Analysis of Students' Dissertation: A Case for Promotion of Lesser-used Vegetables in Ghana

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Résumé
Britwum Acquah, Stella. *Analyse du mémoire des étudiants: Un cas pour la promotion des légumes les moins utilisés au Ghana.* Les légumes sont précieuses sources de vitamines, minéraux, fibres et sont importants dans la lutte contre les maladies et la malnutrition. Mille cinq cent trente quatre (1,534) thèses des étudiants sur les plantes soumises aux facultés de l'agriculture de Kwame Nkrumah University of Science and Technology, l'Université du Ghana et Université de Cape Coast, couvrant la période 1980-2005 ont été examinés afin de déterminer la poussée et l'intensité de la recherche sur les légumes. Les résultats indiquent que la recherche des étudiants dans les trois universités axés sur les légumes bien connus à savoir la tomate (*Lycopersicon esculentum,* Mill.), le gombo (*Abelmoschus esculentus* (L.) *Moench*), l'oignon (*Allium cepa* L.) et l'aubergine (*Solanum spp*.). Les légumes les moins utilisés tel que lablab (*Lablab purpureus* (L.) Sweet), la gourde (*Lagenaria siceraria* (Molina) Standl.) qui a le potentiel de contribuer à la nutrition alimentaire et à la sécurité alimentaire ont reçu peu ou pas d'attention de recherche. Sur la base de leur contribution potentielle en adressant le déséquilibre nutritionnel, il est recommandé qu'une certaine attention est dirigée à la recherche sur le développement, la culture, la gestion et l'utilisation des légumes les moins utilisés au Ghana.

Mots-clés: Les légumes, recherche, les thèses d'étudiant, les valeurs nutritives, moins utilisés.

Abstract
Vegetables are valuable sources of vitamins, minerals, fibres and are important in fighting against diseases and malnutrition. One thousand, five hundred and thirty-four (1,534) student theses on plants submitted to the Faculties of Agriculture of the Kwame Nkrumah University of Science and Technology, University of Ghana and University of Cape Coast covering the period 1980-2005 were reviewed to determine the thrust and intensity of research on vegetables. The results indicate that students research in the three universities focused on the well-known vegetables namely tomato (*Lycopersicon esculentum* Mill.), okra (*Abelmoschus esculentus* (L.) Moench), onion (*Allium cepa* L.*)* and garden egg (*Solanum* spp.). The lesser-used vegetables such as lablab (*Lablab purpureus* (L.) Sweet), bottle gourd (*Lagenaria siceraria* (Molina) Standl.) which has the potential to contribute to food nutrition and food security received little or no research attention. On the basis of their potential contribution in addressing nutritional imbalance, it is recommended that some attention is directed to research on the development, cultivation, management and utilization of the

lesser-used vegetables in Ghana.

Keywords: Vegetables, research, student theses, nutritive values, lesser-used.

Introduction

Plant Resources of Tropical Africa (PROTA) is an information brokerage aimed at documenting information on 7000 useful plants of tropical Africa. The 7000 useful plants have been categorised into 16 commodity groups including vegetables. Vegetables play an important role in human nutrition, especially as sources of vitamins and minerals (Abbiw, 1997; Quebedeaux and Bliss, 1988; Warcovich, 2000). They help in boosting the immune system, and in fighting against obesity, chronic diseases, coronary heart disease, stroke, cataract formation and malnutrition (van Duyn and Pivonka, 2000; Kearney *et al.*, 2005; National Research Council, 2006). Some vegetables in Ghana grow in the wild or are grown in homestead gardens. A number of these vegetables are being forgotten because of lack of information on them especially, in the area of documented recipes/usage (Abbey *et al.*, 2006). Considering the importance of vegetables in human nutrition, there is the urgent need to provide up to date information on the production to consumption pathway. Higher agricultural productivity is a precondition for growth and development in most African countries, and increasing yields is key to raising incomes in rural communities. Farmers and commercial producers would benefit especially if they can diversify their cropping system to include high nutrient but lesser-used vegetables. Strong agricultural research is however necessary to promote the lesser-used vegetables.

About 800 plant species have been documented as vegetables in Tropical Africa (Omino *et al.,* 2004). Of these, 356 species are primarily used as vegetables. In the West African sub-region 194 plant species are used as vegetables. Although 64 species of Tropical Africa plants are listed as vegetables in Ghana (Grubben and Denton, 2004) relatively few are commonly used and traded in the markets. Paucity of information on their properties, nutritional characteristics, breeding, management and post harvest handling has precluded the development and utilisation of many of the lesser-used but potentially important vegetables. The objective of this paper is to review students' dissertations or research on vegetables undertaken by the Faculties of Agriculture of Kwame Nkrumah University of Science and Technology (KNUST), University of Ghana (UoG) and University of Cape Coast (UCC) to determine the thrust and intensity of research on vegetables. In addition, it points to the need to stimulate research into the lesser-used vegetables with the aim of promoting

their cultivation, sustainable management and utilisation.

Methodology

The PROTA Afrirefs (grey literature on plants from Tropical Africa) database an Inmagic DB/TextWorks software was used to derive information on vegetables. One thousand, five hundred and thirty-four (1,534) theses on plants from the Faculties of Agriculture of KNUST, UoG and UCC covering the period 1980-2005 in Afrirefs database were exported into Microsoft Access. The records were sorted based on the University, Faculty and then the year. The titles, abstracts and keywords of the theses were used to determine the plant species and commodity group in line with PROTA categorisation. The PROTA handbook on basic list and commodity groupings were used as a guide to classify all the plants. The area of research or subject matter on each thesis was also recorded. Intensity of research (%) on the dominant and the lesser-used (underutilised) vegetables were determined. The data were subjected to descriptive analysis.

Results and Discussion

Overall 303 student theses from the Faculties of Agriculture of the three universities dealt with various problems relating to vegetables. The number of theses and the list of vegetable species covered by each of the three Agriculture Faculties over the 25 year period is in Table 1.

The most researched vegetable crops by the three universities were tomato (*Lycopersicon esculentum* Mill.), okra (*Abelmoschus esculentus* (L.) Moench), onion (*Allium cepa* L.) and garden eggs (*Solanum* spp.). (Figs. 1a, 1b, 1c). Cabbage (*Brassica oleracea* L.) and lettuce (*Lactuca sativa* L.) also received considerable attention at UCC and KNUST respectively. All the dominant species worked on by the three universities are vegetables of national importance which are readily available in all the major markets throughout Ghana. To further boost the production of these major vegetables there is the need for synthesis of available information aimed at identifying research gaps and developmental challenges. The four major vegetables (tomato, onion, okra, garden eggs) are the most commonly consumed vegetables in tropical Africa (Lester and Seck, 2004). Lettuce consumption is concentrated in the urban centres (Grubben, 2004a) whiles cabbage is produced for local urban markets (van der Vossen and Seif, 2004). There was preponderance of agronomic studies in the 303 theses dealing with problems relating to vegetables (Table 2). However, post harvest handling, economics and marketing received less research attention (Fig. 2).

Meanwhile, lack of knowledge in the handling of vegetables including transportation and storage are some of the major impediments in the management and marketing of

Table 1. Theses and vegetable species coverage in three public universities in Ghana.

	Kwame Nkrumah University of Science and Technology	*University of Ghana*	*University of Cape Coast*
Number of theses	85	72	146
Number of species	29	20	31
Species identity	*Abelmoschus esculentus* (L.) Moench *Allium cepa* L. *Alternanthera sessilis* (L.) DC. *Amaranthus hybridus* L. *Amaranthus spinosus* L. *Basella alba* L. *Bidens pilosa* L. *Brassica oleracea* L. *Canavalia ensiformis* (L.) DC. *Celosia trigyna* L. *Citrullus lanatus* Thunb. Matsum. & Nakai *Cleome rutidosperma* DC.	*Abelmoschus esculentus* (L.) Moench *Allium cepa* L. *Amaranthus hybridus* L. *Asystasia calycina* (Roth) T. Anderson *Brassica oleracea* L. *Celosia argentea* L. *Commelina benghalensis* L. Crotalaria sp. *Cucumeropsis edulis* (Hook. f.) *Cucumis sativus* L. *Curcubita pepo* L. *Hibiscus sabdariffa* L. *Lactuca sativa* L. *Lycopersicon esculentum* Mill.	*Abelmoschus esculentus* (L.) Moench *Adansonia digitata* L. *Allium cepa* L. *Amaranthus cruentus* L. *Amaranthus spinosus* L. *Basella alba* L *Brassica oleracea* L. *Cassia obtusifolia* L. *Curcubita pepo* L. *Citrullus lanatus* (Thunb.) Matsum. & Nakai *Cleome gynandra* L. *Colocasia esculenta* (L.) Schott

Corchorus olitorius L.	*Psophocarpus palustris* auct. non Desv.	*Corchorus olitorius* L.
Crotalaria retusa L.	*Psophocarpus tetragonolobus* (L.) DC.	Crotalaria sp.
Cucumis sativus L.	*Solanum gilo* Raddi	*Cucumis sativus* L.
Daucus carota L.	*Solanum integrifolium* L.	*Daucus carota* L.
Hibiscus sabdariffa L.	*Solanum melongena*	*Hibiscus cannabinus* L.
Lactuca sativa L.	*Solanum torvum* Sw.	*Lactuca sativa* L.
Lycopersicon esculentum Mill.		*Luffa acutangula* (L.) Roxb.
Physalis angulata L.		*Luffa aegyptiaca* Mill.
Portulaca quadrifida L.		*Luffa cylindrica* (L.) Roem
Psophocarpus tetragonolobus (L.) DC.		*Lycopersicon esculentum* Mill.
Solanum aethiopicum L.		*Psophocarpus tetragonolobus* (L.) DC.
Solanum integrifolium L.		*Sesamum radiatum* Thonn. ex Hornem.
Solanum macrocarpon L.		*Solanum integrifolium* L.
Solanum melongena L.		*Solanum melongena* L
Solanum torvum Sw.		*Solanum scabrum* Mill.
Talinum triangulare (Jack.) Wild.		*Solanum torvum* Sw.
Vernonia amygdalina Delile		*Solanum macrocarpon* L.
		Talinum triangulare (Jack.) Wild
		Vernonia amygdalina Delile

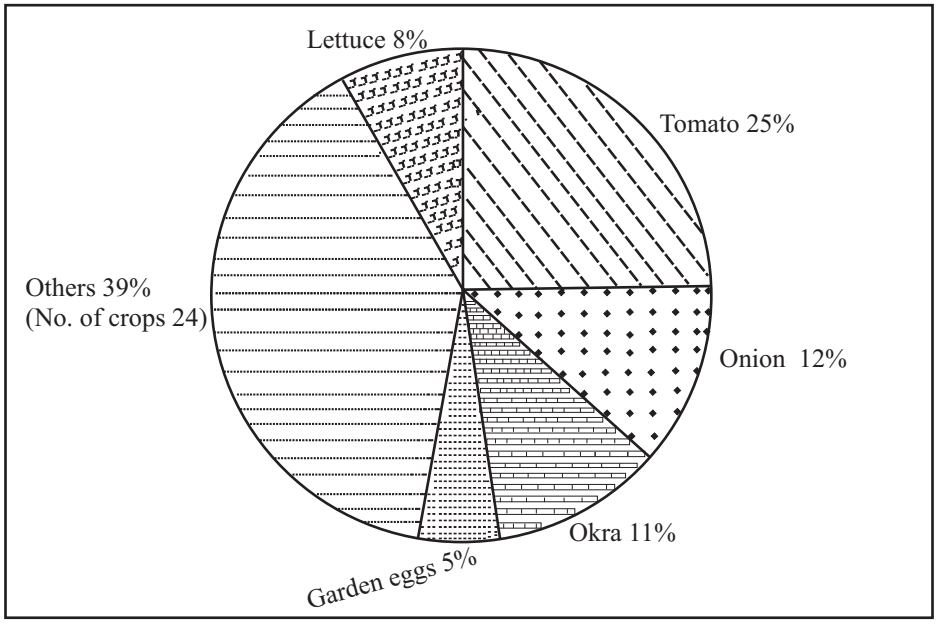

Figure 1a. Research intensity on vegetables at the Kwame Nkrumah University of Science and Technology.

vegetables (Hasanawu, 2004). More research effort should be directed towards post harvest handling including transportation and storage in order to reduce farmers' frustration arising out of post harvest losses. Furthermore, studies on breeding and genetics should be intensified to aim at producing more adaptable pest and disease resistant varieties.

There were considerable overlap and sometimes duplication of research objectives in the theses from the three universities. There is therefore urgent need for the universities and institutions of higher learning to confer to determine research niche to reduce duplication and over concentration of research efforts on few species.

Of the 64 species listed as vegetables in Ghana (Grubben and Denton, 2004) less than ten species received over 80% research investment over the 25 year period. The study has demonstrated the critical need to extend research activities to the lesser-used or underutilised vegetable species in Ghana. These vegetables have potentials for addressing nutritional deficiencies, poverty and hunger particularly in the rural settings where poverty is most pervasive. Table 3 lists the nutritive values of many of the underutilised species which have potential for addressing nutritional disorders in Ghana.

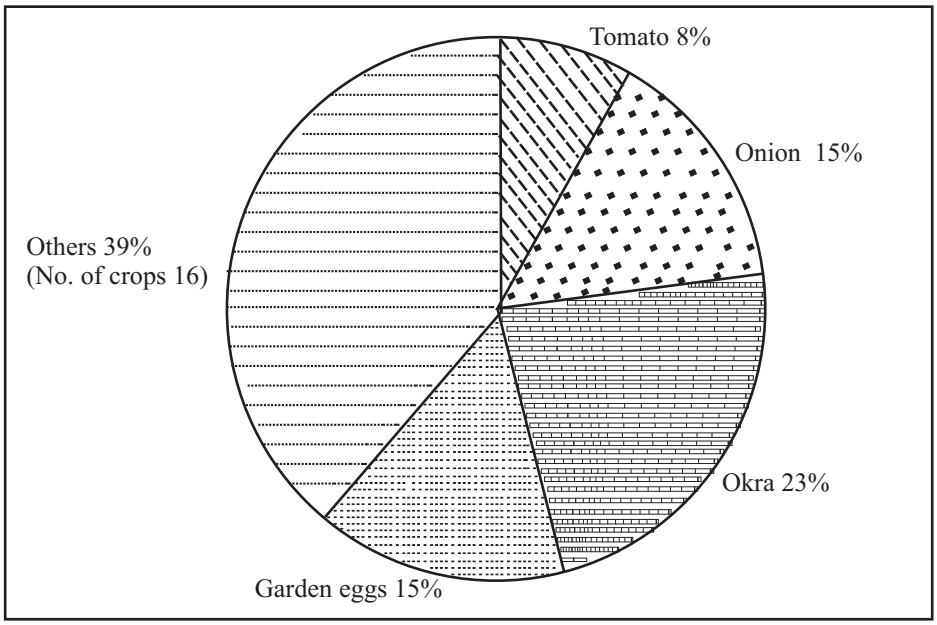

Figure 1b. Research intensity on vegetables at the University of Ghana.

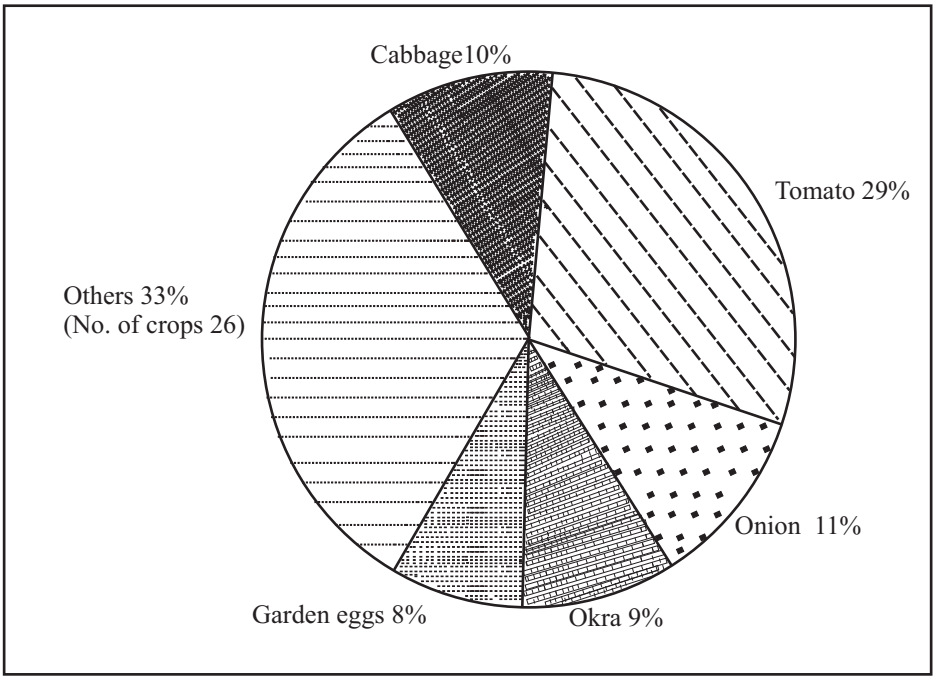

Figure 1c. Research intensity on vegetables at the University of Cape Coast.

Table 2. Research areas of thesis from the faculties of three public universities in Ghana.

Research area	*% number of thesis*						
	Tomato	*Okra*	*Onion*	*G. eggs*	*Lettuce*	*Cabbage*	*Others*
Breeding & genetics	20.4	11.6	4.5	25.0	0.0	0.0	0.0
Pest & diseases	29.6	32.6	2.3	15.6	31.3	65.2	27.4
Agronomy	36.7	46.5	77.3	59.4	62.5	30.4	61.3
Post harvest handling	5.1	2.3	9.1	0.0	0.0	0.0	3.2
Economics & marketing	8.2	4.7	4.5	0.0	6.3	4.3	3.2
◆Others	0.0	2.3	2.3	0.0	0.0	0.0	4.8

◆The other research areas were on documentation and review of the plant species.

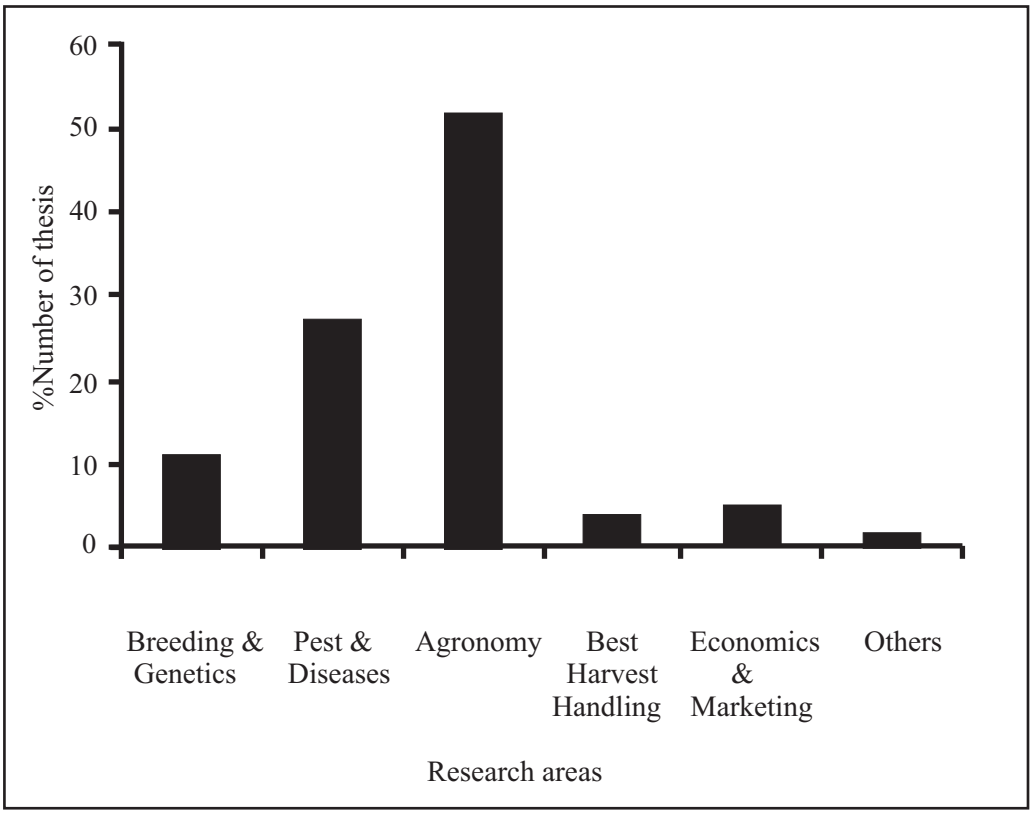

Figure 2. Percentage of thesis devoted to research areas.

Table 3. Nutritional value of species with a well-defined vegetable use that deserve more attention from extension and research in Ghana.

Species	*Family*	*English/Vernacular name(s)*	*Nutritive composition per 100g edible portion*				
			Energy KJ	*Protein g*	*Ca mg*	*Fe mg*	*P mg*
Adansonia digitata L.	Bombacaceae (APG: Malvaceae)	Boabab, monkey-bread tree, dead-rat tree cream- of-tartar tree	289	3.8	402	NN	65
Amaranthus blitum L.	Amaranthaceae	Amaranth, wild Amaranth pigweed	75	3.5	270	3.0	65
Amaranthus cruentus L.	Amaranthaceae	Amaranth, African spinach	176	4.6	410	8.9	103
Basella alba L.	Basellaceae	Ceylon spinach, vine spinach Indian spinach	79	1.8	109	1.2	52
Celosia argentea L.	Amaranthaceae	Celosia, cock's comb	185	4.7	260	7.8	43
Citrullus lanatus (Thunb.) Matsum. & Nakai	Cucurbitaceae	Egusi melon, Cooking melon, Watermelon	89	1. 4	25	0.9	24
Cleome gynandra L.	Capparaceae (APG: Brassicaceae)	Spiderplant	142	4.8	288	6.0	111
Cnidoscolus aconitifolius (Mill.) I.M. Johnst.	Euphorbiaceae	Chaya, tree spinach	NN	4-8	140-500	2-11	70-100
Colocasia esculenta (L.) Schott	Araceae (APG: Malvaceae)	Taro, cocoyam	147	4.4	110	2.3	60
Corchorus olitorius L.	Tiliaceae	Jew's mallow, bush okro	243	4.5	360	7.2	122
Cucumeropsis mannii Naudin	Cucurbitaceae	Egusi-itoo	2282	26.2	86	NN	NN
Cucurbita maxima	Cucurbitaceae	Pumpkin, winter squash	55	0.7	29	0.4	19

Duchusne							
Hibiscus cannabinus L.	Malvaceae	Kenaf	280	5.5	484	12.1	8
Hibiscus sabdariffa L.	Malvaceae	Roselle	180	3.3	213	4.8	93
Ipomoea aquatica Forssk	Convolvulaceae	Kangkong	80	2.6	77	1.7	39
Lablab purpureus (L.) Sweet	Papilionaceae	Lablab	193	2.1	50	0.7	49
Lagenaria siceraria (Molina) Standl.	Cucurbitaceae	Bottle gourd	180	4.4	560	7.4	88
Launaea taraxacifolia (Wild.) Amin ex C. Jeffrey	Asteraceae	Yanrin, African lettuce, Wild lettuce	184	3.2	326	NN	58
Luffa acutangula (L.) Roxb.	Cucurbitaceae	Ridged gourd	70	0.8	12	0.3	32
Momordica charantia L.	Cucurbitaceae	Bitter gourd	71	1.0	19	0.4	31
Moringa oleifera Lam.	Moringaceae	Drumstick tree, bean oil tree	268	9.4	185	4.0	112
Portulaca oleracea L.	Portulacaceae	Purslane, garden purslane	67	1.3	65	2.0	44
Psophocarpus tetragonolobus (L.) DC.	Papilionaceae	Winged bean, asparagus pea	113	2.6	64	0.8	37
Sena obtusifolia (L.) Irwin & Barneby	Caesalpiniaceae	Sickle pod, African foetid cassia	251	5.6	589	5.9	96
Solanum aethiopicum L.	Solanaceae	African eggplant, garden egg, scarlet eggplant	137	1.5	28	1.5	47
Solanum macrocarpon L.	Solanaceae	Gboma, African eggplant	176	4.6	391	NN	49
Solanum torvum Sw.	Solanaceae	Pea eggplant, cherry eggplant, devil's fig. plate brush	197	2.4	104	4.6	70
Trichosanthes cucumerina L.	Cucurbitaceae	Snake gourd, snake tomato	89	0.5	26	0.3	20
Vernonia amygdalina Delile	Asteraceae	Bitter leaf	218	5.2	145	5.0	67

Source: Grubben, G.J.H. & Denton, O.A. (Eds). 2004, PROTA 2: Vegetables.
NN: Not known.

However, vegetables contribution of minerals and vitamins to human nutrition is limited due to the presence of anti-nutritional factors such as oxalic acid, phytic acid, tannic acid, prussic acid, saponins and polyphenols (Messiaen 1994; Mosha *et al.,* 1995; Ejoh *et al.,* 2009). These anti- nutritional factors render some of the nutrients in vegetables unavailable for human nutrition (Ejoh *et al.,* 2009). Some studies have suggested that systematic breeding, different processing techniques and blanching could reduce these anti-nutritional factors to accepted levels (Norman, 1992; Mosha *et al.,* 1995; Ejoh *et al.,* 2009). Many of the vegetables listed could contribute to food security and livelihoods if improved through research and appropriate awareness.

Ghana is endowed with a variety of vegetables and some of these vegetables are consumed by a few ethnic groups in Ghana: *Corchorus olitorius* (Jew's mallow) eaten mainly by Ewes, *Colocacia esculenta* (Taro) by Akans and *Sesamum radiatum* (Black benniseed) by the Northern tribes (Abbiw, 1997). Diversification of production and consumption habits to include a broader range of species can contribute to improved health and nutrition, household food security, livelihoods and ecological sustainability. *Adansonia digitata* (baobab) is one of the underutilized vegetable crops which received little research attention by the Faculties of Agriculture. The National Research Council (2006) reports indicate that baobab contains 11 to 17 percent crude protein and with an amino-acid composition comparing favorably with that considered as ultimate for human nutrition. Leaves of baobab contribute a protein of vital quality and the young tender baobab leaves contain good levels of provitamin A. The baobab tree is found nearly all over Ghana, but it is more prevalent in the Northern, Upper East and Upper West Regions of Ghana where poverty is more pervasive. Research has shown it to be of such nutritional quality that it may be therapeutically useful in the management of protein-calorie malnutrition, the biggest baby-killer of all, and a common feature across Africa (National Research Council, 2006). However, nutritional properties reported in the literature (Bosch *et al.,* 2004*)* vary considerably and little is known about how best to cultivate and care for this all important vegetable crop. Research could be conducted along these lines together with studies on variation in growth rate, leaf production, breeding and fibre yield.

Compared to some of the common vegetable crops (tomato, okra, onions, garden eggs) *Amaranthus cruentus* (amaranth) is remarkably rich in vitamin A, vitamin C, iron, calcium and folate (Grubben, 2004b). It is the main leafy vegetable in Benin, Togo and Sierra Leone and very important in many lowland areas e.g. in southern Nigeria,

DR Congo, Kenya and Tanzania (Grubben, 2004b). In India, weaning foods are fortified with amaranth leaf flour but this vegetable is underutilised in Ghana as very little research has been conducted on it (National Research Council, 2006). *Amaranthus cruentus* is an easy-to-grow vegetable and it will thrive in most parts of Ghana. Its excellent nutritional value makes it an important vegetable for human nutrition. Research could focus on the optimization of cultural practices, on breeding for fungus and insect resistance and on post harvest handling as well as marketing.

For many of the vegetable species found in Ghana, it is unclear what the market demand is, what prices are paid and what quantities are traded. Local or national studies could provide insight in opportunities for farmers and traders. Bachelor of Science and Master of Science research could provide basic statistical data and series of such studies could indicate developments that justify further study. Changes over time in species or cultivars on offer in markets can reveal shifts in cultivars and species grown could indicate a need for conservation measures (Bosch *et al.,* 2005).

Conclusion

There are a number of vegetables in Ghana with high nutritional value but student theses or research from the Faculties of Agriculture of KNUST, UoG and UCC have focused on the popular or commonly used species. Given the potential of many of the lesser-used vegetables in contributing to food security, it is vital that more research is conducted on the lesser-used vegetable crops. The study also revealed that agronomic research was dominant. On the other hand, post harvest handling and economics and marketing received less research attention. It is recommended that some research investment is directed to the development, cultivation, management and utilisation of the lesser-used vegetables in Ghana.

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