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Consumer Perceptions of Fruit and Vegetable Quality: Certification and Other Options for Safeguarding Public Health in West Africa

Bernard Keraita and Pay Drechsel

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Project

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Contents

Summary

With increasing change of traditional diets and the emergence of new supply and marketing chains, urban food consumers in low-income countries are faced with multiple food safety challenges, among which microbial contamination and pesticides are key concerns for vegetables sold on urban markets in West Africa.

Although consumers have a genuine interest in healthy food, and are willing to pay premiums, their interpretation of food quality and risks deviates from scientific health risk assessments and does not translate into recommended risk mitigation behavior. To safeguard public health, especially where transmitted food-borne diseases can be infectious, as it is the case for pathogens transmitted via wastewater irrigation, alternative measures are needed to support consumers' risk awareness and decision making.

The review looked at common and less-common options to trigger and support behavioral change, including safety labeling (certification), corporate social responsibility models, incentive systems, and social marketing of safe practices, to address potential food safety risks from farming in urban and peri-urban areas.

Overall, it appears that regulatory measures for risk management including certifications will be – for now – less effective in the West African setup due to low educational levels in view of chemical and microbial risk, diverse and often informal food chains, poor safety supporting infrastructure and weak institutional capacities for compliance monitoring. Thus most of the currently observed certification schemes target export and foreign markets, and not the domestic one where only specialized shops and high-end outfits confirmed actual market demand for safer products.

To reach a broader populace, an important step aside education would be the development of an exclusive market channel or segment for organic or safe vegetables through the cooperative effort of producers, without having to resort to labeling and monitoring, at least in the short term. This will help minimize cost, but has to be supported by marketing strategies, ideally backed by a well-established brand, for example, under a corporate social responsibility model. Instead of subscribing to any international (export) label which would require to follow, for example, European thresholds and standards, a step-wise approach of risk reduction starting with the compliance with local standards might be more appropriate and is also recommended, for example, by the World Health Organization (WHO). This approach will have to go beyond a focus on (organic) farming as postharvest contamination is also common.

INTRODUCTION

Urban areas in developing countries have many formal and informal food chains and face diverse food-quality and -safety challenges resulting from infrastructure (e.g., cold transport and storage) and institutional capacities (e.g., for monitoring of compliance with safety standards), and legislations in general might not be able to keep pace with the dynamics of urban food demand, including changes from traditional diets to 'fast food', the emergence of new supply and marketing chains, as well as growing competition between food outlets with possible cuts on food safety. But the largest risk factor in developing countries is that the public sector cannot count on the consumer to be alert as educational levels are usually too basic. Several national and international reports have noted that poor hygienic practices in the home are responsible for between 30-40% of food-borne illnesses (FAO 2015).

Among the many risk factors related to food safety, pesticide misuse and those risk factors which can cause diarrhea are of particular importance in developing countries (De Bon et al. 2014; WHO 2006, 2014). Especially precarious are those hazards which build on fecal-oral transmission, where water-borne pathogens of fecal origin enter the food chain, which takes place when vegetables are irrigated with wastewater from human settlements (WHO 2006). Vegetables, especially those eaten raw, have for long been associated with water-borne diseases. This route has been established for more than a century since Morse associated typhoid infection with eating of celery in 1899 (Melick 1917). Ever since, several studies have been conducted and water-/food-borne illnesses have been strongly associated with pathogenic bacteria, viruses and parasites of animal or human origin (Harris et al. 2003). Contamination of vegetables is known to occur either preharvest (e.g., via irrigation) or postharvest (e.g., through unsafe handling), with or without subsequent growth of the pathogen eventually responsible for infection or intoxication (Beuchat 2006). In developing countries, continued use of fresh manures as fertilizers and untreated wastewater as irrigation water for production is seen as a major contributing factor to contamination that causes numerous food-borne disease outbreaks (Beuchat 1998; WHO 2006).

Grunert (2005) identified three main streams of research on food quality and safety: (i) provision of quality and safety; (ii) dealing with consumer demand for quality and safety; and (iii) consumers' perception of quality and safety. Food safety is defined as the assurance that the food will not cause harm to the consumer when it is prepared and/or eaten according to its intended use (FAO-WHO 1997), whereas, food quality is "the totality of features and characteristics of a product or service that bear on its ability to satisfy stated or implied needs". In simpler words, one can say that a product has good quality when it "complies with the requirements specified by the client". Food safety is a component, and may be the most important component, of food quality (Grunert 2005). Food quality may therefore include measures of purity, flavor, color, maturity, safety, wholesomeness, nutrition, or any other attribute or characteristic of the product as valued in the local context.

It is widely agreed that food quality and safety have both objective and subjective dimensions (Grunert 2005). Objective quality refers to the physical characteristics built into the product and is typically dealt with by engineers, public health authorities and food technologists. Subjective quality is the quality as perceived by farmers, traders and consumers. Similarly, *objective food safety* is a concept based on the assessment of the risk of consuming a certain food by scientists and food experts while *subjective food safety* is in the mind of the local user.

Starting with some scientific information on the safety of vegetables, the focus of this report is more on the subjective dimensions of vegetable safety and related quality aspects, trying to approach (i) the general question of how consumers think and could be best protected given the common unsafe use of polluted water and pesticides across Africa, and (ii) the particular question of how far certification programs could play a role.

HEALTH RISKS FROM CONSUMING VEGETABLES AND FRUITS GROWN IN URBAN AND PERI-URBAN AREAS

Food safety concerns in fresh vegetables and fruits can be broadly categorized into three: *(i) physical hazards* such as wood splinters, stones and pieces of glass, which become embedded in produce during production, handling or storage, (ii) *chemical hazards*, mostly pesticides, herbicides, heavy metals and industrial toxins, and (iii) *human pathogens*, such as soil-associated pathogenic bacteria (*Clostridium botulinum*, *Listeria monocytogenes*), feces-associated pathogenic bacteria (*Salmonella spp.*, *Shigella spp*., *E. coli* O157:H7), pathogenic parasites (*Cryptosporidium, Cyclospora*) and pathogenic viruses (Hepatitis, Enterovirus). In addition, there are emerging concerns related to the possible overuse or misuse of antibiotics, which can enter the food chain, for example, via wastewater aquaculture and support antimicrobial resistance (WHO 2014).

Comparing urban and peri-urban vegetable contamination from pathogens, pesticides and heavy metals in view of their potential impact on the Ghanaian population, pathogenic risks were ranked highest, followed by pesticides and with least concern for heavy metals and emerging contaminants (Amoah et al. 2006; Lente et al. 2012; Drechsel and Keraita 2014). This report will thus limit its scope to microbial risks and pesticide use, knowing that the importance of various kinds of food safety concerns differs across countries and regions, depending, among others, on the industrial development, enforcement of regulations and waste(water) management. Yet, even countries with very advanced safety systems can be affected. For example, a broad range of stakeholders under the EU FP7 Veg-i-Trade project ranked bacterial pathogens to be the most important food safety issue for fresh produce, followed by food-borne viruses, pesticide residues and mycotoxins (Van Boxstael et al. 2013; De Keuckelaere et al. 2015). The high ranking was explained by the fact that in case of a food-borne outbreak the consequences are often severe both from a public-health point of view (large number of cases and high severity of disease) and from the economic point of view (loss of sales, tourists, and trust). An example given was the Escherichia coli O104:H4 outbreak in Germany in May-July 2011 associated with consumption of sprouted seeds and later on a norovirus outbreak in Germany in September-October 2012 associated with consumption in school canteens of a dessert, containing frozen strawberries (Van Boxstael et al. 2013).

If a 50% attribution between food- and water-borne diseases leading to diarrhea, hepatitis, typhoid and cholera is assumed, this would imply more than 200,000 Ghanaian cases annually of diarrhea caused by food-borne diseases, with a loss to the economy of about USD 35 million (MoFA and World Bank 2008). A lower estimate of about USD 5 million was derived from a quantitative risk assessment, looking only at infections from wastewater irrigated vegetables resulting annually in about 12,000 DALY[1] in urban Ghana (Drechsel and Seidu 2011).

ATTRIBUTES USED BY CONSUMERS TO ASSESS FOOD SAFETY AND QUALITY

In general, consumers use various attributes or set of criteria to assess the quality of fruits and vegetables of which safety is an integral component and define their acceptance limit, below which a product is rejected (Tijskens 2000). For fruits and vegetables, these properties/attributes

[1] Disability adjusted life years; a global measure for the disease burden (WHO 2006).

include generally, for example, color, firmness and freshness at the time of purchase (Kader 2002). The same was consistently confirmed for Ghana and neighboring countries. Balamatti (2000), Nurah (2001), Osei-Asare (2009), Probst (2012) and Obuobie et al. (2014) summarized results from farmer, trader and consumer interviews and surveys in Accra, Sunyani, Kumasi and Tamale (Ghana), Cotonou (Benin), and Ouagadougou (Burkina Faso) and confirmed that vegetables were perceived as healthy and of good quality if their appearance is fresh[2] and neat, i.e., color (Figure 1) and size match buyers' expectations, they are clean and have no appearance of dark spots, etc.

Similar attributes of vegetable quality and safety have also been reported from many other countries as, for example, the Philippines where appearance, taste, freshness, price, color, and texture were the key criteria that consumers considered when purchasing fresh vegetables. While the least important factor was the brand name of the product, the notion of "Certified safe, by residue testing", was the fifth most important factor consumers considered in their decision to purchase (López Camelo 2004).

FIGURE 1. Which one would you buy not knowing that the large crop was irrigated with wastewater?

Photo: B. Keraita.

In a study conducted in Ghana and Benin, on organic production of cabbage and tomatoes, consumers said they looked for vegetables that were free of damage from insects, fresh, big, bright, hard and free of dirt (see Table 1) (Coulibaly et al. 2011). In a related study conducted on organic lettuce in Ghana, freshness, no damage by insects, size and cleanliness were used as product-quality attributes (Owusu and Anifori 2012).

[2] Retailers respond to these attributes by sprinkling (often polluted) water on the vegetables so that they look fresh and have intensive colors (Amoah et al. 2011).

TABLE 1. Characteristics used by consumers in assessing quality of cabbages and tomatoes in Benin and Ghana.

Characteristics	Cabbages (%)		Tomatoes (%)	
	Ghana (N=100)	Benin (N=100)	Ghana (N=100)	Benin (N=100)
Color	74	69	24	92
Freshness	69	80	75	90
Size	51	83	32	93
Firmness	37	6	23	2
Free from insect damage	33	87	67	86
Cleanliness	5	86	9	9

Source: Adapted from Coulibaly et al. 2011.

Probst (2008) argued that 'freshness' is closely correlated with the 'health value' of the vegetable and that this relates to the nutritive health value. Thus health-consciousness was directed to positive attributes, not negative attributes, like contamination.

CONSUMER PERCEPTIONS ON RISK

Risk Perceptions on *Organically Grown* Fruits and Vegetables

In the international context, the growing consumer concerns about the quality and safety of conventionally grown foods are considered to be one of the major motives for the increased demand for organic foods (Hoefkens et al. 2009; Magkos et al. 2006). Organic agriculture has been defined as a holistic production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles, and soil biological activity. It emphasizes the use of management practices in preference to the use of off-farm inputs, taking into account that regional conditions require locally adapted systems (FAO-WHO 1999). The ways in which consumers perceive organic products have been investigated in a number of studies, as has been reviewed, for example, in Bonti-Ankomah and Yiridoe (2006). Based on existing consumer science literature, organic foods are mainly perceived as healthier and safer compared to conventional foods. Whenever organic foods are purchased, it follows that they are subjectively perceived by the consumer to be of superior quality (whether or not this is scientifically guaranteed) (Midmore et al. 2005). So, from the point of view of the organic food consumer, 'organic' implies 'quality' in itself.

In Ghana, Osei-Asare (2009) in a countrywide survey of households and other institutions potentially interested in organic food received a strong feedback ranking food quality and safety highest, after providing supplementary explanation on what organic produce is to those who did not know it. Holding certain factors such as price and product availability constant, about 93% of consumers opted for organic products when given the opportunity to choose between organic and conventional produce based on the attributes "healthier (49.6%)" and "free from chemicals (40.5%)".

While it is obvious that consumers will look favorably at a product explained by the interviewer as healthy compared to one explained as risky, the fact remains that healthy food is an important quality attribute. Whether 'organically' grown food is from a scientific point of view really superior over conventionally produced foods is a different matter (Midmore et al. 2005; Williamson 2007; Hoefkens et al. 2009). In many cases as in West Africa, the term '*organic*' has been limited only

to production where synthetic pesticides and/or chemical fertilizers are not used. That this does not imply an increased safety was, for example, demonstrated by Drechsel et al. (2000) showing that the extensive use of fresh poultry manure can contribute to microbiological contamination of vegetables.

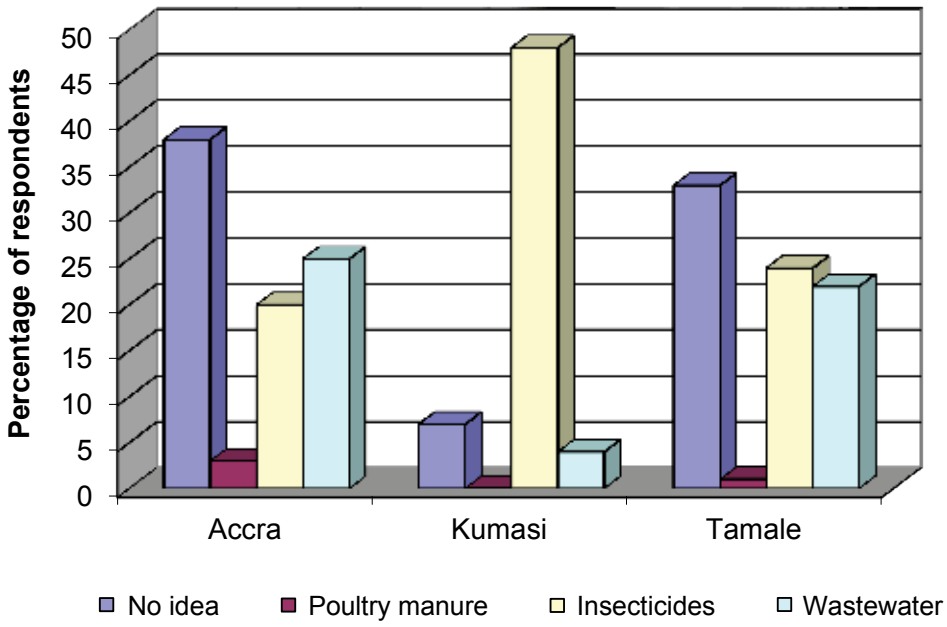
Risk Perceptions on Wastewater Irrigated Vegetables

Obuobie et al. (2014) reported about risk perception studies carried out over many years with several hundred consumers of urban and peri-urban irrigated vegetables in the Ghanaian cities of Accra, Tamale and Kumasi. When asked if consumers would buy vegetables irrigated with water of questionable quality if they had a choice, 75-96% answered – as could be expected – in the negative. Others were of the opinion that such vegetables could be cleaned adequately to remove any disease-causing organisms. Between 40 and 60% of the consumers thought it important – when directly asked – to know where the vegetables were produced in order to avoid those irrigated, for example, with wastewater.

Consumers' reactions as to what they would do in a (realistic) scenario where all leafy vegetables on urban markets were grown with wastewater were analyzed too. Nearly 40% of the respondents in Tamale said they would clean vegetables adequately and use them instead of avoiding them. At least 30% would either cultivate vegetables themselves or buy from rural areas.

Between 60 and 80% of the respondents in Accra and Kumasi pointed out that they would like to stop buying vegetables from the market, though they could not point out where they would go for safer vegetables which could be an opportunity for providers of certified food. Comparing different potential risk factors across cities, consumers in Kumasi had fewer concerns with water pollution than in Accra and Tamale. It is more common to see irrigated vegetable farmers using polluted water from drains in Accra and Tamale than in Kumasi, and this could influence the decision on the input with the highest risks (Figure 2).

FIGURE 2. City specific food risk perceptions in Ghana.



Source: IWMI unpublished.

Difference between Perceived and Measured Risks

While, for the consumer, it would be challenging to distinguish between crops grown with natural or industrial pesticides or different water qualities, farmers should have a fair understanding based on their practice and own quality indicators (smell, color, etc.) (Keraita et al. 2008; Knudsen et al. 2008). In view of irrigation, studies conducted in West Africa with vegetable farmers using highly polluted (waste)water for irrigation showed a significant mismatch between objective and subjective risks.

In Ghana and Burkina Faso, for example, several studies have shown very high microbial contamination levels of irrigation water and irrigated vegetables (Amoah et al. 2011; Cissé 1997) with corresponding high potential risk of infection (Seidu et al. 2008; Drechsel and Seidu 2011) based on experienced outbreaks and globally accepted dose-response functions (Blumenthal et al. 2000; Blumenthal and Peasey 2002; Shuval et al. 1986).

Although poor water quality was perceived by farmers as a production challenge, the use of the water was not perceived as a noteworthy risks factor, especially not for consumers of irrigated produce. This is not surprising as, in Ghana, there are only a very few cases where the farm family also consumes the (exotic) vegetables they produce. Exotic vegetables, such as lettuce, are not common in the traditional Ghanaian diet consumed at home, in contrast to the street food sector where small amounts of raw salad are a common side dish of popular fast food like rice and chicken.

Given the length of the marketing chain, health complaints related to their produce rarely reach the farmers. The situation is different in Francophone West Africa where green salads are more common part of food eaten at home; but so also are risk-mitigation measures like the use of bleach for cleaning vegetables in kitchens, a powerful sanitizer which is not commonly used for food in Ghana (Amoah et al. 2011). However, also in Burkina Faso, the notion of 'healthy' has to be detached from our (advanced) health perception of hygiene and pathogens as stressed by Ouedraogo (2002). Local farmers in Ouagadougou, Burkina Faso, perceived the risk of getting sick as determined by God, bad luck, and their own "stomach strength".

In view of occupational risk, about 10% of the 138 farmers interviewed in Accra mentioned the occurrence of skin irritation as a likely result from direct water contact (Obuobie et al. 2014), while, in general, there was no significant difference in health complaints between farmers using wastewater and the control groups in Accra and Ouagadougou (Gbewonyo 2007; Gerstl 2001).

Reasons for the mismatch could be many:

- It can be that the correlation between contamination and heath is weak as the scientific dose-response functions have not been locally verified and underestimate local adaptation. Thus the researchers expect a larger impact than what actually happens on the ground.
- There could be a higher health impact but also denial as farmers might fear loss of their source of water or land (Box 1).
- It is likely that the common educational level does not support any deeper knowledge about contamination pathways. This deficit applies in particular to 'invisible' health risks as originating from pathogens or pesticides.
- It is likely that the reason especially of diarrheal infections is hard to trace as it can derive through often complex and little transparent pathways related to contaminated food or water or poor personal hygiene, which are difficult to distinguish.
- It can be that farmers, in fact, do not perceive any particular risk as they are facing multiple hazards related to poor sanitation, and each could cause harm, but none is any

longer perceived as a hazard ('illusion of risk-control'; Knox 2000), or as they are since childhood normal components of a farmer's environment.

Box 1. Defensive strategies.

Interview results might be biased if farmers feel the need to develop defensive strategies to show that their practices are safe so that their business is not jeopardized or so that they are not seen as propagators of public-health risks within the community. Negative perceptions by the interviewer, the public, or harassment from authorities and media, can drive farmers to develop defensive strategies to consciously underestimate health risks associated with their practice. Similar findings have been reported among pesticide users in Brazil (Peres et al. 2006). Such denial and defensive strategies can greatly hinder risk communication and are difficult to separate from low-risk perception associated with living conditions that are unsanitary. Therefore, it is crucial to build trust among community members and vendors for any risk-factor communication (Siegrist 2000). This was also shown in a related study done for street-food vending where purchase of street food was mainly based on trust in the vendor, since no reliable indicator existed for actually evaluating food safety. Therefore, trust also becomes a necessity, where no other evaluation parameter is available (Rheinländer et al. 2008). The opposite of a defensive strategy also occurs where farmers expect external assistance and therefore exaggerate their problems.

Source: Keraita et al. 2010a.

Such personal circumstances equally influence researchers, who might have been brought up under different sanitary standards and are now challenged to perform unbiased interviews. Moreover, being exposed to different levels of sanitary standards, both scientists and farmers might have problems in agreeing on common indicators for diseases to be associated with the wastewater or excreta exposure on the farm. Detailed epidemiological studies will be necessary to show the fraction attributed to different risk factors.

Compared to pesticide use and Integrated Pest Management (IPM),[3] training on health risks from wastewater irrigation has not been mainstreamed in curricula including those of agricultural extension officers due to the informal nature of this practice and its relatively low national importance from the traditional rural agricultural perspective.

Risks from pesticide use in vegetable production for farmers and consumers have been confirmed by Ntow et al. (2009) and Amoah et al. (2006). In contrast to the use of polluted water, farmers were generally aware that pesticides are hazardous (Ntow et al. 2006) although there were slight differences in farmers' and experts' perception of the relative hazard of using the WHO ranking as reference. Inhalation and irritation were perceived as the main indicators of a pesticide's hazard level.

IPM and organic agricultural strategies can produce comparable yields, and have resulted in many success stories (Afreh-Nuamah and Akotsen-Mensah 2015). However, pesticide use remains an issue, especially in the labor-intensive production of exotic vegetables where returns to labor and economic benefits are often perceived low in contrast to the risk of failure (Danso et al. 2002).

[3] See, for example, Nacro (2007) and Afreh-Nuamah and Akotsen-Mensah (2015).

Difference between Expressed Risk Perception and Actual Behavior

Awareness alone is not a driver of behavioral change (Karg et al. 2010). Similar to the reasons outlined above for farmers using polluted water, it appears as if consumers' actual behavior does not reflect the expressed (genuine) interest in healthy food. Many observations in markets showed that once a consumer has assessed the physical appearance of vegetables positively, the standard discussion with the seller concerns the price.[4] Questions on the origin of the produce or its treatment in view of possible contamination (or 'organic' production) are very seldom (Obuobie et al. 2014), and the few exceptions reported in the literature are associated with differently educated consumers, as in a reported case in Kumasi, with expatriates (Mensah et al. 2001).

In a study in Kumasi and Sunyani, about 49% of the 217 consumers interviewed reported being concerned with pesticide residues but only 5% said this concern has prompted them to change their buying habits (Nurah 2000).

However, it should be noted that for the consumer – even if interested –it is practically impossible to distinguish between likely contaminated and uncontaminated crops, and it is also very unlikely that any seller would reveal a questionable vegetable source which could reduce the market value of the crop.

Combined with the general low education on pathogenic pathways and more positive association of green vegetables with health than with risks, it would probably be inappropriate to expect more 'risk mitigation measures' from consumers to verify their interest in healthy food (Obuobie et al. 2014). Also at the farmers' end, protective measures (like rubber boots), be it to avoid contact with polluted water or pesticides, did not show much adoption as it is common across the tropics because of discomfort and heat and similar reasons (Amoah et al. 2011; Keraita et al. 2010a; Ntow et al. 2006). Among farmers, who are using synthetic pesticides, fewer than 30% of the respondents wore full protective covering, while among wastewater farmers fewer than 10% used at least some protective gear (Ntow et al. 2006; Obuobie et al. 2014).

Aside from personal discomfort and limited risk awareness, habits are another major motivational barrier which prevents knowledge translating into actual behavior. Habits have grown over a long time, are carried out unconsciously, frequently and go along with norms and social influence on the practice in question ("this is the way one does things"). Therefore, change of habit usually requires high psychological costs, and needs a strong incentive like a profit gain of at least 30%. However, barriers such as habits, and opportunity costs, are mostly not taken into account in campaigns introducing 'best practices' (Karg and Drechsel 2011).

An increase in interest in health-risk issues and risk mitigation was however noticed where farmers were exposed to the topic through research projects and media attention (Keraita et al. 2008). Thus even with limited personal risk awareness, farmers felt the pressure to respond to avoid public exposure which could affect their business.

WILLINGNESS TO PAY FOR SAFER FRUITS AND VEGETABLES

Assessing consumer's willingness to pay (WTP) for food quality attributes has been a major stream of research in agricultural economics. In view of food-safety risks and the option to offer

[4] It is important to add that although a competitive (low) price is the target of consumers' bargaining, surveys testing consumers' interest in 'quality' vegetables showed that a low price can be associated with low quality (Probst 2008).

'certified (risk free) produce' the common question is whether consumers are willing to pay more (a premium) for this service and how much more, allowing others to analyze later if demand and amount are sufficient to cover the additional costs for labeling and quality control.

There are many methodological approaches for rigorous willingness to pay for atudies and it is beyond the scope of this paper to elaborate on the used technique and quality of the reviewed studies.

The overall picture across the existing studies corresponds well with consumers' general interest in food safety. Most studies confirm a broad willingness to pay for increased safety of produce independently, if related to organic food or clean irrigation water. There was also an indication that customers expect high-quality food to have a higher (premium) price (Probst 2008), although there were different opinions if organic and conventional food should be differently priced (Danso et al. 2002; Osei-Asare 2009).

In a study across Ghana, 56% of consumers accepted a maximum premium payment of 20% for organic products (Osei-Asare 2009). An even higher premium (of over 50%) for organic fruits and vegetables was recorded by Owusu and Anifori (2012) and Coulibaly et al. (2011). For example, given a standard price of USD 0.25 for an average size head of cabbage or a pack of tomatoes treated with synthetic pesticides, consumers were willing to pay up to 57 and 50% more for organic cabbage and tomatoes, respectively, above that of synthetic pesticide–treated cabbages or tomatoes in Ghana. In Benin, premiums were estimated to reach up to 66% for cabbages and 56% for tomatoes. While Owusu and Anifori (2012) conclude that their data are "suggesting a huge market potential for organic fruits in Ghana" the studies did not test if the actual ability to pay can support the expressed willingness.

There are significant differences between types of shops and their customers as reported by Nurah (2000) for Ghana and Lagerkvist et al. (2012) for Kenya. Interest in organic food and willingness to pay a premium increased significantly from traditional markets to high-end markets, that is, with wealth and educational level of the customers.

In another study done in Ghana, 95-97% of the urban households were willing to pay twice as much as currently for safer vegetables while street food consumers offered less than 10% (Yahaya 2009). The interesting part of this result is that exotic vegetables and raw salads are not part of the traditional Ghanaian diet and in general not consumed within homes but only in streets or restaurants.

While we miss the data to assess if the expressed premiums would support an organic business with or without labeling, another type of reality check was provided by Nurah (2000) who interviewed 137 vegetable traders and retailers in the Ashanti and Brong-Ahafo regions of Ghana, including Kumasi and Sunyani. The author found that 73% of these sellers were not desirous of selling organic products, mostly as it is a) difficult to identify genuine organic products on the market, and b) many have an unattractive appearance which does not appeal to consumers who prefer vegetables and fruits that are well-ripened, firm and free of sensory defects such as insect holes, blemishes, soft spots or rots and cracks.

Thus, 99% of all sellers in the central and road side markets of Kumasi and Sunyani believed that their customers are more interested in cheap, but good-looking, vegetables, resulting in limited efforts to separate crops grown organically. Only a very small proportion of customers in the city central markets (less than 5%) asked for chemical-free vegetables but they will not refuse to buy conventional vegetables in the absence of chemical-free vegetables. In the green groceries and supermarkets however, 20% of traders perceived consumer interest in organic products by about 15% of their customers (Nurah 2000), which in two out of three cases belong to the middle- or upper-income bracket (Osei-Asare 2009).

MANAGING RISK

As objective and subjective assessments of safety deviate in many cases (Grunert 2005; Lazo et al. 2000) and the natural interest in healthy food does not automatically translate to risk-reducing behavior – or willingness to pay into related priority setting and/or ability to pay – safeguarding public health cannot rely on consumers' views and expressed perceptions and intentions. This is even more important where a disease can be infectious, as it is the case for pathogens transmitted via wastewater irrigation into the food chain serving a market as large as the street-food sector where every day in Ghana's five largest cities about 700,000 urban dwellers eat fast food with a raw salad (Drechsel and Seidu 2011).

Until recently, consumer information and education were considered the mantra for initiating behavioral change. More recently – and in light of the failure of (short-term) attempts to 'educate consumers'– this attitude has given way to a recognition of the necessity to deal more closely with consumers' perceptions of risk and safety and the relevant reasons (Frewer et al. 2005; Scott et al. 2007) to identify options for supporting or triggering behavioral change from initial awareness to actual application (Karg and Drechsel 2011). In the following, some options, opportunities and limitations are presented.

Certification as a Tool for Guiding Consumers

Demand for certified organic foods and products has been growing steadily over the past decade in European and North American markets to a current retail sales level well over USD 46 billion per year (*http://organicafrica.wsu.edu/*).

Imported organic products represent an increasing percentage of the supply and represent a value-added opportunity for producers and businesses in Africa to export to these markets. Access to the organic market requires undergoing a rigorous certification procedure to comply with the various organic standards in place. Efforts are underway in Africa to develop opportunities for trade of organic products and their certification, supported by the African Growth and Opportunity Act (AGOA).

As in most West African countries, the organic agricultural sector in Ghana is still relatively underdeveloped. In 2013, about 28,000 hectares of agricultural land were under organic cultivation, accounting for 0.18% of the total agricultural area in Ghana. These numbers, including fully converted land as well as "in conversion" land area, have been growing substantially in recent years and relate mostly to *export crops* (Willer and Lernoud 2015). Ghana's main organic export commodities aside from cocoa are palm oil and fresh fruits, partly relying on outgrower schemes. The certification of farms already using organic methods makes progress in these markets. Other key organic products include bananas, cashew nuts, culinary herbs, cereals, export vegetables, cotton and shea butter (IFOAM 2003). Ghanaian NGOs and farmer groups promote the expansion of organic production in the existing product range as well as in new sectors. These indigenous groups are active in developing and disseminating improved organic farming methods. Compared to the export market, investments in the domestic market for organic produce are negligible. Thus despite the reported consumers' preferences and willingness to pay a premium, the amounts appear to be more academic and do not attract the business sector. Probst (2012) therefore concluded that demand from the food-vending sector alone will not institutionalize domestic certification mechanisms; but needs public commitments to a multi-stakeholder process for developing domestic certification mechanisms.

In view of the *domestic market,* attempts at certification are only emerging. The spectrum ranges from farmers growing organically but without a third-party audit, and selling their produce to the local market without attracting any premium. Middle-class Ghanaians prefer to buy from such sources. At the other end of the spectrum major supermarkets patronized by the upper class started selling certified vegetables imported into the country, for example, from South Africa. Label recognition remains generally low and only a minority (12.5%) of consumers identified the organic produce they purchased by reading the labels (Osei-Asare 2009).

Some organizations in Ghana that promote certification and/or provide technical support towards certification are in particular the Ghana Organic Agriculture Network (GOAN), as well as the Kumasi Institute of Tropical Agriculture (KITA), the international Agro Eco-Louis Bolk Institute, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and Care International to name a few. Others are the Crop Services Directorate (CSD) of the Ministry of Food and Agriculture (MoFA) – with the Desk for Organic Agriculture, and the Plant Protection and Regulatory Services Directorate (PPRSD) of the same ministry in Pokuase, and some selected consultants at the public universities. Examples of some initiatives aiming at healthier food are:

- *Quin Organics,* a subsidiary of Quarcoo Initiatives Company Limited (QUIN), is a platform created for the marketing of organically produced fruits and vegetables on the local, regional, and international markets. Quin Organics is focused on postharvest handling of fresh produce (cool chain, value addition, consumer packs and supplies) working with small-scale farmers, farmer groups and Farm Based Organizations. Quin Organics uses the organic box system and supplies a surprise box of organic fruits and vegetables weekly. Its produce is certified by the United States National Organic Program (USDA-NOP). *http://www.quinorganic.com/*
- *Weija Agricultural Development (WAD) African Foods Limited* started in the year 2000 as a vegetable project and a logistics provider to small-scale farmers at the village of Tuba-Weija. The office was at the Weija Irrigation Company site. The project extended to Atwia the following year (2001) where it started exporting sugarloaf pineapples to Switzerland. The company exports organic fresh and dry pineapples, coconut, mango, banana, ginger and papaya. The project moved its office to the Ghana Industrial Commercial Estate limited (GICEL) facility in the year 2003. It started processing dry fruits (pineapple, coconut, mango, papaya and banana) at GICEL. Currently, the company can be located in its own facility at P1 GICEL. WAD is Fairtrade and Organic certified. The project exports weekly or fortnightly to Switzerland and also to Germany. *http://www.wadco.ch/; http://pip.coleacp.org/en/node/18426*
- *Volta Presentation*: Volta Presentation (VP), a small and developing farm in the Volta Region of Ghana is recognized as one of the farms in West Africa that practices healthy, sustainable and biodynamic agriculture in its growth and distribution of produce without chemical pesticides. It supplies most of its vegetables all year-round to selected customers in Accra. Even though VP produces organic vegetables it is not verified by a certifier or third party; therefore, it is meant for the local market and not for export. *http://voltapresentation.com/*
- *Green Labels for safe vegetables:* In September 2014, the Ministry of Food and Agriculture proposed initiating 'Green Labels' for safe vegetables in the Ghanaian market (MoFA 2014). This was to be done in collaboration with the Ghana Standard Authority,

the vegetable producers and other relevant stakeholders. The "Green Label" is expected to be the trade mark for hygienic and wholesome vegetables in Ghana by ensuring farmers use best agricultural practices in the production of vegetables. According to the Ministry, only vegetables produced under hygienic conditions will be certified and labeled as wholesome for consumption thus compelling others to adopt the best practices. The Ministry's initiative could be a positive step towards safeguarding safety and quality of vegetables in the domestic markets in Ghana. However, identification of safer produce will require regular laboratory analyses and should cover the entire farm-to-fork chain, as postharvest contamination is very common (Amoah et al. 2011). A key challenge will be who should pay for the analysis.

- *Individual farmer organizations:* The Gyenyase Organic Vegetable Growers' Association (GOVGA) in Kumasi, is one of many associations trying to find a market, like selling directly to restaurants, groceries, supermarkets, etc. Normal, wholesale and retail markets are not receptive for different qualities, and the organic produce from GOVGA got mixed up with other inorganically produced vegetables, making the farmers' efforts to organically produce vegetables futile (Boateng et al. 2007). That organic and conventional produce is often presented without differentiation has been confirmed by several studies (Nurah 2000; Osei-Asare 2009).

To reach a broader populace, Nurah (2000, 2001) suggested that an important step would be the development of an exclusive market channel or segment for organic vegetables through the cooperative effort of producers, *without* having to resort to labeling and monitoring, at least in the short term. Although recent attempts to build dedicated outlets have failed, the reasons were more of an institutional nature than market-related (Larbi et al. 2014). Such a first step will help minimize the cost and effort involved in labeling. To establish a domestic safety label later, which goes beyond a niche market for better educated (and wealthier) strata, intensive educational and marketing strategies are needed. Another consideration is to seek association with already established local private- or public-sector brands which symbolize food quality and have locally viable monitoring systems in place, than subscribing to any international quality label which (i) might not be locally known, and (ii) would build on, for example, European standards, capacities, and hazards which might not match the local ones. Such a recommendation is supported by WHO's concept of health-based targets which is recommending a step-wise approach of risk reduction (Keraita et al. 2010b).

Enhancing Food Safety through National Standards and Legislation

Many countries have food-safety standards linked to recommendations made by UN Organizations, like the *Codex Alimentarius* (FAO-WHO 1997, 1999). These standards might be more 'targets' in the context of developing countries where poor smallholders engaged in farming or marketing face diverse constraints to implement international standards or comply with best practices which are not realistic in the local context. Aside from capital, land and labor constraints, locations, water sources and quality, transport means, markets, etc., vary with many factors out of control for the individual concerned. Another challenge is that the public sector has little capacity for enforcing (imported) standards, due to lack of staff, financial and material resources (Probst 2012). Moreover, markets like the vegetable market are highly informal, comprising a large number of individuals that are not registered and very mobile. As a result, food safety of vegetables is

currently "ungoverned" in urban West Africa (Probst 2012) although there are, for example, 12 institutions and agencies involved in food-control activities in Ghana. Some of the key institutions and legislations are shown in Table 2.

TABLE 2. Key institutions and selected legislations in Ghana.

Legislation	Institution
Food and Drugs Act (P.N.D.C.L. 3058, 1992)	Ghana Food and Drugs Authority
Standards Decree (N.R.C.D. 173, 1973)	Ghana Standards Authority
General Labelling Rules, 1992 (L.I. No. 1541, 1992)	Ghana Food and Drugs Authority
Ghana Standards (Certification Mark) Rule, LI662,1970	Ghana Standards Authority
Pest and Plant Disease Act 307, 1965 (L.I. No. 1541, 1992)	Plant Protection and Regulatory Services Directorate (MoFA)
Pesticides Control and Management Act 528, 1996	Ministries of Food & Agriculture (MoFA)
Infectious Diseases Act, 1908 (CAP 78)	Ministries of Health

Source: Adapted from MoFA and World Bank 2008.

More than often, the mandates overlap between institutions causing confusion while gaps remain.[5] However, there is an ongoing review of the statues to realign the functions and responsibilities of these agencies to overcome overlapping areas and increase efficiency.

A key authority is the Ghana Standards Authority (GSA) formerly the Ghana Standards Board (GSB): As an authority under the Ministry of Trade and Industry, the GSA is tasked with setting standards, including those on food quality in line with relevant international standards, like the FAO-WHO supported Codex Alimentarius. The application of food standards in products and processes is governed by national standards. The GSA has established over 300 standards on food products that offer protection, reliability and choice while ensuring safety and quality. Sections of the standards on food safety touch on hygienic, microbiological, packaging and labeling requirements. An example of such standards is the GS ISO 22000:2005, which specifies requirements for an enterprise in the food supply chain, to plan, implement, operate, maintain and update a Food Safety Management (FSM) system. The FSM combines the Hazard Analysis and Critical Control Points (HACCP) plan (Box 2) with basic conditions and activities necessary to maintain hygienic environments suitable for the production, handling and provision of safe end products via good practices. The standards require that all hazards expected to occur in the food chain, including those associated with the type of process and facilities used, are identified, assessed and controlled or eliminated, to ensure food safety (Drechsel et al. 2014a).

Another key operational area of the GSA is quality control and testing: chemical and microbiological analysis of food and drinks and agricultural products for quality-evaluation and certification purposes, pesticide residues in food products, product-testing and certification to ensure conformity with specific (export) target markets. However, as the GSA is addressing many sections of life, it is less equipped in terms of staff and resources to follow up on all its responsibilities. For food safety, the GSA is, in part, relying on assistance by the Food and Drugs Authority (FDA) (Drechsel et al. 2014).

[5] The institution in charge of food safety controls, for example, for long followed normal office hours although large parts of the fast food sector started operations only in the evening.

Box 2. Hazard Analysis Critical Control Point (HACCP).

The HACCP is a systematic preventative approach to food safety and quality assurance of food products based on a system of identification, evaluation and control of hazards. It addresses physical, chemical and biological hazards as a means of preventing threats rather than inspection of finished products. The HACCP is recognized by FAO and WHO as a Quality Assurance System that contributes to enhancing food safety and preventing the outbreak of food-borne diseases. Legislators in an increasing number of countries stipulate legal requirements regarding hygiene in the food industry based on the HACCP principles as laid down in the Codex Alimentarius Code of Practice – General Principles of Food Hygiene.

Source: Drechsel et al. 2014a.

Interestingly, in the survey of Osei-Asare (2009) the codes of ethics required in the practice of organic agriculture by the Ghana Standards Board were hardly known among the organic producers surveyed. Only 14% of the *organic* producers were aware of the existence of such codes, reflecting probably well the challenges that regulatory bodies in Ghana face.

Enhancing Food Safety via Cooperate Social Responsibility[6]

For increasing food safety, corporate social and environmental responsibility can be powerful drivers where public institutions and interventions miss capacity to stimulate change.

Independent of any export labeling, international companies including supermarket chains are increasingly subscribing to international codes of conduct, like the Global Social Compliance Programme (GSCP) supported by the Foreign Trade Association (FTA) and its Business Environmental Performance Initiative (BEPI), the latter serving retailers, importers and brands committed to improving environmental performance in supplying factories and farms worldwide. Supermarkets or wholesale companies engaging outgrower schemes can opt for compliances with a 'responsible sourcing policy' or other best practices or codes of conduct to meet international quality and sustainability standards, and to remain internationally competitive. For instance, in Botswana and South Africa industries and supermarket chains are directly sourcing their crops from urban and peri-urban vegetable, grapevine or olive farmers to secure a continuous supply, also from sites where wastewater of low quality is used for irrigation. For risk reduction, the companies are either supporting best on-farm practices, or put postharvest measures in place to clean the crops from possible pathogenic contamination. This is in line with WHO's emphasis on health-based targets, where the irrigation water quality is less critical than the quality of the food at the point of consumption (WHO 2006). Thinking beyond the farm is also important, as even where irrigation water is safe, postharvest contamination can be severe. But here also, social responsibility programs can be very powerful change agents. In Ghana, for example, about 90% of the wastewater irrigated vegetables are sold raw as side dishes to popular fast food centers in the urban street food sector. For authorities and NGOs it is a challenge to enter or control this informal sector. However, the situation can be different for the private sector. Nestle, for example,

[6] This section draws on Drechsel et al. Forthcoming.

supplies the street restaurant sector across West Africa with ingredients, like Maggi® bouillon cubes, and uses its branding power to (i) maintain close links within the sector, and (ii) use it to advertise its brand. As part of Nestle's consumer service program, the company initiated in Ghana the formation of trader associations, the Maggi® Fast Food (Seller) Association (MAFFAG) which quickly became the strongest association in Ghana's street food sector. MAFFAG regularly provides training in food preparation, cooking, environmental hygiene and food safety throughout the country combining elements of corporate responsibility with branding, free merchandise, and product promotion. Compared with governmental workshops, the MAFFAG events attract large crowds, and their training programs are very well positioned for addressing food-safety concerns across the informal street food sector.

As the Maggi® colors are today prominent in West Africa's street food sector, the high degree of brand recognition also implies responsibility to maintain the company's quality image. This motivation facilitated in Ghana the strong interest of MAFFAG in training in safe vegetable washing to minimize any food-related risk including those from vegetable irrigation (Amoah et al. 2009). Any 'safe produce' branding would thus be most powerful if it could be backed by another brand locally well-known for quality.

Private-sector support is not only important where the public sector struggles but also where initially only a minority of consumers with better education will support a safe food niche market. Although it can be anticipated that consumer demand will continuously increase through awareness creation, market-based incentives might not be sufficient for success at scale and have to be complemented with other triggers for the adoption of safety practices. Social marketing offers particular opportunities as it is only a relatively small step from the promotion of handwashing to salad-washing (Karg and Drechsel 2011; see below). Also here private-sector participation can be powerful as for example the Public-Private Partnership to Promote Handwashing between UNICEF and UNILEVER in West Africa has shown (see *http://www.unicef.org/wcaro/overview_2765.html)*.

A current opportunity for private-sector support was initiated in 2014 by the Dutch Embassy in Ghana. The GhanaVeg Initiative's mission is to establish a sustainable and internationally competitive vegetable sector that contributes to inclusive economic growth and has the capacity to continuously innovate in terms of products and services. GhanaVeg (http://ghanaveg.org/) is driven by a strong belief in healthy and quality vegetables from Ghana through new ways of doing business. The initiative is supported by (and also serves) the Dutch private sector. Although it targets more the high-end domestic and international market, the technical support and call for innovations around input supply, production, processing, retail and logistics could build important linkages and incentives for increased food safety.

Enhancing Food Safety through Other Mechanisms[7]

As food safety can be jeopardized from farm to fork, the actual task goes beyond (organic) farming. In fact, the adoption of safe practices by key actors means that farmers, produce sellers and those who prepare food in households and street restaurants need to change their behavior and routine practices. However, although experience shows that conventional awareness-raising and training in improved safety practices are important, both are not a guarantee for any behavioral

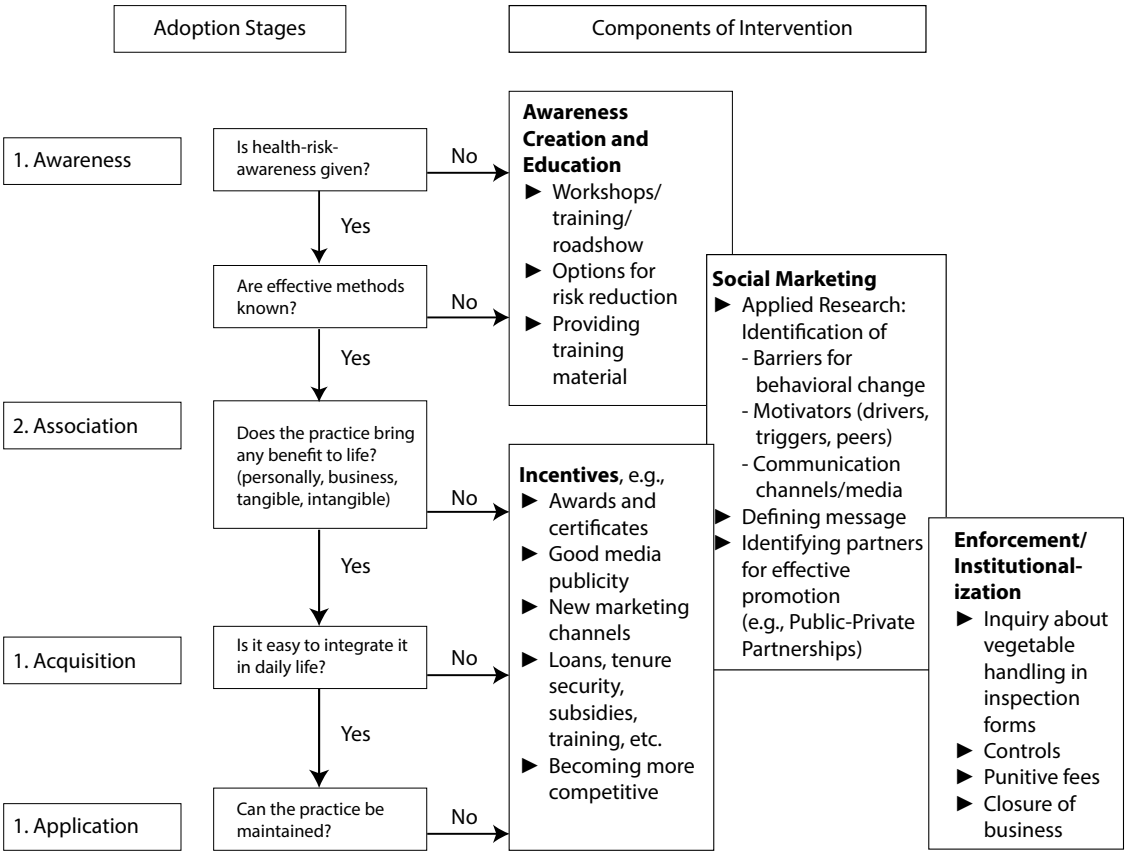
[7] The section draws on Drechsel et al. 2014b.

change and practice adoption (Drechsel and Karg 2013). Indeed, for most risk-mitigation measures, the related actors will need to make an 'investment'. The investment can be in different forms such as (i) increased labor, (ii) some capital or operational costs, (iii) loss of space and yield, or (iv) other inconveniences from behavioral change.

To support this investment, it is important to understand what could trigger behavioral change and/or which incentive systems and support are needed to trigger and maintain it from awareness creation to an effective and lasting change of behavior (Figure 3).

Some specific factors that could enhance adoption of risk-mitigation measures in urban vegetable farming on unused open spaces are given below.

FIGURE 3. Suggested multi-strategy campaign framework for the adoption of interventions for the reduction of health risks from wastewater irrigation in urban Ghana.



Source: Karg et al. 2010.

Economic incentives: As discussed above, the payment of a premium for safer crops could be an ideal incentive for farmers and traders to adopt innovations. However, this will only happen if consumers show risk awareness and are willing to pay more for safer produce. Where this is the case, producer groups should be encouraged to sell their products outside the existing marketing channels to avoid mixing-up with unsafe produce. This could be done by linking farmers directly to large consumers like hotels and demarcating specific selling points in markets and supermarkets.

Economic incentives can also come from the public sector, for example through subsidies or soft loans for key actors to adopt safer practices, or rewards for those who have already adopted them. For this to happen, local authorities need to understand the overall benefits of safer practices to society, as well as the overall costs. A quantification of such costs and benefits, and

demonstration that benefits are higher than costs will help justify this public support. A supporting measure can be economic disincentives, such as taxes or fines for noncompliance with mutually agreed safety measures.

Enabling stakeholders to visualize the risk: To encourage behavioral change, key actors need to be aware of the risks of wastewater irrigation and the benefits of adopting safer practices. This awareness concerns consumers like traders and producers (Amoah et al. 2009). The importance of awareness to increase demand and willingness to pay for safer products has been discussed in the previous section. A particular challenge of pathogenic risks is their invisible nature which makes it difficult for the key actors to (i) be aware of the risks and (ii) to assess the effectiveness and quantify the impacts of suggested risk-mitigation measures. Risk visibility would greatly facilitate risk perceptions and encourage adoption of safer practices. While many actors like farmers and produce sellers in low-income countries use physical indicators such as color, neatness, dirt and odor to assess the (lack of) cleanliness of the produce, these physical indicators do not always correspond with microbiological indicators. In fact, organic food is generally perceived as not neat as revealed during interactions with consumers (Osei-Asare 2009). Innovative ways are needed for scientists to work with consumers, traders and farmers to validate physical indicators or combinations of physical indicators that can indicate levels of microbiological contamination (Keraita et al. 2008; Amoah et al. 2009).

Social marketing: Social marketing seeks to induce a target audience to voluntarily accept, modify or abandon behavior for the benefit of individuals, groups or society as a whole (Siegel and Doner Lotenberg 2007). This could be an important tool for adopting risk-mitigation measures in low-income settings where economic (market) incentives are limited by low-risk perceptions among customers (Drechsel and Karg 2013).

Even if health considerations are not valued highly in the target group, social-marketing studies can help identify valuable related benefits, including indirect business advantages (such as attracting tourists), improved self-esteem and a feeling of comfort or respect for others. Studies must look for supportive core values that trigger the adoption of innovative approaches. For example, if a feeling of being 'advanced' can be associated with using vinegar rather than salt for vegetable washing, or drip kits compared to watering cans, then the social-marketing messages and communication strategies should reinforce these existing positive associations (Karg and Drechsel 2011) as it was successfully demonstrated in handwash and end-open-defecation campaigns. The trigger in these cases might not be 'health' per se, but feeling of 'comfort', 'status', or 'disgust'. As in handwash campaigns, women in charge of food preparation should be a key target group.

An example for negative incentives would be fear of exposure: Where safety regulations cannot be monitored by authorities, media exposure ('naming and shaming') can be a powerful alternative to steer compliance. Urban farmers and food restaurants in Ghana feared media exposure as it can trigger ad hoc policy responses like eviction from the land or business closure.

Land tenure security: Concentration of population and economic activities in cities results in very limited land availability and intense competition for its use in and around urban areas. Besides, and especially in Ghana, there is often uncertainty regarding the ownership of land. In general, market forces push up land price and landowners will seek maximum revenue (rent) from their plots making farming noncompetitive. That we still see many hectares under agriculture is the result of informal farming on plots with low housing value (flood-prone zones and so forth) or where agriculture is tolerated as a transitional occupancy, especially on so-far-unused governmental or institutional land. Both forms have in common a very weak land tenure security which was often mentioned by farmers as a key risk factor for their livelihoods. This situation

concerns less fruit production, but more irrigated urban vegetable farming. An incentive such as better tenure security could facilitate farmers' interest in investments in structures that have positive health impacts, such as small-scale wastewater treatment ponds. Municipalities may adopt a variety of approaches to securing land for horticulture, including regularization of informal titles, zoning and promoting urban farming on public land (such as terraces along urban rivers). Similar incentives are possible for street food restaurants, which are often more informal than formal.

Training and extension: Another key factor for the correct application of safer practices and compliance over time is having trained and qualified actors. Media, extension services and research-extension linkages will have a significant role to play. The current curriculum of urban extension officers is not much different from the one for rural extension, and modules on exotic vegetable production or irrigation with polluted water sources are needed. Training materials (also for trainers) supporting food safety on- and off-farm have been prepared, for example, by IWMI and FAO and can be used within larger training programs like farmer field schools for urban and peri-urban producers (e.g., FAO 2007). Many more FAO training materials are available for organic farming and IPM (http://www.fao.org/agriculture/crops/thematic-sitemap/theme/spi/scpi-home/managing-ecosystems/integrated-pest-management/ipm-how/en/).

Regulations and standards: Regulations and standards, even if ambitious, can form the required framework to institutionalize new food-safety recommendations and compliance monitoring via both incentives (e.g., regular certificates) and disincentives (e.g., fees). To integrate improved food-handling practices into institutional structures, inspection forms can be updated, inspectors and extension officers can be trained and pressure can be applied to farmers and caterers to enhance compliance. However, as mentioned above, regulations should not be based on imported standards, but rather on locally feasible standards that are viewed as practical and are not prone to corruption. In this way, regulation and institutionalization may contribute to ensuring the long-term sustainability of behavioral change, whereas promotional and educational activities are usually limited to a specific time frame.

Effective communication: To be useful, knowledge (whether it is farmers' innovations, latest research findings or pressing policy issues) must be effectively shared amongst people and institutions. It is important to understand the information pathways (type of media) used by key actors, such as farmers, produce sellers and those who prepare foods in households and street restaurants, who should adopt risk-mitigation measures, so that effective communication channels are selected to reach the target groups. For example, a pilot social marketing study in Ghana showed that it is more likely that innovations spread from farmer to farmer through peers and social networks than through any external facilitation (Keraita et al. 2010a).

Farmers prefer field demonstration and/or learning-by-doing. This also verifies the importance of encouraging actors' own experimentation because it promotes knowledge generation, as well as ownership, self-monitoring and evaluation. However, it is pertinent for the implementation process to recognize the wider system within which key actors operate. The wider system, made up of institutions, media, regulatory bodies and input and output markets can have a significant positive or negative influence on key actors' decision making, while this is often ignored by scientists.

CONCLUSION

Available scientific knowledge raises safety and quality concerns on vegetables grown and marketed in low-income urban and peri-urban settings in West Africa due to continued use of improperly composted manures, low-quality irrigation water and misuse of pesticides. To address these concerns, several measures for safeguarding public health including the promotion of organic production, produce or producer certification, on-farm water-treatment systems, or improved postharvest handling have been discussed, promoted and/or tested.

Many surveys confirm that healthy food is important to consumers, and healthy-looking food is the key attribute consumers in West Africa use when buying food. But the interest in 'healthy' food and the expressed willingness to pay for it are not supported by sufficient knowledge about (invisible) risks. Thus, vegetables grown organically or biologically, or crops irrigated with high-quality freshwater are less likely to be bought if they do not look as neat and large (subjectively 'healthy') as crops grown with synthetic pesticides and/or nutrient-rich wastewater. Thus for many reasons, interest in ‘healthy’ food and expressed willingness to pay for it, do not automatically translate into the behavioral change required for actual risk management, including the payment of a premium in support of certification.

Apart from educational gaps, the limited (food)-risk perception in West Africa has also to be seen in the context of the general living conditions. Most city dwellers daily experience many potentially health-affecting factors, such as, poor sanitation, accumulating waste, unreliable supply of potable water and malaria which are routine parts of their lives. In this context, it is unlikely that poor households will give a single hazard like green-salad leaves, fresh fruits or tomatoes (which all ‘look’ very healthy) or special attention compared to more obvious hazards. So the question is which other options do we have for safeguarding public health from risk factors hidden from the public eye?

Formal tools for risk management, such as regulations, appear less-effective in the West African setup due to the informality of large parts of the food sector, poor supporting infrastructure like cooling, low consumer-knowledge levels on food safety, and insufficient institutional capacity and monitoring systems. With only 12.5% of consumers actually looking at food labels and 14% of *organic* farmers being aware of related national codes and regulations, it is not surprising that so far vegetable and fruit certifications target the export market and not the domestic market. Other certified food is only accessible to the wealthier populace, and thus does not protect the local population that consumes over 90% of urban- and peri-urban-grown vegetables. However, innovative approaches including social marketing of safe practices, direct and indirect incentives, as well as private-sector engagement, driven by corporate social responsibility, can have significant impact, and penetrate, for example, the informal sector where public authorities struggle. While subscribing to any international label would require, for example, following European standards, a step-wise approach of risk reduction based on local standards and supported by locally well-recognized brands would be most appropriate.

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