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Farmers' perception on excreta reuse for peri-urban agriculture in southern Ghana

Fred Nimoh[1]*, Kwasi Ohene-Yankyera[1], Kofi Poku[2], Flemming Konradsen[3] and Robert C. Abaidoo[4]

[1]Department of Agricultural Economics, Agribusiness and Extension, KNUST, Kumasi, Ghana.
[2]Department of Marketing and Corporate Strategy, School of Business, KNUST, Kumasi, Ghana.
[3]Department of Internal Health, Immunology and Microbiology, University of Copenhagen, Denmark.
[4]College of Agriculture and Natural Resources, KNUST, Kumasi, Ghana.

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Ghana lags behind the Millennium Development Goals' target for sanitation, despite widespread effort by the central government. Most households in peri-urban communities in Ghana lack improved sanitation facilities, and access to faecal sludge disposal sites is also problematic. This study investigates farmers' attitude and perception toward excreta reuse for peri-urban agriculture in Shai-Osudoku district, Ghana. Data were collected on 400 randomly selected respondents using questionnaires and focus group discussions. The study found that a majority of the respondents 'disagree' that excreta are a waste and are willing to use excreta as fertilizer, although a majority 'agrees' that excreta can pose health risks. Perceptions toward excreta reuse for agricultural purpose however differ among households. There is the need for more open discussions on the benefits and risks of excreta reuse in agriculture; this could help enrich farmers' knowledge on the appropriate use of excreta as fertilizer. Further research on the factors that influence farmers' decision to use excreta as fertilizer and their perceptions on the health risks is recommended.

Key words: Sanitation, excreta reuse, farmers' perception, peri-urban agriculture, Ghana.

INTRODUCTION

Most households in peri-urban communities in Ghana lack access to improved sanitation such as improved household latrines. According to the WHO/UNICEF Joint Monitoring Project (JMP), an improved toilet facility is one that hygienically separates human excreta from human contact, and includes: flush/pour-flush to piped sewer system, septic tank and pit latrine; ventilated improved pit latrine (VIP); and composting toilet (WSMP, 2009).

Anecdotal evidence suggests that the few public toilets in peri-urban communities in Ghana are being over-utilised and poorly managed. The sewer excreta systems, such as flush latrines, are rare due to the high costs and scarce water resources. Moreover, the demand for improved sanitation for most households in peri-urban communities may not be high until other needs such as housing, water, farming, and schooling are met (Card and Sparkman, 2010).

Studies have shown that households may benefit more

*Corresponding author. E-mail: frediemoh@yahoo.com / fnimoh.agric@knust.edu.gh

in their investments in improved sanitation if such investments offer tangible value to them, such as reuse of excreta as fertilizer for agricultural purpose (Jensen et al., 2005). Interestingly, sanitation service providers, such as pit-emptiers in peri-urban communities, have also indicated that there is lack of dumping sites for faecal sludge. Perceived as a waste and not as a resource by traditional sanitation (Gjefle, 2011), it is not surprising that some households are turned off immediately by the term 'faecal sludge' as it is usually considered as dirty, smelly and harmful substance, albeit the rich resource it provide in agriculture (IWMI, 2013).

Traditionally, human excreta have been used for crop fertilization in many countries including Japan, China and Sweden (Esrey et al., 1998). Farmers in China, South-East Asia and parts of Africa have used human excreta to fertilize fields and replenish the soil organic fraction (Timmer and Visker, 1998; Strauss et al., 2000). Empirically, many ancient Arab, Chinese, Greek, Roman and Spanish authors attest the benefits of human excreta manure (Thurston, 1992). Human excreta, like animal manure, are reported as good soil conditioner and a renewable source of plant nutrients, such as nitrogen, phosphorus and potassium (Drangert, 1998). Vinneras et al. (2006) have provided convincing evidence to support that crop yields resulting from the use of human manure are very high.

In Africa, although the use of human excreta is not widespread, some studies in the continent have attested the economic importance of the organic matter for agricultural purpose. In Uganda, for example, co-compost from faeces is used as fertilizer for various types of crops like bananas, pineapples, maize, cassava, sorghum, jackfruits and passion fruits (Müllegger and Freiberger, 2010). In Ghana, human excreta composts have been tested for its impact on the germination capacity and early growth of vegetables commonly grown in the urban and peri-urban areas (Cofie and Koné, 2009). Farmers in Ghana have also attested to the agronomic benefits of excreta, and users of excreta make three times the net income of non-users (Cofie et al., 2010).

Farmers and other stakeholders in Ghana seem to have inadequate knowledge on human excreta, despite the potential benefits for its reuse in agriculture. While this essential organic manure is considered as waste, the government spends scarce foreign exchange to import chemical fertilizers which are becoming more expensive (Cordell et al., 2009), due to the increasing demand for their use in peri-urban agriculture (Asare et al., 2003). Moreover, chemical/inorganic fertilizers have the potential to pollute both surface and ground water and can cause accumulation of heavy metals in the soil (Mariwah and Drangert, 2011). In addition, the quantum and persistent use of chemical fertilizers for agricultural production can cause serious health problems to producers and consumers. To minimise or alleviate the possible effects of chemical fertilizers use, there is the need for governments and other stakeholders, including farming households to consider ecological sanitation, a new paradigm in sanitation that recognizes human excreta as a resource that can be recovered, treated where necessary, and safely used again (WHO, 2006; Gjefle, 2011).

In considering human excreta reuse for agricultural purpose, it is also important to note that actual use of human excreta depends on people's attitude and perceptions (Mariwah and Drangert, 2011). Douglas (1966) maintains that 'dirt is matter out of place' and the same matter is viewed as dirt in some places and not dirt in the other. Gibson (1979) also appositely puts it that 'perceptions may determine people's behaviour, thus perception determines what we do next'. The aim of this study is to investigate peri-urban (farming) households' attitude and perceptions toward human excreta reuse for agricultural purpose in the Shai-Osudoku district in Ghana. This study is a part of the Sustainable Sanitation Ghana (SUSA-Ghana) project with a broader aim to expand access to improved sanitation facilities among peri-urban residents in Dangme West District, Ghana (http://susaghana.com).

Theory of knowledge, attitudes and perceptions

Information on the knowledge, attitudes and perceptions (KAP) of study participants is important for effective planning, implementation and evaluation of an intervention. The WHO (2008) asserts that a KAP's study can help identify knowledge gaps, cultural beliefs, or behavioural patterns that may facilitate understanding and action, as well as pose problems or create barriers for an intervention or adoption of a technology. Moreover, information that is commonly known and that are commonly held by study participants can also be identified. Furthermore, KAP to some extent, can help identify factors that influence behaviour that are not known to most people, the reasons for people's attitudes, and how and why people practise certain behaviours. Mariwah and Drangert (2011) confirm that the theory of planned behaviour is useful to a perception study because perceptions, like behaviour, are influenced by people's knowledge, beliefs, values, and norms. For instance, the more knowledgeable one is about human excreta, the clearer his/her opinion tends to be, and the stronger the feelings or perception. Similarly, being informed about an issue is even more likely to influence behaviour when knowledge is gained from first-hand experience (Fazio and Zama, 1981). This study, which employs the KAP's approach, is also corroborated by the ideas of Bieberstein (2012) who reports that people's perceptions of risk (for example health-related risks associated with human excreta reuse in agriculture)

related to food products are important determinants of food choices, their attitudes toward technologies used in the food and agricultural sector, as well as behaviour related to safety practices during food production. As observed by Wortman et al. (1992), it is assumed that knowledge about the importance of human excreta can help provide a better understanding and promotion behaviour consistent with beliefs and feelings of study participants like farmers.

METHODOLOGY

Study area

Peri-urban farming communities in Shai-Osudoku district (previously Dangme West district) in the Greater Accra region of Ghana constitute the study area. The study area was chosen as a convenience sample because it is peri-urban and form part of the research area for Dodowa Health Research Centre (DHRC), a partner institution of the SUSA-Ghana Project which provided funding for this study. The district is situated in the south-eastern part of Ghana, lying between latitude 5° 45' south and 6° 05' North and Longitude 0° 05' East and 0° 20' West. The total population of Dangme West is 122,836 persons (47.9% males and 52.1% females), representing about 0.50% of Ghana's total population and 3.06% of the Greater Accra region population (GSS, 2012). The average household size in the District is estimated at 5.2 persons. Agriculture, the dominant occupation, employs about 59% of the people, followed by trade (22.1%) and fishery (6.4%). Financial reports indicate that the highest contribution to internally generated revenue in the District comes from fees and fines, followed closely by business operating permits (http://www.ghanadistricts.com/districts). It is estimated that about 36 and 40% of households defecate in the beach and bush, respectively (SUSA Baseline Report, 2011).

Population, sampling and data collection

Crop farmers in the peri-urban farming communities of the study area constituted the population for this study. Using a household list from the District's Agriculture unit, the study employed a cross-sectional data collected in 2013 on 400 respondents who were randomly selected from purposively considered farming communities in the district: Dodowa (50), Henyum (21), Odumase (39), Adumanya (30), Ayikuma (100), Asebi (100), Abonya (30), Metase (10), Ziakpone (10) and Adumadzan (10). The communities were chosen on the reasons that they are major peri-urban agricultural areas and also form part of the research area of the DHRC, a partner institution of the SUSA-Ghana Project which provided funding for this study. In each selected household, the head or any other adult member who gave consent was interviewed with a survey questionnaire. The questionnaire for the study comprised three main sections: section one elicited household and farm data; section two captured data on respondents' knowledge on human excreta; and section three obtained data on respondents' attitudes and perceptions on excreta reuse for agricultural purpose. In addition, two focus group discussions (FGD) comprising male and female farmer-groups were conducted to complement the responses from the interviews. Consent was sought to tape-record the discussions of the FGDs. With the help of field assistants/interpreters, all the instruments were administered by the researcher in the local language, 'Dangme'.

Analysis of data

Descriptive tools such as frequencies and percentages were used to summarize the socioeconomic characteristics of the respondents. A three-point Likert-type scale ranging from 1 (Agree) to 3 (Disagree) was used to measure the respondents' knowledge and perceptions in their response to pre-set statements on human excreta and their reuse for agricultural purpose. The respondents were asked eight questions about their attitudes and perceptions toward human excreta. Ten statements were also used to assess farmers' knowledge about the use of excreta as fertilizer, as well as their decisions to use excreta as fertilizer. Prior to the interview, the researcher explained the purpose of the study and the possibility of using (sanitized) excreta in agriculture to the respondents. The significant differences between the mean responses of respondents' knowledge, attitudes and perceptions on excreta and their socioeconomic characteristics were assessed using the t-test and a one-way analysis of variance (ANOVA). The data from the FGDs were transcribed to support the quantitative findings from the individual household interviews.

RESULTS AND DISCUSSION

Socioeconomic characteristics of respondents

Table 1 presents the results of the socioeconomic characteristics of respondents. A majority (68%) of the respondents were men and had lived in the study communities for more than 10 years (about 90%). The average age of about 43 years of the respondents was found to be almost similar to the national average of 45 years for farmers in Ghana. A majority had basic education (73%; primary to JHS/MSLC[*]) and about 65% had a household size of at most five persons which is relatively low, implying that household family labour may not be adequate for farm activities. The average farm size of 0.62 ha was found to be relatively lower than the district and national average of 1.5 and 3.0 ha respectively (Shai-Osudoku District Assembly, 2006). The crops cultivated include: plantain, maize, cassava, yam, mango, watermelon, pineapple, and vegetables, mostly on rented plots (71%). A majority of the households earned GH¢400 (US$150) per month. The per capita income was GH¢117.67 (US$59.13) which is below the per capita gross national average monthly income of GH¢224.7 (US$124) (GSS, 2013). This modal monthly income which is positively skewed reflects a characteristic of that of most countries worldwide.

Farmers' attitude and perceptions toward excreta reuse in agriculture

This section presents the results and discussion on the respondents' knowledge, attitudes and perceptions on human excreta reuse for agricultural purpose.

[*] Junior High School/Middle School Leaving Certificate

Table 1. Socioeconomic characteristics of farmers.

Variable		Freq. (%)	Mean (SD)
Gender	Male	272 (68.0)	
	Female	128 (32.0)	
Age (years)	20-29	32 (8.0)	
	30-39	137 (34.2)	
	40-49	134 (33.5)	42.5 (10.9)
	50-59	62 (15.5)	
	60 and above	35 (8.8)	
Length of stay in community	Below 10 years	44 (10.5)	
	10-19 years	107 (26.8)	
	20-29 years	92 (23.0)	24.6 (14.2)
	30-39 years	87 (21.8)	
	40 and above	72 (18.0)	
Education	Tertiary (Univ./Poly/College)	18 (4.5)	
	Secondary (SHS/O'Level/A'Level)	58 (14.5) 161 (40.2)	
	Junior High/MSCL	134 (33.5)	
	Primary school None/no formal education	29 (7.2)	
Household size	5 and below	259 (64.8)	4.9 (1.8)
	6-10	141 (35.2)	
Household monthly income (GHS)	Below 500	219 (54.8)	488.73 (204.1) Mode (400)
	500-1000	177 (44.2)	
	Above 1000	4 (1.0)	
Land tenure system	Own land	61 (15.2)	
	Family land	57 (14.2)	
	Rented land	282 (70.5)	
Crops cultivated	Vegetables (pepper/tomato/onion)	93 (23.2)	
	Maize	184 (46.0)	
	Root/Tubers (cassava/yam)	106 (26.5)	
	Plantain	3 (0.8)	
	Fruits (mango/melon/pineapple)	14 (3.5)	
Farm size	Below 0.5 ha	179 (44.8)	
	0.5-1 ha	183 (45.8)	0.62 (0.28)
	Above 1 ha	38 (9.5)	

US$1.00 = GHS1.99 (May/June, 2013).

Households' attitude and perceptions toward human excreta

More than half of the respondents 'disagreed' that human excreta are waste and not a resource for agricultural production (Table 2). A majority (81%) however 'agreed' that handling human excreta can pose great health risk and for that matter human excreta should not be handled in any way (87%). The comments in the FGDs confirmed the respondents' diverse perceptions toward excreta. A participant in the women's FGD remarked: "Even when you go to toilet you will wash your hands before you do something and now you want to touch it (excreta)." Another participant with a contrary view said that: "It (excreta) came from you so you can touch it." In contrast, another participant said: "When we put cow dung on the floor you can pick it with your two hands but when we put human excreta there it will be a different thing". The facial

Table 2. Respondents' attitudes and perceptions toward human excreta.

Statement	Level of agreement (%)		
	A	DK	D
Human excreta are waste and suitable only for disposal	32.5	14.2	53.2
Human excreta are not resource for agricultural production	31.0	16.0	53.0
Human excreta have no (economic) benefit to humans	30.8	17.0	52.2
Toilet should not be built in/near the household's place of residence	34.8	5.0	60.2
Human excreta should not be handled in any way	87.0	4.8	8.2
Use of human excreta in agriculture is a great health risk	80.8	4.2	15.0
It is a taboo to touch faeces	21.5	7.0	71.5
It is a taboo to touch treated faeces	13.0	9.5	77.5

Note: A, agree (1); DK, don't know (2); D, disagree (3).

Table 3. Respondents' knowledge on utilization of human excreta in agriculture.

Statement	Level of agreement (%)		
	A	DK	D
Human excreta are a resource to the soil	61.5	27.0	11.5
Sanitized human excreta can be used as fertilizer	63.0	27.8	9.2
I will use human excreta on my crops if sanitized	62.5	26.8	10.8
Taste of crops will change when fertilized with human excreta	14.0	30.0	56.0
Smell of crops will change when fertilized with human excreta	12.0	31.0	57.0
Crops can be destroyed when fertilized with human excreta	11.0	32.2	56.8
Crops fertilized with human excreta are good for consumption	57.8	30.2	12.0
I will never consume crops fertilized with human excreta	12.0	31.0	57.0
Animal manure (faeces) can be used as fertilizer	90.5	6.2	3.2
Ever used human excreta as fertilizer on my farm	11.2	0.0	88.8

Note: A, agree (1); DK, don't know (2); D, disagree (3).

expression of a participant in the women's FGD provided evidence of a 'disagreeing' perception towards excreta. Considered as not a taboo (72%), a participant in the men's FGD remarked: "If you cannot touch faeces then you should not shit at all because sometimes you will touch it when you are wiping so it is not a taboo". Moreover, more than half of the respondents (60%) also 'agreed' that a household toilet should not be far from the place of residence; implying the necessity and importance of a household toilet.

Households' knowledge and perceptions on excreta reuse in agriculture

A number of studies have reported on the importance or otherwise of (sanitized) excreta and households' attitudes and perceptions toward the reuse of excreta as fertilizer (Asare et al., 2003; Cofie et al., 2004; Cofie and Koné, 2009; Cofie et al., 2010; Mariwah and Drangert, 2011). From Table 3, it can be observed that more than half of the respondents 'agreed' to the statement that human excreta are a resource to the soil and that sanitized excreta could be used as fertilizer, although only 11% of them had ever used excreta on their crops. A majority of the respondents 'agreed' to use (sanitized) excreta as fertilizer. This was corroborated by a participant in the men's FGD who remarked: "Yes it (excreta) is good for the soil, it is manure, and for example when there are faeces on the ground and crops germinate there, like tomatoes and water melon, they become very fresh and green". In addition, another participant said: "Even human excreta are better for crops than animal manure".

Moreover, more than half of the respondents 'agreed' to the statement that crops fertilized with human excreta are good for consumption. A participant in the women's FGD remarked that: "Yes, we can eat crops fertilized with excreta." This was supported by another woman who said: "The crop will change at maturity and you will not see any excreta, but the crop." Another respondent also said: "It is the food you eat which turns into toilet and when you harvest the crop you don't see the toilet on it so it will make the crop sweeter instead". A participant in the men FGD also remarked that: "Even the taste will be

better; you eat salt so the taste of the salt will go inside the crop and would even taste better". More than half of the respondents 'disagreed' to the statements that 'use of excreta as fertilizer can affect the smell and taste of crops, or can destroy crops'. A statement by a participant in the women's FGD corroborates the general view by the sampled respondents; she remarked: "No, excreta cannot destroy crops; even at the public toilet the cocoyam there are very fresh and we harvest kontomire (spinach) from there". In support of this statement, another participant said: "People defecate behind our house, and a tractor came to plough the land for farming, and the maize there looked nicer than using inorganic fertilizer". These findings show that the respondents were knowledgeable about the potential benefits of human excreta for agricultural purpose.

Perceptions on excreta reuse in agriculture by socioeconomic characteristics

Table 4 presents the mean responses of the respondents' overall attitudes and perceptions on human excreta by their socioeconomic characteristics with regard their value and decision to use excreta as fertilizer. The results of the study show that women were generally more negative to excreta than men. This is consistent with a report by Mariwah and Drangert (2011) who observed that women are more negative towards excreta than men. Perceptions on the value of excreta and decisions on excreta reuse for agricultural purpose by length of stay in the study communities, education, household income, type of crop cultivated and farm size were all significant at the conventional levels. Respondents with less experience in the study area were more likely to 'disagree' that excreta are a waste than those with more experience. In addition, younger people were more likely to 'disagree' that excreta are a waste and were willing to use it as fertilizer on their crops than the aged. This result concurs with the finding by Mariwah and Drangert (2011), although their result was not significant. It can be inferred from this results that younger farmers in the study area are more ambitious and ready to bear risk than elderly farmers.

The results also show that respondents with higher formal education were more likely to 'disagree' that human excreta are a waste and were more likely to 'agree' to use excreta for agricultural purpose than those with no formal education. Moreover, higher income earners were more likely to use excreta as fertilizer than lower income farmers. Land owners were also more likely to 'disagree' that excreta are waste and were more willing to use excreta as fertilizer than tenant farmers. Although inconsistent with the findings of Cofie et al. (2010) who observed that lack of ownership of land does not affect the decision to use excreta, it can be inferred from the results of this study that tenant farmers are more careful in their decision on the use of excreta on rented plots. Moreover, large-scale farmers were more likely to 'disagree' that excreta are a waste than small-scale farmers, and they were more willing to use excreta as fertilizer than small-scale farmers. This result concurs with the findings by Cofie et al. (2010) who reported that the high cost of inorganic fertilizers normally compels farmers to use alternative products (such as like excreta), particularly with increasing farm size. However, vegetable and fruit crop farmers were less likely to 'disagree' that excreta are a waste and were less willing to use excreta as fertilizer than as perceived by arable crop farmers. This result concurs with the findings by Cofie et al. (2010) that due to possible health risks, excreta are used mainly for maize production than for vegetables.

CONCLUSION AND RECOMMENDATIONS

This study investigated (farming) households' attitudes and perceptions toward human excreta reuse for agricultural purpose in the Shai-Osudoku district in Ghana. Data were collected in 2013 on 400 randomly selected respondents using questionnaires and focus group discussions. Using a three-point Likert-type scale and the t-test and ANOVA, respondents' knowledge and perceptions as well as the relationships between their perceptions and socioeconomic characteristics on excreta reuse for agricultural purpose were assessed. The study found that a majority of the respondents in the study communities 'disagree' that excreta are a waste and are willing to use excreta as fertilizer or to consume crops fertilized with excreta, albeit a majority 'agreeing' perception that excreta can pose health risks. The respondents' attitudes and perceptions toward excreta and their decision to use excreta for agricultural purpose however differ with respect to their socioeconomic characteristics. Since farming is the predominant occupation for the people in the study area, it is important that programmes aimed at promoting improved sanitation in those areas should consider alternative ecological sanitation systems such as the use of (sanitized) excreta in farming so as help improve crop yields at minimal cost. There is also the need for more open discussions on the benefits and risks associated with excreta reuse in agriculture; this could help enrich farmers' knowledge on the handling and appropriate use of excreta as fertilizer. Further research on the factors that influence farmers' decision on excreta reuse for agricultural purpose and perceptions on health risks is recommended.

Conflict of Interest

The authors have not declared any conflict of interest.

Table 4. Respondents' attitudes/perceptions on excreta by socioeconomic characteristics.

Variable	N	Human excreta are waste and suitable only for disposal			Will use (sanitized) human excreta in agriculture		
		Mean	SD	F/t-test Stat. (p-value)	Mean	SD	F/t-test Stat. (p-value)
Sex							
Male	272	2.29	0.88	t-test (0.010)**	1.44	0.67	t-test (0.078)*
Female	128	2.04	0.93		1.57	0.71	
Age (years)							
20-29	32	2.62	0.75	ANOVA (0.010)**	1.19	0.47	ANOVA (0.010)**
30-39	137	2.31	0.89		1.39	0.63	
40-49	134	2.13	0.91		1.55	0.71	
50-59	62	2.08	0.91		1.63	0.73	
60 and above	35	1.97	0.89		1.57	0.74	
Length of stay in community							
Below 10 years	42	2.76	0.62	ANOVA (0.000)***	1.07	0.26	ANOVA (0.000)***
10-19 years	107	2.46	0.85		1.34	0.66	
20-29 years	92	2.00	0.94		1.62	0.71	
30-39 years	87	1.93	0.89		1.69	0.70	
40 and above	72	2.11	0.88		1.51	0.69	
Education							
Tert. (Univ./Poly/College)	18	2.94	0.24	ANOVA (0.000)***	1.06	0.24	ANOVA (0.000)***
Sec. (SHS/O'/A' Level)	58	2.76	0.66		1.17	0.53	
Junior High/MSCL	161	1.93	0.91		1.65	0.73	
Primary school	134	2.20	0.88		1.46	0.63	
None/no formal education	29	2.24	0.87		1.59	0.78	
Household size							
5 and below	259	2.20	0.90	ANOVA (0.932)	1.48	0.67	ANOVA (0.996)
6-10	141	2.21	0.91		1.48	0.71	
Household income/mth (GH¢)							
Below 500	219	1.99	0.91	ANOVA (0.000)***	1.64	0.72	ANOVA (0.000)***
500-1000	177	2.47	0.83		1.30	0.59	
Above 1000	4	2.50	1.00		1.00	0.00	
Land tenure system							
Own land	61	2.56	0.79	ANOVA (0.002)***	1.15	0.44	ANOVA (0.000)***
Family land	57	2.28	0.90		1.40	0.62	
Rented land	282	2.12	0.91		1.57	0.71	
Crops cultivated							
Veg. (pepper/tomato/onion)	93	1.80	0.83	ANOVA (0.000)***	1.69	0.71	ANOVA (0.000)***
Maize	184	2.20	0.94		1.51	0.72	
Root/Tubers (cassava/yam)	106	2.60	0.74		1.23	0.52	
Plantain	3	2.67	0.58		1.67	0.58	
Fruits (mango/melon/pineapple)	14	1.93	0.92		1.64	0.63	
Farm size							
Below 0.5 ha	179	2.20	0.88		1.49	0.67	
0.5-1 ha	183	2.13	0.94		1.53	0.72	
Above 1 ha	38	2.66	0.67		1.21	0.47	

*** Significant at 1%; ** Significant at 5%; *Significant at 10%.

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