https://dx.doi.org/10.4314/gjas.v59i1.3

Baseline Survey and Promotion of Grain-Producing Amaranth (*Amaranthus* spp.) Crop among Ghanaian Vegetable Growers

B. DARFOUR*, A.S. APPIAH & J. NUNOO

(B.D.: Radiation Technology Centre, Biotechnology and Nuclear Agriculture Research Institute, Ghana Atomic Energy Commission, Accra, Ghana; A.S.A.: Biotechnology Centre, Biotechnology and Nuclear Agriculture Research Institute, Ghana Atomic Energy Commission, Accra, Ghana; J.N.: Nuclear Agriculture Research Centre, Biotechnology and Nuclear Agriculture Research Institute, Ghana Atomic Energy Commission, Accra, Ghana; B.D. & A.S.A.: Department of Nuclear Agriculture and Radiation Processing, School of Nuclear and Allied Sciences, University of Ghana, Legon, Ghana)

**Corresponding author's email: yawdar4@yahoo.com*

ABSTRACT

Cultivated amaranth species can be used as a leafy vegetable, grain, forage and ornamentals. The objective of this study was to obtain baseline information on vegetable production in Ghana, with an emphasis on grain-producing amaranth. The survey was administered in three major vegetable production fields in Accra, Ghana. The questions were structured, 55 respondents were purposefully selected and interviewed, and the data were represented in pie or bar charts. Male farmers exceeded their female counterparts, and each farmer cultivated about one acre. Cultivation was all year round and irrigation was applied predominantly using stream water. At least 82% of the farmers may change currently cultivated vegetables if there were alternatives with increased demand. About 61% had ever cultivated leafy amaranth and 58% were willing to restart cultivation. Amaranth farmers were challenged in the field mostly by pests (44%) and insects (26%) infestations, and diseases (23%). None of the farmers was aware of the edibility of amaranth seeds/grains while at least 81% had an interest in cultivating grain amaranth based on increased consumer demand. Importantly, the interest of respondents to cultivate grain-producing amaranth can help achieve SDG goals 1 to 3 of No poverty, Zero hunger, Good health and well-being.

Keywords: Amaranth; drying; food security; grain; vegetable

Original scientific paper. Received 30 Oct. 2023; revised 13 Feb. 2024

Introduction

Vegetable farming is a lucrative vocation in cities and towns in Ghana (Owusu-Boateng & Amuzu, 2013). Vegetable production in urban cities improves food and nutrition security, livelihoods, and income of farmers (Lee-Smith & Prain, 2006; Hoornweg & Munro-Faure, 2008; Drechsel & Keraita, 2014). In Ghana, leafy vegetables are the most cultivated, and it is market-driven, highly productive and profitable (Drechsel *et al.*, 2006). Amaranth (*Amaranthus* spp.) is the collective name for

species belonging to the genus *Amaranthus*, native to the Americas. Amaranth grain is the biggest non-grass "cereal-like" (pseudo-cereal) crop in the world. Cultivated amaranth species can be used as a leafy vegetable, food grain, forage, and ornamentals. Both the leaves and grains can be consumed, admired, and sought by peasant farmers who mostly experience food insecurity each day. Amaranth has superior nutritional value when eaten as a grain or vegetable (Ulbricht *et al*., 2009; Maurya & Arya, 2018). The crop is early maturing and demonstrates resilience against pests (birds, rodents, and termites), diseases, and droughts and thus, has the potential to increase climate resilience in agricultural production systems. In Ghana, the humid condition provides an excellent growing environment and can also survive dry/drought.

The research gap with respect to amaranth cultivation and utilization can largely be attributed to the lack of sensitization which might have resulted in the lack of improved varieties, arduous cultivation and processing, poor access to markets, and a negative image of the crop as 'food for the poor'. The benefits of amaranth include its utilization as food (grains and leaves) with enormous health benefits. Since amaranth is gluten-free, gluten-sensitive individuals can use it as a substitute for wheat. Furthermore, the crop has been identified as a food and nutrition security crop, being drought tolerant, adaptable to varying soil conditions, and short maturity period. The health benefits of maize are not comparable to amaranth grain/leaf (Neluheni *et al.*, 2007; Nutrition-and-you.com, 2019; Link, 2019).

Reducing food insecurity, child malnutrition, and hunger generally in Africa has been a challenge. Similarly, under-nutrition and micro-nutrient deficiencies which largely affect women and children are also unresolved. Therefore, sensitizing and advocating for the extensive cultivation and consumption of amaranth grains as sources of micro-nutrients and bio-active compounds, and as a food security crop is long overdue. Compared to amaranth grains, several studies have been done on amaranth leaves which is the part mostly consumed (Kwenin *et al*., 2011; Darkwa & Darkwa, 2013; Kaburi, 2015; Baidoo, 2015). Thus, this study was the basis for a broader project for the sensitization, introduction, cultivation, and utilization of amaranth grain in Ghana. The study sought to obtain baseline information on vegetable production in Ghana with an emphasis on grain-producing amaranth crops.

Materials and Methods

The survey was administered in three (3) major vegetable production fields in Accra, Ghana. Thus, the Ghana Atomic Energy Commission (Ga East municipality), Roman Ridge and Dzorwulu (Ayawaso West Municipality). These fields were purposefully selected, because all the farmers cultivate only vegetable crops (Darfour, 2019). Structured questions were used, and 55 respondents were interviewed. The questions were read and translated into the local Ghanaian language of farmers who had limitations in reading and writing. The questions ranged from general information on vegetable farmers, production of other vegetables and amaranth crops, challenges faced by amaranth farmers, and the awareness and willingness of vegetable farmers on amaranth cultivation. The data were calculated in percentages and represented as pie or bar charts and were then descriptively explained. The graphical illustrations were made with Microsoft Excel Spreadsheet.

Results and Discussion

General information on vegetable farmers and farming

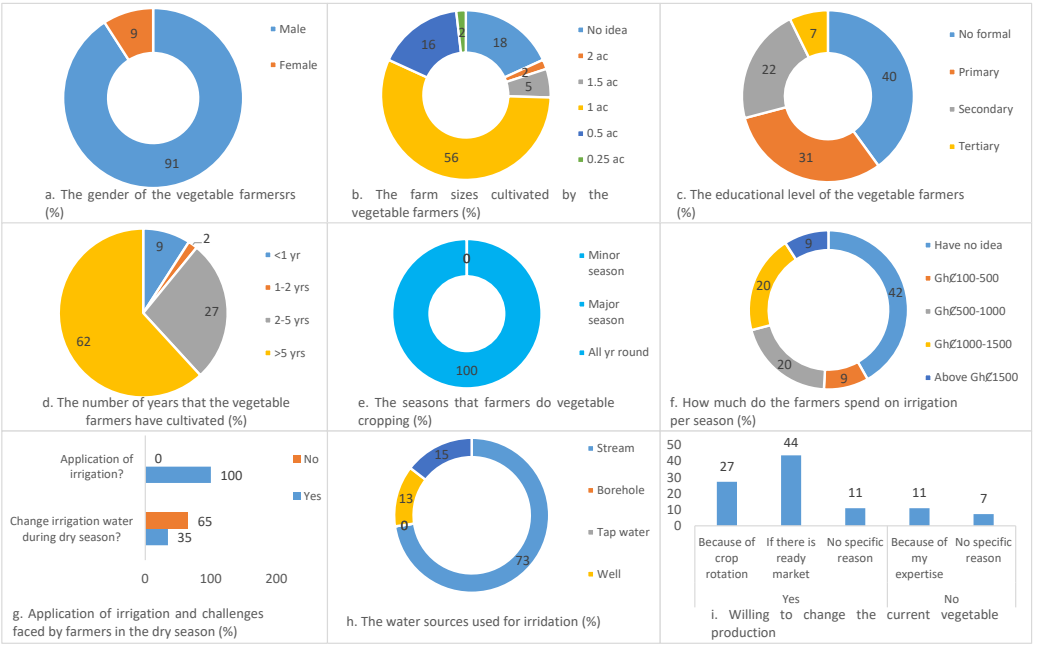

Fig. 1: General information and knowledge about vegetable farmers in three selected areas in Accra, GhanaFigure

Figure 1 shows the general information and knowledge about vegetable farmers in the three selected vegetable production fields in Accra, Ghana. The number of male farmers (91%) far exceeded their female counterparts (9%) (Fig. 1a). This is an indication that males dominate the vegetable production industry in Accra. The study affirms the results that vegetable production in urban cities is male-dominated (Djokoto *et al*., 2015; Abdulai *et al.*, 2017; Osei *et al.*, 2017; Wongnaa *et al.*, 2019), and that, males have much interest in vegetable production. About 56% (Fig. 1b) of the farmers cultivate approximately one acre of land, due to limited availability of land, inability to manage large farms due to labour and input-related costs as well as the non-existence of financial support. The land area cultivated is basically between 0.025 and 0.3 acres (Judicom, 2004; Kessler *et al.*, 2004). Due to limited cultivation, the demand for vegetables far exceeds supply, culminating in high prices for vegetables and vegetable products in Accra. Most of the farmers either had no formal education (40%) or primary education (31%) (Fig. 1c).

This makes the transfer of knowledge to farmers and subsequent application of the transferred knowledge very difficult to implement. Drechsel & Keraita (2014); Djokoto *et al.* (2015) made corresponding submissions, but (Abdulai *et al.*, 2017; Wongnaa *et al.* (2019) claim that urban vegetable farmers are formally educated. In as much as records keeping and other related issues are immensely affected

by lack of education, strenuous efforts from agricultural extension officers are required to help these farmers in their routine practices (Djokoto *et al.*, 2015). Sixty-two percent (62%) and twenty-seven (27%) of farmers have been in vegetable cultivation for at least 5 and 2-5 years respectively (Fig. 1d). Importantly, all the farmers (100%) cultivate all year round (Fig. 1e) using irrigation (Fig. 1g). The cost of irrigation per season of cultivation (Fig. 1f) was mostly found in the range of GH₵ 500-1000 (20%) and GH₵ 1000-1500 (20%). Since most farmers had no formal education, 42% of them could not indicate how much they spent on irrigation per year.

The farmers attributed the high cost of irrigation to the high cost of fuel for pumping the water, and the frequency of pumping water during the dry season. Spending at least GH₵500 on irrigation alone in Ghana is extremely expensive which might have contributed to the high cost of vegetables in Accra. At most, 35% of the farmers changed the source of water supply during the dry season (Fig. 1g). The change in water supply was necessitated by the dryness of the existing water sources which were predominantly streams (73%, Fig. 1h). At least 82% of the farmers were willing to change their current types of vegetable production (Fig. 1i) based on the following reasons; no specific reason (11%), crop rotation (27%) and presence of ready market/high demand (44%). It was observed that the farmers' current trend of vegetable production is controlled by high levels of demand or ready market. Of the remaining 18%, 7% had no specific reason for not opting for different crops, and 11% did not see the need to change since they have had extensive experience in their current crop.

Production of other vegetables and amaranth crop

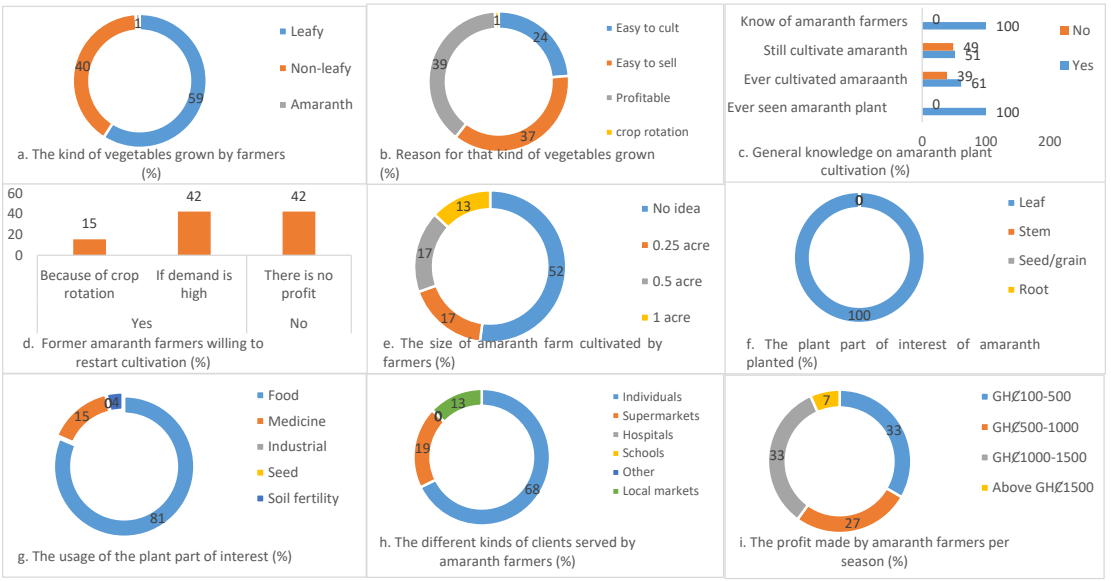

Fig. 2: Other vegetables planted, and general information on amaranth farming

Figure 2 indicates the other vegetables cultivated by farmers and the general information on amaranth farming. The farmers cultivated a wide range of vegetables (Fig. 2a) including leafy vegetables (59%), non-leafy vegetables (40%), and leafy amaranth (1%). It was observed that most of the farmers inter-cropped at least two kinds of vegetables on the same piece of land, a situation also reported by (Drechsel & Keraita, 2014; Wongnaa *et al.*, 2019). The reason for the huge cultivation of the other vegetables but low amaranth was because they were profitable and easy to cultivate and sell (Fig. 2b). Generally, all the farmers had seen or known other farmers who cultivate amaranth. However, only 61% and 51% of the farmers respectively had ever cultivated and still cultivate leafy amaranth (Fig. 2c). About 58% of former amaranth farmers were willing to re-start cultivation (Fig. 2d) with the reason of practicing crop rotation (16%) and the availability of increased demand (42%). The remaining 42% declined to re-start cultivation due to a lack of profit in cultivating the crop.

It is possible that, the low consumption of amaranth could be due to a lack of information on its health benefits. It is therefore suggested that consumers should be sensitized on the benefits of amaranth to increase consumption and demands. Fifty-two percent (52%) of the respondents had no idea about the size of their amaranth farms. This may be linked to the fact that most farmers had no formal education, and therefore, record keeping was a challenge. The total land area for amaranth cultivation was between 0.25 and one acre (Fig. 2e); the possible reason for the low consumer patronage and profit margins for farmers. According to the farmers, amaranth is cultivated purposely for its leaves (Fig. 2f) which is currently the only portion of the plant consumed as food (Fig. 2g). The knowledge of edibility and the nutritional benefits of amaranth grains was non-existent among the respondents. It is therefore imperative to educate farmers on the nutritional benefits of amaranth grains to encourage its cultivation and consumption among the Ghanaian populace. According to the farmers, the major clients for the harvested amaranth leaves were individuals (68%), supermarkets (19%), and local markets (13%) (Fig. 2h).

According to (Wongnaa *et al.*, 2019), market women, individual consumers, and institutions are the main sales outlets, with the market women being the most preferred (Drechsel & Keraita, 2014). The low cultivation, patronage, and consumption of amaranth in Accra may be the reason for the low profit margin (GH₵100-1500 per season) experienced by farmers (Fig. 2i). Furthermore, the majority of farmers do not break even to offset irrigation, land, soil, and pest management costs (Obuobie *et al.*, 2006). Wongnaa *et al.* (2019) reported GH¢2,907.9 per acre profit obtained by Ghanaian farmers for the cultivation of leafy vegetables. Nevertheless, vegetable production can be a profitable venture, if farmers determine the price of the product at the farm gate. Most times, farmers have the notion of being cheated by buyers or market women who normally price the produce at harvest (Drechsel & Keraita, 2014; Abdulai *et al.*, 2017). Alleviating poverty among vegetable farmers requires extensive and continuous cultivation, utilization and market demand, and increased capacity of farmers to price their products.

Challenges faced by amaranth farmers, and the willingness of vegetable farmers to cultivate grain-producing amaranth crop

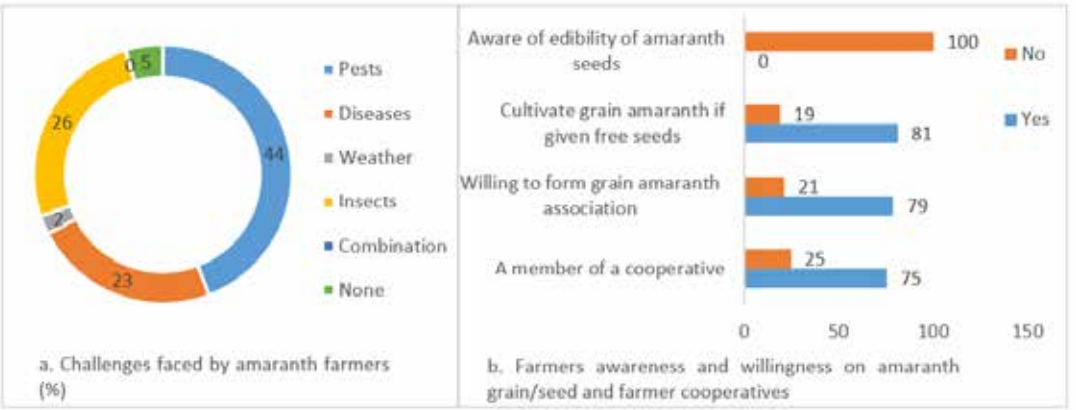

Fig. 3: Awareness and willingness of vegetable farmers, and the challenges faced by amaranth farmers

Figure 3 shows the awareness and willingness of vegetable farmers, and some challenges faced by amaranth farmers. Amaranth farmers were challenged in the field predominantly by pests (44%) and insects (26%) infestations, and diseases (23%) (Fig. 3a). These challenges can be curtailed by regularly organizing training workshops and seminars on the best cultural, diseases, insects, and integrated pest management practices for farmers. Without proper management of these challenges, amaranth grains or seeds or leaves may be expensive as a result of high treatment costs or excessive damage to the crop. Fig. 3b shows that none of the farmers was aware of the edibility of amaranth seeds/grains. At least 81% of the farmers had an interest in cultivating grain amaranth when provided with free seeds. Nonetheless, the willingness of farmers to cultivate grain amaranth is subject to increased demand from consumers. The increase in demand may be proportionate to the intensity of public sensitization on the benefits of consuming amaranth grain. This can subsequently reduce malnutrition and mitigate poverty among farmers.

Remarkably, 79% of the farmers consented to form grain amaranth farmer cooperatives, hence, dissemination of information on grain amaranth may not be too challenging. Amaranth is a C4 photosynthetic plant (NASEM, 2006), hence drought resistant. Farmers, therefore, may spend less amount of income on irrigation, especially in the dry seasons, and also avoid the use of unsafe water for irrigation which makes vegetables un-wholesome for consumption. Furthermore, amaranth grain or leaf may be inexpensive compared to other crops that depend on extensive irrigation.

Conclusion and Recommendation

In achieving SDG goal 2 (Zero hunger: End hunger, achieve food security and improved nutrition, and promote sustainable agriculture), the adoption of grain-producing amaranth as a staple crop is significant. This can reduce malnutrition and poverty among farmers, and increase food and nutrition security. First and foremost, it is important that respondents have shown interest in the cultivation of grain-producing amaranth based on increased

consumer demand. However, farmers ought to be educated on good agronomic practices for amaranth cultivation. Public sensitization on the benefits of amaranth grain is warranted, since that is the major key for increased cultivation and consumption.

Acknowledgement

The authors are grateful to the national service personnel who assisted in administering the questionnaire and all the farmers who participated in the study.

REFERENCES

Abdulai, J., Nimoh, F., Darko-Koomson, S. & Kassoh, K.F.S. (2017) Performance of vegetable production and marketing in peri-urban Kumasi, Ghana. *Journal of Agricultural Science*, **9**(3), 202.

Baidoo, J.K. (2015) Value chain assessment of two indigenous leafy vegetables (*Amaranthus* and *Corchorus* spp.) in Kumasi Metropolis. MPhil Thesis submitted to the College of Agriculture and Natural Resources, Faculty of Agriculture, Department of Horticulture, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.

Darfour, B. (2019) Controlling the deterioration of harvested grain/seed to improve food security. Ph.D. Dissertation submitted to the Graduate College, Agricultural and Biosystems Engineering Department, Iowa State University, Ames, Iowa, USA. https://lib.dr.iastate.edu/etd/16996.

Darkwa, S., Darkwa, A.A. (2013) The use of indigenous green leafy vegetables in the preparation of Ghanaian dishes. *J Food Process Technol,* **4**, 286.

Djokoto, J., Afari-Sefa, V. & Addo-Quaye, A. (2015) Vegetable supply chains in Ghana: Production constraints, opportunities and policy implications for enhancing food and nutritional security. *International Journal of Tropical Agriculture*, **33**(3), 2113–2122.

Drechsel, P., Graefe, S., Sonou, M., & Cofie, O.O. (2006) Informal irrigation in urban West Africa: An overview (Vol. 102) IWMI.

Drechsel, P. & Keraita, B. (2014) Irrigated urban vegetable production in Ghana: Characteristics, benefits and risk mitigation. IWMI.

Hoornweg, D. & Munro-Faure, P. (2008) Urban agriculture for sustainable poverty alleviation and food security. Position paper, FAO. Africa.

Judicom (2004) Étude pour l'élaboration du plan de développement de la filière fruits et legumes au Burkina Faso. Ministère de l'agriculture, de l'hydraulique et des ressources halieutiques, Ouagadougou, Burkina Faso.

Kaburi, S.A. (2015) Effect of three different rates of application of cattle dung on quality of two traditional leafy vegetables (*Amaranthus cruentus* and *Corchorus oliterius*). MPhil Thesis submitted to the College of Agriculture and Natural Resources, Faculty of Agriculture, Department of Horticulture, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.

Kessler, A., Streiffeler, F., & Obuobie, E. (2004) Women in urban agriculture in West Africa. *Urban Agriculture Magazine*, **12**, 16–17.

Kwenin, W.K.J., Wolli, M. & Dzomeku, B.M. (2011) Assessing the nutritional value of some African indigenous green leafy vegetables in Ghana. *Journal of Animal & Plant Sciences*, **10**(2), 1300–1305.

Lee-Smith, D. & Prain, G. (2006) Understanding the links between agriculture and health. IFPRI, focus 13. www.ifpri.org.

Link, R. (2019) Amaranth-health-benefits. Healthline. com/nutrition/amaranth-health-benefits.

Maurya, N.K. & Arya, P. (2018) Amaranthus grain nutritional benefits: A review. *Journal of Pharmacognosy and Phytochemistry*, **7**(2), 2258–2262.

NASEM (2006) The National Academies of Sciences and Engineering Medicine. Lost crops of Africa. Chapter 1-Amaranth, Volume (II): vegetables. NW, Washington, DC 20001.

Neluheni, K., Du Plooy, C.P. & Mayaba, N. (2007) Yield response of leafy amaranths to different irrigation regimes. In Proceedings of the 8th African Crop Science Society Conference, El-Minia, Egypt, 27–31 October 2007; **8**, 1619–1623.

Nutrition-and-you.com. (2019) www.nutrition-and-you.com/amaranth-grain.html.

Obuobie, E., Keraita, B., Danso, G., Amoah, P., Cofie, O.O., Raschid-Sally, L. & Drechsel, P. (2006) Irrigated urban vegetable production in Ghana: Characteristics benefits and risks. Accra: IWMI-RUAF-CPWF.

Osei, S.K., Folitse, B.Y., Dzandu, L.P. & Obeng-Koranteng, G. (2017) Sources of information for urban vegetable farmers in Accra, Ghana. *SAGE Journals*, **33**(1), 72–79.

Owusu-Boateng, G. & Amuzu, K.K. (2013) A survey of some critical issues in vegetable farming along River Oyansia in Opeibea and Dworwulu, Accra-Ghana. *Global Advanced Research Journal of Physical and Applied Sciences*, **2**, 024–031.

Ulbricht, C., Abrams, T., Conquer, J., Costa, D., GrimsSerrano, J.M., Taylor, S., *et al.* (2009) An evidence-based systematic review of amaranth (*Amaranthus* spp.) by the natural standard research collaboration. *J Diet Suppl*., **6**, 390–417.

Wongnaa, C.A., Akuriba, M.A. & Ebenezer, A. *et al.* (2019) Profitability and constraints to urban exotic vegetable production systems in the Kumasi metropolis of Ghana: A recipe for job creation. *Journal of Global Entrepreneurship Research*, **9**(33).