ISSN 2348-3156 (Print)
International Journal of Social Science and Humanities Research ISSN 2348-3164 (online)
Vol. 5, Issue 2, pp: (159-170), Month: April - June 2017, Available at: www.researchpublish.com

Adopting Farm Based Risk Reduction Measures in Developing Countries: An Assessment of Influential Factors in Kumasi Metropolis

Nyantakyi Osei-Adu[1], Isaac Kwadwo Nkrumah[1]

[1]Kwame Nkrumah University of Science and Technology (KNUST),[1]Kumasi, Ghana

Abstract: **This paper is part of a bigger research which aimed at assessing the financial costs and benefits of adopting World Health Organization's (WHO's) Farm Based Risk Reduction Measures (FBRRMs). The study focused on exploring the characteristics of the vegetable farmers and their farms and its influence on adopting FBRRMs and other acceptable farming methods. In all, the study considered a total of 148 vegetable farmers distributed proportionally across ten vegetable farming sites in Kumasi Metropolis. Qualitative and quantitative methods were employed complementarily in order to better explain the findings of the study. This study revealed that Metropolis farmers disregard potential health risk associated with wastewater and constantly use it for irrigation. Farmers (68 percent) "unintentionally" comply with FBRRM by using sedimentation ponds. This is even compromised as farmers step in sedimentation ponds to fetch water for irrigation. Analysis further shows that factors such as educational level of farmers, land tenure system, cost of adoption and among others are factors that determine vegetable farmers adoption of FBRRMs. The study concludes that effective monitoring of irrigation practices should be done by responsible institutions to ensure that acceptable standard of water is used for farming.**

Keywords: **Urban Agriculture; Kumasi; Farm Based Risk Reduction Measures; Farmers; Vegetables; World Health Organization.**

I. INTRODUCTION

The study sought to assess the characteristics of vegetable farmers in Kumasi in order to better understand their farming methods, especially in relation to the Farm Based Risk Reduction Measures (FBRRMs)[1]. The characteristics of the farmers and the farm characteristics have been found by numerous studies to influence farming methods employed [1]–[4]. This ranges from the intellectual capacity of the farmers to the financial capacity of farmers. For example Omorogbee & Onemolease, realized that factors such as education and household size were key determinants in farmers adoption of farm practices [1]. Basing on these, it is essential that the characteristics of these vegetable farmers are explored to better understand and subsequently inform interventions that are needed.

Peri-Urban agriculture is not new in the Kumasi Metropolis and this has led to the establishment of numerous vegetable farming sites in the Metropolis[2] [5]. With a number of factors favoring peri-uban agriculture (example: closeness to

[1] This research is a subsidiary to a parent research titled "the financial costs and benefits of adopting the World Health Organizations FBRRMs".

[2] All of these sites are close to streams of water bodies. Such environs seem to be the most suitable place for vegetable farmers.

market, and marginal lands with streams of water) there is a wave of vegetable farming in and around the city at the moment. This is because the opportunity in vegetable farming involves low cost of operation[3] with high returns due to demand. It is no surprise that approximately 90 per cent of the vegetables eaten in the Metropolis are from this practice [6]. At this point it is prudent to note that wastewater is the preferred source for irrigation amongst vegetable farmers [7]. Less has been done about this by government institutions because it was an unplanned event which emerged in the city [8].

II. REVIEW OF LITERATURE

In trying to understand why wastewater is the preferred choice for irrigation, it would be prudent to explore this phenomenon from the global view. The earth is covered with an abundance of water but ironically a very less amount of it is available to mankind for drinking and agricultural purposes. The world is covered with 70 per cent of water [9], [10] which implicitly connotes an abundance of water. Out of this abundance of water, only 2.8 per cent is regarded as freshwater for drinking or agricultural use [9]. Moreover, 77 per cent (2.15 of the 2.8 per cent of fresh water) is locked up in ice leaving 0.65 per cent of water available unto mankind. Scarcity of water is not new in the international arena [10]–[12]. This is to show how much of the whole abundance of water is available unto mankind and therefore demands the best possible use of this natural resource. This coupled with other factors (climatic conditions and uneven distribution of water globally) calls for the reuse or recycling of our water resources and it is therefore no surprise the urban agriculture has come to embrace the reuse of wastewater for irrigation.

The use of wastewater in agriculture is a contemporary issue in a number of developing countries [6]. The use of waste water for agricultural purposes has been identified to produce an array of health risks to the environment [13]–[15]. Wastewater for irrigational purposes was then viewed as inappropriate. That was the status quo until the World Health Organization (WHO) in conjunction with the United Nations Environment Programme (UNEP) proposed some treatments methods for treating wastewater before irrigation [16]. In the course of time, it was realized that these treatments methods were feasibly impractical in most developing countries (of which Ghana is no exception) due to the cost implications and lack of enforcement [15]. Vegetable farmers in developing countries continued with the use of the raw polluted wastewater for irrigation. To discontinue the persistent health risks posed by this unpopular act, non-treatment methods were developed which were considered as low cost options. The Food And Agriculture Organization, then recommended that these non-treatment measures should be used in conjunction with some treatment methods [17]. On the other hand Abaidoo, posited that a combination of these non-treatment guidelines could produce a tremendous effect of getting the polluted waste water to acceptable standards therefore debunking the idea of attaching treatment methods to non-treatment methods [6]. The non-treatment methods identified include cessation, use of sedimentation ponds, simple filtration techniques, the three tank method, furrows and safe irrigation methods [18]–[20]. Premising on the foregoing, it would be prudent to ascertain the characteristics of vegetable farmers which could aid or hinder the implementation of these non-treatment methods. Literature already has it that farmers adoption modern methods are often guided by certain farmer characteristics and even awareness of these “new” methods [21].

III. MATERIALS AND METHODS

The study hinged on both secondary and primary sources of data. To better understand the characteristics of the vegetable farmers, qualitative and quantitative data was gathered to better explain the phenomena. Prior to the collection of data, sample frame (236 vegetable farmers) was attained which contained all the vegetable producing sites in the Kumasi Metropolis and the number of farmers at each site- the Metropolis can be likened to Bucharest Municipality in Romania[22]. A sample size (148 vegetable farmers) for the study was then generated and samples were proportionally distributed per the sample frame obtained. Samples were taken using the simple random sampling technique. Data was then taken with a semi structured questionnaire which was pretested prior to the data collection. This was done to trim the questionnaire of errors. A face to face interview with the vegetable farmers was the technique adopted in administering these questionnaires. Data collected was then inputted into the SPSS software and backed with Microsoft Excel to generate frequencies and percentages. The results were analysed descriptively with inferences drawn.

[3] The use of “free” untreated wastewater and free (not rented out) lands largely dwindles the cost of farming.

ISSN 2348-3156 (Print)
International Journal of Social Science and Humanities Research ISSN 2348-3164 (online)
Vol. 5, Issue 2, pp: (159-170), Month: April - June 2017, Available at: www.researchpublish.com

IV. RESULTS AND DISCUSSION

A. Sex Composition of the Vegetable Farmers

The study, which selected 148 vegetable farmers from 10 sites in the Kumasi Metropolis identified that males are dominant (see figure 1). The male dominance in this sector is not unique. It is consistent with the male dominance in the agricultural sector of Ghana [23]. The Ghana Statistical Service in 2012, identified that males account for 53 per cent of the labour in the agriculture in Ghana [23].

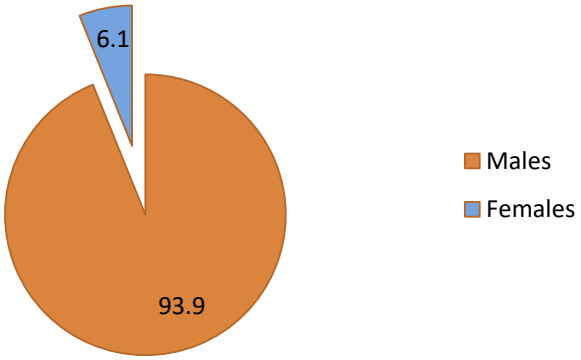

Fig. 1. Sex Compositions of Vegetable Farmers

This finding of this study is in line with that of Obuobie et al. [24]. The authors identified that males constitute approximately 80 to 90 per cent of urban vegetable farmers in Ghana. However, the extent of male dominance is very wider with respect to vegetable farming in Kumasi Metropolis and this is because, vegetable farming in Kumasi is dominated by male immigrants from external ethnic groups. The study identified that, in most cases male migrants come alone with the hope that, when they settle then their family can join them.

Probing further into the issue, cultural orientation of the farmers also influenced the male dominance in the sector. The vegetable farmers revealed that, the occupation is labour-intensive and strenuous hence requires physical strength. Moreover in the Ghanaian societies, males' take up gender roles involving physical strength hence the male dominance in vegetable farming. The females usually prefer to take commercial responsibilities[4]. Contributing to that, males are seen as the household heads hence they have to work to provide for the needs of the household while females take up the responsibility of 'keeping the house'. This is also a contributing factor to the male dominance amongst vegetable farming in Kumasi Metropolis.

B. Age of Vegetable Farmers

Agriculture in Ghana is mostly labour intensive [24] hence age plays an important role as there is a linkage to output. From the study, the modal age range was 30 to 34. The mean age of the vegetable farmers is 37 (see Table 1).

Table 1. Ages of Vegetable Farmers

Age Range	Frequency	Per cent (%)
15-19	3	2.0
20-24	9	6.1
25-29	28	18.9
30-34	29	19.6
35-39	26	17.6
40-44	21	14.2
45-49	16	10.8
50-54	7	4.7
55-59	3	2.0
60-64	5	3.4
65+	1	.7
Total	**148**	**100.0**

[4] In a farming household, it was observed that the Household head (Male) worked the farm whilst the wife handled the sale of the produce. Moreover, the bulk purchase produce on farm were also handled the "Market women"

ISSN 2348-3156 (Print)
International Journal of Social Science and Humanities Research ISSN 2348-3164 (online)
Vol. 5, Issue 2, pp: (159-170), Month: April - June 2017, Available at: www.researchpublish.com

The mean age of the vegetable farmers was inconsistent with the mean age of Ghana and Ashanti region which is 24 years [23]. The wide difference between the mean ages can be explained by the inclusion of children in the calculation of the mean age of the nation and region respectively. However, the finding of the study is consistent with the works of Obuobie et al [24], who identified the average vegetable farmer to be within the ages of 31 years and 40 years. Other things being equal, a youthful[5] farmer would not employ extra hands on the farm. It is therefore not surprising that, amongst the 48 per cent of farmers who do not employ any extra hands on their farms, 52 per cent are between the ages of 15 and 35 years which is a youthful age range. That notwithstanding, the size of the farm duly plays a part in the employment of extra hands.

A crosstab of the age of farmers and the use of a mitigation measure showed that 50 per cent of the farmers within the ages of 25 and 49 employ a mitigation measure. It is also worthy to note that 31 per cent of vegetable farmers in that same age category do not employ a mitigation measure. With respect to the farmers who employ a mitigation measure, the age they find themselves represents that of a curvilinear. This is to say that younger farmers (15 to 24 years) and older farmers (50 years and above) exhibit lower levels of adoption of the FBRRMs.

C. Educational Attainment of Vegetable Farmers:

Education is very important in enhancing an individual's mental capacity. Various researchers have tried to link the level of educational attainment of individuals to poverty and income levels [21], [25]. Research has proven that, education goes a long way to increase a farmers efficiency which has a consequential surge in productivity and adoption of new technology or methods [21].

Data from the field depicts that, 27.8 per cent of the vegetable farmers had never been to school. Touring down the same line, out of a total number of 93 who employ a risk reduction measure, 70per cent have been to school and while only 30 per cent have never been to school. At least, 60 per cent of the farmers completed Junior High School. This affirms the conclusion of various research on the influence of education on agricultural practice [21], [25]. Education plays a major role in farmers adopting new methods and opportunities hence the educated have taken the lead with the employment of sedimentation ponds which serve as a mitigation measure and subsequently provide water in times of need[6].

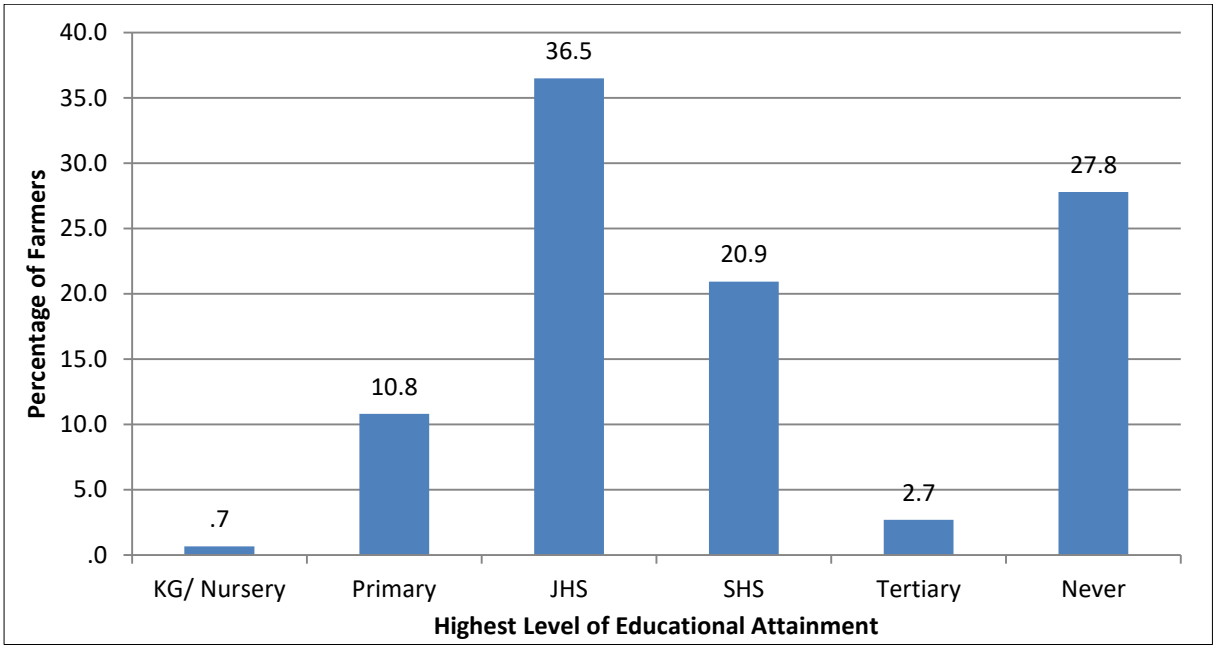

Fig. 2. Level of Educational Attainment of the Vegetable Farmers.

[5] The definition of "Youth" was adopted from the African Union which suggested a youth to be between the ages of 15 and 35 [30].

[6] Some of the vegetable farmers had sedimentation ponds not to purify the water but to have water at vantage points in the farms. This reduces the distance and stress they have to cover watering their crops. It is no surprise that not even one farmer adhered to the caution of not stepping into the ponds whilst fetching from it.

ISSN 2348-3156 (Print)
International Journal of Social Science and Humanities Research ISSN 2348-3164 (online)
Vol. 5, Issue 2, pp: (159-170), Month: April - June 2017, Available at: www.researchpublish.com

The modal and median level of educational attainment is the JHS. On the average, each farmer has attained at least primary education. This finding affirms the research of Obuobie et al. who stated that on the average, an urban farmer has attained at least primary education [24]. This suggests that, on the average the adoption of new farming techniques would mentally not be a problem as there would be easy understanding and application of methods and higher efficiency [21].

D. Household Size:

It is common in Ghana to find very large household sizes not less than 7 especially amongst farmers in rural areas. A study conducted in Sene district revealed that farmers in rural areas have an average household size of 6-10 persons [26]. The study further revealed that, such households have higher tendency to use family members as labor (unpaid) on the farm. This is to serve as an opportunity to reduce the cost of production as family members are used (unpaid labor) for production purposes. However at the national and regional level, there is an average household size of 4.4 and 4.1 respectively [23]. This study identified an average household size of 4.9 which is not so different from the national and regional scene. It tallied well with the findings (5.0) of Obuobie et al. [24].

The disparity between rural farming household size and that of urban farmers can be attributed to the use of family members as labor. Analysis of data from the field suggests that 51.4 per cent (a little over half) of the farmers employ laborers to work on their farms hence there is no need having a very large household size to use as farm labor[7]. This is a contributing factor for the disparity between rural farming households and urban farming households. Family labour is not the only reason why there are large family sizes in rural areas, but it is surely one of the reasons. Another reason for the low household size observed amongst vegetable farmers is that their families have not joined them yet. Most of these vegetable farmers are migrants seeking for greener pastures.

Education also plays a contributing factor to the small household size observed amongst the vegetable farmers in urban areas. The farmers attach importance to education hence do not see the need to engage their wards in farming activities. A respondent posited that *'I have seen where education has taken my colleagues to, engaging my ward here means he would be like me or even worse because I don't even own the land'*[8]. With majority (72.3per cent) of the farmers having been to school before, they are aware of the importance of education hence would not risk using their children as laborers.

E. Ethnic Composition of Vegetable Farmers in Kumasi Metropolis:

The results show that, vegetable farming in the Metropolis is not undertaken by only the indigenous ethnic group (Asante) in the Metropolis but other ethnic groups dominate in the occupation. Table 2 presents the ethnic composition of the vegetable farmers in the Metropolis.

Table 2 Ethnic Composition of Vegetable Farmers in Kumasi Metropolis

Ethnic Groups	Frequency	Per cent
Akan	51	36.5
Kusaase	1	.7
Gonja	2	1.4
Frafra	52	35.1
Dagaati	6	4.1
Busanga	33	22.3
Total	**148**	**100.0**

The Akan ethnic group is the most dominant (74.2per cent) ethnic group in the Ashanti region, however this has not reflected in the ethnic composition of vegetable farmers [23]. Foreign ethnics (Busanga, Dagaati, Frafra, Gonja, Akyem & Kusaase) groups occupy 65.5per cent. This is attributed to the fact that, urban agriculture has attracted several ethnic groups mostly from the Northern, Upper East and Upper West regions of Ghana. A respondent on the field put forth that *'A friend revealed to me that, vegetable farming in Kumasi is very lucrative, hence I left my family there and came here to farm'*. It is no surprise that, the occupation is dominated by migrant ethnic groups.

[7] Not forgetting the fact that 65 per cent of the farmers are from ethnic groups originally not hailing from the Kumasi Metropolis. Such farmers usually work alone.
[8] The respondent felt his line of work is presented with insecurities.

ISSN 2348-3156 (Print)
International Journal of Social Science and Humanities Research ISSN 2348-3164 (online)
Vol. 5, Issue 2, pp: (159-170), Month: April - June 2017, Available at: www.researchpublish.com

F. Types of Vegetables Produced:

Information gathered from literature revealed ten vegetable producing sites in the Kumasi Metropolis. However, it was observed that, production of some vegetables were peculiar to certain production sites while some others cut across all producing sites (See Table 3).

Table 3 Vegetable Producing sites and the Vegetables Produced

Vegetables / Vegetable Producing Sites	Lettuce[9]	Cabbage	Spring Onion	Carrot	Green Pepper	Ayoyo	Cucumber	Alefi
Gyinase	✓	✓	✓					
Apemso	✓	✓	✓	✓	✓	✓	✓	
Ayeduase New site	✓	✓	✓	✓	✓			
Emena Hospital	✓	✓	✓		✓	✓		
Emena Township	✓	✓	✓			✓		
KNUST Engineering	✓	✓	✓			✓		
KNUST School of Business	✓	✓	✓		✓			
KNUST Hall Six and Gaza	✓	✓	✓	✓	✓	✓		✓
Ayigya Tech- Kentinkrono	✓	✓	✓		✓			
UEW, Kumasi Campus	✓	✓	✓	✓			✓	

It is obvious that, vegetables like lettuce, cabbage and spring onions cut across all the vegetable producing sites in Kumasi (See table 3). These leafy vegetables are exotic vegetables and this depicts the shifting diet of the populace of the Kumasi Metropolis from a traditional one to exotic [24]. This reflects in the number of farmers producing exotic vegetables (See Table 4). This is so because there is high demand for such vegetables. The study revealed that, production is done all year round in the Metropolis. However, some farmers alternate among the three most cultivated vegetables depending on the season and the demand[10].

Table 4. Vegetable farmers and the Types of Vegetables

Vegetables	Number	Percentage (%)
Lettuce	127	85.8
Cabbage	68	45.9
Spring Onion	91	61.5
Carrot	16	10.8
Green Pepper	12	8.1
Ayoyo	14	9.5
Cucumber	7	4.7
Alefi	1	0.7

G. Average Farm Sizes:

Analysis of data from the field depicts that, farm sizes differ from one production site to the other (See Table 4.5). The factors accounting for this are the land available for vegetable farming and the density of farmers in an area. It was realized that, in areas where farmers are densely populated, farm sizes tend to be smaller[11].

[9] One realization was that most of the farmers usually refer to Lettuce as "salad" mostly pointing to a lettuce plant.

[10] Data gathered unveiled that price of vegetables could rise and drop drastically in times of scarcity and abundance respectively. Unfortunately farmers give in to low prices when there is abundance because their produce may end up going waste.

[11] Some of the farmers do not mind paying their laborers by offering them some of the beds. Eventually these laborers acquire enough beds just to start their own farms.

ISSN 2348-3156 (Print)
International Journal of Social Science and Humanities Research ISSN 2348-3164 (online)
Vol. 5, Issue 2, pp: (159-170), Month: April - June 2017, Available at: www.researchpublish.com

Table 5 Average Farm Size

Farm Characteristics / Vegetable Producing Sites	Average Width (m) of a bed	Average Length (m) of a bed	Average Surface area of a Bed (m^2)	Average number of beds per farm	Average Farm Size (m^2)
Gyinase	1.04	13.73	14.28	74.13	1058.58
Apemso	1.07	13.06	13.97	109.17	1525.11
Ayeduase New site	1.70	13.64	23.19	60.24	1396.97
Emena Hospital	1.04	12.11	12.59	98.22	1236.60
Emena Township	1.04	11.29	11.74	85.55	1004.36
KNUST Engineering	1.05	11.73	12.32	56.36	694.36
KNUST School of Business	2.44	13.78	33.62	62.44	2099.23
KNUST Hall Six and Gaza	2.05	13.95	28.60	54.58	1560.99
Ayigya Tech- Kentinkrono	1.06	12.64	13.40	49.71	666.11
UEW, Kumasi Campus	1.18	12.45	14.70	220.08	3235.18
Total Average	**1.37**	**13.08**	**17.84**	**87.05**	**1447.75**

The study has revealed that, the average size of a bed in Kumasi Metropolis is 17.84 metres square ($m^{2)}$, which is not so different from the findings of Drechsel, who established that the average size of a vegetable bed ranges between 18 to 36 m^2 [27]. However, the average area covered by a bed is inconsistent with the findings of Obuobie et al., who found that the average size of a bed in vegetable farms to range between 3 to 8 square meters [24]. This variation can be attributed to the fact that, the latter included the beds of other vegetable farming cities (Tamale, Accra, Takoradi) which may have been smaller than the average area covered by a bed in Kumasi Metropolis.

Moreover, analysis of data gathered from the field indicates that, the average size of a farm in Kumasi is approximately 1447.75m^2 (0.1447.55 hectares (ha)). This finding is also consistent with that of Drechsel, who found that the average size of vegetable farms in Kumasi to be between 0.05 to 0.36 ha [27]. The vegetable farmers deem it highly unwise that taking into consideration their farm size, yield and ultimately profit they should go for a costly FBRRM.

H. Land Tenure System[12]:

Land insecurity is a common phenomenon among vegetable farmers in the Metropolis. This is because in most cases, farmers do not own the land (see Figure 3) they cultivate. Rather they enter into informal agreements with the owners of the land. Therefore, the farmers would evacuate the land prior to announcement of any development by the owner of the land. Land owners include educational institutions (KNUST, UEW etc.), Government and in a few cases private individuals and this affirms the work of Obuobie et al. [24].

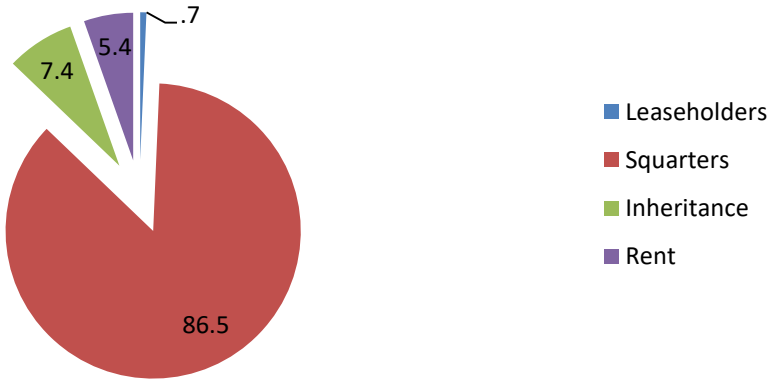

Fig. 3. Mode of Land Acquisition

[12] The leaseholders have a formal agreement with land owners to utilize the land for a stipulated time. Rented lands however referred to lands that occasionally the owners come to seek payments from the farmers. The squarters connotes those farmers with or without informal agreements with land owners.

ISSN 2348-3156 (Print)
International Journal of Social Science and Humanities Research ISSN 2348-3164 (online)
Vol. 5, Issue 2, pp: (159-170), Month: April - June 2017, Available at: www.researchpublish.com

The insecure land tenure compels the vegetable farmers to direct all their resources into short term less costly investments such as fertilizers, seedlings and other inputs which would reap those returns faster. Consequently, the tenure system undermines their desire to adopt the farm-based risk reduction measures. The use of furrows, drip kits and simple filtration would become an additional cost which in times of evacuation would be a loss to the farmers. A respondent exclaimed that *'We don't own the land here, the school does and may come to claim their land at any time. I cannot afford to make the mistake of investing heavily on the land (borehole) because it can all go down the drain when the school starts developing this land'*. In this regard, farmers prefer not to invest in capital intensive works but employ the use of sedimentation ponds as it comes at a lower cost.

I. Source of Water for Irrigation:

Analysis of data gathered from the field depicts that the main source of water for irrigation was the use of streams (see Figure 4). This explains why most of the farms are located near streams e.g. The Wiwi and Asuyeboa Streams. These water sources have been identified to be heavily polluted by waste water which is discharged into the urban environment in an untreated state.

However, with respect to those using streams as source of water, 49per cent of them combine it with shallow ponds on their farms. The study identified that as much as 99.4per cent of the farmers use low quality water for irrigation. The use of sedimentation ponds are practiced, however vegetable farmers do not comply by stepping into the pond with their wellington boots when fetching water.

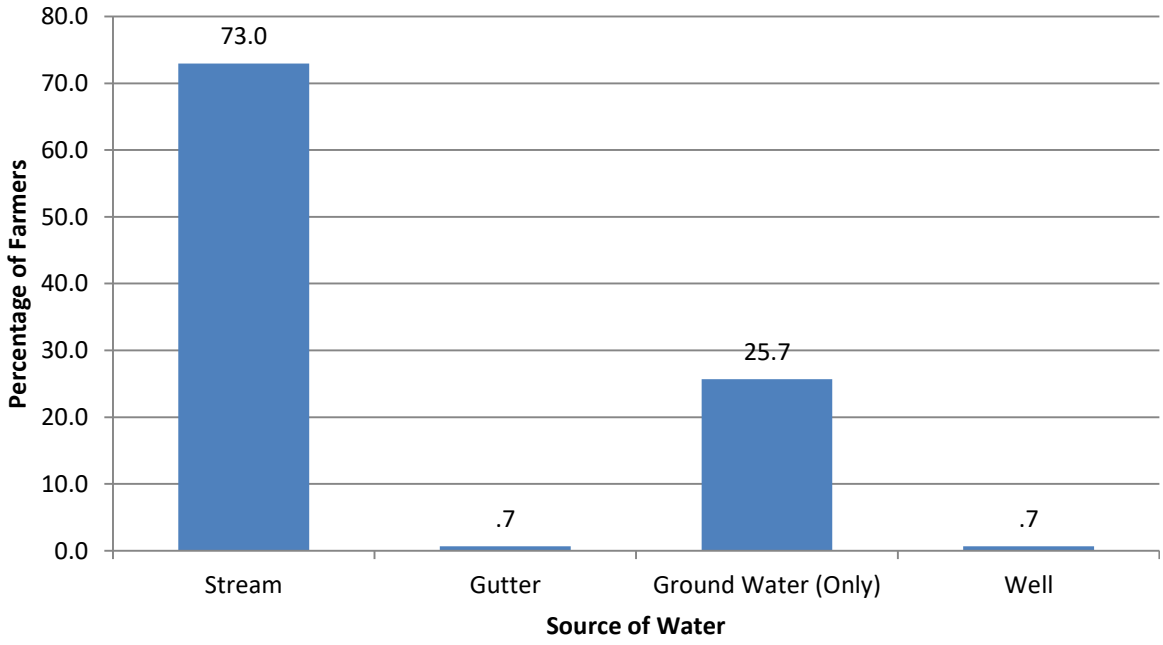

Fig. 4. Source of Water for Irrigation

Although, 99.4 per cent of the farmers use contaminated water (stream, gutter, ground water), as much as 98 per cent of the vegetable farmers claim the water they use as safe for irrigation. It is obvious the farmers do not really know what clean water for irrigation is. A respondent put forth his claim that *'the water is clean and had it been contaminated, there would have been diseases occurring on the vegetables'*. Meanwhile, further investigation depicted that, the water for irrigation was physically not up to standard (See Plate 1), not to talk of its chemical constituents. Since no institution scrutinizes the uses of low quality water in Ghana [6] vegetable farmers tend to use contaminated water. It is a common practice among vegetable farmers in the Kumasi Metropolis. Almost all vegetable farmers deemed their water as safe for irrigation and have no adverse effect on consumer or on themselves. This implies that, consumers are at risk of consuming contaminated food which can lead to diseases and food poisoning. Vegetable farmers are also at risk of ingesting the contaminated water which can cause diseases.

ISSN 2348-3156 (Print)
International Journal of Social Science and Humanities Research ISSN 2348-3164 (online)
Vol. 5, Issue 2, pp: (159-170), Month: April - June 2017, Available at: www.researchpublish.com

Plate 1: Stream for Irrigation

J. Determinants of Prices of Produce:

Analysis of data gathered from the field brought to light that, vegetable farmers are 'Price takers' so far as marketing of their produce is concerned. In most cases, food venders or market women come to the farm to buy the produce on the beds (lettuce, cabbage, spring onion, Ayoyo, Alefi) and sacs (green pepper, carrot, cucumber, cabbage). The first determinant of price of a produce is the supply of a produce (market demand) and this is affirmed by Cornish, Aidoo, and Ayamba who also brought forth that, market demand is a major factor in determining the price of vegetable produce [28]. A respondent revealed that *'when there is an abundance of a produce in the market, the price goes down and in some cases, the produce is not bought at all'*. This confirms the economic principle that all things being equal, as supply increases, the price of the good decreases.

The study revealed other determinants of the price of a produce which includes the crop under cultivation, the size of the bed on which it is cultivated Obuobie et al., (2006) and subsequently the quality of produce (free from pest attack), vegetable density of a bed and the size of the vegetable (e.g. cucumber and cabbage). A combination of these factors explains why the same quantity of lettuce, cabbage and spring onion could be sold at GH₵ 15, 40, and 30 respectfully during unfavorable conditions and sold at GH₵ 80, 110, and 90 respectfully during favorable conditions. The foregoing depicts that, a FBRRM adopted is not a determinant of the price of a vegetable.

K. Level of Compliance with FBRRM:

The study revealed that, the practice of simple sedimentation with sedimentation ponds was the common FBRRM among the vegetable farmers. Apart from that, no other FBRRM was identified to be used by any farmer (see Table 6). The total level of compliance with the FBRRM in Kumasi Metropolis is 62.8per cent.

Table 6 Level of Compliance with FBRRM

Farm Based Risk Reduction Method	Sedimentation ponds	Three tank System	Cessation	Drip Irrigation	Reduction of Splashing	Furrows
Level of Compliance	62.8 %	0 %	0 %	0 %	0 %	0 %

Delving deeper into the use of sedimentation ponds, all farmers do not observe the rules regarding it. Farmers defeat the principle of simple sedimentation by stepping into the ponds and distorting the settled sediments (see Plate 2). Another observation was the motive for the sedimentation ponds. It was realized that the sedimentation ponds were not to allow sediments in wastewater settle but to store water in various parts of the farm and reduce the stress in irrigation. This explains farmers ignorance by stepping into the pond. Furthermore, farmers found the use of wastewater to increase yield. It is true to some extent that wastewater could possess some plant nutrients [7], it is also true that wastewater definitely contains some intolerable level of pathogens [14]. Farmers were of the opinion that the use of wastewater rather aids the crops to grow bigger and look better when ready for harvest. It was observed that vegetable farmers employing the use of sedimentation ponds and those using none of the FBRRMs attracted the same price for their produce. Buyers of vegetable produce are indifferent about the hygiene observed in the process of production13.

[13] When the market women come to the farm, they look for fresh looking, big sized, densed and disease free beds of vegetables to buy. No inquiry is made of the use of a mitigation measure since waste water was used for irrigation.

ISSN 2348-3156 (Print)
International Journal of Social Science and Humanities Research ISSN 2348-3164 (online)
Vol. 5, Issue 2, pp: (159-170), Month: April - June 2017, Available at: www.researchpublish.com

L. **Plate 2. Farmer Stepping into a Sedimentation Pond*Determinants of a Farm Based Risk Reduction Measure***

From the field survey, a number of factors come into consideration when vegetable farmers want to choose a farm based risk reduction measure. The first is education or exposure to a type of farm based risk reduction measure. Farmers adopt and practice measures that they have been taught either through demonstration or adoption by a colleague. A respondent on the field revealed said that "*I only practise what I have knowledge about, and I would not risk adopting a measure I have no in- depth knowledge about. For all you know, it might even reduce my productivity".* This demonstrates that, knowledge about a risk reduction measure is a factor to be considered in establishing the factors that determine the adoption of a farm based risk reduction measure.

Land tenure is also a factor that affects the adoption of a farm based risk reduction measure. Analysis of data from the field shows that, majority (see Figure 3) of the vegetable farmers enjoy no security on the land they use for farming. Hence their occupation is at the risk of any development by the owner on the piece of land they farm on. A farmer from KNUST Business School farming site said that "*even as we are here right now, we have been threatened to leave this premises on numerous occasions by the security*". Due to this, farmers do not want to risk investing heavily into any farm based risk reduction measure. Instead, the vegetable farmers prefer a method that is less costly to them and easily adoptable.

Lastly, another factor that affects the adoption of a farm based risk reduction measure is the cost of adoption. From the field survey, it was identified that, farmers would adopt a method which they consider as less costly. A respondent declared that "*I cannot go in for a risk reduction measure which would deny me of enjoying my profits and taking care of my home. I prefer a risk reduction measure which would have minimal impact on my revenue."* For example, According to sources, installing (purchasing, transporting and setting up) a drip irrigation system on a $120m^2$ (0.012 ha) of land would cost between [14]$5000-6000 which is approximately Ghana Cedis (GH₵) 19,316.10 to 23,179.32 ($ 1 equals GH₵ 3.86). At unfavorable and favorable market prices, the average revenue of vegetable farmers in Kumasi Metropolis is GH₵ 897.50 to GH₵ 14178 respectively per season. Seeing this, it is not surprising that, no vegetable farmer in Kumasi Metropolis uses the Drip Kit Irrigation System because it is not affordable to them. This depicts that, the cost of a farm based risk reduction measure is a factor affecting the adoption of a farm based risk reduction measure.

V. CONCLUSION

It has been observed that peri-urban vegetable farming is largely dominated by males. On the average, vegetable farmers in Kumasi has completed at least the JHS, this is a good situation because it could make the understanding and adoption of the FBRRMs smooth. Age played a vital role in the adoption of the FBRRMs as a curvilinear was observed. Farmers within the ages of 29 through 49 were the highest adopters of the FBRRMs with the extreme ends 15 to 24 and 50 years and above being less likely to adopt a FBRRM. Vegetable farming in the city is not only carried out by indigenous ethnic groups but migrant ethnic groups also have a considerable share. Vegetable plants such as the lettuce, cabbage and spring onions cut across all the vegetable farming sites thereby making them the most cultivated. The FBRRMs have received little awareness and compliance from farmers and this is largely to lack of enforcement from government agencies, low knowledge of farmers about these FBRRMS, unfavourable land tenure systems and the perceived cost of adopting these

[14] Information on the cost of setting a drip irrigation system was gotten from the Horticulture Department of KNUST.

FBRRMs. Even those using sedimentation ponds defeat the rule under which it should be utilized. Adding to this phenomenon is the fact that vegetables produced under unhygienic conditions still receive market for produce, and this dwindles the pursuit of encouraging farmers to adopt FBRRMs. What is there to lose if a farmer does not comply to any of the FBRRMs? Besides, the general public is not even aware of this.

First of all, relevant institutions should be brought on board to tackle the whole issue from a holistic perspective. The Ministry of Food and Agriculture in collaboration with subsidiary local governing bodies should bring on board policies with the roles to be played by each stakeholder [29]. Per the study, majority of the farmers were not even aware of the FBRRMs which is vital to public health. It is suggested that massive awareness be created on these FBRRMs with numerous workshops to educate farmers on these FBRRMs. With farmers reluctance to commit financially to FBRRMs which may be costly amidst the fact that they don't even own the land, it is recommended that the use of the sedimentation ponds are encouraged with safe irrigation practices such as focusing water at the base of the plants[15]. Farmers should be disabused of the use of the sedimentation ponds which is to allow sediments in wastewater to settle other than making water available in various parts of the farm therefore easing the activity of irrigation. Such a mind does not allow the vegetable farmer adhere to the rule of not disturbing the surface of the water when fetching. Vegetable farmers who use low quality water have to comply with these FBRRMs in and perpetrators should be duly punished by the responsible institutions. Periodic monitoring of irrigation practices in the identified farming sites should be embarked on by the responsible institutions in order to ensure that public health is kept safe.

ACKNOWLEDGMENTS

First thanks to God almighty for the gift of life He provided me during the whole research. Special thanks goes to Dr. Owusu Amponsah for accepting to supervise this work and generous guiding and sharing materials on this study. Aminu Sulemana Morat, you are also not forgotten as you assisted me in the collection of data. Thanks also to Akosua Serwaa and Kwadwo Osei-Adu for funding the survey. Thanks to Grace Asare Doku also for providing all the emotional support I could ever imagine.

Conflicts of Interest: The author declares no conflict of interest. The founding sponsors had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, and in the decision to publish the results.

REFERENCES

[1] F. E. Omorogbee and E. A. Onemolease, "Farmers' Characteristics and Adoption' of Recommended Practices Under the Fadama Project Scheme in Edo State, Nigeria," *Sabinet Gatew.*, pp. 51–56, 2008.

[2] J. Sartwelle, T. Eggers, D. Brien, and W. Tierney, "The Effect of Personal and Farm Characteristics upon Grain Marketing Practices Jams," *J. Agric. Appl. Econ.*, vol. 32, no. 1, pp. 95–111, 2000.

[3] R. A. Fazio, J. M. R. Baide, and J. J. Molnar, "Barriers to the Adoption of Sustainable Agricultural Practices: Working Farmer and Change Agent Perspectives," 2017.

[4] I. M. Nkari and F. N. Kibera, "The Influence of Farmer Characteristics on Performance of Commercial Farmers in Kiambu County, Kenya.," *Eur. J. Bus. Soc. Sci.*, vol. 5, no. 3, pp. 63–78, 2016.

[5] O. Amponsah, H. Vigre, T. Wilde, E. Seiwaa, I. Braimah, and R. Clement, "Assessing low quality water use policy framework : Case study from Ghana," *"Resources, Conserv. Recycl.*, vol. 97, pp. 1–15, 2015.

[6] R. C. Abaidoo, "Simple Solutions to Reduce Health Risks from the Use of Wastewater in Urban and Peri- Urban Agriculture," *Addressing Water, Food Poverty Probl.*, pp. 167–172, 2013.

[7] P. Amoah, B. Keraita, M. Akple, P. Drechsel, R. C. Abaidoo, and F. Konradsen, "Low-Cost Options for Reducing Consumer Health Risks from Farm to Fork Where Crops Are Irrigated with Polluted Water in West Africa.," 2011.

[8] P. Drechsel and H. Karg, "Motivating Behaviour Change for Safe Wastewater Irrigation in Urban and Peri-Urban Ghana," *Sustain. Sanit. Pract.*, no. 16, pp. 10–20, 2013.

[9] Florida Department of Environmental Protection, "Distribution of the Earths's Water," vol. 7700, no. 850. Florida

[15] A farmer who had tried this before explained that this is time consuming and even adds to the already strenuous nature of the work.

Department of Environmental Protection, Florida, p. 1, 2008.

[10] Shakhashiri, "Chemical of the Week: Water," *General Chemistry*, p. 7, Mar-2009.

[11] Food And Agriculture Organization, "Wastewater Treatment and Use in Agriculture - FAO irrigation and drainage paper 47," 47, 2004.

[12] International Water Management Institute, *Irrigated Urban Vegetable Production in Ghana Irrigated Urban Vegetable Production in Ghana :*, Second Edi. 2014.

[13] U. J. Blumenthal, D. D. Mara, A. Peasey, G. Ruiz-palacios, and R. Stott, "Reducing the Health Risks of Using Wastewater in Agriculture," *UA Mag.*, pp. 26–29, 2001.

[14] U. J. Blumenthal, D. D. Mara, A. Peasey, G. Ruiz-palacios, and R. Stott, "Guidelines for the Microbiological Quality of Treated Wastewater Used in Agriculture: Recommendations for Revising WHO Guidelines," *Bull. World Health Organ.*, vol. 78, no. 9, pp. 1104–1116, 2000.

[15] J. H. J. Ensink, W. Van Der Hoek, Y. Matsuno, S. Munir, and M. R. Aslam, "Use of Untreated Wastewater in Peri-Urban Agriculture in Pakistan: Risks and Opportunities," Sri Lanka, 2002.

[16] D. Mara and S. Cairncross, "Guidelines for the Safe Use of Wastewater and Excreta in Agriculture and Aquaculture: Measures for Public Health Protection," Geneva, Switzerland, 1989.

[17] Food And Agriculture Organization, "Wastewater Treatment and Use in Agriculture - FAO irrigation and drainage paper 47," Rome, 47, 1992.

[18] B. Keraita, J. Akatse, M. Kinane, K. collins Osei, and R. C. Abaidoo, *On- Farm Practices for the Safe Use of Wastwater in Urban and Peri-urban Horticulture*. Rome, Italy: Food and Agricultural Organization, 2012.

[19] E. N. Ndunda and E. D. Mungatana, "Determinants of Farmers' Choice of Innovative Risk-Reduction Interventions to Wastewater-Irrigated Agriculture," *African J. Agric. Res.*, vol. 8, no. 1, pp. 119–128, 2013.

[20] P. Drechsel, B. Keraita, P. Amoah, and H. Karg, "Health Risk Management for Safe Vegetable Irrigation," in *Health Risk Management*, Kumasi, Ghana: International Water Management Institute, 2014, pp. 180–198.

[21] S. Weir, "The Effects of Education on Farmer Productivity in Rural Ethiopia," University of Oxford, 1999.

[22] National Institute of Statistics, "Romania in Figures," Bucharest, Romania, 2011.

[23] Ghana Statistical Service, "2010 Population & Housing Census: Summary Report of Final Results," Accra, Ghana, 2012.

[24] E. Obuobie, B. Keraita, G. Danso, P. Amoah, O. O. Cofie, L. Raschid-sally, and P. Drechsel, *Irrigated Urban Vegetable Production in Ghana: Characteristics, Benefits and Risks*. Accra, Ghana: International Water Management Institute, 2006.

[25] E. Oduro-ofori, P. Aboagye Anokye, and N. E. A. Acquaye, "Effects of Education on the Agricultural Productivity of Farmers in Offinso Municipality," *Int. J. Dev. Res.*, vol. 4, no. 9, pp. 1951–1960, 2014.

[26] C. A. Wongnaa and D. Awunyo-Vitor, "Factors affecting loan repayment performance among yam farmers in the Sene district, Ghana," *Agris On-line Pap. Econ. Informatics*, vol. 5, no. 2, pp. 111–122, 2013.

[27] P. Drechsel, "Comparing Soil Nutrient Depletion in Typical Urban, Peri-urban and Rural Farming Systems in Ghana," in *Practices and Constraints of Land and Water Resources Management in Urban and Peri-urban Agriculture*, 2002, p. 7.

[28] G. A. Cornish, J. B. Aidoo, and I. Ayamba, "Informal irrigation in the peri- urban zone of Kumasi , Ghana: An analysis of farmer activity and productivity," England, 2001.

[29] O. Amponsah, H. Vigre, T. W. Schou, E. S. Boateng, I. Braimah, and R. C. Abaidoo, "Resources , Conservation and Recycling Assessing low quality water use policy framework : Case study from Ghana," *Resour. Conserv. Recycl.*, vol. 97, pp. 1–15, 2015.

[30] African Union, "The African Youth Charter as a Booster to Economic , Political and Social Integration of Africa," 2006.