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Knowledge and perceptions towards organic farming: a case of pineapple farmers in central Uganda

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Abstract
This study examined the knowledge and perceptions as well as factors that influence the knowledge and perceptions of pineapple farmers towards organic farming in Uganda. Through multi-stage sampling procedures, purposive and random techniques were applied at different stages to select participants from both Luwero and Kayunga districts in central Uganda. Data was collected using a semi-structured questionnaire. A composite index for knowledge and perceptions was computed for each respondent and subjected to descriptive statistics while the censored Tobit regression model was used to determine factors that influenced farmers' knowledge and perceptions of organic farming. Results showed that both organic and non-organic farmers had a high level of knowledge and favorable perceptions towards organic farming with no significant difference. Perceived environmental and economic benefits of organic farming did not significantly differ ($p > 0.05$) among organic and non-organic farmers. However, mean scores for perceived health and nutritional (4.30 vs. 3.94) benefits, and access to markets (4.10 vs. 3.89) differed significantly ($p < 0.05$) between organic and non-organic farmers. There was a positive and significant relationship between knowledge and perception of organic farming among non-organic farmers while for organic farmers, a significant and negative relationship was observed. Factors that significantly influenced farmers' knowledge were information sources and farmers' experiences. Farmer perceptions were influenced by education, information sources, group membership and extension services. Therefore, to enhance the adoption and growth of organic pineapple production in Uganda, policymakers and promoters should consider these factors when designing policy documents and sustainability strategies for the development of organic agriculture.

Keywords Attitudes · Organic farming · Knowledge · Perception · Pineapple · Sustainable agriculture

1 Introduction

Global sales of organic foods and drinks exceeded 115 billion USD in 2019 [1], due to increased consumer demand. Uganda continues to benefit from global market opportunities through exports of organic fruits including pineapples which are largely produced by smallholder farmers. Despite the successes registered by the agriculture sector, Uganda's organic sub-sector is constrained by several challenges including low levels of knowledge, limited organic agriculture

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research, and the limited use of improved technologies [2]. Also, the number of organic producers in the country is declining [3], resulting in low production of organic food products for both the domestic and export markets. In addition, other studies have reported non-conformances by farmers to organic principles and standards on mixed smallholder organic pineapple farms such as the use of synthetic acaricides and antibiotics in livestock production [4–7], thus denying the potential synergies between crop and livestock production. This raises a question as to whether farmers have adequate knowledge and positive attitudes toward organic farming to adopt its required practices. Knowledge is a collection of experience, appropriate information, and skilled insight which offers a structure for estimating and integrating new experiences and information [8].

Knowledge is an understanding that can be gained through learning or experiences, thus making it important for organic farming adoption. In philosophy, psychology, and cognitive science, perception is the process of attaining awareness or understanding of sensory information [9]. Perception is one basic source of knowledge because it provides a prior understanding of the generic conditions of knowing, conditions such as truth, belief, and justification [10]. Therefore, gaining insights into what farmers perceive about organic farming is important in providing an opportunity to reflect on the farmers' understanding of organic farming and then provide necessary information that might be needed to enhance their knowledge. Organic farming is a knowledge-intensive system [11], yet many farmers in Uganda still lack the critical knowledge to produce, process, and market organic products. Several studies have underpinned the importance of farmers' knowledge and attitudes in the practice of organic farming [12–16]. Farmer characteristics and socio-economic factors are important determinants of farmer knowledge and perceptions of organic farming [12, 15]. In Uganda, the influence of farmer's socio-economic factors on knowledge and perceptions of organic farming is not fully understood. Understanding these aspects is key if organic agriculture is to be adopted and used as a catalyst for improved farmer livelihoods and eco-friendly production systems in the country. Therefore, this study examined farmers' knowledge levels and perceptions of organic farming and the factors that influence their knowledge and perceptions.

2 Materials and methods

2.1 Description of the study area

The study was conducted in Luwero and Kayunga districts located in central Uganda. These districts are key producer areas for pineapples in Uganda [17]. Luwero district is located about 68 km North of Kampala at an altitude of about 1000–1500 m above sea level. Rainfall is well distributed throughout the year, with an average annual of 1300 mm and a mean annual temperature range of 15 °C and 30 °C. Kayunga district is situated about 74 km East of Kampala city at an altitude of about 1000–1200 m above sea level. It has bi-model rainfall patterns with the first rains in March–May, while the second is from September to December. Rainfall is evenly distributed. The mean annual temperature is 24.7 °C. The growth of pineapple requires an optimal temperature range between 20 and 30 °C. Therefore, these districts are conducive for pineapple growing.

2.2 Study design and sampling

A cross-sectional survey design was employed for this study. A four-level multi-stage purposive sampling approach was employed to select respondents. The first stage involved the purposive selection of the Central Region of Uganda. The region is one of the major pineapple-growing areas with farmers who produce for both local and international markets [5]. The second stage involved the purposive selection of both Luwero and Kayunga districts based on two reasons: they are the major pineapple growing areas in the central region; they have the largest share of organic pineapple farms in the country [2]. The third stage of sampling involved the purposive selection of sub-counties known for pineapple production from both Luwero and Kayunga districts. In the fourth stage, farmers were randomly selected from the lists provided by the districts' agricultural offices and farmer-based organizations. The sample size was informed by the need to meet a statistical power of 95% and a 5% level of precision. The computations were done using the equation for determining the sample size of proportions [18]. The fact that the households involved in pineapple production in the selected sub-counties are a finite population, corrections for sample size were made using the equation below for finite population sample size correction [18].

$$n = \frac{n_0}{1 + \frac{(n_0 - 1)}{N}}$$

where n is the corrected sample size, n_0 is the computed sample size and N is the population size. A population of 385 pineapple farmers in both districts was targeted. Therefore, the resultant sample of 317 respondents was obtained. However, we were able to reach a total of 250 farmers (78%) for face-to-face interviews. The total number of farmers sampled from the sub-counties was determined based on the number of households growing pineapples in each of the selected districts. One hundred and fifty respondents (60%) were randomly sampled from Luwero district while 100 respondents (40%) were from Kayunga district.

2.3 Data collection

Data were collected using a semi-structured questionnaire between March and April 2022. A pre-test of the questionnaire was done with organic and non-organic farmers and the necessary revisions were made. Data was collected with the help of trained enumerators who first obtained verbal informed consent from the participants before the start of the interviews. To facilitate proper conceptualization of questions and capture of the correct responses during data collection, the enumerators asked the questions in the local language of 'Luganda', while the responses were recorded in English directly in the questionnaire. The questionnaire comprised questions on the socio-economic and demographic characteristics of farmers, experience in farming, farm practices, farmers' knowledge, and perceptions of organic farming. The knowledge of organic farming was measured by asking farmers to indicate true (1) or false (0) to 10 knowledge questions while perceptions were assessed by asking them to indicate their opinion on twenty-five statements. The statements were scored on a five-point Likert scale of strongly agree (5), agree (4), undecided (3), disagree (2), and strongly disagree (1). The negative statements were reverse-scored [19]. Knowledge and perception questions were adopted from [20] and [14]. Sources of information on farming accessible and preferred by farmers were evaluated by presenting respondents with a list of information sources developed from the available literature.

2.4 Data analysis

The data collected were entered into Microsoft Excel spreadsheets, cleaned, coded, and later analyzed using the Statistical Package for Social Sciences (SPSS, version 25) to generate descriptive statistics. Additionally, inferential statistical tools, independent samples t-tests, and Chi-square tests were used to compare numerical and categorical variables respectively. The results are presented as percentages, means with standard deviations as well as the associated p values. Means were considered significantly differently at 95% confidence interval. Responses on knowledge and perceptions of organic farming were analyzed by calculating an index using the formula adopted from [15]. A composite index for knowledge and perceptions was computed for each respondent.

$$Index = \frac{Respondent's\ total\ score}{Total\ possible\ score} \times 100$$

Mean scores greater than $\bar{X} \geq 0.5$ represented a high level of knowledge. For perceptions, the reference means for the scale was three ($5+4+3+2+1=15/5=3$). Thus, $\bar{X} \geq 3$ was judged favorable perception while $\bar{X} < 3$ was judged as having unfavorable perceptions towards organic farming.

The censored Tobit regression model was used to describe the relationship between the independent variables and the dependent variables [21]. This model predicts an outcome that is censored from above and below or both [22]. Tobit regression generates a model that predicts the outcome variable to be within a specified range. To model the relationship between the observed y and x, we consider a latent variable y* that is subject to censoring. A change in x affects y only through the effect of x on y*.

Latent variable: $y^* = \int (\mathrm{x}) = \mathrm{X}\beta + \text{error}$.
Observed variable: $y = h(y^*)$.
Model equation: $y_i^* = x_i'\beta + \varepsilon_j$, β measures the effect of a change of $\mathrm{x_i}$ on y*

An index was calculated for each respondent for the dependent variables (knowledge and perception). A composite index was generated for each knowledge and perception statement. The index ranged between 0.2 (lower limit) and 1 (upper limit). In the Tobit regression model, the dependent variables were censored at the upper limit. Table 1 presents the measurements and definitions of the dependent and explanatory variables included in the model.

3 Results

3.1 Farmers' socio-demographics characteristics

The respondents were mainly males. The proportion of farmers with other income sources other than farming was higher for non-organic farmers compared to organic farmers (Table 2). Majority of farmers had formal education. Organic farmers had greater experience in farming than non-organic farmers. On average, organic farmers had close to 3 years more experience than their counterparts who practiced conventional farming.

3.2 The extent of knowledge of organic and non-organic farmers about organic farming

Farmers in both categories had a high level of knowledge of organic farming as represented by the mean scores of 0.5 and above of the knowledge statements (Table 3). The Chi-square test showed no significant difference in knowledge level between organic and non-organic farmers in almost all aspects, except one, where the organic farmers were significantly more knowledgeable about animal health and welfare, good environmental practices, and product quality as a focus for organic farming.

Table 1 Measurement and summary of explanatory variables used in the regression model and their hypothesized relationship to knowledge and perceptions of organic farming

	Definition and measurement	Mean ± SD, %	Expected sign
Dependent variable			
Knowledge and perception	Index of knowledge and perception	Lower limit: 0.2 Upper limit: 1	
Explanatory variables			
familyszie	Number of household members	5.8 ± 2.6	+
educ_yrs	Years of education	11 ± 6.0	+
head_occup_ off farm	Other income sources; 1 = yes, 0 otherwise (dummy)	21.6%	+
farm_group	Farmer group membership, 1 = yes, 0 otherwise (dummy)	67.6%	+/–
save_group	Saving group membership 1 = yes, 0 otherwise (dummy)	72.0%	+/–
_age	Age; years (discrete)	43.8 ± 12.1	+/–
farm_exper	Pineapple experience; years (discrete)	17.3 ± 10.4	+
livestock_exp	Livestock experience years (discrete)	13.2 ± 8.9	+
smartphone	Access to mobile phone; 1 = yes, 0 otherwise (dummy)	65.2%	+
info_extension	Access to extension services 1 = yes, 0 otherwise (dummy)	96.3%	+
farmsize_owned	Total farm size; acres (continuous)	6.3 ± 6.9	+/–
pineapple_acres_owned	Total land under pineapples; acres (continuous)	1.7 ± 1.7	+/–
own_livestock	Livestock ownership; 1 = yes, 0 otherwise (dummy)	76.4%	+
agrochemical_use	Use agrochemicals 1 = yes, 0 otherwise (dummy)	38.8%	–
manure_fertilizer	Use manure 1 = yes, 0 otherwise (dummy)	62.4%	+
total_cattle	Cattle available in household (continuous)		
	Local breed	6.6 ± 11.2	
	Cross bred	3.2 ± 2.0	+
smal_livstock	Small ruminants available in household (continuous)	10.3 ± 18.7	+
Infomn_soces	number of Information sources	100%	+

Table 2 Socio-demographics characteristics of respondents

Parameter	Type of farmer		*p* value
	Non-organic ($n=85$)	Organic ($n=165$)	
% of female-headed households	4.7	7.9	0.891
Age of the household heads	43.85 (12.47)	43.83 (11.95)	0.992
Years spent in school	11.24 (6.57)	10.51 (5.67)	0.365
% of farmers with no formal education	4.7	7.9	0.010
Years of experience in farming	15.44 (9.02)	18.32 (10.98)	0.038
% of married household heads	89.4	81.8	0.117
Family size	5.49 (2.29)	5.36 (2.81)	0.196
% of household heads with income sources other than farming	42.3	10.9	0.000
Total farm size (acres)	7.00 (8.05)	5.87 (6.14)	0.218
% of household heads that belong to farmer groups	71.8	65.5	0.313
% of household heads that belong to a savings group	70.6	72.7	0.205
% that own livestock on farm	75.3	77.0	0.768
Distance to nearest output market	5.36 (8.18)	6.79 (40.19)	0.758

Parenthesis () are standard deviations of farmers' age, experience, duration in school in years, farm size, and distance to markets

Table 3 Distribution of mean scores for knowledge statement of organic farming

Knowledge statement	Type of farmer		*p* value
	Non-organic Mean	Organic Mean	
Organic farming (OF) is easier to practice than non-organic farming	0.68	0.58	0.122
OF focuses on animal health and welfare, good environmental practices, and product quality	0.75	0.90	0.003*
OF promotes and maintains animal health through balanced organic nutrition, stress-free conditions, and breed selection	0.80	0.85	0.270
OF requires only organic feeds for livestock	0.78	0.79	0.836
OF does not use synthetic drugs/pesticides/herbicides	0.71	0.76	0.377
OF needs clean/non-polluted water for irrigation	0.67	0.74	0.240
Dolomites (calcium magnesium carbonate fertilizer) can be used in organic farming	0.51	0.55	0.467
Supplying large quantities of organic manure for OF is not a difficult task	0.57	0.45	0.072
OF is successful in both smallholder and large farms	0.58	0.61	0.652
OF is not a costly investment	0.49	0.41	0.220

* Significant at $p<0.05$

3.3 Perception statements regarding organic farming

Results indicated that farmers in both categories had favorable perceptions towards organic farming as represented by the mean scores of 3 and above of the perceptual statements (Table 4). Nevertheless, organic farmers had favorable perceptions (score > 4) on more aspects of organic farming than their counterparts.

3.4 Farmers' perceptions toward organic farming

Results indicated that there were no wide deviations in mean scores of perceptions regarding the perceived environmental (0.67 vs. 0.68) and economic (1.00 vs. 1.05) benefits for organic and non-organic farmers respectively (Table 5). Results for other variables also indicate proximity in deviation for high input costs, organic farming as a better farming option, and high cost of organic certification. Statistical tests indicated a significant difference ($p<0.05$) between organic and non-organic farmers for the perceived health and nutritional benefits of organic farming and access to markets.

Table 4 Distribution of mean scores for perceptual statements of organic farming

	Type of farmer	
	Non-organic	Organic
	Mean	Mean
Perception statement		
Organic farming (OF) enhances soil fertility	4.4	4.2
OF will not pollute the environment and natural resources	3.9	4.1
Organic produce provides health and nutritional benefits to the consumers	3.9	4.3
OF does not generate poisonous fumes in the air	4.0	4.1
OF will not pollute water resources	4.1	3.9
OF does not harm soil or other organisms	3.9	4.3
Inorganic fertilizers, insecticides and other chemicals used in non-organic farming cause long-term harmful effects on the environment	4.1	3.9
OF is more profitable than conventional farming systems	4.0	4.1
Organic pineapples have high profit returns	3.8	4.1
OF is gaining popularity among local farmers	3.9	4.0
OF provides the chance to make good use of farming skills	3.9	4.1
Organic pineapples have high market competition/demand	3.9	4.0
Cost of production can be reduced in OF, because crop residuals and manure can be applied as fertilizer	3.9	3.9
Cost of production can be reduced because family labor can be utilized in OF	3.8	3.9
OF can mitigate climate change impacts	4.0	4.1
Organic pineapples can be sold easily	3.9	4.2
There are adequate buyers for organic pineapples	4.0	4.1
Negative statements (reverse coded)		
OF cannot control pests, diseases, and weeds	3.5	3.5
Required standards in OF make it too restrictive to be practical	4.1	3.9
OF is a thrilling new challenge to switch to organic farming (knowledge intensive farming) (reverse scored)	3.7	3.7
OF requires high production costs	3.9	3.6
The method is labor-intensive	4.0	4.1
Transport cost is higher in OF because large quantities of organic fertilizer have to be transported (reverse scored)	3.7	4.0
OF returns lower yields	3.4	3.3
Certification is difficult to obtain	3.2	3.6

Table 5 Mean scores variations in farmers' perceptions towards organic farming

Attributes	Type of farmer				*p* value
	Non-organic		Organic		
	Mean	SD	Mean	SD	
Environment benefits	4.06	0.68	4.07	0.67	0.901
Health/nutritional value	3.94	1.35	4.30	0.97	0.017*
High input costs	3.74	0.78	3.75	0.94	0.897
Economic benefits	3.92	1.05	4.11	1.00	0.165
Cost of certification	3.64	1.27	3.76	1.14	0.418
Access to markets	3.89	0.74	4.10	0.83	0.047*
Better farming option	3.78	0.59	3.85	0.79	0.515

* Significant at $p < 0.05$

3.5 Variation in knowledge level and perceptions towards organic farming

Results showed that there was no significant difference ($p > 0.05$) in farmers' knowledge and perception presented as mean scores derived from farmers' responses to knowledge and perception statements (Table 6).

3.6 Sources of information on organic farming

The results (Table 7) revealed that radio and extension agents were the most used and preferred sources of information on farming for both organic and non-organic farmers.

3.7 Relationship between farmers' knowledge and perceptions towards organic farming

A Pearson correlation coefficient showed a positive and significant relationship between knowledge and perception towards organic farming for non-organic farmers (Table 8). However, organic farmers had contrasting findings, their knowledge and perceptions showed a negative and significant relationship. When both organic and non-organic farmers were combined, the analysis revealed a relatively weak and negative relationship between the two variables which was insignificant as shown in Table 9.

Table 6 Mean variations in farmers' knowledge level and perceptions of organic farming between organic and non-organic farmers

Type of farmer	*N*	Mean	Std. dev	*t* value	*p* value
Knowledge of organic farming					
Non-organic	85	64.7	18.7	−0.674	0.501
Organic	165	66.2	16.2		
Perceptions of organic farming					
Non-organic	85	75.6	9.8	−1.414	0.159
Organic	165	77.9	13.0		

N number of respondents, *Std* standard deviation

Table 7 Percentage distribution of respondents based on their information sources

Info sources	Non-organic farmers				Organic farmers			
	Yes	Frequency of access		Preference	Yes	Frequency of access		Preference
		Regular	Occasional	Most preferred		Regular	Occasional	Most preferred
Radio	87.1	81.2	18.8	77.0	86.7	79.6	20.4	77.6
Extension agent	76.5	66.1	33.9	64.6	84.2	75.0	25.0	51.1
Farmer association	47.1	41	59	7.5	61.2	79.3	20.7	20.8
Relatives	38.8	40.6	59.4	12.1	60.0	55.8	44.2	31.3
TV	63.5	75.5	24.5	57.4	50.3	78.4	21.6	51.8
Pamphlets	57.4	58.8	41.2	56.5	34.5	71.2	28.8	17.5
Internet	48.2	63.4	36.6	56.1	35.8	81.4	18.6	55.9
Mobile phones	43.5	44.1	55.9	29.7	46.7	77.3	22.7	37.7

Table 8 Correlation between knowledge and perceptions among pineapple farmers

Farmer category	Correlation coefficient	*p* value
Non-organic farmers ($n = 85$)	0.398**	0.000**
Organic farmers ($n = 165$)	−0.328**	0.000**
Non-organic and organic farmers combined ($n = 250$)	−0.098	0.122

** Correlation is significant at the 0.01 level (2-tailed)

Table 9 Censored Tobit regression analysis for predictors of farmers' knowledge level and perceptions towards organic farming

Variable	Farmers' knowledge of organic farming Coef.(Std. Error)	Farmers' perceptions of organic farming Coef.(Std. Error)
Family size	0.207 (0.484)	−1.302** (0.303)
Years of education	−0.031 (0.187)	−0.339* (0.117)
Other income sources (yes)	5.220 (3.204)	−3.700* (1.762)
Farmer group membership (yes)	1.775 (3.204)	8.733** (1.990)
Saving group membership (yes)	0.657 (3.313)	−0.754 (2.058)
Age	−0.222 (0.134)	0.163 (0.085)
Pineapple experience	0.377* (0.181)	−0.075 (0.112)
Livestock experience	−0.509** (0.171)	0.172 (0.107)
Mobile phone access (yes)	−0.455 (2.549)	−8.783** (1.593)
Extension services access (yes)	−4.931 (3.422)	4.227* (2.120)
Farm size	−0.089 (0.245)	−0.031 (0.151)
Land under pineapples	1.414 (0.774)	0.094 (0.476)
Livestock ownership (yes)	−5.858 (3.433)	10.193** (2.166)
Use agrochemicals (yes)	−2.681 (2.408)	−4.906** (1.498)
Use manure (yes)	0.368 (2.894)	−8.067** (1.844)
Cattle	0.526** (0.188)	−0.056 (0.112)
Small ruminants	1.204 (2.628)	−2.948 (1.667)
Information sources	−1.361** (0.510)	−1.012** (0.317)
Constant	83.854** (6.021)	79.430** (3.638)
Number of obs	212	212
Uncensored	201	189
Left-censored	0	0
Right censored	11	23
Log-likelihood	−849.13	−717.57
LR chi^2 (21)	47.29	129.44
Prob > chi^2	0.0002	0.0000
Pseudo R^2	0.0271	0.0827

Parenthesis () standard errors

* Significant at $p < 0.05$, ** $p < 0.1$

3.8 Censored Tobit regression analysis of factors influencing farmers' knowledge and perceptions

Results indicated a significantly positive effect of cattle herd size on farmers' knowledge of organic farming. In other words, an increase in the number of cattle has the likelihood of increasing farmers' knowledge of organic farming by 5.38 times. Conversely, farmers' livestock experience and sources of information had significant and negative effects on farmers' knowledge. Farmers' perceptions were significantly and positively affected by farmer group membership, extension services, livestock ownership, and use of vet drugs (Table 9). On the other hand, family size, education, other income sources, mobile phone access, use of manure, and use of agrochemicals had significant and negative effects on farmers' perceptions of organic farming.

4 Discussion

4.1 Characteristics of organic and non-organic pineapple farmers

Pineapple farmers were mostly male, and this suggests that the opportunity to benefit from the value of the pineapple enterprise is missed by most women. This finding agrees with other studies [5, 16, 23] which reported males to be more involved in organic agricultural production mainly for income generation. Despite organic farming being strong on gender and participation, the way it is introduced to the community offers little to improve gender equity. This is because organic farming is in most cases introduced to farmers growing cash crops that have the potential for organic markets in which females are less involved [2, 24, 25]. The average age of pineapple farmers was 43 years. This finding agrees with [20] and [5] who reported the age range of organic farmers to be 40–50 years. However, this contradicts [2] findings that reported youth (<40 years) to be substantially involved in organic pineapple farming. Innovation and profits are the key drivers for adopting organic farming among young people [26]. Most organic and non-organic pineapple farmers had formal education, which is a basis for facilitating learning and information sharing. Literacy among farmers was earlier reported to improve the level of adoption of new technologies in farming households [27, 28]. Most pineapple farmers without formal education practiced organic farming, a finding that agrees with [29]. This suggests that pineapple farmers with less ability to read and write accessed information on organic farming and learned from each other in the community. Moreover, Bandura's Social Learning Theory posits that people learn from one another via observation, imitation, and modeling when there are limitations of education, provided social networks support them [30]. Organic pineapple farmers had more experience in farm production than non-organic pineapple farmers. This finding agrees with other studies [31–33] which indicated that experienced farmers cope better with organic farming compared with farmers with fewer years of experience.

4.2 Knowledge level and perceptions towards organic farming

Both categories of pineapple farmers had a high knowledge level for most aspects of organic farming. This finding contrasts with other studies [14, 15] that reported organic farmers as having better knowledge than non-organic farmers due to the special training they receive. The current finding could suggest that there was a farmer-to-farmer knowledge exchange about organic farming since organic and non-organic pineapple farmers reside within the same community. The high knowledge level could also have resulted from the regular access to radios and extension agents reported in this study. These sources probably provide information on organic farming, thus creating awareness for organic and non-organic farmers. In addition, the farmers specifically involved with certified organic farming receive advisory and quality control services from export companies that they are registered with. The level of knowledge of organic farming deneated by non-organic pineapple farmers shows good prospects for such farmers to convert to organic farming. Organic and non-organic farmers had favorable perceptions towards organic farming, which did not differ significantly. This finding agrees with studies by [13] and [29]. This finding could be attributed to the awareness of organic farming created by non-government organizations (NGOs), extension agents, and organic export companies that operate in the study area. Moreover, attitudes greatly contribute to adopting organic farming [14]. Most farmers agreed that organic farming has economic and environmental benefits and is a better farming option. Farmers who adopt these perceptions not only have a chance to increase their income but also have an opportunity to protect the environment against agrochemical pollution.

4.3 Relationship between Farmers' knowledge and perceptions towards organic farming

The positive and significant relationship between knowledge level and perception towards organic farming among non-organic farmers implies that as the knowledge level of organic farming increases, it is followed by an increase in positive perceptions towards organic farming for these non-adopters. This finding implies that other factors may deter farmers from practicing organic farming beyond the knowledge and perceptions that have been investigated in this study. Among organic farmers, knowledge level and perceptions towards organic farming were negatively and significantly correlated. In other words, organic farmers with high knowledge levels of organic farming had negative perceptions. This finding contradicts other studies [16, 29]. Previous studies reported challenges experienced by smallholder organic pineapple farmers which

included pests and diseases, lack of organic inputs, limited organic markets, and high certification costs [4, 5, 7]. These experiences probably contributed to the negative perceptions among the organic pineapple farmers observed in this study.

4.4 Factors that influence Farmers' knowledge and perceptions towards organic farming

This study revealed that several socio-economic factors appeared to affect perceptions more than the knowledge of farmers. Livestock farming experience had a significant and negative influence on knowledge but was positive on perceptions. This has implications for the adoption of organic farming especially when livestock is integrated. Pineapple farming experience affected farmers' knowledge positively but perceptions negatively. The latter is expected because being knowledgeable may also negatively affect perception, for example, if farmers have adequate information that organic pineapple production might be affected negatively by having livestock that is not reared following organic principles, this could affect their attitude towards organic pineapple farming which involves integration of livestock. Most smallholder organic pineapple farmers operate mixed crop-livestock systems; however, livestock management practices do not entirely conform to organic principles and standards.

Family size had a significant and negative effect on farmers' perceptions. An increase in the number of family members in a household would imply an increase in labor for organic farming, however, with few members, labor would be a constraint. Organic farming is labor intensive, and farmers' families have been the major source of labor in all agricultural systems irrespective of the fact that there has been an increasing role of hired labor in farm practices [34]. An increase in farmers' education resulted in a likelihood of farmers having negative perceptions towards organic farming. Education provides key information and awareness that can influence farmers' perceptions towards organic farming positively, or it might discourage adoption since education provides more profitable off-farm employment opportunities [35]. Other income sources had a significant and negative influence on farmer perceptions. This is because organic farming is usually considered riskier in terms of yield loss during initial years of conversion [36]. So, a farmer with no other source of income which might have worked as a safety net, could have a negative perception, and feel hesitant to convert to organic farming as they tend to be more risk averse. Overall household income is an important factor in terms of adoption decisions as it indicates higher financial leverage to undertake risks associated with new technology [34].

Owning livestock, belonging to a farmer group and access to extension services affected farmers' perceptions positively. This finding agrees with studies by [34] and [14]. Livestock holding is very crucial as it supplies the much-needed manure for fertilizing the soil in organic crop-livestock-integrated systems. More significantly membership in a group formed for organic farming and the extent of activities such as training conducted through it has been very successful in encouraging farmers to convert to organic farming [34, 37]. Increased access to extension services focused on organic farming improves farmers' perceptions, and consequently adoption of organic practices. This finding agrees with [38] who reported that access to agricultural extension services improved farmers' use of organic fertilizers. Conversely, mobile phones had a negative influence on farmers' perception of organic farming. Mobile phones are a cheaper source of information, increase market participation, and have a positive impact on crop production [39]. Information sources had a significant and negative influence on farmers' perception of organic farming. Information sources that might portray organic farming negatively would result in negative perceptions for farmers, consequently affecting its adoption. However, the positive effect of information sources on knowledge and perceptions has been reported by other similar studies [12, 15, 16].

The use of manure had a significant effect on farmers' perceptions. This implies that when farmers own livestock and use manure as a source of fertilizer on their pineapple farms, there is a likelihood of having positive perceptions toward organic farming since chemical fertilizers are prohibited in organic systems. The use of agrochemicals is the other factor that had a significant effect on farmers' perceptions of organic farming. Organic farming prohibits the use of synthetic chemicals, so if a farmer uses them, the perception towards organic farming is also expected to be negative which decreases the likelihood of adopting organic farming. Other studies reported similar variables as determinants of farmers' perceptions of organic farming [13, 15, 16, 40].

5 Conclusion

The study examined pineapple farmers' knowledge and perceptions of organic farming and the determinants of pineapple farmers' knowledge and perceptions. Both organic and non-organic pineapple farmers were knowledgeable about organic farming and had positive perceptions of it. This is a good pre-condition for the development of organic farming

in the two districts and possibly the country at large. The key determinants of pineapple farmers' knowledge and perceptions of organic farming were farming experience, family size, information sources, farmer group membership, mobile phones, extension services, other income sources, and livestock ownership. Since some of these socioeconomic factors have implications on information access, farm productivity, and organic farming adoption, they need to be addressed institutionally by the government or support institutions such as the National Organic Movement (NOGAM) in Uganda. In addition, farmer groups and extension functionaries involved with organic farming need to provide adequate information on organic farming including organic livestock production. Women and youths should be encouraged to get actively involved when providing training on organic farming.

The suggestions of this study are the foundational recap of the knowledge and perceptions of organic farming in Uganda, using pineapple production in Kayunga and Luwero districts as a case study. Further research should note what should be precisely looked at to understand knowledge acquisition amongst organic farmers and the factors that affect farmers engaged in the production of other organic cash crops.

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Author contributions SN, FK, and FB conceived the study. SN, FK, FB, and MK developed study protocol including data collection tool and data collection strategy. SN was involved in field data collection activities. SN, MK, NK and AN conducted data analysis and interpretation. SN, MK, HK, NK, DN, VL, AN and JN were involved in the preparation of the manuscript. All authors contributed to the article and approved the submitted article.

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Data availability The dataset(s) supporting the conclusions of this article is (are) available from the corresponding author on reasonable request.

Code availability Not applicable.

Declarations

Ethics approval and consent to participate All methods were carried out in accordance with relevant guidelines and regulations. The study was approved by the School of Agricultural Sciences, Makerere University. Study participants provided their verbal informed consent before the interview.

Competing interests The authors declare no competing interests.

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