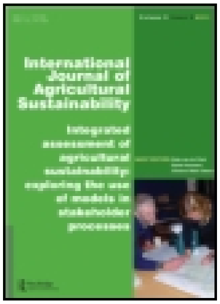

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Past studies of the use of soil fertility management strategies by farmers usually model input use decisions based on the neoclassical utility/profit maximization principle in which farmers use soil fertility management inputs primarily to increase revenues and profits. However, there is, to date, no study that explains exactly how this decision-making process occurs and the role which personal values play in driving the choice of soil fertility management inputs. This article systematically maps the relationship between choice of soil fertility management strategy (attributes), its outcomes (consequences) and the personal values that motivate the choice. It specifically uses the means-end chain approach to construct hierarchical value maps that relate the attributes to consequences, and ultimately to the personal values. The study finds that the use of soil fertility management strategies by peri-urban fresh vegetable growers is driven by five personal values, namely happiness, comfortable life, independence, good/healthy life and achievement of life goals. It also finds that while farmers seek to increase profit (hence incomes), profit maximization is not the end driver of the use of soil fertility management inputs. It concludes that a lot more goes into farmers' decision-making process relating to the use of soil fertility management practices than can be explained by the neoclassical profit/utility maximization principle. The study discusses the policy implications of these findings.

Keywords: peri-urban vegetable farmers; manure and fertilizer use; personal values; means-end chain approach

Introduction

Increase in urban populations in many developing countries has increased the demand for food in many of their cities (Karanja *et al*. 2012). At the same time, increased incomes and consumer concerns with medical health have led to growing demand for non-staple foods, especially vegetables (Okello and Swinton 2010, Okello *et al*. 2011). Peri-urban areas, due to their close proximity to urban markets with better prices, have become important sources of fresh vegetables consumed in urban centres (Nyamwamu *et al*. 2012). Thus, the cultivation and sale of leafy vegetables in peri-urban areas are an important source of income to many smallholder farmers (Odour *et al.* 1998). However, the continuous production of vegetables in peri-urban areas has led to declining soil fertility and productivity (Dechsel *et al.* 2004). Consequently, peri-urban farmers have resorted to the use of soil fertility management strategies that rely on the use of animal manure and chemical fertilizers to boost productivity of their soils (Largerkvist *et al*. 2012, Nyamwamu *et al.* 2012).

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The use of manure and fertilizers for crop production by peri-urban farmers has increased significantly in recent years (Nugent 2000, Ngigi *et al*. 2011, Karanja *et al*. 2012, Nyamwamu *et al*. 2012). Nugent (2000), for instance, highlights the intensive use of inorganic fertilizer and manure in peri-urban crop production systems in developing countries. Karanja *et al*. (2012) and Nyamwamu *et al.* (2012) document the widespread use of intensive production practices involving fertilizers in the production of urban and peri-urban crops. Kutto *et al.* (2011) find that 72% of peri-urban vegetable farmers use animal manure in leafy vegetables as a way of maintaining the fertility of vegetable plots. These studies demonstrate the growing importance of livestock manures (both solid and slurries) and chemicals fertilizers in meeting crop nutrient requirements and increasing farm productivity in general. This pursuit of increase in productivity is usually geared at improving farm revenues and hence profitability (Wanjiku and Manyango 2005). Indeed, several past studies indicate that farmers use yield-enhancing technologies such as fertilizers and organic manures to increase yield and hence farm income (Shiferaw *et al*. 2009).

Excessive use of fertilizer and animal manure can, however, result in accumulation of nitrates and heavy metals in leafy vegetables which may pose health risks to consumers. Karanja *et al*. (2012), for instance, find high concentration of nitrates and some heavy metals in kale produced in peri-urban areas where high rates of usage of these inputs occur. Kutto *et al*. (2011), on the other hand, find evidence that some of the animal manure applied in such areas contain microbial pathogens such as *E. coli* O157, Salmonella, Listeria, Campylobacter, Cryptosporidium and Giardia in some of the samples which may cause food-borne illnesses. Indeed, the World Health Organization (2005) indicates that the presence of nitrates and pathogenic microorganisms in plants is a primary risk to human health. The management and handling of livestock manures, particularly the length of time and how they are stored, further determine the pathogen loads and the likelihood of their contaminating the food crops (Hide *et al*. 2001, Kutto *et al.* 2011).

Past studies on the drivers of the use of fertilizer and manure have focused on the role of economic and institutional factors (Shiferaw *et al.* 2009). Indeed, there is a vast literature on fertilizer use, response and profitability (Mwangi 1996, Shapiro and Sanders 1998, Sullivan 2004, Ariyapala and Nissanka 2006, Poulton *et al.* 2006, Zhiying *et al*. 2007, Duflo *et al.* 2010). These studies specifically use parametric methods to identify the economic factors that influence the use, yield response and ultimately the profitability of these inputs. The underlying theme of these studies is that farmers make adoption decisions based on utility or profit maximization principle. A few of these studies acknowledge the importance of household self sufficiency in the decision-making process. However, none of them delve into the actual decision-making process. A notable exception is Duflo *et al*. (2010) who use a simple model of biases in farmer decision-making inspired by models of procrastination that combine concepts from psychology and economics literature to examine drivers of fertilizer use. Generally, no study to date has examined how decisions relating to the use of soil fertility improvement technologies are made by farmers and, especially, how personal value drives farmers' decision to use soil fertility management strategies.

This study applies the means-end chain (MEC) approach to investigate the role that farmers' personal values play in the decision to use two of the most widely applied soil fertility improvement inputs namely organic manures and chemical fertilizers. The study specifically systematically maps the process by which farmers relate the practices they use (i.e. the attributes) to their outcomes/benefits (i.e. the consequences), and ultimately the farmers' personal/core values that drive the choice of these practices. The study then uses the MEC approach to show how attributes relate to consequences, which are themselves driven by farmers' personal values in the form of hierarchical value maps. This study differs from all previous studies on soil fertility management in two main ways. First, no other study has attempted to explain how farmers' decision-making process regarding the use of soil fertility improvement inputs is affected by their personal values. Second, it also differs from all past studies that have applied the MEC approach because it is the first to apply this approach in analysing farmer's decision-making process. Understanding the decision-making process and inner motivations behind farmers' decision to use soil fertility improvement technologies is important because farmers differ from each other in personality, cognitive ability, attitude and purpose for farming. These differences are usually inadequately captured by the neoclassical utility/profit maximization approach (Wambugu *et al.* 2009).

This study focuses on the use of animal manure and inorganic fertilizers by kale (*Brasica oleracea*) farmers in peri-urban areas of Nairobi, namely Wangige, Athi River and Ngong. Peri-urban farmers supply large amounts of fresh leafy vegetables consumed in most urban towns including Nairobi. The decline in agricultural land sizes in peri-urban areas (due to population growth and the conversion of some farmlands into other uses, notably residential and industrial manufacturing) has encouraged farmers to use intensive vegetable production approaches which involve heavy dependence on inorganic fertilizers and animal manure. Kale farmers were chosen for this study because kale is one of the most widely consumed leafy vegetables by urban households in Kenya.

Conceptual framework: the means-end chain approach

This study applies the MEC approach in explaining how farmers' personal values inform their decisions to use fertilizers and animal manures. The approach was developed by Gutman (1982) and Olson and Reynolds (2001) based on the personal construct psychology developed by Kelly (1955). It has been used widely in the fields of marketing and psychology to study the factors influencing choice or decision-making by individuals and consumers. Consumer-oriented applications of the MEC approach for fresh food are vast (for an overview of the existing literature, see Santosa and Guinard 2011). In this study, we extend the use of MEC approach to the analysis of the farmer's decision-making process. In the context of farming environment, the theory posits that the farmer utilizes or applies a certain production practice (*means*) to generate particular benefits that will ultimately serve to attain more abstract cognitive personal/core values (known as *end*) which the farmer associates with the benefits. Thus, the MEC approach could facilitate the understanding of kale farmer's motivations for using fertilizers and animal manures in managing the fertility of their soils.

The generic MEC approach states that perceived self-relevant product *attributes* lead to *consequences* which lead to certain personal *values* being fulfilled through a set of *consequences*. The MEC theory is therefore a hierarchy of an individual's perceptions and product knowledge that ranges from *attributes* (A) to consumption/use outcomes *consequences* (C) to personal *values* (V). The *attributes* are usually at the top level of MEC analysis hierarchy and are the most recognizable aspect of the product by an individual. Individuals recognize the *attributes* of a product easily because they describe the features or characteristics of that product or system. Attributes, in turn, have *consequences* for the individual. For example, driving a car that is convertible (*attribute*) can be associated with a feeling of being young, cool and/or trendy (*consequence*). Each attribute may have one or more *consequences* for any given individual. Thus, the feeling of being young, cool and/or trendy can be associated with being part of a friendship/peer group or class. Being part of a friendship/peer group or class is another *consequence*. Finally, each *consequence* is linked to a core or personal *value* of the person's/individual's life. For example, the sense of being young (*consequence*) makes the driver of a convertible car feel a sense of belongingness (core/personal *value*) to peers.

An *attribute-consequence-value* (A-C-V) sequence forms a chain (also known as a *ladder*) that indicates the relationship between a product *attribute* and a core/personal *value*. A collection of all the ladders for a given domain forms a *hierarchical value map* (HVM) that illustrates all the major means-end and A-C-V connections and describes individuals' behaviour based on their core *values*. These maps usually contain many product *attributes* that are linked to a smaller set of *consequences*, which are, in turn, mapped to a core set of individual *values*.

Each *consequence* in the MEC analysis therefore supports one or more personal/core *values*. The *consequences* can be direct, indirect, physiological, psychological or sociological in nature (Gutman 1982). In the farming context, *consequences* can be thought of as benefits or positive outcomes that arise from the *attributes* (which in our case is the use of animal manure or inorganic fertilizer on kale). Thus, farmers who make decisions about soil fertility management methods (i.e. *attributes*) act so as to maximize the positive *consequences* and minimize the negative *consequences*. They learn which *attribute* leads to what *consequence*. In addition, the more important the *value* is, the more significant are the *attributes* and the *consequences* leading to this *value* (Gutman 1997).

Values are the end states of the MEC and are cognitive representations of an individual's existential goals, being similar to needs/desires that motivate action/decision by an individual. They represent the personal standards that guide an individual's thought and action (Roccas *et al.* 2002). *Values* play an important role in an individual's behaviour because they are cognitive representations of an individual's needs and desires, on the one hand, and of societal demands on that individual on the other. That is, *values* are translations of an individual's needs into a socially acceptable form that could be presented and defended publicly (Mason 1995). Application of MEC theory to farmers' decision-making process concerning choices of production practices (especially soil fertility management strategies) can be useful in explaining the hierarchy of consequences (means) and ultimate goals that guide the farmer's choices or behaviour.

A farmer's behaviour is in this context directed towards the attainment of ultimate goals which themselves relate to their personal/core *values*. Thorough understanding of such drivers of the decision-making process which informs the use of fertility management practices is imperative for development of measures to improve proper application of soil fertility management technologies, and hence safety and quality of food produced in peri-urban areas.

Research methods

The MEC analysis is usually implemented using the information gathered through the laddering interviews. This interview technique was originally developed by Hinkle (1965) and refined through subsequent work by Reynolds and Gutman (1988) and Gengler *et al.* (1995) who developed detailed interview protocols for this technique. Laddering has been widely used in personal construct research (Costigan *et al.* 2000), in research on knowledge acquisition (Rugg and McGeorge, 1995) and in organizational research (Rugg *et al.* 2002). In marketing studies, the techniques have been extensively applied to consumer research and food product design (e.g. Reynolds and Gutman 1988, Grunert and Grunert 1995, Costa *et al.* 2004). However, the application of MEC paired with laddering to study the motivational structure of farmers is sparse and limited, to our knowledge, to Salame (2004) who studied a Lebanese farmer's motivations for choice organic versus conventional production methods.

The laddering technique builds on a face-to-face (i.e. personal) case study interview format. It involves individual in-depth interviews in which the subjects/interviewees are guided through a series of questions to generate (or, in some cases, verify) associations between attribute-consequence values (ACVs). This can be done in two ways, namely in sequences utilizing an a priori list of ACVs (hard laddering), or situations in which subjects are more free to chart out their ACV associations and hence the ACVs are reconstructed during the interview (soft laddering). There is still a big debate about which type of laddering is most appropriate (Costa *et al.*

2004). Hard laddering entails the risk of discerning associations that are non-existent thus generating a very restricted scope of motivations. It also has the tendency of providing an artificial environment that potentially risks the predictive ability of the technique by reducing the active involvement of subjects during interviews (Jonas and Beckman 1998). Soft laddering, on the other hand, is more often employed in studies with few respondents (<50) and where the focus is more exploratory. It has the advantage, from the motivational viewpoint, of being more appropriate in revealing more complex underlying motivations for decisions taken by respondents (Reynolds and Olson 2001). Soft laddering is therefore more widely used in empirical studies.

Laddering interviews consist of two stages: first, respondents are asked to indicate the most salient attributes associated with the topic under study (namely soil fertility management), and second, through a series of probing questions in form of 'why is that important to you?', respondents are gradually led to reveal the importance of these attributes in terms of their consequences and values. For the purpose of this study, respondents were required to reveal how production practices (i.e. attributes), usage consequences and personal values were linked in the respondent's mind and hence help in creating 'mental maps' of the respondent's decision-making process. The ACV relationships generated in the process of the laddering interview form the MEC. Combining the maps of similar farmers, in turn, helps in developing a large and more exhaustive map known as HVM. The HVM is therefore a graphical description of a laddering interview which is used to reveal the relationships between the attributes, consequences and values.

A semi-structured laddering approach involving some elements of both the hard and soft laddering techniques was used in this study. First, the respondents were informed that the study intended to investigate what informs their decision to use soil fertility management practices in their kale plots. They were then asked to list the most important soil fertility management practices they undertake in kale plots and rank the first two practices. The respondents were, at the same time, informed that there were no right or wrong answers to the interview questions and were encouraged to describe exactly what they routinely do in their kale plots. This step was intended to make the respondents feel more at ease, hence they were able to speak more freely and honestly about their choices and actions (Reynolds and Gutman 1988).

Next, following the hard laddering approach, each kale farmer was asked to rank soil fertility management methods they use in producing kale in order of preference. The responses were grouped into two attributes, namely (1) manure (including cow, goat/sheep, poultry, pig, rabbit and compost manure) and (2) chemical fertilizers. These two categories of inputs are generally the main soil fertility management methods used by farmers in the study areas. Pig, rabbit and compost manure were mentioned by only two respondents, and were therefore dropped from further analysis.

Soft laddering interview technique based on a series of questions posed such as 'why is that important to you?' was then used to generate the ladders that reveal the farmer's personal motivations for the use of two soil fertility management strategies. For instance, for the farmer who ranked manure as the most preferred soil fertility management strategy, the first question was

> 'Mr/Ms. . . . ., you have indicated that you use manure in growing kale, why is it important to you that you apply manure in kale plots?'

Through a series of such questions, ladders that link the *attributes* to *consequences* and, ultimately, to *values* were generated. By asking the question in the form of 'which is . . . important to you?', the laddering technique typically avoids pitfalls of posing leading questions that were normally posed to generate Yes/No responses. In this study, and as required under laddering, the interviewer did not explain the questions and/or provide examples/clues that could also lead the respondents. Also, as recommended by Grunert and Grunert (1995), where the respondent is 'stuck', the question is posed as 'what would happen if you did not have …? (or for instance, what would happen if *you did not apply fertilizer*)?'

Following Russell *et al*. (2004), where more than one response was elicited, each response was probed, in turns, further by the interviewer thus allowing for the 'forking of the responses/answers'. The interviewers used Dictaphones to record the responses for each interview. In addition, each interviewer sketched/drew the ladders (graphically) on a notebook during the interviews and reviewed them after every interview session to ensure that all *consequences* arising from the attributes were followed to the end, and that it ended with a value or values. The generated ladders were also used as reference points during transcription of the recorded responses. The transcribed ladders across the respondents were recorded on a separate coding form, inspected and compared with the graphical sketches drawn during the interviews to ensure completeness. A set of summary codes was then developed to ensure that all the attributes, consequences and values identified by the respondents were included. This was done by first classifying all responses into *attributes*, *consequences* and *values* for both manure and fertilizer ladders in order to produce consistency in content analysis.

The analysis of the laddering data was based on Reynolds and Gutman's (1988) recommendations. The personal *values* identified by the respondents were first sorted into similar but broader categories. This process yielded six types of values, namely comfortable life, happiness, healthy life, independence, achievement of life goal and personal satisfaction. These values are closely related to those used in similar studies in the literature (Mason 1995, Russell *et al.* 2004, Lind 2007).

Finally, following Largerkvist *et al*. (2012), the MECanalyst Software was used to construct an implication matrix that indicates how frequently the concepts that are linked to each other (both directly and indirectly) have been mentioned by the respondents. The MECanalyst Software[1] especially aggregates the MEC into a HVM. See the identified attributes, consequences and values form chains in the HVM hence depicting the cognitive or motivational decision structure of the farmer (Grunert and Grunert 1995) that informs the decision-making process.

Data

This study used data collected from three peri-urban areas of Nairobi, namely Wangige, Ngong and Athi River. The areas were chosen based on the proximity to Nairobi city and on involvement in kale production. They are representatives of major smallholder peri-urban vegetable-growing sites in Kenya. The farmers in the study areas practiced intensive agriculture characterized by the use of manure, fertilizer and pesticides in kale production. The average land ownership was one acre per household of which 0.5 acre is available for farming. Some of the farmers rented the plots they used for kale production.

The respondents were randomly sampled from a list of 120 farmers who had earlier participated in a household survey conducted as the first phase of the study conducted in 2010. The 120 farmers were randomly sampled from lists of kale growers in the three sites, with weights that were proportional to the population of farmers in each of the study areas. For the laddering interviews, however, a smaller but random sample of these household survey respondents was taken in each of the study sites. This process yielded a total of 54 kale farmers (Athi River, $n = 5$; Ngong, $n = 24$; and Wangige, $n = 25$). The smaller sample sizes in this study were mainly due to the time-consuming nature of the laddering interviews. Nonetheless, this study used a sample size that is greater than those used in most laddering/MEC studies (usually about 45 respondents) (Russell *et al.* 2004). Table 1 summarizes the characteristics of the farmers interviewed during this study.

Table 1. Summary statistics of the laddering interview respondents ($n = 54$).

Variable	Mean	SD
Age (years)	47	13.36
Gender (1 = male, 0 = female)	0.75	0.44
Farming experience (years)	16.26	12.23
Years of schooling	8.88	3.44
Highest education†	1.49	0.70
Kids under 5 years (1 = yes, 0 = no)	0.52	0.45
Household size	3.45	1.97
Household income (Kshs§)	16,882	11,619
Farm acreage (hectares)	0.43	0.80
Kale growing acreage (acres)	0.49	0.40
Distance to nearest market (Km)	3.48	3.58

†1 = primary; 2 = secondary; 3 = university/college.
§Ksh = Kenya Shillings. 1 US dollar was equal to Ksh 71 at the time of this study.

It shows that the farmers interviewed in this study are middle aged with an average age of 47 years. In addition, most of the respondents had, on average, primary level of education and were mostly male (75%) with, on average, about 16 years of farming experience. The results also indicate that farmers were of relatively low and variable average monthly income, with an average of Kshs16,882 (US$ 238).

Results and discussion

Peri-urban farmers' motivations for using animal manures in kale production

The HVM in Figure 1, generated using the MEC approach, represents an analysis of drivers of farmers' decision to use manure in kale production as soil fertility improvement strategy. The map highlights similarities in farmers' motivational structure and behaviour in relation to the use of animal manure in kale production. In Figure 1 and the rest of the HVMs, Nr = number of respondents identifying with the chain; sub = the percentage of the subset of the 54 farmers who identified with this chain.

A cut-off level of nine was chosen to develop HVM which means that a link was drawn between two concepts (i.e. points) if at least nine respondents had mentioned it as a direct or indirect link. Choosing a cut-off level typically involves a trade-off between the amount of data represented by the map and the transparency of the map. Usually, a minimum of 70% of the relationships on the map should be represented (Gengler *et al*. 1995). In this study, the HVM in Figure 1 includes 89% (at the cut-off of 9) of all direct links mentioned by the respondents.

The three consecutive levels of the map represent *attributes* (at the bottom), *consequences* (in the middle) and *values* (at the top). The lines represent the MECs or the associations, with the thickness indicating the strength of the associations. Hence, a very thick line between two concepts/points means that many respondents made this association during the interview. Ladders or codes with incomplete chain or missing antecedent were excluded in the implication matrix from being represented graphically in the HVM.

The results presented in Figure 1 relate to only one *attribute,* namely cow manure usage, because the study assumed that the decision to use manure from different sources was likely to be motivated by different factors. In addition, the cut-off level used eliminated the other attributes (namely pig, rabbit and compost manure usage). The decision to use cow manure as an attribute

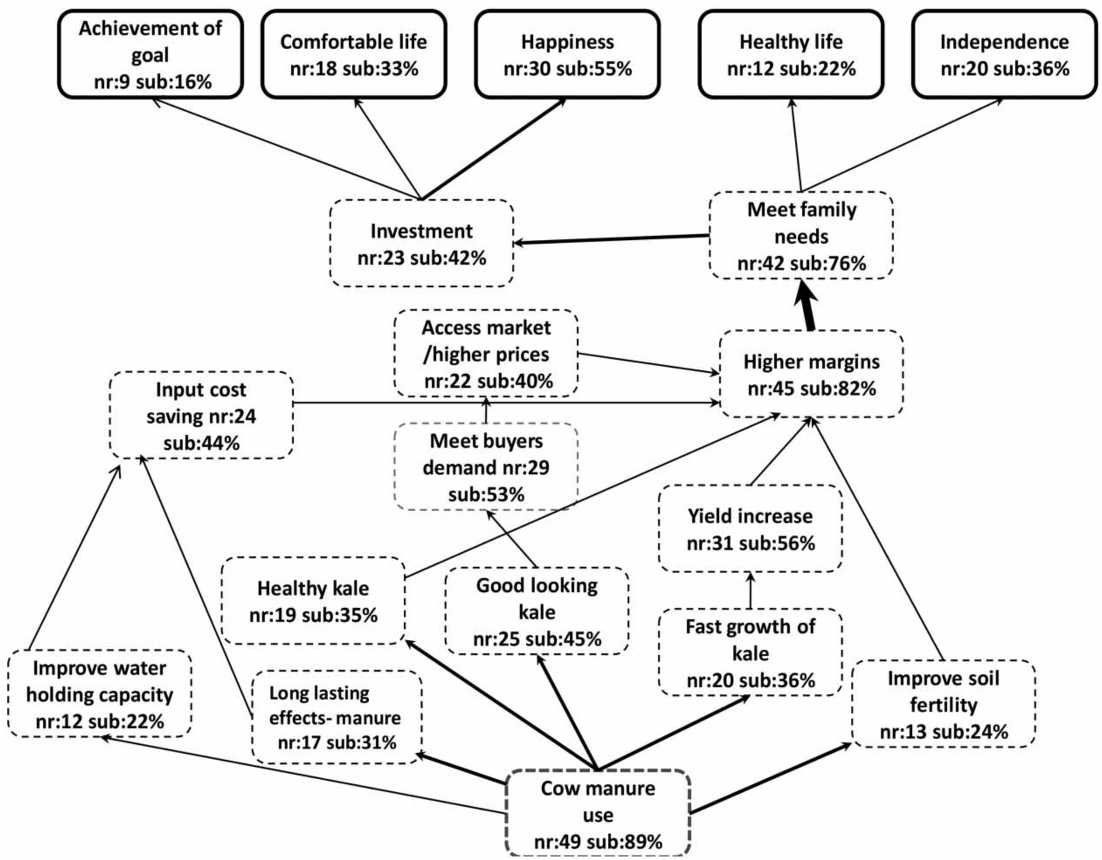

Figure 1. Hierarchical value map for cow manure use in kale production. Consequences are presented in boxes with dashed border and values are in boxes with bold border (nr = number of respondents; sub = share of respondents). Thickness of lines depicts strength of associations. Cut-off level = 9.

had 13 *consequences* that relate to five core/personal *values* namely, achievement of goals in life, happiness, good health, comfortable life and independence.

The illustration shows that kale farmers mostly used cow manure as a source of crop nutrients. The motivation (or *consequences*) associated with applying cow manure in kale are to improve soil fertility, ensure that kale was good-looking or was of high sensory quality attributes and improve water-holding capacity of soil (thereby reducing frequency of irrigation). In addition, farmers applied cow manure due to its long lasting or residual effects and also because they believed that it produced healthy kale with attractive aesthetic quality attributes (i.e. healthy and good-looking kale). The *consequence* of healthy and good-looking kale are associated with yet another *consequence* that relates to the ability of the kale to attract more buyers by meeting buyers' and consumers' aesthetic quality requirements. It is also associated with the farmers' ability to venture into high-end markets, namely supermarkets and speciality stores, where they get higher prices.

Having healthy and good-looking kale is also associated with increased harvestable quantities, which, in turn, generates more money resulting in higher profit margins to growers. Farmers additionally sought to produce good-looking kale in order to make the buyers/consumers happy to have good kales, suggesting that farmers care about the experience and feelings their ultimate customers have in consuming kale. This finding corroborates that of Largerkvist *et al.* (2012), who indicate that consuming, among other things, care about the effect of applying pesticides in kale on the health of kale consumers. On the other hand, the *consequences* of long residual effect of manure and ability to improve water-holding capacity are associated with a reduction in the frequency of irrigation of kale as well as reduction in the need to apply much inorganic fertilizers to enhance kale growth. Reduction in these activities, in turn, lowers the need for labour leading to savings in the cost of hiring labour. These findings suggest that while farmers are aware that the use of animal manure improves the physical properties of the soil, the real incentive for deciding to apply cow manure in vegetables is to save on labour costs and hence increase margins.

The *consequence* associated with higher margins from kale production is the ability of the farmer to meet his/her family needs. These needs include children's education as well as the provision of food, clothing and shelter for the family. Higher margins from kale also lead to yet another *consequence* namely that of being able to invest in other projects (i.e. long-term cash-generating venture) or to expand the farm business. As the HVM shows, the major personal/core value of the farmer derived from being able to meet family needs is a healthy life and becoming independent (i.e. not depending on others – neighbours and friends – to meet family needs). In other words, famers used cow manure essentially to eschew failure to meet family needs which may deprive them of happiness and cause them poor health. Some of the problems cited by most respondents as resulting from inability to meet family needs were sleeplessness, the feeling of being a failure in life and hypertension. Self-dependence (i.e. independence), which specifically relates to being able to provide own and family needs without external help, was mentioned by most respondents as being a key driver in pursuing higher margins from the use of cow manure because it eliminated the shame of borrowing or depending on others for financial support (which is interpreted by the society as failure in life).

Investment in long-term ventures is related to three core/personal values namely happiness, comfortable life and the feeling of having achieved one's life goal (i.e. success in life). Happiness was the dominant driver of the desire by farmers to invest in long-term ventures. Indeed, a majority of famers who identified with this consequence-value chain argued that the lack of happiness could cause stress-related diseases hence poor health. The other end consequence of kale farmers' motivation to use cow manure as a route to investing in other longer-term income-generating activities is the desire to live a comfortable life (i.e. life free from want) in the future.

Peri-urban farmers' motivations for use of sheep and goat manure in kale production

The HVM for goat/sheep manure use (see Figure 2) is almost similar to that of cow manure. However, goat/sheep manure usage was only mentioned by nine respondents, probably due to the limited population of these animals in the study areas. As shown in the HVM, the motivations for applying goat/sheep manure in kale production were to improve the fertility of the soil, produce good-looking kale or kale with high sensory quality attributes. Goat/sheep manure was also applied in kale in order to improve the water-holding capacity of the soil or because it had longer-lasting effects on soil health, which, in turn, ensures that the farmers produces healthy kale in future plantings. As in the case of cow manure, improved water-holding capacity was associated with cost savings due to reduced irrigation water use and labour. The *consequences* identified under goat/sheep manure HVM are therefore similar to those identified in cow manure HVM.

One unique *consequence* that featured in the goat/sheep HVM but not in cow manure was economic growth. Respondents who mentioned this consequence indicated that input cost savings increased their income and hence contribution to economic growth of their local economies through payment of value-added taxes on purchases of non-agricultural products.[2] Economic growth results in employment creation for the youth (i.e. who include their children), hence an improvement in living standards for all. The personal values that drive the decision-making process among farmers who use goat/sheep manure are healthy life, happiness and independent life.

Peri-urban farmers' motivations for use of poultry manure in kale production

The use of poultry manure in the study areas was more common among households that raised poultry for urban markets. This was the case for households in Wangige which has one of the largest poultry eggs market in East Africa (the Wangige market) (Okello *et al.* 2010). The hierarchical value map in Figure 3 represents the motivations for the decision by the farmer to use poultry manure as a source of crop nutrients and the associated personal/core values. The map is based on the 11 respondents who indicated that they applied chicken manure in kale. The motivations (*consequences*) for using poultry manure in kale production by these respondents included the demand for good kale by buyers, the desire by farmers to produce good-looking/healthy kale, water conservation and fast growth of kale. The last *consequence* is important to kale growers because it enables the vegetable to get ready for the market faster. Overall, these *consequences* are in turn associated with one important *consequence* namely the ability to meet family needs by earning higher margins (through increased profits).

As expected, earning higher margins satisfied farmers' personal values relating to having a comfortable life. Indeed, most of the earlier *consequences* converged to the consequence of higher margins and subsequently to the personal *value* of a comfortable life. As before, the consequence relating to meeting family needs is also associated with happiness and having healthy life. These values are the same as those discussed in the first two cases above.

Peri-urban farmers' motivations for using inorganic fertilizers in kale production

The use of inorganic fertilizers in vegetable production has in the past generated concern about the potential negative health effects, especially of nitrates, associated with heavy consumption of fresh leafy vegetables (Ngigi *et al.* 2011). Application of nitrate fertilizers in vegetables by smallholder is common both in developing and developed countries (Santamaria 2006). Nitrates are safe. However, their metabolite nitrite is considered carcinogenic; hence, the ingestion of nitrates

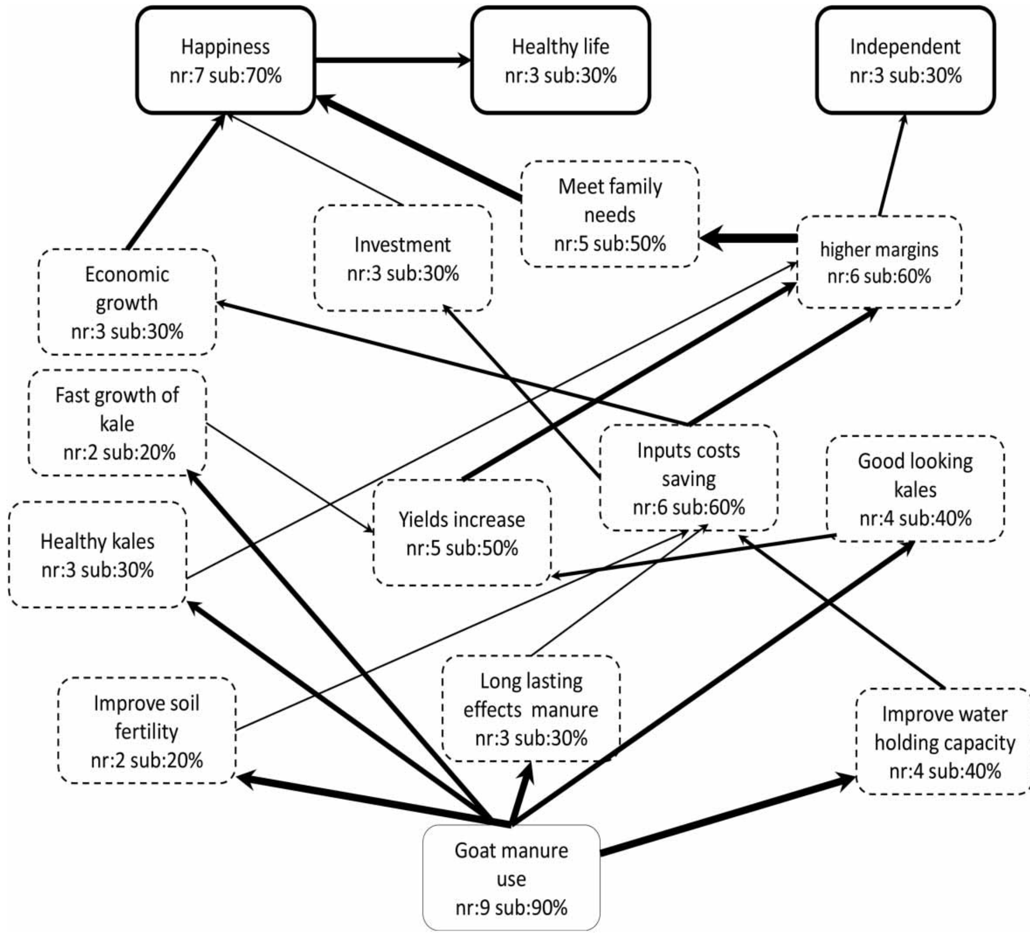

Figure 2. Hierarchical value map for goat/sheep manure use in kale production. Consequences are presented in boxes with dashed border and values are in boxes with bold border (nr = number of respondents; sub = share of respondents). Thickness of lines depicts strength of associations. Cut-off level = 9.

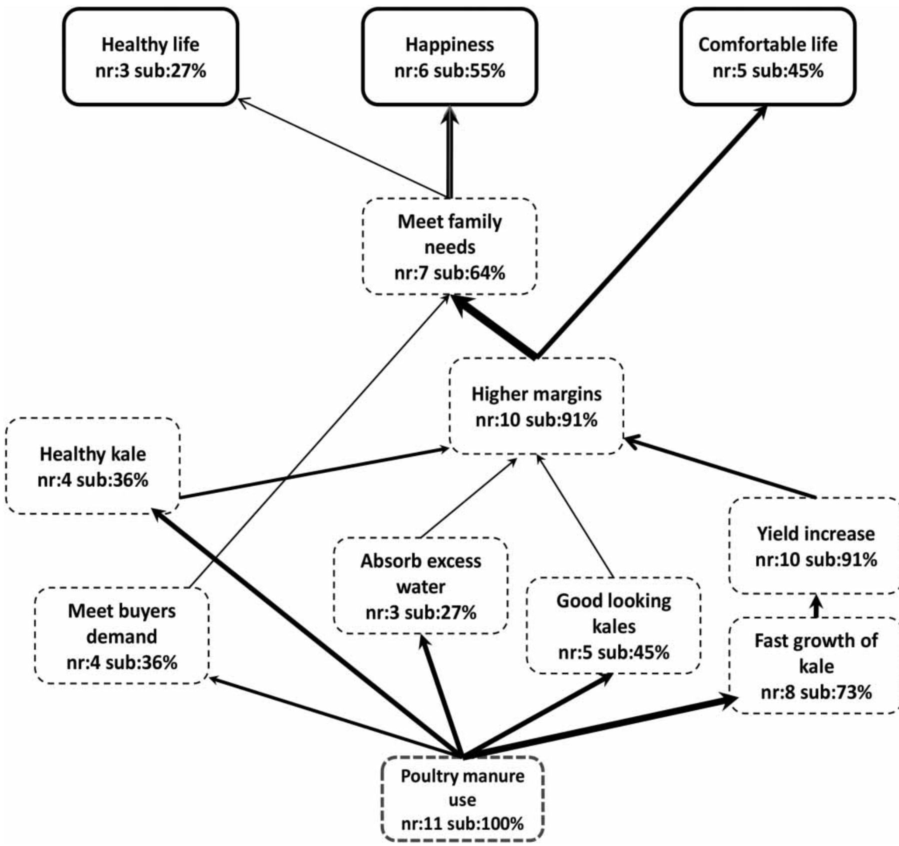

Figure 3. Hierarchical value map for poultry manure use in kale production. Consequences are presented in boxes with dashed border and values are in boxes with bold border (nr = number of respondents; sub = share of respondents). Thickness of lines depicts strength of associations. Cut-off level = 9.

may have long-term health effects (Sanchez-Echaniz *et al.* 2001). This section therefore investigates the motivations for use of inorganic fertilizers, majority of which are loaded with nitrates. Figure 4 presents the hierarchical value map for fertilizer use in kale production.

A cut-off level of five was chosen in developing HVM for the 50 respondents who mentioned that they use inorganic fertilizers for soil fertility enhancement. The HVM indicated that there were six ladders with respect to fertilizer use. The personal values satisfied by the use of fertilizer in growing kale are happiness, independence, comfortable life, good health, achievement of life goals and personal satisfaction.

Starting from the bottom of the ladders, the three main motivations (i.e. *consequences*) for applying fertilizer in kale production were (i) fertilizers dissolve faster in soil, (ii) it produces good-looking kale and (iii) it facilitates faster growth of kale. The *consequence* of producing good-looking kale in turn results in another *consequence* namely that kale attracts more buyers and also meets buyers' demands relating to aesthetic quality attributes. Aesthetic quality is one of the most sought after attributes by consumers and high-end retailers. It therefore improves the farmers' chances of gaining access to high-end markets, namely supermarkets and speciality stores, which pay higher prices resulting in higher margins.

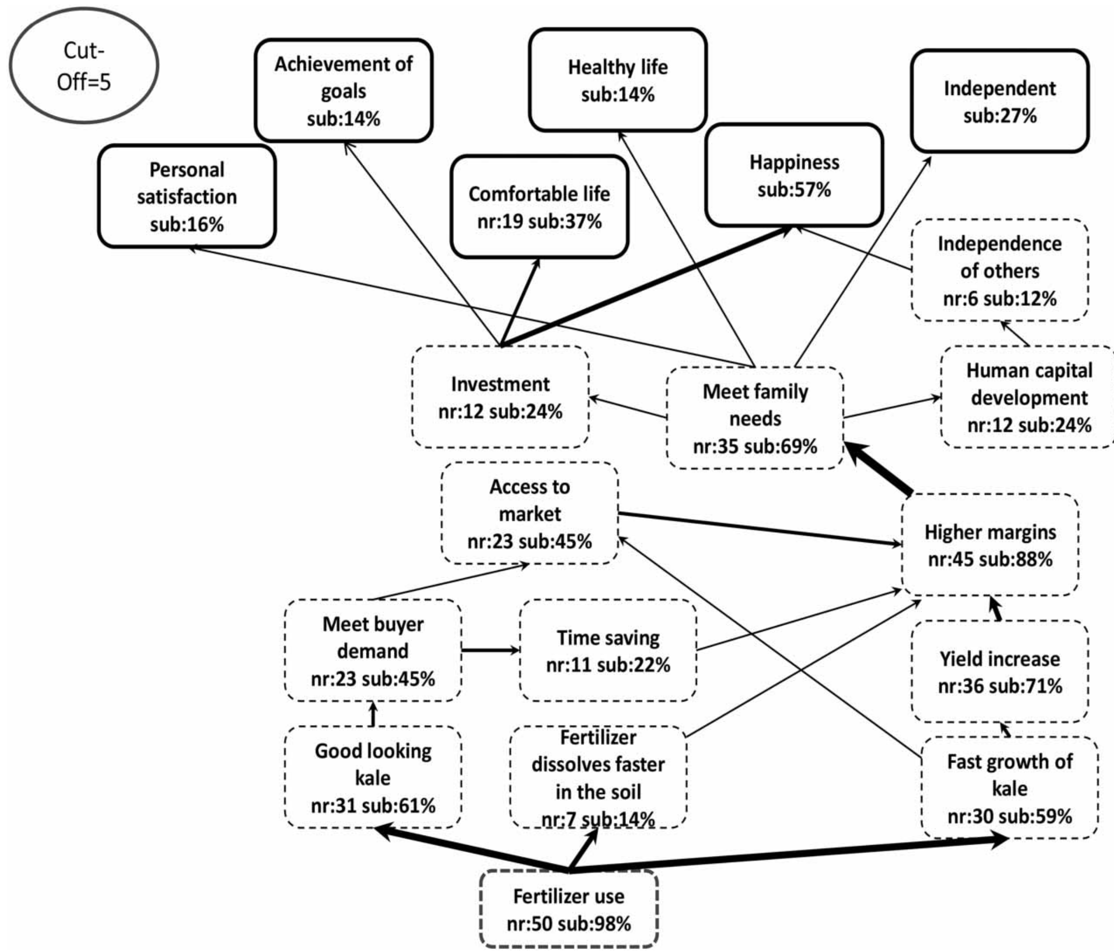

Figure 4. Hierarchical value map for fertilizer use in kale production. Consequences are presented in boxes with dashed border and values are in boxes with bold border (nr = number of respondents; sub = share of respondents). Thickness of lines depicts strength of associations.

Meeting buyer demands is important for peri-urban farmers because it saves them time spent in the market during selling activity as good-looking kale attracts more buyers and sells faster. As in the earlier cases, farmers also associated healthy and good-looking kale with good consumption experience and satisfaction of the consumers. The *consequence* of fertilizer dissolving in soil faster leads to faster growth of kale and also higher margins as a result of higher yields.

The consequence associated with making more money from kale production is the ability to meet family needs. As before, these needs include children's education and the provision of food, clothing and shelter for the family. Children's education leads to human capital development which contributes to those children becoming self-reliant (hence the *consequence,* independent of other) in the future. The farmers' personal/core *value* satisfied by self-reliance of children in the future is happiness that he/she has succeeded in life. Another *consequence* associated with meeting family needs is the ability to invest in other projects with long-term benefits or expanding farming business. As HVM shows, the major personal *values* satisfied by this *consequence* are (i) achievement of life goals, (ii) comfortable life and (iii) happiness. The personal *values* of kale farmers that are satisfied by being able to meet family needs are personal satisfaction, healthy life and independence.

Summary, conclusion and policy implications

This study examines peri-urban vegetable farmers' decision-making process in the use of soil fertility-improvement strategies. The study specially uses MEC analysis approach to investigate the role that farmers' personal/core values play in the decision to use animal manure and inorganic fertilizers in the production of kale. It finds that the choice of soil fertility improvement technologies especially the use of animal manures and inorganic fertilizers is driven by a number of personal values including happiness, achievement of life goals, good health, comfortable life, personal satisfaction and independence. Farmers use animal manure in growing kale to improve fertility, improve water-holding capacity of soil, enhance the aesthetic quality of kale, enjoy the benefits of long-lasting residual effects of manure and also produce healthy vegetables. While the overriding purpose of using these soil fertility improvement technologies is to increase yield and profit margins thus enabling them to meet family needs, the study finds that farmers also care about their customers' consumption experience and the performance of rural economy.

This study also finds that a majority of the farmers use chemical fertilizers to make kale grow faster thus selling faster which allows for more plantings per year, produce good-looking kale that meets aesthetic quality attributes demanded by the market, increase yield (hence make higher profit margins) and subsequently make more money with which to meet family needs. In both cases, meeting family needs is associated with satisfying farmers' core values listed above.

This study demonstrates that the process of decision-making in the use of soil fertilizer management technologies is quite complex and is driven by many considerations. Some of these considerations relate to the neoclassical profit-making objective, while others fulfil a farmer's social objective. Most importantly, this study demonstrates that decisions to use soil fertility management technologies are driven by deeper personal/core values that include the pursuit of happiness, independence, comfortable life, good health and achievement of life goals. It therefore illuminates the decision-making process by exposing the motivations and core values that affect the choice of soil fertility management strategies.

The findings of this study also imply that while farmers use soil fertility-improvement strategies in production of kale, the major goal is profit making rather than good environmental stewardship. This finding suggests that there is a danger that farmers could adopt intensive production system, notably the use of fertilizers, which could potentially have negative environmental effects as vegetable prices increase and markets become more demanding of the aesthetic quality attributes. At the same time, the same market (economic) incentives could cause farmers to apply inadequately cured manure thus increasing the risk of kale contamination with pathogens. Environmentally safe use of animal manures and fertilizers (for fertility management purposes) by peri-urban fresh vegetable farmers thus require policies that promote good environmental stewardship.

Based on the findings of this study and likely implications, it is important that the focus be directed at educating farmers on the importance of appropriate use of fertilizers and animal manure. Educating farmers on the benefits of incorporating environmental stewardship goals in their private profit maximizing and social goals specifically help align incentives with good practices. Farmer education, however, entails a cost and will therefore require a partnership between public and private sectors and also the concerted efforts of both conservation and public health agencies. Environmental stewardship (through conservation) is needed to promote integrated soil fertility-improvement approaches including safer manures management practices. At the same time, public health agencies will need to play a more regulatory role of ensuring that sustainable and environmentally friendly production strategies are adhered to. Experience with European standards, notably the Global Good Agricultural Practices (GlobalGAP), also indicates that private fresh vegetable retailers can promote environmentally friendly practices by enacting and enforcing good production protocols among their suppliers (Okello and Okello 2010). Thus, Kenyan supermarkets can play a role in aligning farmers' incentives to practice good environmental stewardship.

Notes

1. Details of the software are provided in the following homepage link: http://skymax-dg.com/mecanalyst/chain.html
2. Smallholder farmers in Kenya do not pay income taxes hence contribution to tax base is through value-added taxes.

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