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# Land Tenure and Water Sources for Urban Vegetable Farmers in Asante-Mampong, Ghana

**Bismark Dwumfour-Asare[1*], Kwabena Biritwum Nyarko[2] and Abu Adams[1]**

[1]Departments of Environmental Health and Sanitation Education, College of Agriculture Education, University of Education, Winneba, Asante-Mampong, Ghana; dwumfourasare@gmail.com, lanjimbu1982@gmail.com
[2]Department of Civil Engineering, College of Engineering, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana; nyarko.k.b@gmail.com

## Abstract

**Objectives:** Farmland tenure and water sources are increasingly challenging among urban vegetable farmers. The pertaining situation and wastewater reuse potential are assessed in one of well-known vegetable producing centers in Ghana. **Methods/Statistical Analysis:** Data was collected using structured interviews and observations in a farm-based survey with 50 selected farmers (i.e. 30% of estimated farmers) between February and March 2015. Data analyses employed descriptive statistics, one-sample t-test and Chi square goodness-of-fit test at 5% significance level. **Findings:** Few farmers (12%, n=6) own their farmlands, and 36% (n=18) were renting at a median cost of GHS 87.5 per acre/year (GHS 77.3±35.6), which is costlier than the expected. Sizes of farmlands were mostly 1 – 2 acres (82%, n=41, p=0.064), smaller than expected although statistically insignificant. Most farmers planted vegetables all seasons (both dry and wet) (88%, n=44), and 1 – 2 different vegetables are planted on-plot at a time by most farmers as well (86%, n=43). Farmers mostly depended on direct rains (rain fed irrigation) and rain-dependent water sources (94% to 95%). Meanwhile, awareness and willingness to practice wastewater irrigation is low, 20% (n=10) and 4% (n=2) respectively. Some cost analyses and means of family livelihood are discussed in the paper. **Application/Improvements:** Vegetable farmland tenure arrangements are not the best but make farmers insecure and incur high rent. Farmers' livelihoods are prone to rainwater source overdependence. Wastewater reuse potential must be explored.

**Keywords:** Farmland Tenure, Ghana, Vegetable Farmers, Wastewater Reuse, Water Sources

## 1. Introduction

Vegetable farming as part of urban and peri-urban agriculture plays significant role in urban societies especially in low-income countries. Easily identifiable benefits from urban farming include improvement in livelihoods, urban food (supply) security, meeting nutritional requirements, boosting local economies, supporting buffer zone management along streams and rivers, and to some extent improving sanitation and health services[1,2]. However, critical challenges to urban farming that exist commonly in low-income countries include issues of availability of land and water sources. These challenges are predominantly necessitated by stress on land and water resources because of factors such as rapid population growth and urbanization, high demand for water supply and land for settlements, and increasing climate variability[3]. In urban Ghana, key factors affecting urban and peri-urban farmers especially in Accra are availability of land and access to low-cost water supply[4]. Also the imminent impact of climate change on rainfall (onset and cessation) variability nationwide (in Ghana) makes rain-fed agricultural vulnerable[5,6]. Nevertheless, food security can be ensured if attention is focused on addressing competing needs for land and water resources[7].

*Author for correspondence

Land planning and zoning in low-income countries like Ghana should be key in resolving land tenure insecurity concerns related to urban farming. In[8] cite that "tenure security is a more elusive term generally understood to mean a lack of fear of eviction". In principle, land insecurity together with water scarcity, shortage of cultivable land, and unpredictable weather are the major constraints to urban farming[9]. In Ghana, water sources for vegetable farms include wastewater, pipe-borne water, stream/river water, shallow wells, storm water drains etc[4,10]. Globally reuse of wastewater is not new and it is reported to have been practiced for centuries, even by prehistoric civilizations for irrigation[11]. It is therefore not coincidental that 60% of the total irrigable land in Ghana is watered with wastewater especially during the dry seasons[12]. One of the main concerns against wastewater reuse is the health risk and to a great extent from contaminants such as human and zoonotic pathogens[11]. Health risk associated with wastewater reuse could influence consumers' interest in wastewater-irrigated vegetables. Recent studies report that vegetable produce in Accra Ghana are contaminated with pathogens[13], and in India consumers prefer to pay more for vegetables irrigated with clean water[14]. Meanwhile, surface water sources could also be contaminated because of improper disposal of untreated waste. In Ghana it is estimated that at least 90% of all wastewater end up in water bodies[15,16]. In addition, land and water resources are scarce to urban and peri-urban vegetable farmers. More and better understanding is required in this regard to inform policy and practice especially for places of large-scale vegetable production. This study therefore looks at existing vegetable farmlands use arrangements, irrigation water sources, awareness of wastewater irrigation and willingness of its practice in the Asante-Mampong Municipality, one of the urban vegetable production centres in Ghana.

## 2. Study Area and Methodology

### 2.1 Study Area Description

Asante Mampong Municipal is one of the over 27 Metropolitan, Municipal and District Assemblies in the Ashanti region of Ghana. The Municipality is located within longitudes 0.05°and 1.30° west and latitudes 6.55° and 7.30° north (Figure 1) [I]. The Municipality's population, gender ratios, average household size, and agricultural households are presented by the 2010 National Population and Housing Census report[17] as: population – 88,051 with 48% males and 52% females; household size around 5; agricultural households represent close to 61% where more of these families have


**Figure 1.** The study site (Source II).

4 members for male headed households, and around 79% with 4 – 5 household sizes for female headed households. Generally, more males 52% are into farming than the female counterparts 48%[17]. The Municipal capital, Asante Mampong is known to be one of the urban vegetable producers for its environs and also the regional capital, Kumasi city. There is a common speculation among local inhabitants that vegetables produced in the Municipality are safe and hygienic compared to those grown in other urban towns in the region, all because of the perception that farmers use safe water for vegetables irrigation.

### 2.2 Data Collection and Analysis

The farmers involved in the study were engaged in market production based farming instead of subsistence orientation[12]. Data collection involved interviews with 50 farmers in a farm survey within a month (February – March 2015). These farmers were selected to represent at least 30% of the estimated 130 – 150 vegetables farmers in the study area, although the existing Mampong Vegetable Farmers Association has a membership of around 100. Informed consent was first sought from the Asante Mampong Vegetable Farmers Association (AMVFA) through its chairperson before visiting the farmers on their farms. All farmers that were interviewed participated in the study willingly and voluntarily after informed consent were sought verbally from each participant during the data collection. The field data were processed and analyzed using Microsoft Excel and RStudio version 3.2.3 (2015-12-10) software. The data analyses used are mainly descriptive, one-sample t-test and Chi square goodness-of-fit test (Chi sq GOF) at significance level of 5%.

## 3. Results and Discussion

### 3.1 Brief Profile of the Vegetable Farmers Interviewed

The basic profile of vegetable farmers that were interviewed is presented in Table 1. Male farmers significantly dominated their female counterparts, a confirmation of men dominance in open-space vegetable farming across Ghana and West Africa[10]. More than half of the vegetable farmers (54%, n=27) were youthful (35 years and below)[18] from the age distribution. Majority of respondents are married/co-habiting and these farmers were people of all educational levels (basic to tertiary) including the non-educated[19]. Comparatively less farmers had tertiary education (12%) but generally the distribution is fair and valid according to the statistics (p=0.120). The average household size of farmers is 4, and most of these farmers are breadwinners who together with their families solely depend on the vegetable farming for household income.

The low number of women could be because women in many cases are limited to subsistence farming to feed their families unlike men who go into commercial farming for cash income, and more probably because of the arduous nature of commercial farming tasks[19]. The educational background of our farmers is similar to those found in the Accra study[19] where farmers had diverse educational background as well. A good number of our farmers 74% (n=37) were aged below 40 years, which is contrast to the Accra study where 83% of farmers were aged 40 years and above[19]. Clearly, more youth involvement in vegetable farming at Asante-Mampong is a positive indication that youthful populace[18] could be attracted to gainful employment via this informal subsector. Potential for job creation in the area is high since already urban agriculture is known to be supporting incomes of several millions of people worldwide[10]. Little over half of our respondents (54%, n=27) claim that the vegetable farming is the main source of household income while to the rest it supplements their primary income sources (Table 1). Significant majority of these farmers (90%, n=45, $p<0.001$) claim being main breadwinners of their households. Thus, these are critical family livelihood farms, and could concurrently support hundreds of others along the vegetable market chain by creating employment while improving diet and food security[10].

The dwelling place (locality) of all vegetable farmers interviewed is presented in Figure 2. The results show that majority (54%, n=27) of these farmers are dwelling in Asante Mampong town, the capital of the Municipality, and the rest are from other five surrounding communities namely Abuontem, Boabin, Kofiase, Kyeremfaso, and Nkwanta Figure 2. The distances from farms to farmers' dwelling places are estimated between 0.5km and 45km (CI 18.3 – 27.5, $p<0.001$), thus the average distance is significantly farther than the expected 1km consideration for household farming. Only 14% (n=7) were within 1km, and such farmers can be classified as household farmers, i.e. farming in and around homes[4]. Those that are distanced away from their dwelling places could be termed as open-space and/or peri-urban or off-site farmers[4,10].

**Table 1.** Basic profile of the vegetable farmers interviewed

| Parameters | Details | Distribution n(%) | Chi sq GOF (p) |
|---|---|---|---|
| Gender | Male | 48 (96%) | < 0.001 |
| | Female | 2 (4%) | |
| Age (years) | Maximum | 55 | |
| | Minimum | 22 | |
| | Average | 35±8 | |
| Marital status | Single | 6 (12%) | |
| | Married/ co-habiting | 36 (72%) | |
| | Divorced/ widowed/ separated | 8 (16%) | |
| Educational background | No formal education | 13 (26%) | 0.120 |
| | Basic | 18 (36%) | |
| | Secondary | 13 (26%) | |
| | Tertiary | 6 (12%) | |
| Vegetable types planted per farmer | 1 kind | 23 (46%) | 0.013 |
| | 2 kinds | 20 (40%) | |
| | 3 & more kinds | 7 (14%) | |
| Vegetable farming: main household income | Yes | 27 (54%) | 0.572 |
| | No | 23 (46%) | |
| Vegetable farmers: main breadwinners | Yes | 45 (90%) | < 0.001 |
| | No | 5 (10%) | |
| Household size | Maximum | 11 | |
| | Minimum | 1 | |
| | Average | 4±2 | |

## 3.2 Land Ownership and Land Use Arrangements

The farmers claim it is more difficult to acquire and/ or own farmlands especially when the lands are closer to residential settlements. It is evidenced by the observation that few farmers (12%, n=6) own their farmlands via inheritance and/or donation and the majority (88%, n=44) has made various agreement with their landlords/ landowners (Table 2). This stark disparity between landowning and non-landowning farmers is statistically significant with p<0.001 and the landlords include individuals and/ or corporate entities. Most farmlands in our study area are from friends or landlords (of farmers' residence) unlike in Accra where the vegetable farmlands were predominantly (70%) owned by the state/government[19]. Generally, our findings support the assertion that most urban and peri-urban farmers do not own farmlands[4,19]. Our farmers have access to the farmlands by informal arrangements, partly similar to the situation in Accra[4]. According to the farmers, there is no formalized (written) documentation concerning the release and use of lands except personal and verbal agreements on payment terms and/ or other land use conditions that are spelt out by the landowner. Majority of farmlands were leased for free (59%, n=26/44) while the rest (41%, n=18/44) were rented or hired with cash payment terms, however, the differential distribution is not statistically significant (p=0.228). The farmers claim that the existing land tenure make them more vulnerable to exclusive and erratic decisions by their landowners concerning the size and span of land use. Their claims therefore support the assertion that urban and peri-urban vegetable farmers face high land tenure insecurity in Ghana[4, 12]. Probably addressing this land tenure challenge will require adopting a similar initiative in Cotonou of Benin, where officially sizeable "open green spaces/urban farming sites" are allocated in cities and urban areas[12].

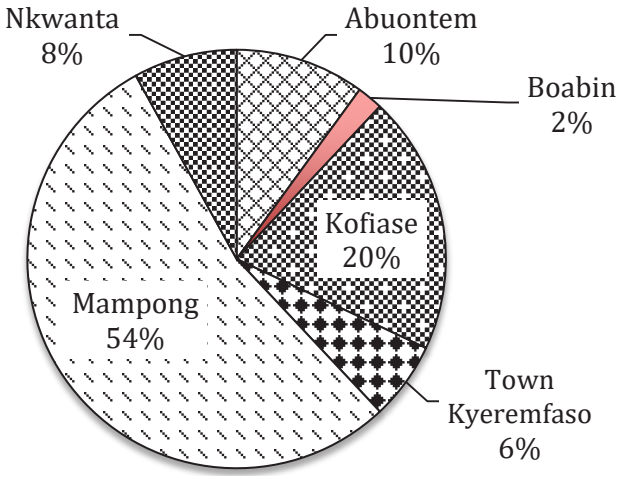


**Figure 2.** Residential location of vegetable farmers.

On farmland sizes, most farms (82%, n=41) although not statistically significant are between 1 – 2 acres with very few (18%, n=9) parcels being 3 acres and/or more in size (Table 3). The farmers in this study are farming on comparatively larger plots/parcel than their counterparts in other Ghanaian cities who are farming on less

**Table 2.** Farmlands use arrangements for non-landowners

| Land use arrangement | Land owners | Distribution n(%) |
|---|---|---|
| For Free (n=26/44) | Chief's land | 3(7%) |
| | Church | 1(2%) |
| | Friend/Landlord | 7(16%) |
| | Idle Land | 1(2%) |
| | Relative | 8(18%) |
| | State/Government | 6(14%) |
| Renting/Hired (n=18/44) | Friend/Landlord | 13(30%) |
| | Relative | 4(9%) |
| | State/Government | 1(2%) |

than 0.1 hectare (i.e. 0.25 acre) per farmer[12]. However, majority of the farmers do not have access to the maximum farmland size of 1.5 hectares (i.e. 3.8 acres) which is asserted possible to acquire in peri-urban settings of Ghana[12]. This suggests that sizeable peri-urban farmlands may be a mirage and not readily available as acclaimed, more probably because farmlands are lost to increasing shelter needs[12] due to rapid population explosions and urbanization. Although this may not directly correspond to the number of farmlands paid for use but that could be a factor in the high cost of farmlands paid by the minority who are renting them. According to the farmers, the rent for farmlands are charged based on the discretion of the landowners without necessarily any known convention or consideration. Generally, the cost of farmlands ranged from GHS 50 to GHS 300 (average GHS 147& median GHS 135; n=18) per farmer/year. Because of the wide cost range, the median could be more representative than the average cost. In terms of plot sizes, the farmland cost translates into GHS 12.5 – 150 per acre/year, and it is logical that this unit cost is lower (cheaper) for larger plot sizes because of economy of scale (Table 4). While the median cost is GHS 87.5 per acre/year, the first and third quartiles are GHS 50 and GHS 100 per acre/year respectively.

According to a similar study, the cash cost of farmlands could typically be around US$ 4 ha/season (GHS 15.2 ha/season)[12]. This Figure is around GHS 12.2 per acre/year, and this suggests that the hired farmlands in our current study are quite expensive (median GHS 87.5 per acre/year) by about seven times. It is therefore not surprising that the farmers in this study are complaining about high cost. From our analysis, the farmlands cost about 4% - 5% of the gross annual income (not net income).

**Table 3.** Farmland distribution by size among farmers

| Land sizes (acres) | Distribution n (%) | Chi sq GOF (p) |
|---|---|---|
| 1 acre | 15 (30%) | 0.063 |
| 1.5 acres | 7 (14%) | |
| 2 acres | 19 (38%) | |
| 3 & more acres | 9 (18%) | |

**Table 4.** Rented farmlands distribution and cost

| Land sizes (acres) | Distribution n (%) | Cost: GHS per acre/year Range (μ±σ) |
|---|---|---|
| 1 acre | 5 (30%) | 50 – 150 (104±36.5) |
| 1.5 acres | 0 (0%) | 0.0 |
| 2 acres | 9 (50%) | 50 – 100 (80.6±24.3) |
| 3 & more acres | 4 (20%) | 12.5 – 60 (36.5±19.6) |

Note: GHS 3.8 = US$ 1, i.e. 2015 midyear; μ = mean, and σ=standard deviation

## 3.3 Sources of Water for Vegetable Farming

All farmers (100%) grow vegetables in the wet season, majority (88%, n=44) claim they farm in both wet and dry seasons, and very few farmers (12%, n=6) plant only just in the wet season. Table 5 and Plate 1 show the main water sources during both dry and wet seasons as reported by the farmers. The water sources are significantly rivers/streams during the dry season and direct rains and rivers/streams in the wet season (Table 5).

The water sources for farmers in the study area are predominantly rainfall and streams/rivers confirming the assertion that peri-urban vegetable farmers rely mainly on these sources[4] as shown in Figure 4. The six (6) farmers who plant only in wet seasons attributed their one-season based farming to the challenges of dissatisfaction with water sources in the dry season. They claim the water sources become polluted, inadequate, and unreliable with high cost of pumping to meet their demand. Also 2 out of the 44 all-seasons round farmers shared similar sentiments and added the challenge of delayed rainfalls recently. Although few farmers (< 15%) complained about water source availability, reliability, quantity and quality in recent times, it can be presumed that climate variability could be impacting on their activities as recently reported

**Table 5.** Main water source available to farmers by seasons

| Seasons | Water source | Distribution n (%) | Chi sq GOF (p) |
|---|---|---|---|
| Dry Season (N=44) | Onsite wells | 2 (5%) | < 0.001 |
| | Rivers/stream | 42 (95%) | |
| Wet Season (N=50) | Direct rain & rain-fed dug out | 1 (2%) | < 0.001 |
| | Direct rains | 2 (4%) | |
| | Direct rains & rivers/streams | 47 (94%) | |

on the general agriculture sector[6,20]. On the means of water collection or abstraction, the main option is the use of mechanical pumps (69%, n=33) and cans/buckets/bowls (31%, n=15), thus irrigation is by small pumps and/or manual[21]. None of the water sources directly costs the farmers anything, thus all water sources are free except the effort used to collect and/or transport water, either by physical strength (manual) or use of mechanical pumps.

## 3.4 Awareness of Wastewater Reuse and Willingness to Practice Wastewater Irrigation

Very few farmers (20%, n=10) claim awareness of wastewater irrigation and among these ones 8 out of 10 heard it from friends while the other 2 heard it from other farmers who practiced wastewater irrigation themselves. Clearly there is low awareness level of wastewater reuse among farmers in our study unlike in Accra where some farmers use greywater in addition to pipe borne water[4]. The difference is that vegetable farmers in Accra have limited alternative water sources and therefore consider wastewater irrigation as one of the few definite options[1]. Only two (2/50) of our vegetable farmers claim they have used wastewater before (i.e. specifically runoff) for irrigation and are still willing to use it whenever it becomes necessary. Meanwhile, the remaining majority (96%, 48/50) is not willing to use any form of wastewater for irrigation. Their reasons are largely based on water quality concerns since they perceive wastewater to be unsafe for vegetable production (Figure 3). This observation shows a profound difference in the awareness

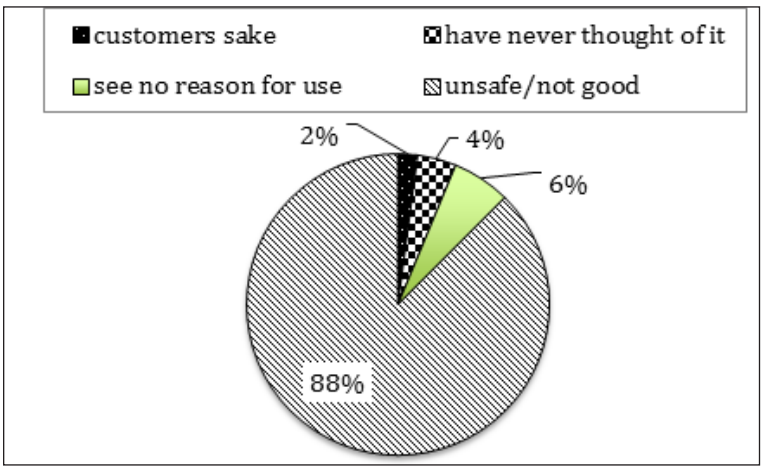


**Figure 3.** Reasons for not using any wastewater on farm.

A B C

**Figure 4.** Source of watering: **A)** rain-fed dug-out, **B)** river/stream & **C)** watering the farm.

and perception of wastewater irrigation between farmers in the current study and those in Accra and probably elsewhere where majority of vegetable farmers believed that there is "no actual health risk with wastewater reuse"[10].

However, majority of the farmers in our study (62%, n=31, p=0.090) are willing to invest in any on-farm wastewater treatment facility that will allow for safe wastewater reuse. There is relatively high willingness although not significant to invest in treatment facility for irrigation irrespective of the unfavorable existing farmland tenure arrangements. The observation could be contradictory to the existing understanding that land tenure insecurity hinders farmers' readiness towards irrigation infrastructure investments[4,12,21,22]. However, the basis for farmers' high willingness towards such investment appears unclear since the amount most farmers wish to invest GHS 20 – 500(GHS 193 ± 149), thus US$ 5 – 132 could be too low to acquire a good treatment facility. The first quartile (or 25$^{th}$ percentile) and the median (second quartile or 50$^{th}$ percentile) are around GHS 100 (≈ US$ 26), and the third quartile (75$^{th}$ percentile) is GHS 250 (≈ US$ 66). Fundamentally, none of these farmers will be able to acquire even one of the most affordable and handy technologies like constructed wetlands which could cost around US$ 74/m$^2$ in India, another low-income country context[14].

## 3.5 Farmers' Gross Income and Finding a Common Voice

Our study reveals that even these few vegetable farms are supporting 50 individual families (households) of some 216 persons either as sole (54%) income source or as supplementary (46%) income source. In Accra about 60% of farmers rely on vegetable cultivation as their only source of income[10], thus driving home the message that most farmers in urban Ghana take vegetable farming as their main source of income. It is also emphasized that 90% of our farmers are the breadwinners of their homes/families. Meanwhile, urban vegetable farmers could make net income (profit) of US$ 400 – 800 per year[12], which by our estimate is around GHS 1,520 – 3,040 per year. Although our study did not establish the profit (net income) for our farmers, but the profit can be determined by conservative estimate based on the report of a similar work[23]. The author asserts that the total cost of farming is around 50% of total income. By this assumption, an estimated net profit of GHS 1,500 per year (≈ US$ 395 per year) can be realized by the farmers from their median annual total income. While the lower and upper quartiles of the annual gross income are GHS 1,500 and GHS 4,000 respectively, the median annual income is GHS 3,000 and the median is preferred (in the profit estimation) over the average because of the wide range and high standard deviations (Table 6). In this case, the farmers are earning net profit of about GHS 125 (≈ US$ 33) per month based on the median income. This estimated profit is close to the minimum profit (i.e. US$ 35 – 160 per month) established for vegetable farmers in the regional capital Kumasi of our current study[10]. Thus, Asante-Mampong vegetable farmers may not be making good profits but their gains could be similar to their counterparts in other urban areas in the region.

By considering the average household size of 4 (same as the median) for our vegetable farmers (noted in Table 1) and also their net profit (as income) of US$ 33 per month, almost none of the families are living above the international poverty line of US$ 1.25 per person/day[24,25]. The closest was one out of fifty (1/50) of the farmers who could attain a higher per capita income of US$ 1.44 per person/day which is slightly above the poverty line. In general, our vegetable farmers could be considered as poor by the international standard and this could be a true reflection of the general economic status of people employed in the agriculture sector of Ghana.

**Table 6.** Annual Gross Income gained by vegetable farmers

| Income Description | Income by Season (GHS) | | |
|---|---|---|---|
| | Wet Season range (μ±σ) | Dry Season range (μ±σ) | Annual range (μ±σ) |
| Actual Income | 100 - 8,000 (1,516±1,553.8) | 100 - 8,000 (2,186.4±1,574.9) | 200 - 14,000 (3,440±2,658.6) |
| Income per acre | 200 - 7,000 (1,165.5±1,189.1) | 200 - 8,000 (2,002.5±1,526.6) | 400 - 13,000 (2,927.9±2,264) |

Note: GHS 3.8 = US$ 1, i.e. 2015 mid year; μ = mean and σ = standard deviation

This is because a worker's wage in the sector is around GHS 121 (US$ 32) per month, and this is estimated from the Ghana Living Standard Survey Round 6 (GLSS 6)[26] (i.e. GHS 0.69 per hr*8hrs*22days in a month= GHS 121 in a month).

All the farmers expressed worry about many unmet needs apart from the concern that their activities are not fully recognized by authorities and the authorities are unwilling to hear their plight although they have created employment for themselves and others through the vegetable market chain. For instance, only two (2/50) respondents reported that the Municipal Assembly through representatives from the Environmental Health and Sanitation Unit visited their farms once for inspection and encouragement. Meanwhile, these farmers appear to be less organized for any common front than expected. Although majority of farmers (86%, n=43) were aware of the existence of Asante-Mampong Vegetable Farmers Association (AMVFA), more than half (58%, n=29) of them do not claim membership. Notwithstanding the low membership from our respondents, the existence of the association confirms that urban and peri-urban farmers might form associations to some extent even in the informal farming sector[21]. The farmers expressed the need for united and collective efforts among themselves and/or with the association (AMVFA) to push for the necessary support from authorities and partners.

## 4. Conclusion and Recommendations for Practice

Most farmland sizes are not large enough (1 – 2 acres) and land ownership among the farmers is very low as anticipated with urban farmlands. Most farmlands are used freely but a good number of them are rented at expensive cash fees at the current rate of GHS 87.5 per acre/year. Farmers feel insecure with the existing land tenure arrangements. The main water sources are rainfall and rain-dependent sources like rivers/streams, which could be liable to failure especially in the dry seasons. Farmers have limited awareness of wastewater irrigation with high unwillingness to practice it because of public health concerns. Farmers could not be making good gains although the farms are sources of livelihoods for many. These are recommended: 1) exploratory study on financial viability of the vegetable farms for maximum use of farmlands; 2) Farmers should be educated on the benefits of exploring wastewater reuse as unavoidable alternative water source in the midst of water stress driven by climate change; and 3) Issues regarding land tenure insecurity should be resolved before encouraging investments in on-farm wastewater treatment facility for irrigation.

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