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Health Risk Perception on Excreta Reuse for Peri-urban Agriculture in Southern Ghana

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Abstract
Access to proper sanitation and disposal sites for faecal sludge is problematic in Ghana, particularly in peri-urban communities. Using a cross-sectional household-level survey data, this study investigates farmers' perceptions on the health risks of excreta reuse for peri-urban agriculture in Shai-Osudoku district in Ghana. It was found that a majority of the farmers 'disagree' that excreta are a waste and are willing to use excreta as fertilizer, albeit a majority 'agreeing' perception that excreta reuse can pose health risks. Empirical results from an ordered probit model show that the decision to use excreta as fertilizer is more related to perceptions on excreta as a resource rather than personal and farm characteristics. However, there is some relationship between personal and farm characteristics and perceptions on the health risks of excreta reuse for agricultural purpose. There is also a strong relationship between the perception that excreta are a waste and perceptions on the health risks of excreta reuse. Programmes aimed at promoting improved sanitation should consider the reuse potential of excreta in agriculture, as attested by the farmers as a resource for crop production. There is the need to educate farmers on how excreta could properly be handled and used in agriculture. Other policy options toward risk reducing strategies that involve relevant government institutions and the local media should also be considered to avoid any health hazards associated with excreta reuse in agriculture.
Keywords: Sanitation, Excreta reuse, Health risk perception, Peri-urban agriculture, Ghana

1. Introduction

Ghana has low coverage of improved sanitation[1], particularly in urban and peri-urban communities. The few public toilets in peri-urban communities in Ghana are overstretched and human excreta management is poor. The sewer excreta systems, such as flush latrines, are also rare due to the high costs and scarcity of water (Cofie *et al*., 2004). Moreover, access to disposal sites for human excreta (faecal sludge) is problematic. These conditions create a disincentive for owning a household latrine. Moreover, studies have shown that households may benefit more in their investments in improved sanitation if such investments offer tangible value to them such as the reuse of excreta in agriculture. Jensen *et al*. (2005) point out that (farming) households would probably accept improved sanitation technologies and hygiene promotional activities if they could be accommodated with the agricultural production system and be seen as offering an economic benefit. In that sense, the idea of excreta reuse for agricultural purpose could however provide an avenue for balancing food security and environmental health, particularly in peri-urban communities in developing countries like Ghana.

On the contrary, some households have biased attitudes toward human excreta reuse in agriculture, as they perceive excreta as a waste rather than as a resource by traditional sanitation (Gjefle, 2011). Moreover, some people are turned off immediately by the term 'faecal sludge' as it is usually considered as dirty, smelly and harmful substance (Douglas, 1966; IWMI, 2013). Jensen *et al*. (2005) also argue that the use of excreta can have severe negative health consequences. The negative attitudes and concerns about the environmental and health hazards of faecal sludge have however decreased the spreading of excreta on fields, in recent times (Malkki, 1999).

In Ghana, 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 agriculture (Asare *et al.*, 2003). Moreover, chemical fertilizers have the potential to pollute both surface and ground water and can cause accumulation of harmful heavy metals in the soil (Mariwa and Drangert, 2011). To minimise the possible health hazards with chemical fertilizers use in agriculture therefore necessitate a consideration of ecological sanitation, which is 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). This study aimed at investigating the factors that could influence farmers'

[1] The WHO/UNICEF joint monitoring project (JMP) defines an improved toilet facility as one that hygienically separates human excreta from human contact, and it includes: flush/pour-flush to piped sewer system, septic tank and pit latrine; ventilated improved pit latrine (VIP); and composting toilet (WSMP, 2009).

decision on excreta reuse as fertilizer, and their perceptions on the health risks associated with excreta reuse for agricultural purpose in Shai-Osudoku district in southern Ghana. The study hypothesized that household and farm characteristics, as well as farmers' knowledge and attitudes toward excreta influence their decisions and health-risk perceptions on excreta reuse for agricultural purpose.

2. Excreta Reuse for Agricultural Purpose

Human excreta are a valuable nutrient source, and their use in agriculture could help ensure sustainable development (Malkki, 1999; IWMI, 2013). Excreta reuse in agriculture is considered a sound practice for several reasons: as cheap fertilizer; as a good soil conditioner; and as an integral part of nutrient recycling in different types of integrated farming systems (Jensen *et al*., 2005). 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). Vinneras *et al*. (2006) provide convincing evidence that crop yields resulting from the use of human manure are very large. Drangert (1998) also confirm that human excreta, like animal manure, are good soil conditioner and a renewable source of plant nutrients such as nitrogen, phosphorus and potassium.

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 in agriculture. In Burkina Faso, for example, excreta are used as fertilizer for mango trees (Jönsson *et al*., 2004). In Uganda, co-compost from faeces is used as fertilizer for various types of crop production like bananas, pineapples, maize, cassava, sorghum, jackfruits and passion fruits (Müllegger and Freiberger, 2010). In Ghana, human excreta compost has 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).

3. Methodology

3.1 Study Area

Peri-urban farming communities in Shai-Osudoku district (*formerly* Dangme West district) in the Greater Accra region of Ghana form 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 collaborator institution of the SUSA-Ghana Project which provided funding for this study. The district is situated in the south-eastern part of Ghana, between latitude 5° 45' south and 6° 05' North and longitude 0° 05' East and 0° 20' West. The total population is about 96,809 persons (48.2% males and 51.8% females), representing about 3.3% of Ghana's total population and an estimated growth rate of 2.1% per annum (http://www.ghanadistricts.com/districts). Agriculture is the dominant occupation which employs about 59% of the people, followed by trading is next (22.1%) and fishing (6.4%). Financial reports indicate that the highest contribution to internally generated revenue in the district is from fees and fines, followed by business operating permits.

3.2 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 proportionately and randomly sampled from selected 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 of been peri-urban and part of the research area for DHRC. 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 on personal, household and farm data; section two for data on farmers' knowledge and perceptions on excreta reuse for agricultural purpose; and section three for data on constraints to excreta reuse as fertilizer. All the instruments were administered by the researcher in the local language, '*Dangme*', with the help of field assistants and interpreters.

3.3 Analysis of Data

Both descriptive and inferential methods were employed for data analysis and reporting. Descriptive tools such as frequencies and percentages were used to summarize the data on the respondents' socioeconomic characteristics and their perceptions on excreta reuse. A three-point Likert-type scale ranging from 1 (Agree) to 3 (Disagree) was used to measure the respondents' knowledge and perceptions in their responses to pre-set statements on excreta reuse and perceptions on health-related risks of excreta reuse in agriculture. The constraints to excreta reuse were examined with the Kendall's Coefficient of Concordance (*W*) (Mattson, 1986). The factors that influence farmers' decisions and perceptions on the health risks associated with excreta reuse in agriculture were estimated using the ordered probit model.

3.4 Econometric Model on Farmers' Perception on Excreta Reuse

Following Greene (2008), an ordered probit model was used to examine the factors that influence the farmers' decisions to use excreta as fertilizer as well as their perceptions on the health risks of excreta reuse. The dependent variables were categorized as 0, 1 and 2, corresponding to 'disagree', 'neutral' and 'agree', respectively on farmers' decisions and perceptions on health risks of excreta reuse. The model, based on the latent regression function, was specified as: $Y_i^* = \beta' X_i + \varepsilon_i$, where Y_i^* is the exact but latent dependent variable (decisions and health risks perception) of the i respondent, X_i is a vector of explanatory variables influencing respondents' decisions and perceptions, β' is a vector of parameters to be estimated, and ε_i is a random error term assumed to be standard normal distributed. Since Y_i^* is latent it is unobserved, but what is observed is the classified category Y as follows:

$$Y = \begin{cases} 0, & if \quad Y_i^* \le \mu_1 (Disagree) \\ 1, & if \quad \mu_1 < Y_i^* \le \mu_2 (Neutral) \\ 2, & if \quad Y_i^* > \mu_2 (Agree) \end{cases}$$

where μ_1 and μ_2 are the classifying threshold values. The associated probabilities with the classifying categories of the ordered probit model can be specified as:

$$\Pr(Y = 0 | x, \beta) = \Phi((u_1 - x'\beta))$$
$$\Pr(Y = 1 | x, \beta) = \Phi((u_2 - x'\beta)) - \Phi(u_1 - x'\beta)$$
$$\Pr(Y = 2 | x, \beta) = 1 - \Phi(u_2 - x'\beta)$$

where Y is an alternative response, x is a set of explanatory variables, β is a vector of parameters to be estimated, and Φ is the standard normal cumulative distribution function which ensures that the predicted outcome of the model always lies between 0 and 1. The z-statistics provide the significance of the estimated individual βs in the model by testing the null hypothesis $H_0 : \beta_i = 0$, thus the estimated coefficient of the ith variable is zero. If H_0 is rejected as a result of the z-statistic, we conclude that the variable significantly affects the farmers' decision and perception on health risks with excreta reuse for agricultural purpose.

The direction of the effect of a change in x_j depends on the sign of the β_j coefficient. However, the estimated coefficients cannot be interpreted as the marginal effects of the independent variable, as β_j is weighted by the factor Φ, thus the normal density function which depends on all the regressors. An interpretation of the effect of the explanatory variables however requires a consideration of the marginal effects, which is specified as:

$$\partial \Pr(Y = 0 | x', \beta) / \partial x = -\beta \Phi(u_1 - x'\beta)$$
$$\partial \Pr(Y = 1 | x', \beta) / \partial x = -\beta((\Phi((u_2 - x'\beta)) - \Phi(u_1 - / x'\beta))$$
$$\partial \Pr(Y = 2 | x', \beta) / \partial x = \beta \Phi(u_2 - x'\beta)$$

Thus, the sign of β_j shows the direction of change in the probability of *Y* with a change in x_j. *Pr(Y=0)* changes in the opposite direction of the sign of β_j, while *Pr(Y=2)* changes in the same direction as the sign of β_j. A positive coefficient in the model may therefore be interpreted as meaning that the corresponding variable has a potential to raise the predictive probability of 'agreeing' decision and perception on excreta reuse, thus (*Pr(Y=2).*

This study presents the results of the marginal effects of the explanatory variables to ease interpretation and discussion.

3. Results and Discussion

3.1 Socioeconomic Characteristics of Respondents

The descriptive statistics of the variables relating to the respondents' socioeconomic characteristics and their perceptions toward excreta reuse investigated in the study are presented in Table 1. 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 (74%; primary to JHS/MSLC[1]) and about 65% had a household size of at most five persons which is relatively low, hence implying that household family labour may not be adequate for farm activities. The average farm size of 0.62 hectares was found to be relatively lower than the district and national average of 1.5 ha and 3.0 ha respectively http://www.ghanadistricts.com/districts. The major crops cultivated were vegetables, maize and root and tubers (cassava and yam), mostly on rented plots (71%). The mean monthly income was GH¢488.73 (US$183). A majority of the households earned GH¢400 (US$150) per month which is above the per capita gross national average monthly income of GH¢224.7 (US$124) (GSS, 2013). The modal monthly income which is positively skewed reflects a characteristic of that of most countries worldwide.

Table 1: Variable definition and sample statistics

Variable	Variable definition	Mean	SD
Dependent variables			
HE_useAGRIC	Respondents' decision to use excreta for agricultural purpose	1.48	0.68
HE_HlthRISK	Respondents' perception on health risks of excreta reuse	1.34	0.73
Explanatory variables			
Gend_M	1 if male, 0 otherwise	0.68	0.47
Age	Age of respondent (years)	42.5	10.9
LengthStay	Length/duration of stay in community (years)	24.6	14.2
HHSize	Household size	4.9	1.8
FarmSz	Farm size (ha)	0.62	0.28
HH_Income	Average monthly income (in GH¢)	488.73	204.10
Educ_TERT	1 if highest education level is tertiary, 0 otherwise	0.05	0.21
Educ_SEC	1 if highest education level is secondary, 0 otherwise	0.14	0.35
Educ_BASIC	1 if highest education level is basic, 0 otherwise	0.74	0.44
OwnLAND	1 if respondent cultivates crops on own land, 0 otherwise	0.15	0.36
RentLAND	1 if respondent cultivates crops on rented land, 0 otherwise	0.71	0.46
VEG_Crop	1 if respondent cultivates vegetables, 0 otherwise	0.23	0.42
MAIZE_Crop	1 if respondent cultivates maize, 0 otherwise	0.46	0.50
R&T_Crop	1 if respondent cultivates root & tuber crops, 0 otherwise	0.26	0.44
HE_Waste	1 if respondent perceives excreta as waste, 0 otherwise	0.32	0.47
HE_Resource	1 if respondent perceives excreta as a resource, 0 otherwise	0.61	0.49
HE_ HlthRisks	1 if respondent perceives excreta as health risks, 0 otherwise	0.81	0.40
HE_UseBf	1 if respondent has used excreta as fertilizer before, 0 otherwise	0.11	0.32
ANIM_Manure	1 if respondent has used animal manure before, 0 otherwise	0.90	0.29

US$1.00 = GH¢1.99 (May-June, 2013). *Source*: Computation from field data, 2013

3.2 Perceptions toward Excreta Reuse for Agricultural Purpose

This section presents the results and discussion on the respondents' perceptions and decisions to use excreta for agricultural purpose.

3.2.1 Farmers' Attitude and Perception toward Excreta Reuse

The attitudes and perceptions of the respondents toward excreta reuse were assessed using seven pre-set statements (Table 2). Prior to the interview, the researcher explained the purpose of the study and the possibility of using (sanitized) excreta in agriculture. The results of the study show that more than half of the respondents 'disagreed' that human excreta are a waste. Moreover, a majority 'agreed' to the statement that human excreta are a resource to the soil and were willing to use excreta as fertilizer, although only 11% of the respondents had ever used excreta as fertilizer before. Tsiagbey *et al*. (2005) also noted that a majority of households in peri-urban and urban communities in Ghana perceive excreta reuse as positive towards achieving household food security. However, a majority (81%) of the farmers had an 'agreeing' perception that handling and using excreta

[1] Junior High School/Middle School Leaving Certificate

can pose health risks, and for that matter excreta should not be handled in any way (87%).

Table 2: Respondents' knowledge on utilization of human excreta in agriculture

Statement	N	Level of agreement (%)		
		A	DK	D
Human excreta are waste and suitable only for disposal	400	32.5	14.2	53.2
Human excreta are a resource to the soil	461	61.5	27.0	11.5
Sanitized human excreta can be used as fertilizer	461	63.0	27.8	9.2
I will use human excreta on my crops if sanitized	461	62.5	26.8	10.8
Ever used human excreta as fertilizer on my farm	461	11.2	0.0	88.8
Handling/use of human excreta is a great health risk	400	80.8	4.2	15.0
Human excreta should not be handled in any way	400	87.0	4.8	8.2

N, total sample; A, agree (1); DK, don't know/neutral (2); D, disagree (3)
Source: Computation from field data, 2013

3.2.2 Constraints to Excreta Reuse

Certain that not all the respondents were willing to use human excreta as fertilizer (Table 2), it was necessary to examine the factors that constrain their decisions on excreta reuse as fertilizer. As shown in Table 3, the respondents' perception on the health risks of excreta reuse was identified as the most important factor that influence the decision to use excreta as fertilizer. A test of the significance of *W* (0.318) among the respondents was significant at 1%, indicating that the respondents unanimously agree in the order of ranking of the constraints that influence the decision to use excreta as fertilizer. This result concurs with the findings by Cofie *et al.*, (2010) and Mariwa and Drangert (2011) who indicate that although farmers consider excreta as a resource in agriculture, the most important factor that prevents them from using excreta as fertilizer is the perception on the health risks associated with excreta reuse. Besides, a majority (81%) of the sampled respondents 'agreed' that excreta reuse can pose health risks (Table 2).

Table 3: Ranking of constraint affecting excreta reuse in agriculture

Variable	Mean rank	Overall rank
Health risk	1.99	1
Appearance of crop may be affected	2.89	2
Smell/aroma of crop may be affected	3.23	3
Consumers may not buy my crop	3.85	4
Taste of crop may be affected	3.96	5
Religious belief of respondent	5.07	6
Kendall's **W: 0.318**; Chi-square: 448.34; df.: 5; Asymp. Sig.: 0.000; N = 282		

Source: Computation from field data, 2013

3.3 Empirical Estimates of Farmers' Perception on Excreta Reuse

The previous section reported on the respondents' attitude and perceptions toward excreta reuse and the factors that constrain their decision to use excreta as fertilizer. This section presents the empirical results of the factors that influence the respondents' decision to use excreta as fertilizer and their health risks perceptions on excreta reuse.

Using the maximum likelihood approach, an ordered probit model was estimated, and the marginal effects which measure the impact of the likelihood of the respondents' decision to use excreta as fertilizer and the health risks' perception on excreta reuse are presented in Table 4. The dependent variables used in the regression models represent farmers' decision to use excreta as fertilizer (HE_useAGRIC) and their health-risks perception (HE_HlthRISK) indicators ranked into three coded responses (Table 1). The explanatory variables included personal and household characteristics and respondents' perceptions on excreta reuse. Other statistics presented based on the estimates include the *z*-value, McFadden R^2 and the log-likelihood statistics.

The empirical results of the study show that the coefficient of the variable representing perception on excreta as a resource has a positive effect on farmers' decision to use excreta as fertilizer (Table 4). This was significant at 1%, implying that the perception on excreta as a resource increases the decision to use excreta as fertilizer by 83%. Moreover, Malkki (1999) argue that human excreta are a valuable source of nutrients which should be used in agriculture for sustainable development, instead of ending up in water bodies which pollute the environment. Although not significant, the results show that the coefficient of the variables representing age, length of stay in the study area, household size, farm size and perception on the health risks of excreta reuse have negative effects on the 'agreeing' decision to use excreta as fertilizer. However, income, education, cultivation on own land and experience with excreta reuse have positive effects on the 'agreeing' decision to use excreta as fertilizer, albeit

the variables were statistically insignificant at the conventional levels. The results suggest that respondents with higher income and higher education do not perceive the health risks with excreta reuse as a problem, and would therefore use excreta as fertilizer. It also implies that higher educated individuals are more enlightened and knowledgeable about the handling of excreta, and would value excreta as a resource and therefore use as fertilizer.

The results of the factors that influence the perception on health risks with excreta reuse show that the coefficient of variables representing length of stay in the study area, household size, income, use of rented land for production and perception that excreta are a waste were all significant at the conventional levels. Specifically, it was found that length of stay in the study area, household size, use of rented land for production and perception that excreta are a waste have positive effects on 'agreeing' perception that excreta reuse can pose health risks. The results show that each additional year of stay in the study area increases the 'agreeing' perception of the health risks associated with excreta reuse by 0.4%. This implies that the experience of the farmer in the study area could marginally influence farmers' perception on health risks of excreta reuse. Similarly, households with more members are 2.1% positive to have an 'agreeing' perception that excreta reuse can pose health risks. Handling of excreta can cause severe health hazards (Jensen *et al*., 2005); household members may therefore be at risks of contagious diseases with excreta reuse. Moreover, the respondents who operate on rented land are 13.9% positive to have an 'agreeing' perception that excreta reuse can pose health risks. This implies that tenant farmers are more risk averse than landowners. Furthermore, the perception that excreta are a waste increases the 'agreeing' perception of the health risks associated with excreta reuse by 20%. This result corroborates the argument by Douglas (1966) that 'dirt is matter out of place'; implying that the perception that excreta are a waste influences farmers' perception on excreta reuse for agricultural purpose.

Conversely, higher-income households are 0.02% negative to have an 'agreeing' perception that excreta reuse can pose health risks. This implies that the farmers' perceived economic benefits tend to marginally override their perceptions on the health risks associated with excreta reuse for agricultural purpose. Moreover, Cofie *et al.* (2010) point out that farmers know the associated health risks of excreta reuse, but the agronomic benefits tend to make them want to use excreta in agriculture. Experience with excreta reuse in agriculture also has a negative effect on the 'agreeing' perception that excreta reuse can pose health risks, albeit statistically insignificant. However, the type of crop cultivated has a positive effect on the 'agreeing' perception that excreta reuse can pose health risks, albeit also not statistically significant.

Table 4: Marginal effects of ordered probit estimates of farmers' decision to use excreta and perception on health risks

Variables	HE_useAGRIC			HE_HlthRISK		
	Coefficients	Std. Error	*z*-Value	Coefficients	Std. Error	*z*-Value
Gend_M	0.0301	0.0558	0.54	0.0432	0.0424	1.02
Age	-0.0037	0.0031	-1.18	-0.0028	0.0018	-0.52
LengthStay	-0.0037	0.0024	-0.91	0.0037**	0.0015	2.50
HHSize	-0.0081	0.0160	-0.51	0.0207**	0.0101	2.05
FarmSz	-0.1649	0.1718	-0.96	-0.0681	0.0860	-0.79
HH_Income	0.0003	0.0002	1.48	-0.0002**	0.0001	-2.29
Educ_TERT	0.1259	0.1617	0.78	-0.1343	0.1512	-0.89
Educ_SEC	0.0084	0.1218	0.07	-0.0718	0.1027	-0.70
Educ_BASIC	0.0727	0.0964	0.75	-0.0218	0.0668	-0.33
OwnLAND	0.1232	0.0894	1.38	0.0367	0.0509	0.72
RentLAND	-0.0246	0.0792	-0.31	0.1385**	0.0657	2.11
VEG_Crop	-0.0477	0.0809	-0.59	0.0291	0.0492	0.59
MAIZE_Crop	-0.0231	0.0781	-0.30	0.0441	0.0430	1.02
HE_UseBf	0.1306	0.0835	1.57	-0.0707	0.0606	-1.17
HE_Resource	0.8314***	0.0347	23.95			
HE_HlthRisk	-0.1056	0.0664	-1.59			
HE_Waste				0.2010***	0.314	6.42
	Pseudo-R^2, 0.5378; Log-likelihood, -163.83; LR chi2(16), 381.33; Prob > chi2, 0.0000; Observations, 400			Pseudo-R^2, 0.1895; Log-likelihood, -191.755; LR chi2(15), 89.65; Prob > chi2, 0.0000; Observations = 400		

*** Sig. at 1%; ** Sig. at 5%. *Source*: Computation from field data, 2013

5. Conclusion and Recommendations

This study investigated farmers' perceptions on the health risks of excreta reuse for peri-urban agriculture in Shai-Osudoku district in Ghana. Household survey data were collected in 2013 on 400 proportionately and randomly selected respondents using questionnaires. A three-point Likert-type scale was used to examine the respondents' knowledge and perceptions on excreta reuse in agriculture. The constraints to excreta reuse were examined using the Kendall's Coefficient of Concordance. The socioeconomic factors and other perception variables that influence the farmers' decision to use excreta as fertilizer as well as their perceptions on the health risks of excreta use were examined with the ordered probit model.

The study found that a majority of the sampled farmers 'disagree' that excreta are a waste and are willing to use excreta as fertilizer, albeit a majority 'agreeing' perception that excreta can pose health risks. It was found that the farmers' decision to use excreta as fertilizer is more correlated with their perceptions on excreta as a resource rather than their personal and farm characteristics. However, the perception on the health risks of excreta reuse for agricultural purpose is more related to a farmer's experience in the study communities, household size, income, use of rented land for production and perception that excreta are a waste. Clearly, experience in the communities, household size, operating on rented land and perception that excreta are waste tend to positively influence farmers' perception that excreta reuse can pose health risks, while income has a negative influence. The study recommends that programmes aimed at promoting improved sanitation should consider the reuse potential of excreta in agriculture, as attested by the farmers as a resource for crop production. There is the need to educate farmers on the proper handling and use of excreta in agriculture. Other policy options toward risk reducing strategies that involve relevant government institutions and the local media should also be considered to avoid any health risks associated with excreta reuse in agriculture.

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