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On-farm urban vegetable farming practices and health risk perceptions of farmers in Kumasi

Abdul Wahid Arimiyaw · Kabila Abass · Razak M. Gyasi

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Abstract The paper examines risk perceptions of urban and peri-urban vegetable farmers in relation to their on-farm activities. The study involved 66 in-depth interviews with vegetable farmers from four farming sites in urban and peri-urban Kumasi using interview guide and systematic observations. Relevant data were analysed thematically using NVivo 9 analytical software. Findings show that most vegetable farmers used contaminated water for irrigation and also applied fertilizers and pesticides to crops without any regulations. While these practices are potential health threats to both farmers and the unsuspecting public, the farmers perceived it otherwise and demonstrated lack of knowledge of the harmful health effects of these chemical compounds and the wastewater utilised. The paper argues that the current vegetable farming practices in the study communities are consequences of farmers' low risk perception, which is shaped by socio-economic, political and cultural circumstances. Effective monitoring by environmental health agencies, coupled with sustained public education and campaigns on the potential health risks of unsafe farming practices could engender acceptable behavioural change among farmers.

Keywords Farming practices · Health risk perception · Vegetables · Kumasi · Ghana

A. W. Arimiyaw · K. Abass (✉)
Department of Geography and Rural Development, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana
e-mail: wahidarim@gmail.com

K. Abass
e-mail: abakabila@yahoo.com

R. M. Gyasi
African Population and Health Research Center (APHRC), Nairobi, Kenya
e-mail: RGyasi@aphrc.org

Introduction

Urban agricultural activities have been on the rise largely as a result of the important role they play in maintaining a resilient urban economy and livelihood (Nel et al. 2017). However, most urban and peri-urban areas are water-stressed, particularly in low-income countries. Consequently, wastewater has almost always become an alternative to conventional water for irrigation in these settings (Drechsel and Seidu 2011). This becomes a 'moral panic' when wastewater has generally been identified to harbour excreta-related pathogens such as *Escherichia coli* and *Salmonella*, skin irritants and heavy metals (Amoah et al. 2007) and, therefore, considered harmful and a threat to human health (Prosser and Sibley 2015).

Typically, irrigation practices among most urban vegetable farmers in Ghana rely on, contaminated microbial water sources which makes the produce somewhat unsafe for human consumption (Abass et al. 2016, 2017). Several studies have reported the association between contaminated vegetables and the transmission of diarrhoea in Ghana (Fung et al. 2011). Studies have shown the possibility of internalisation of pathogens in vegetable leaves arising from wastewater use for vegetable cultivation which, may put consumers' health at risk (Donkor et al. 2010).

Beside wastewater irrigation practices, there are problems with the use of pesticides. In many richer countries, the use of pest-killing compounds is strictly regulated with enforcement mechanisms put in place for their safe use and handling (Glover-Amegor and Tetteh 2008; Matthews et al. 2011; WHO 2011). The control mechanisms also ensure that any decision for approval of these pesticides for the sale and use is made based on scientific information about their safety to human health and the larger environment (Glover-Amegor and Tetteh 2008; Handford et al. 2015). However, pesticide importation and use in most low-income countries often remain largely unregulated (Glover-Amegor and Tetteh 2008; Matthews et al. 2011; WHO 2011). Besides, studies have reported that farmers in these contexts often face greater risks of exposure due to the use of toxic chemicals that are banned or restricted in advanced countries. Indeed, evidence show that incorrect pesticides application techniques, poorly maintained or totally inappropriate spraying equipment, inadequate storage practices have also resulted in negative health outcomes (Barraza et al. 2011; Damalas and Eleftherohorinos 2011; Williamson et al. 2008). Research conducted for the past decade in Ghana and elsewhere point to the presence of pesticide residues in a number of vegetables such as lettuce, cucumber, onions, cabbage, pepper, okra, among others. Pesticide residues do not only constitute a possible danger to soil microflora, their toxic effects in humans are manifested when bio-accumulation occurs along the food chain after initial plant uptake (Al-Wabel et al. 2011; Armah 2011). Unregulated use of pesticides in urban and peri-urban vegetable farming has shown negative health effects on the farmers such as impotency and sterility (Amoah et al. 2006; Mensah et al. 2001). Research in Ghana indicated dithane, unden, lindane and karate as the most commonly used pesticides by vegetable farmers. Despite the hazardous nature of lindane leading to its ban in several other countries, the chemical is still distributed and used among Ghanaian vegetable farmers (Glover-Amegor and Tetteh 2008).

Several studies have examined farmers' risk perceptions of the use of wastewater and pesticides in urban agriculture (Karg and Drechsel 2011; Keraita et al. 2010; Ntow et al. 2006; Obuobie et al. 2014; Ouedraogo 2002). In Ghana, for example, poor risk perceptions of farmers on wastewater irrigation have been observed (Keraita et al. 2010; Obuobie et al. 2014). Obuobie et al. (2014) reported in Accra, Ghana that over 71% of studied farmers lacked knowledge about the actual risk to themselves and to consumers. The authors argue that the low risk perception of these farmers ought to be understood in the context of the general living conditions of these farmers. Like most city dwellers, they are beset daily with many potentially health-affecting conditions such as unclean living condition and associated ailments which are routine parts of their lives. It is thus difficult in this context to elevate a single risk factor over others. Research has shown that awareness does not necessarily translate into behavioural change (Keraita et al. 2010). In situations where farmers showed awareness of the potential health risks of using polluted water sources, they perceived such risks to be low and willing to accept these risks because of the economic benefits from using polluted water and the unavailability of other water sources (Keraita et al. 2010). Low health risk perception has also been reported by Ouedraogo (2002). But a similar study in Nairobi showed farmers having higher levels of both subjective and objective knowledge combined with higher levels of perceived risks (Lagerkvist et al. 2013).

Health risk perceptions study of vegetable farmers is essential for mitigating the effect of bad farming practices. In the view of Stewart-Taylor and Cherries (1998), risk perception influences how risks are managed and the consequence of exposure to risks. While existing works (e.g. Keraita et al. 2008, 2010; Keraita and Drechsel 2015; Ntow et al. 2006; Obuobie et al. 2014) have extended technical studies on risks associated with wastewater and pesticide use, employing natural science-based risk analysis approach, their theoretical foundations are weak. Indeed, these works have generally overlooked the importance of contextual or socio-cultural factors in risk studies which limit their policy relevance. In the current work, risk is viewed as a social construct, in which an acceptable risk is not borne out of an objective scientific measurement but one that is socially accepted (Boudia and Jas 2007). It shows how risk perceptions are filtered by socio-cultural meanings and transmitted via social groups and relations (Barraza et al. 2011). Vegetable farmers' actions and views have been examined from social risk theoretical perspective in order to understand why some risks are ignored in their farming operations. It identified how attitudes, beliefs, practices and perceptions of respondents are embedded in the social, economic and cultural contexts of populations. This study, therefore, builds on the existing risk perception studies.

Theoretical framework

Urban vegetable farming involves a number of decisions including type and method of application of manures; sources of water for irrigation and the choice of appropriate irrigation method; and selection, timing and mode of application of pesticides. These and many other decisions can be examined from different theoretical perspectives.

Central to this study is the theory of risk perception which has been employed by previous researchers to examine or evaluate related studies (Abass et al. 2017, 2018). According to Slovic (1987), risk perception refers to the intuitive risk judgements of individuals and social groups in the context of limited and uncertain information. These judgements may vary between individuals due to different levels of information and uncertainty, different intuitive behaviour, and specific power constellations as well as positions of interest (Messner and Meyer 2006). Perception thus acts as a filter through which the decision-maker views the 'objective' environment. Faced with the complexities of natural and human systems, for which there is an imperfect knowledge base, the decision maker inevitably has to seek an optimum, rather than ideal outcome. Within this broad theory are specific theoretical perspectives such as bounded rationality, cognitive, knowledge and cultural theories.

Simon (1957) introduced the concept of bounded rationality and pointed out that in view of the enormous complexity of the decision tasks confronting firms and consumers, optimisation transcends human cognitive ability (Selten 1990). Beyond its original application, the concept simply suggests that the choices and decisions people make are influenced by their knowledge and experience (Smith 2001). It assumes that in decision-making, the rationality of an individual is constrained by the information available to them, the cognitive limits of their minds and the finite amount of time available to them in the decision-making process (Selten 1990).

Risk perceptions may vary from person to person due to some cognitive biases that make some individuals to perceive less risk. Some scholars have argued that individuals' decision process, particularly a greater susceptibility to cognitive biases, may lower their perception of risk (Busenitz and Barney 1997; McCarthy et al. 1993). Individuals take actions that may have undesirable consequences because of their low risk perception (Kahneman and Lovallo 1993; MacCrimmon and Wehrung 1990). Where individuals evaluate situations that are identical, some people will draw conclusions that it is very risky, whereas others may have a contrary view (Simon et al. 2000).

Related to the preceding concept is the knowledge theory, which is based on the notion that people perceive things or actions to be dangerous because they know them to be so (Wildavsky and Dake 1990). Knowledge of a health threat seems to be the most obvious prerequisite for the motivation to replace a risky behaviour (Renner and Schupp 2011). Lack of awareness of the risky nature of one's actions may not lead to the motivation required for risky behavioural change.

The cultural theory of risk interrogates social and cultural construction of risk (Douglas and Wildavsky 1982). In this context, risk perception is influenced by culturally determined intricate set of factors including risk source attributes, worldviews or values, occupation or profession, ethnicity as well as demographic, socio-economic and cultural background of individuals (Bang 2008; Peters and Slovic 1996; Rohrmann 1994). The view taken by a community in which one lives and the experience that an individual has regarding a particular hazard, may affect his or her risk perception (Garvin 2001). Relating this to vegetable farming, farmers may see no problem with the use of polluted stream for irrigation if the community widely endorses that action and sees nothing wrong with it.

From the lens of political ecology of disease, Nyantakyi-Frimpong et al. (2016) noted that, it will be difficult to understand the decisions and behaviours of urban farmers without considering the social history and political-economic contexts within which farming takes place. In their view, farmers' decision to irrigate with wastewater cannot be attributed simply to ignorance, but rather, to social forces far removed from farmers' everyday lives, including historical factors that have created inadequate water supply.

Risk perception is also affected by the risk target (Sjoberg 2000); be it the individual, kin, neighbours or acquaintances. The degree of social familiarity of the potential victim may in a way affect both the intensity of perceived risk and the type of actions taken to avoid and minimize the threat. For example, risk perceptions are likely to be more intense when they involve one's immediate family and less so about the general public (Kirschenbaum 2005). Besides, perceived food health risk is influenced by immediacy of health consequences (Lagerkvist et al. 2013). As Frederick et al. (2003) argued, risk will be easier to visualise if the potential consequences of a health hazard are closer in time. By extension, vegetable farmers will continue to engage in risky farming practices probably because the health consequences of their actions on themselves and consumers may take a long time to manifest.

Another way of explaining why people act in a particular and always the same way is related to the theory of habit formation. Habits are automatic responses to contextual cues or situations, acquired through repetition of behaviour in the presence of these cues (Lally et al. 2010). Habitual behaviours are elicited with minimal prior deliberation and persist as long as the cues continue to be encountered (Lally et al. 2010; Verplanken and Wood 2006). In this respect, old habits, which may not necessarily be appropriate, become difficult for individuals to disengage from. Thus, farmers who are used to a particular way of farming may be less receptive to change. It is within these theoretical perspectives that the vegetable farming practices and health risk perceptions of farmers have been examined.

Methods

Research design and context

A cross-sectional qualitative study design was employed which provided a snapshot of farmers' perceptions and other characteristics in a population at a given point in time (Levin 2006). The qualitative approach was useful to study farmers' health risk perceptions as it afforded the researchers the opportunity to elicit rich information on their lived experiences (Williams 2011). This allowed for a better understanding of the participants' behaviour and decision-making in the local context with regard to the farming practices and their associated health risk perceptions.

This study was conducted in four vegetable farming communities within Asokwa and Oforikrom Municipalities of Ashanti Region, Ghana (see Fig. 1). As shown in Fig. 2, Kumasi is dotted with a number of vegetable farming sites given the favourable soil and weather conditions in most part of the year. The major soil type of the study area is the rich forest ochrosols that enables the practices of urban agriculture in and around the Metropolis (GSS 2014). The intensive use of these lands requires that farmers maintain soil fertility through investment in highly effective manure. The study area has a semi-humid, tropical climate with a mean annual rainfall of 1340 mm. It has a double maxima rainfall regime with humidity averaging about 84% at sunrise and 60% at sunset. It has an average minimum temperature of 21.5 °C and the average maximum temperature is about 30.7 °C (GSS 2014). The various drainage systems of Kumasi run north–south with Daban, Subin, Aboabo, Sisa and Wiwi being the main streams. A large number of vegetable farms in urban and peri-urban Kumasi depend on these streams, associated ponds and wells for irrigation water. But these sources are inherently heavily polluted either from domestic or industrial effluents (Keraita et al. 2014).

Sampling and selection of research participants

A total of 66 conveniently sampled vegetable farmers of whom 57 were males and 9 females constituted the study sample. A relatively small number of female farmers' shows that urban vegetable farming is male dominated. Four study communities, namely, Kwame Nkrumah University of Science and Technology (KNUST) enclave, Gyenyase, Kyirapatare and Boadi were purposively selected. The selection of these communities was influenced by the concentration of vegetable farms and represent typical urban vegetable farms. They actually fall in the lowlands around the KNUST known to have the largest agglomeration of farms. In 2014 it was estimated that 59 hectares of

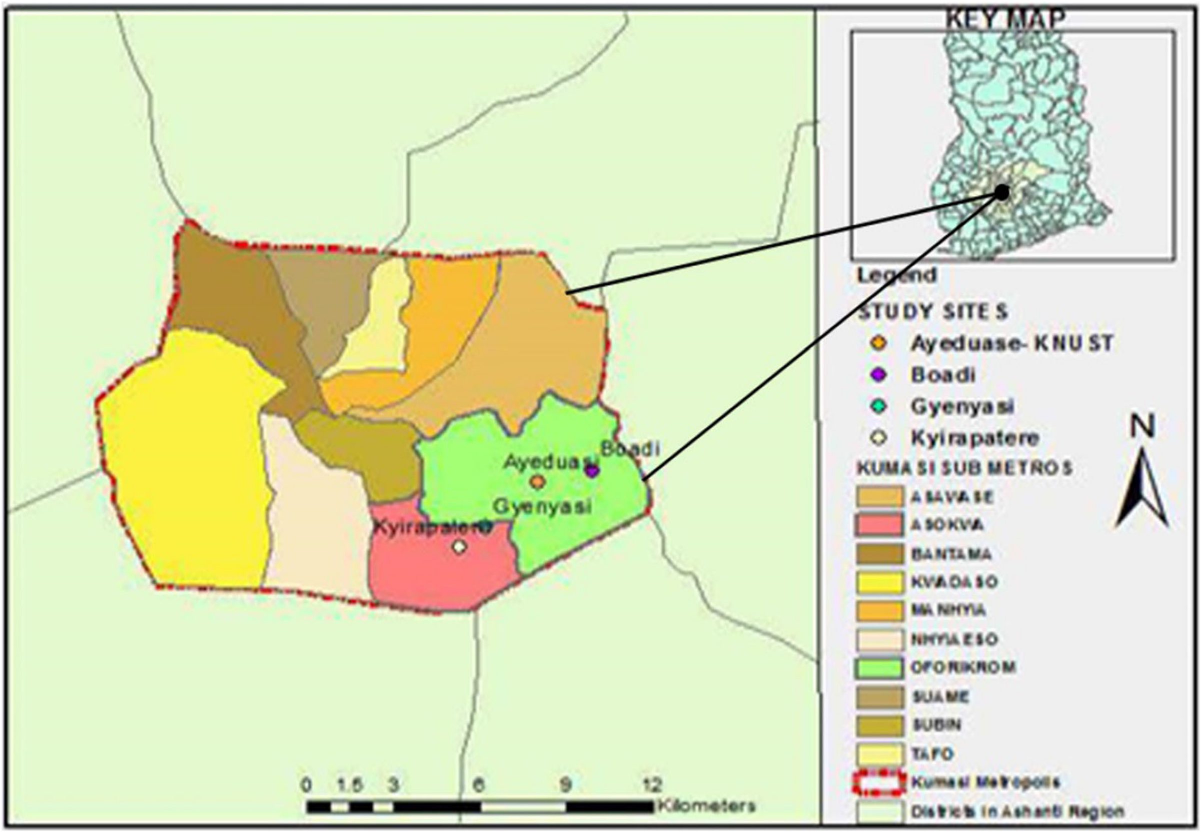

Fig. 1 A map of Kumasi showing the study communities

vegetables in the dry season and 48 hectares in the rainy season on about 20 farming sites were cultivated by 323 farmers (made up of 300 men and 23 women) (Danso et al. 2014). Since there were no accurate up-to-date records on the number of people engaged in the vegetable farming, convenience sampling was used to select the required number of participants. The respective sub-sample sizes for KNUST, Gyenyase, Kyirapatare and Boadi were 15, 2I, 17 and 13. Selection of respondents for interviews was based chiefly on their availability and willingness to participate. Since the farmers normally worked on their farmers in the morning they were targeted as such often between 8 and 12 GMT on each interview day.

Data collection

Data were collected via in-depth interviews (IDIs) using interview guide. In-depth interviews were conducted to obtain detailed information about how the individual farmer's thoughts, opinions, feelings, attitude, perceptions and experiences in relation to their farming practices and associated risks were constructed (Boyce and Neale 2006; Milena et al. 2008). Social cues, such as voice, intonation, body language among others of the interviewees provided the researchers extra information that were added to the verbal answers of the interviewees during the interviews (Opdenakker 2006). Prior to the interviews, the researchers had familiarised themselves with, and also understood the interview guide after a careful review of relevant literature. This blend of background and experience enabled smooth interaction and rich information sharing. Key issues captured in the interview guide were land preparation and planting of vegetables, vegetable irrigation and associated health risks, application of fertilizers (organic and inorganic) and related risks, pesticide application and related risks, and use of protective gears in farming operations. Each of these had sub-themes all of which combined to yield the required assemblage of rich data (see Appendix 1). The reliability of the research

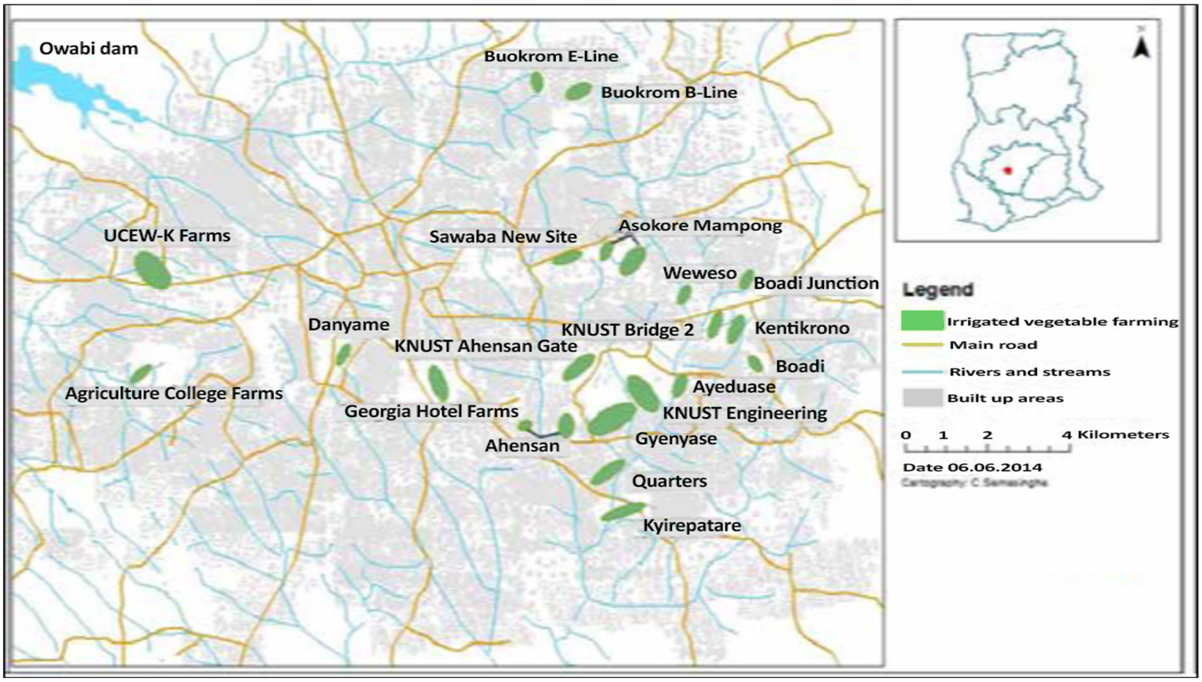

Fig. 2 A map of Kumasi showing vegetable-producing sites (*Source* Danso et al. 2014)

instruments was achieved through pre-test at Asokore Mampong vegetable site which prompted some modification of the items. All interviews were conducted in local dialect, *Twi* and audio-taped upon the approval of respondents. Field notes were also taken chiefly to gauge against any logistical and technical failure during tape recording. Each interview lasted about 45 min on average. Besides, direct observations of specific farming operations were made in the field.

Ethics considerations

Informed written and verbal consents were obtained from all research participants. Participants were requested to sign or thumbprint a written informed consent form. Oral consent was sought from those who felt uncomfortable with either the thumb printing or signing. Participation was entirely voluntary and study participants were fully briefed on the research objectives prior to the interview. Participants were assured of strict confidentiality and anonymity of the responses they provided.

Data analysis

Data analysis was conducted using thematic analytic framework, a method for identifying, analysing, organising, describing and reporting themes found within a data set (Nowell et al. 2017). This analytical method entails a number of steps. In the first place, the first and second authors transcribed the audio recordings into English. Following this was a careful reading of the transcripts, field interview and observational notes by the three authors in order to familiarise ourselves with the data and its key components. At the end of the first step, a separate summary of each transcript that indicated the main issues the participants raised were generated. As a second step, the transcribed interviews were exported to NVivo 9 analytical software, during which deductive and inductive coding of data were done (Fereday and Muir-Cochrane 2006). During coding, the researchers identified key sections of text to which labels were attached in order to index them because they were related to a theme or an issue in the data. The coding process continued to a theoretical saturation point where no new concepts were generated from further coding of data. Step three involved sorting and collating all the potentially relevant coded data extracts into themes. Fourth, the researchers reviewed the coded data extracts theme-by-theme to ascertain whether they formed a coherent pattern. The validity of each theme was considered to check if each accurately reflected the meanings captured in the whole data set. This made it possible for the identification and correction of inadequacies in the initial coding and themes. Next, we defined and named themes. We then identified the story that each theme tells followed by a detailed analysis of each individual theme. In order that our findings meet the desired rigour (Miles et al. 2014), the preliminary results were shared with the study participants for their inputs, feedback and clarification. The feedback helped to further refine the results presented in the following section. The final thematic categories and sub-categories have been presented as narratives. Where appropriate, we used verbatim quotations from interview transcripts to illustrate relevant themes.

Results

Wastewater irrigation farming

All participants practised irrigation farming using streams or shallow dug-outs created within the catchment areas of these streams. For ease of irrigation, these vegetable farms were found strategically located close to urban effluent streams (Fig. 3). These drainage systems, as in for example Wiwi River, are mostly polluted because they are fed by domestic, industrial and institutional wastewater including sometimes faecal matter. Reasons ascribed for the use of these water sources for irrigation included lack of alternative water sources and the anticipated huge cost involved in obtaining alternative sources such as pipe-borne water. Justifying the choice of irrigation water, a participant at Kyirapatere said this:

Fig. 3 Section of the Wiwi stream used for lettuce irrigation

> If we don't get regular supply of water for domestic use how do you expect us to get it for irrigation? You simply will not get it. Granted that pipe water is available, it will be too costly for this work. This dugout is readily available and at no cost to us in using it. Some even contain a bit of nutrients that help my vegetables to mature quickly. This water looks dirty but don't be misled, they're the best for watering. (A Female participant)

We observed different watering methods (see Fig. 4a–c) but the use of handheld watering can (Fig. 4a) was the dominant one at all the study sites where cabbage, lettuce and spring onions were the main crops cultivated. The watering can method enables water to be applied to the vegetables from above.

Regarding farmers' perceived health risk of wastewater use for vegetable irrigation, the results show that vegetable farmers demonstrated little knowledge about the health implications of wastewater use for vegetable cultivation. All the farmers interviewed had no problem with the type of water they were using for irrigating their crops and would not accept its possible link to many consumption-related diseases such as diarrhoea, typhoid and cholera. The respondents perceived their irrigation water sources as safe, clean, pathogen-free and therefore could not pose any direct health risk. Indeed, the respondents argued that if the water they use in their farming operations is really polluted, then they should be the first victims of consumption of water-contaminated vegetables. A female participant had this to say:

> There are no contaminants or germs in the water. We have been using this water for a long time without any problem. Don't mind the colour of the water, it is because of the fallen leaves from

Fig. 4 **a** Application of water by handheld watering cans at KNUST farming site. **b** Application of water using PVC pipe at KNUST farming site. **c** Application of water using flexible water-hose at Gyenyase farming site

> the trees around. Contaminated water can't produce healthy crops like this. (Kyirepatare)

Participants however agreed that the use of contaminated water for vegetable irrigation can contaminate the crops and affect human health. They shared the view that if vegetables grown with polluted water are not properly washed, consumers' health could be compromised. Stomach ache, diarrhea, fever, headache and vomiting were some of the health conditions respondents described could be associated with the consumption of contaminated vegetables. But when asked whether they would use contaminated water to irrigate their crops in the absence of safer alternatives, 82% of the respondents who took part in the in-depth interview responded in the affirmative. This majority argued that they must do so to survive. A respondent stated:

> I have a wife and four children. My source of livelihood is this vegetable farming. This is all I do for a living. If dirty water is the only one available I would have no option but to use it. (Male, Gyenyase)

This farmer's position epitomises the views shared by most of the farmers interviewed. The 18% respondents who said using polluted water for irrigation was not an option felt it would not be safe for them as well as the consuming public. As would be expected, when asked whether they will consume vegetables they knew was irrigated with contaminated or polluted water, about 90% of participants responded in the negative. While this majority indicated they would not, as a health safety precaution, the few who responded in the affirmative (10%) contended that these vegetables would normally be washed or cooked before they are consumed. But when the question was slightly changed to whether they would consume vegetables that they knew were irrigated with faecally-polluted water, all the respondents answered in the negative.

The research also investigated the readiness of vegetable famers to invest in safe-water irrigation projects. No farmer interviewed in the four farming sites was ready to invest in pollution-free water project for the purposes of irrigation and other farm operations because they claimed they lacked the economic muscle to do so. They were however quick to indicate that they would welcome that if the intervention comes from external sources or government. One farmer at *KNUST* site explained it this way:

> We do not have money or resources to invest in safe water irrigation. Even the state may not be able to afford this let alone a poor farmer. If the government wants to support, we would welcome it. (Male participant)

Manure/fertilizer application and health-related risks

Our results show that soil fertilisation is a common practice and indeed an integral part of the processes of urban vegetable farming. The most commonly used form of manure is the organic ones, mostly poultry droppings due to their availability and relative cost-effectiveness. The application of manure is normally done after the preparation vegetable beds. The respondents explained the benefits of application of manure to plants including promotion of rapid growth through provision of the right nutrients to plants. All the respondents indicated that fertilizers increase yield and enhance the quality of vegetables. On the question of whether manures or fertilizers can have negative environmental and health effects, no respondent could identify any specific one although the general perception was that excessive use of these may bring undesirable consequences. A 57-year old farmer at Boadi explained it this way:

> I have been doing this business for three decades now. I have not experienced or heard anyone complain of any health problem. Manures and fertilizers help to promote plants' growth. If these were really harmful, then they should equally be harmful to the soil and to the crops. Once you follow the instructions regarding their use there would be no problem. (Male participant)

Another participant at Kyirapatere maintained said this:

> To me manures are not harmful…I apply mainly poultry droppings to my crops. Since it is natural, there are no side effects. We even use our bare hands in its application. (A Female participant)

Results from the current study show that most farmers did not have specific time for applying manure/fertilizer to their crops. The main concern of these farmers was how to get the best or good looking (green, fresh, spotless) vegetables out of their efforts to their customers against all odds. This is the only way to guarantee attractive prices for their produce and for sustained livelihood security. Financial motivation has often led farmers not to care about procedures much to the detriment of the consuming public. Regarding timing and amount of manure applicable, a farmer at KNUST site put it this way:

> As a farmer, I normally apply the manure just after the bed is created but sometimes after transplanting the vegetable seedlings. Either ways, the result is the same. (Male participant)
>
> He continued:
>
> As you can see, I have different bed sizes, I apply the manure until the entire bed is covered. Since I have been in this business for long, it is the experience that counts. There is no standard measure or amount of manure for my crops.

As a normal practice, poultry droppings used as manure is supposed to dry well enough or stored long enough before they are applied to raised beds. While the study participants indicated that they allowed the organic manure to dry before applying to crops, the questions regarding how long and the rationale for drying did not yield satisfactory responses. Respondents could not tell how long enough these manures were kept. We observed in many instances that the manure used was not allowed to dry well before application. Besides, these farmers made use of top-dressing methods instead of incorporating manure into the soil. The farmers primary concern for drying their manure was not for pathogenic reduction but for ease of application by sprinkling. A farmer at Gyenyase noted:

> I normally allow the poultry droppings (manure) to dry to enable me to hand-spread it easily on the vegetable beds. I don't know that there are other benefits for storing or composting it long enough. (Male participant)

Urban vegetable farming, pesticide use and health-related risks

Overall, all the farmers applied different pesticides mostly for pest control, rapid growth of vegetables and increased yield. A Middle-aged female farmer at Boadi shared this view:

> The application of the pesticide is done a week after transplanting and two weeks before harvesting the crops. These vegetables are easily attacked by worms and insects which can destroy the whole farm. I spray often in order to kill these pests.

Though participants could not indicate the many aspects of an expert type of risk assessment, they had some general notion of pesticides as 'dangerous substances' that can cause harm if not handled with care. Respondents agreed that improper handling of pesticides may cause skin irritation, diarrhea, nausea, vomiting, headache and respiratory problems. But this knowledge did not match the actual practice in the field. While respondents applied pesticides regularly against pests, timing of application was somewhat irregular, and was largely dependent upon demand for the produce. As a common practice, vegetables were sprayed at 7 days interval until the crops were harvested. This, according to these farmers, was done to produce good looking and appealing vegetables to boost their market value. Varied information on dose and application practice was obtained through in-depth interviews with some significant deviations from label recommendations. A farmer at KNUST commented that:

> In this business, buyers only look at the appearance or freshness of the vegetables. In order to maintain good looking vegetables and to attract good price, we have no option but to apply the pesticides for about two or three days when it is necessary to do so before harvesting. (Male participant)

Respondents justified their actions on grounds that they have been doing it for years without any negative public feedback. Besides, the vegetables would definitely be washed which would clear any chemical residue on the vegetables. This demonstrates that while farmers were not ignorant of pesticide hazards, they continued to carry out hazardous practices in the field. A vegetable farmer at the Boadi farming site noted:

> We have been doing this for several years and no one has ever complained about any illness. I eat the vegetables myself; you just have to wash it to remove the pesticides. If our vegetables were unsafe we would have been the first victims. (Male participant)

Use of protective clothing in vegetable farming practices

The study found that the use of protective clothing such as goggles, nose masks and hand gloves during irrigation, fertilizer and pesticide application was not a common practice. Only in few cases were participants found wearing wellington boots. Respondents used their bare hands to broadcast manure and sprayed chemical to crops without wearing nose masks. While the study participants acknowledged protective functions of these devices, they also indicated the discomfort associated with their use. Some respondents indicated that when fertilizer and pesticides come into contact with their skin, they cause burns or irritations while the organic manure often produces offensive odour especially when wet. To these farmers, these problems weighed less than the inconvenience of using such protective masks. When asked why they were using their bare hands, a male farmer at Kyirepatare responded this way:

> We normally use a mixture of poultry droppings and sawdust which does not pose any health problems to us. We have been in this business for a while and have not heard someone complain of falling ill because of the manure we use. Poultry manure is not harmful to the body and that is why most of us use our bare hands to apply it. In any case, we always washed our hands each time that we were done.

A few farmers who wore hand gloves and used nose masks however indicated that dust and pesticides from their farming operations sometimes give them catarrh and headaches as explained in the following response:

> I use my protective gears for obvious reasons… the field dust and pesticides are harmful to man if the necessary precautions are not taken. The inhalation of dust during bed preparation gives us slight headache and catarrh. While body contact with the pesticides can cause some skin irritation or burning sensation, contact with the mouth can kill. (Male participant, Boadi)

Discussion

The study investigated health risk perceptions of urban vegetable farmers in relation to specific farming operations. The results showed that urban vegetable farming in the study communities thrived on the use of polluted streams for irrigation. These are streams or freshwater that have been polluted by domestic, industrial and institutional wastewater that drain into them (Abass et al. 2016; Keraita and Cofie 2014). Majority of the study participants, however, held the view that these water sources were safe and would not pose any health risk to them or the vegetable consuming public. These responses may be linked to the fact that more than 80% of farmers in the Metropolis and Municipalities use shallow groundwater and on-farm ponds for irrigation (Keraita et al. 2008) and probably were yet to come to terms with the fact that these water sources are as polluted as the streams that flow into them. The reality is that these waterbodies are generally clear in appearance which, without laboratory analysis, makes it difficult for these farmers to determine their level of contamination. But foul smell, high levels of solid waste content and dark colour can be useful clues of water contamination. Several studies in Ghana and elsewhere have shown very high microbial contamination levels of irrigation water and irrigated vegetables (Amoah et al. 2011) with corresponding high potential risk of infection (Drechsel and Seidu 2011). The use of wastewater for irrigation has been found to increase human health risks by exposing farmers and consumers first, to pathogens, including helminth infections, and second, organic and inorganic trace elements (Qadir et al. 2010).

Not only were the water sources of questionable quality but the method of watering the vegetables further exposed the crops to contamination. Different watering methods were employed, with handheld watering can being the dominant one. Since the water was applied to crops from above, the watering can method may lead to pathogenic contamination of the crops where wastewater is used. An earlier study conducted in Gyenyase, Kumasi has shown a direct relationship between watering height using these cans and the levels of thermotolerant coliforms and helminth counts on lettuce (Keraita et al. 2007).

As regards the continuous use of wastewater for irrigation, Qadir et al. (2010) argued that many farm households in developing countries are not aware of the risks or the potential environmental consequences. They might be illiterate, lack adequate information and resources and have been exposed to poor sanitary conditions for most of their lives. As a result, ‘many farmers accept these health risks for the benefits of their occupation, and in the general context of their living conditions where wastewater contact through irrigation, might only be one of many sanitary challenges’ (Qadir et al. 2010, p. 563). But the view shared by Nyantakyi-Frimpong et al. (2016) that the decision of farmers to irrigate with wastewater cannot be attributed simply to ignorance, but rather, to socio-economic and political social forces far removed from farmers’ everyday lives is valid. Inadequate supply of clean water, rapid depletion of arable land within the city, rapid population growth and poor waste managements, rising levels of unemployment and widening urban poverty gap are factors beyond the control of these farmers (Nyantakyi-Frimpong et al. 2016).

While the continuous use of polluted water for vegetable irrigation may also be interpreted to mean these farmers do not normally consume these exotic vegetables, the current findings do not support this position. While the view that exotic vegetables are not common in the traditional Ghanaian diet consumed at home (Keraita et al. 2008; Keraita and Drechsel 2015) may be valid, all the study participants in the current study indicated they consumed part of what they grew, although they were of exotic type. Indeed, our respondents argued that if the water they use were polluted, then they should be the first victims. Precisely also because many diseases associated with the consumption of contaminated vegetables are similar to what the society complains about on daily basis, it is difficult to make attribution to a particular cause. This means that the farmers may not be able to tell whether a particular health problem they suffer from is due to the consumption of contaminated vegetables. It is of course also difficult to tell if the majority of participants did not experience any problems, or if they downplayed them to protect their business interests. The farmers' justification of the safety of the water they use on the grounds that they themselves have not suffered any health problem linked to the vegetable consumption or have not received any negative feedback from their customers is problematic. Such cognitive bias as indicated by Simon et al. (2000) would only make these farmers to hold onto their risky farming practices that are of public health concern. Given the length of the marketing chain, health complaints associated with vegetables produced rarely get to these farmers (Keraita and Drechsel 2015). The refusal of these farmers to admit that their irrigation water is polluted could probably be a defence against public opinion that the kind of water they use for irrigating their vegetables is contaminated. It is expected that people would challenge or put up a defence mechanism when their long-held views and beliefs come under scientific scrutiny. It may also be a smart way for farmers to prove that they are not 'risk factors' and that their actions or practices are not causally linked to contamination of vegetables.

Consistent with the findings of Keraita et al. (2008), all the respondents agreed that the use of contaminated water for vegetable irrigation can contaminate the crops and affect human health. While majority of the farmers interviewed indicated that they would not consume vegetables they knew were cultivated with contaminated wastewater, it is difficult to comprehend why these same respondents were prepared to apply contaminated water to their crops in the absence of cleaner alternatives simply because of economic imperatives. As farmers who struggle to eke out a living principally from vegetable cultivation, their position may be justified. Economic consideration may underscore why all respondents showed unwillingness to invest in safe-water irrigation projects. From the standpoint of the risk theory, one may agree with Kirschenbaum (2005) that the farmers' contradictory positions could possibly have been influenced by the degree of social familiarity of the potential victim. It is possible, contrary to the farmers' narratives, that they themselves or their immediate relations do not consume the very vegetables they grow and as such would not be concerned about the health consequences of their risky farming practices. It may also be the influence of habit. As Keraita and Drechsel (2015) noted, habit is a major motivational barrier which prevents knowledge translating into actual behaviour. These farmers have learnt and used these farming methods for decades, and thus, it is difficult to change these practices. Old habits are hard to break and new habits are hard to form. A factor strongly affecting behaviour change has to do with implementation costs in terms of capital, land, labour or time requirements to adopt a new practice or change an old one (Karg and Drechsel 2011). Therefore, change of habit usually requires high psychological costs, and needs a strong incentive by way of a profit gain (Keraita and Drechsel 2015).

Results from the current study showed that the use of organic manure in land preparation was a common practice. The application of manure is normally done after the planting bed has been raised. While the study participants demonstrated knowledge of the benefits associated with the use of manure and chemical fertilizers, their ecological and health risks especially when they are not properly applied were little known to them. In situations where farmers applied fresh or improperly dried organic manures to vegetable beds, as was observed in the field, it would not only make broadcasting a difficult exercise but could also promote pathogenic contamination of vegetables (Chen and Jiang 2014). Long storage or composting allows for pathogen die-off but the increasing demand for organic manure often makes it difficult to have it stored or composted long enough before it is applied (Keraita and Cofie 2014). This situation exposes not only the farmers to risks of infection but could compromise the quality of vegetables produced through bacterial and viral contamination. The use of top-dressing methods instead of incorporating manure into the soil is found to be problematic. This method, that has been reported in other studies in peri-urban Nairobi (Kutto et al. 2011) has been found to increase the chances of direct contact between edible plant parts and manure, thereby increasing the risk of pathogen contamination (Lagerkvist et al. 2013). The discrepancy in the respondents' position regarding the use of dry manure and what was observed in the field could be explained by the farmers' lack of knowledge of how long the manure is to be stored before application and the limited understanding of the rationale for doing so.

The study also found the use of different pesticides by the respondents. Pesticides have played a key role in providing reliable supplies of agricultural produce at prices affordable to consumers, improving the quality of produce, and ensuring high profits to farmers (Damalas and Eleftherohorinos 2011). The irregular timing or application of these pesticides for economic reasons and the need to meet consumer taste can be dangerous to the public. There is the economic imperative to increase output and quality for the consuming public for higher returns. The reality is that regular spraying leaves the vegetables spotless and attractive which in effect attract good prices and higher income to the farmers. Such economic considerations and pressure to use pesticides by other economic agents such as middlemen were found as the underlying reason for increased use of pesticides in Talamanca, Costa Rica (Barraza et al. 2011). The view that vegetables would eventually be washed before consumption further reflects a cognitive bias and in consequence a reflection of low risk perception by the study participants. Clearly, washing vegetables with ordinary water is most unlikely to solve the problem where chemical internalisation has taken place (Abass et al. 2017). Increased consumption of chemical-laden vegetables may thus pose serious health risks. Although pesticides are developed to function with reasonable certainty and minimal risk to human health and the environment, many studies have raised concerns about health risks from exposure of farmers (or other end-users of pesticides) and from non-occupational exposure of the population to residues found on food and drinking water (Damalas and Eleftherohorinos 2011). Analyses of vegetables for pesticide residue in Ghana for example have shown contamination beyond the acceptable limit for consumption (Amoah et al. 2006; Armah 2011). Wrong direction of spraying of pesticides by hand or knapsack sprayer had been reported by Ntow et al. (2009) in Ghana where about 97% of study participants in their study had experienced symptoms attributable to pesticide exposure, including frequency of weakness and headache. Frequent ill health episodes and cases of hospitalisation following application and fatalities through accidental exposure or misuse have been reported by farmers growing food staples in Ethiopia and Ghana (Williamson et al. 2008).

The use of protective clothing (goggles, nose masks and hand gloves) during farming operations was not a common practice by the study participants. While the respondents indicated that non-use of protective clothing during pesticide and manure application often causes skin burns and unpleasant odour, these problems weighed less to these farmers than the inconvenience of using such protective gears. Similar studies have found low level of adoption of protective measures due to the general discomfort and heat associated with the tropical environment (Ackerson and Awuah 2010; Amoah et al. 2011; Keraita et al. 2010; Ntow et al. 2006). This study is also consistent with the findings of Barraza et al. (2011) where both men and women farmers who participated in their study demonstrated that they did not need more protection, even when there was the recognition of the presence of poisoning symptoms or skin injuries during discussions, and women use of long sleeved shirts and other working gears was for aesthetic reasons.The fact that the potential health consequences may not be immediate, it is difficult for these farmers to visualise the dangers and the harm they are exposing themselves to (Lagerkvist et al. 2013).

The following limitations of the study must be acknowledged. The study adopted purely qualitative approach that did not permit the strength of association between farmers' perceptions and their background information to be established. Besides, the small number of study participants involved in the research may limit the generalisation of the findings beyond the study area. Notwithstanding, this study contributes to the growing body of research on health risk perception of vegetable farmers in relation to their farming practices. The qualitative approach and the theoretical perspective offered a deep and varied reasons of farmers never changing farming habits.

Conclusion and policy recommendations

Vegetable farming practices in Kumasi urban and peri-urban areas remain largely unsafe, as a result of over-reliance on contaminated domestic, industrial and institutional wastewater for irrigation. This, coupled with contamination from the use of manures and pesticide, compromise the quality of vegetables produced from these farms. This may present startling short- and long-term adverse health outcomes for both farmers and the consuming public.

We propose that faithfully enforcing legislation to ensure that farmers comply with food safety standards is a useful way of safeguarding public health. Environmental Health Department of Kumasi Metropolitan Assembly (KMA) in collaboration with Ministry of Food and Agriculture (MoFA) must step up its monitoring operations to ensure that vegetable farming practices are carried out in a safe and hygienic manner. Moreover, sustained public sensitisation and awareness creation on health risks of using untreated wastewater through mass media and agricultural extension services targeting farmers, market women, food vendors and consumers may contribute towards minimising the health risks associated with vegetable farming.

In addition, liberally oriented institutional mechanisms such as 'moral suasion', voluntary collective actions and economic rewards can be employed to influence behaviour. Farmers who comply with safety standards may be publicly recognised and rewarded by providing ready markets for their produce. Rather than an antagonistic posture, an urgent need for trust could be built between vegetable farmers and key institutional stakeholders, scientists and the media in order to ensure knowledge transfer on best farming practices to farmers. More significantly, efforts must be directed towards improving the environmental sanitation through proper waste management in the city.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Informed consents Informed consents were obtained from all research participants. Participants were assured of strict confidentiality and anonymity of the responses they provided.

Appendix 1: Sample interview guide

1. How safe is your source of water for irrigation?
2. Do think that vegetables irrigated with contaminated/polluted water pose any human risk?
3. What kind of risks are farmers exposed to when using contaminated/polluted water for irrigation?
4. What kind of risks are consumers of wastewater irrigated vegetables exposed to?
5. What processes do you take the manure through before applying it to the field?
6. Does the application of fresh manure to vegetables pose any risk?
7. How often are pesticides applied to the crops? Is the use pesticide associated with any risk?
8. Have you personally suffered adverse effects linked to pesticide use?
9. Do you know or heard of someone who has suffered adverse effects linked to pesticide use?
10. Is the use of protective gears of any benefit to the farmer?
11. What risks are associated with vegetable farming and how can these be reduced?

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