lead to a loss in information due to the merging of single indicators.

However, the weighting of the factors was also calculated by the variance of the PCA and resulted in higher weighting for *trust* and *security* than for *landholding* and *housing*. Using results from (male) expert interviews would have led to higher weighting for *landholding* because "land comes first for farmers"[3], but for reasons of objectivity, the results of the PCA were used. The precondition for the calculation of weights based on results of the PCA was that the indicators identified as relevant correlate, which was given after Pearson's correlation.

Along with the measurement of suitability to use the factor weighing approach of the PCA developed by Nicoletti *et al.* (2000), correlations between indicators also provide deeper insights into the data set, which I briefly discuss in the following. From the positive relationship between the perception *economically secure* and *land used for coffee cultivation,* it can be assumed that an increase in *land used for coffee cultivation* is associated with higher income. The positive relationship between the *level of happiness* and the area for coffee cultivation may be explained by a higher level of business activities and greater freedom to spend money for the cultivation of cash crops. Food crops grown by farmers for their own consumption could improve the nutritional status of the HH. Sometimes leftovers from subsistence agriculture are sold at local markets, which yields small amounts of cash income. However, this cash income is not sufficient to cover the costs of families' basic needs such as health care, education, and shelter. One should keep in mind that coffee is only harvested once a year and coffee prices and coffee yields differ from season to season depending on weather and world market prices for coffee. It cannot be assumed that farmers are willing to switch the total area used for subsistence agriculture to coffee cultivation due to significant changes in market prices for the already low prices they get per kilo of coffee. Sometimes prices do not even cover the production costs (Sayer 2002). If, in such cases, farmers would only cultivate coffee and not engage in any subsistence agriculture, a reduction in wellbeing would likely be the result. In addition, landholding as such usually cannot be increased in this region, while access to land often decreases substantially from one generation to the next due to the high fertility rates and the division of inherited land among siblings (Mugagga 2011). This issue will become even more critical if fertility rates remain high and if inherited land continues to be split from one generation to the next (SUPRE 2018). If farmers want to increase the area for coffee cultivation, they will have to do so on the land they currently own. Otherwise, land dispossession could lead to even higher negative impacts on the wellbeing of farming HHs. Previous results from Liebig *et al.* (2016) also indicate that some of the plots in the same districts "showed no or a very low coffee productivity as a consequence of old

[3] In addition to the quantitative interviews presented here, qualitative interviews and expert interviews were conducted by the research team.

coffee bushes or inappropriate management practices". Improving farm management practices could therefore also help the UCDA to reach the goal of quadrupling Uganda's coffee production (see UCDA 2019) by improving farmers' resource situation and enabling them to increase their coffee productivity. Research on the basic conditions for this could not only help to increase coffee productivity; it could also prevent or slow down the reduction in coffee production as the suitable land for Arabica coffee cultivation in Uganda declines due to climate change (Jassogne *et al.* 2012).

Furthermore, results show that farmers' belief that their concerns are taken into consideration by the local government is stronger than their *trust in government officials*. Therefore, it can be assumed that the trust in institutions is higher than the *trust in most people* the farmers work with directly. The *level of happiness* also increases with higher values for *trust in most people*, *trust in government officials*, and consideration of farmers' concerns by the local government (and the other way around). The same correlation is visible for the relationship between all other indicators of *security* and the indicators of the factor *trust*. Research on the individuals who act as middlemen for coffee sellers (Baffes 2006) has shown that they are known to engage in unfair and exploitative business practices. This could explain, for instance, the positive relationship between *trust in most people* and the perception of being *economically secure*. Mosley and Verschoor (2005) confirmed the latter correlation in their study investigating trust levels in Sironko and Bufumbo, districts close to Bulambuli investigated here, and found that trust increases with the wealth status of a HH. However, the high knowledge and information gap in the research area could also have an impact on trust. According to the study by Sseguya *et al.* (2012), which was implemented in Southeast Uganda, information networks among farmers, extension workers, local governments, and the private sector are very uncommon and lead to a high information gap on the part of the farmers, depending on which sources of information a farmer has access to.

The positive relationship between the perception of being *safe from violence and crime* and (a) *trust in government officials* and the high positive values for (b) *local government considers the farmers' concerns* is consistent with the assumption that farmers who have trust in institutions feel more protected.

The results of the data set presented here are only suitable to provide a static specification of wellbeing at the time of data collection. To measure dynamic changes in wellbeing over time, further data collection could enable repeated evaluations and could also include medical or nutritional status or additional aspects of housing quality to increase the number of potential physical indicators. In addition, detailed investigation of factors influencing wellbeing (e.g., income, education, number of children) and of the relationship between perceived deficiencies and wellbeing should be a focus of further research.

5. Conclusions

The main aim of this paper was to understand how coffee farmers in the Mount Elgon region of Uganda perceive their wellbeing. The CI for wellbeing and the wellbeing indicators served as suitable instruments to test the hypotheses that (1) wellbeing in the investigated research area is not equally distributed within and between sub-counties and that (2) the physical wellbeing component causes a lower wellbeing level of HHs than social

and psychological indicators. The findings from these hypotheses regarding the composition of wellbeing and the dependencies between wellbeing indicators provide a sound basis for policy recommendations.

The selection of nineteen potential indicators for the resulting physical and social-psychological components of wellbeing was made according to statistical relevance. The results of the explorative PCA show that *trust*, *security*, *housing*, and *landholding*, containing in total ten of the previously selected indicators, provide the most comprehensive composite picture of wellbeing, explaining 81.20% of the total variance. The weight of each factor within the CI of wellbeing—which was calculated by the percentage of variance explained by the factor after varimax rotation divided by the total variance of all factors—was ranked from *trust*, showing the highest weight, to *security* and *housing,* all the way to *landholding* with the lowest weight.

Nevertheless, *housing* and *landholding* provided the highest z-scores in both directions, negative and positive, and were thus identified as the highest-impact factor for all sub-counties, even after the lowest weighting within the CI formula. Due to the high negative values for *landholding* in Bulegeni and Namisuni, the hypothesis that physical wellbeing causes lower wellbeing constitutions of HHs than social-psychological wellbeing can be confirmed. For Simu, a sub-county with greater access to land, the factor *landholding* also has a high impact on wellbeing, but in a positive way.

The main finding for the physical indicators is the overall low level of wellbeing. The final CI for wellbeing shows differences in wellbeing between and also within sub-counties, which confirms the previously mentioned first hypothesis.

The dependencies between indicators and different impact levels of indicators of wellbeing within the CI of wellbeing provide the basis for several policy recommendations. Because land area is a variable that cannot be increased in the area under investigation here, the only recommendation that can be made would be to mandate official registration of land to prevent potential land-grabbing motivated by the nutrient-rich volcanic soils in the Mount Elgon region (UNDP 2012). Official land registration should attempt to establish equal land rights between husbands and wives. At the moment, it is common that the man holds the land rights (even though this is not official). In cases of the male HH head's death, his male relatives inherit those rights. The loss of land often increases the economic vulnerability of the remaining HH members. This is an important issue, considering that about the half of the female-headed HHs of the HHs presented here are widowed.

The *level of happiness* and the perception of being *economically secure* could be improved by a higher percentage of *land used for coffee cultivation*. Due to the previously mentioned drawbacks for coffee farmers when increasing the percentage of land for coffee cultivation, this cannot be generally recommended. Instead, the results point to policy recommendations that farmers should be trained in methods to improve their currently low coffee productivity to increase their income from coffee production. Another recommendation to increase income from coffee selling would be to implement standardized processes for coffee-selling activities. Contracts between buyers and sellers, improved access to information about the coffee market to reduce the information gap between buyers and coffee farmers, reliable weighing scales, or even a statutory minimum price could be explored as approaches to increase income from coffee selling and mitigate issues of mistrust.

The currently low *housing* quality of the majority of HHs is also having an impact on the wellbeing of the coffee-farming HHs. Here, development activities could focus on improving *housing* quality, for instance, by improving access to financial services, providing construction loans, or offering subsidized prices for bricks and other construction materials. This might be an effective approach to improve the level of wealth in the area under investigation and could improve wellbeing levels, especially in Namisuni and Bulegeni. The results presented here could further be used to investigate the success of existing development approaches in the Bulambuli district.

To conclude, the results presented here suggest that in the future, the already low wellbeing of the HHs in this area will decrease further with each subsequent generation due to existing land inheritance structures and the steadily decreasing suitability of land for Arabica coffee cultivation as a result of changing weather conditions. Policy and market-related activities should be implemented to help the coffee farmers in the Mount Elgon region by enabling them to improve their resource levels and cope with the growing challenges (Dodge *et al.* 2012) in order to maintain—or better, increase—their current levels of wellbeing.

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List of abbreviations

CI	Composite Indicator
HH	Household
JRCEC	Joint Research Centre, European Commission
KS	Kolmogorov-Smirnov
NARO	National Agricultural Research Organization
PCA	Principal Component Analysis
UBOS	Uganda Bureau of Statistics
UCDA	Uganda Coffee Development Authority
UNHS	Uganda National Household Survey