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Vegetable Supply Chains in Ghana: Production Constraints, Opportunities and Policy Implications for Enhancing Food and Nutritional Security

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Abstract: *Vegetables can make an important contribution to food and nutritional security and can enhance livelihood of marginal and smallholders due to their high farmgate values per unit land area. Besides their economic, nutritional and medicinal importance, traditional African vegetables are considered valuable because of their ability to fit into year-round production systems. A study was undertaken within the humid tropics zone of the cocoa belt of Ghana to identify the potential for vegetable integration and diversification into cocoa-based farming systems. Field surveys involving stratified randomized 788 vegetable producer respondents were selected from cocoa growing areas of the Ashanti and Western Regions of Ghana. The elicited quantitative data was complimented with focus group discussions and field observations. A sizable number of farmers integrated vegetables into cocoa production either on separate fields or on the fringes of their cocoa farms. A major constraint is lack of farmer access to high quality improved vegetable seed cultivars. Additionally, diversification of cocoa farming households into vegetables constitutes an important agricultural livelihood diversification strategy. Together, these will contribute to diversifying household income and nutritional related Sustainable Development Goals. The knowledge of production, utilisation patterns as well as current government focus on vegetables and related bottlenecks will provide policy makers opportunity to address them.*

Keywords: *Food security, Ghana, nutritional security, production constraints and vegetable supply chains.*

INTRODUCTION

Nutrition has in recent times been capturing the international spotlight in an unprecedented way in spite of persisting global hunger and undernutrition challenges. One in eight people around the world are still suffering from hunger, and more than double that number are victims of hidden hunger (IFPRI, 2014). Vegetables can make an important contribution to food and nutritional security and can enhance livelihood of marginal and smallholders due to their high farmgate values per unit area. Besides their economic, nutritional and medicinal importance, traditional African vegetables in particular are considered valuable because of their ability to fit into year-round production systems.

In Ghana, cultivation of vegetables is an excellent source of employment for both rural and urban dwellers as it takes place in many rural areas through truck farming and in the outskirts of towns and cities in the form of market and backyard gardening to supply fresh produce to urban markets (Owusu-Boateng and Amuzu, 2013). It thus plays an important socio-economic role as well as in diversifying diets for improved nutrition (Ntow *et al*., 2006). Ghana benefits from considerable foreign exchange through the export of vegetables such as okra and chillies to European countries including Belgium, Britain, Germany, Italy, and Switzerland (Gyau and Spiller, 2007; Armah, 2010). Chilli exports for instance have ranged between 26,000 and 41,000 MT per annum over the past 5 years with corresponding foreign exchange from US$18.2 to US$28.7 million (Armah, 2010).

Despite such enormous combination of agronomic, economic and nutritional benefits, the production and marketing of from vegetables in Ghana and other countries in sub-Saharan Africa are constrained by factors such as poor quality and availability of seeds and other production related risks, lack of appropriate market information and

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support systems, as well as high postharvest losses, thereby preventing farmers from better exploiting the opportunities represented by these crops. This partly stems from the fact that most past and some on-going efforts to address food security have concentrated on the provision of calories via enhancing the availability of staples, particularly, cereals and roots and tuber crops, rather than placing emphasis on appropriate nutritional elements that can be attained from a balanced diet. Thus in spite of the increase in the availability, affordability and consumption of nutrient-dense vegetables as an affordable and one of the most cost effective ways of substantially reversing malnutrition, the use of this option for addressing nutritional security appears to be less valued than food security by key decision makers, and vegetable crops thus receive inadequate research investment.

At the national level, there is increased awareness on the need to diversify both farm household income and diets to improve nutrition of otherwise vulnerable populations, particularly in the cocoa belt of Ghana, whereby positive spillover benefits of increased input use on cocoa farms are made possible for field crops and vegetables through cocoa and other cash crop delivery channels. Thus several food based interventions via farming system intensification and diversification, particularly, vegetable and fruit are likely to be introduced in Ghana and other sub-Saharan Africa by donors and policy makers. Already the GhanaVeg – Commercial vegetable Sector Development in Ghana, a new initiative funded by the Dutch government commenced in 2014 (*http://ghanaveg.org*).

Thus, awareness of the nutritional importance of vegetables has recently increased in many sub-Saharan African countries including Ghana, which should create new opportunities for increased investments in vegetable research and development. In this light, research is needed to better understand the potential opportunities and perceived critical bottlenecks faced by poor smallholder farmers in their production and consumption decisions for integrating vegetables into their farming systems in order to devise the right kind of adoption and dissemination strategy. Owing to the seasonality of output and inadequacy of income from cocoa beans sales what is the potential for vegetable integration and diversification into cocoa-based farming systems? What are the current production constraints and utilisation patterns of vegetables? Finally, what is government focus on vegetables and related bottlenecks? To the best of our knowledge this paper is possibly the first attempt to empirically investigate the underlying supply chain factors that determine and motivate smallholder household decision to integrate vegetables and identify pathways and entry points to improve their adoption and increase own household vegetable consumption within an otherwise predominant cocoa-based farming system in the humid tropics agro-ecological zone of Ghana. The study also examined the production constraints, investigated the utilisation patterns of vegetables and assessed current government focus on vegetables and related bottlenecks.

Section 2 outlines the data and methods. The results and discussion are contained in section 3. The study concludes in section 4 with some policy recommendations.

DATA AND METHODS

Sample sizes were determined based on the population of vegetable farmers identified in the cocoa growing areas of the Ashanti and Western Regions. Sample formula for sample size determination was applied to the population of farmers in each district at the time of the survey, resulting in the sample sizes stated in Table 1. For each district, the number of farmers interviewed was weighted by the proportion of the community's population in the population of the district. A map of the regions is provided in Appendix 1. The interviews were augmented by focus group discussion (FGD) and expert interviews. The participants of the FGD were drawn from seed importers and distributors. The expert interviews were with vegetable policy makers, breeders and other researchers.

Data was captured in the Statistical Package for Social Sciences (SPSS), version 18 for purposes of

Table 1
Sample sizes for each district

	Ashanti Region	*Sample size (N)*
1.	Atwima-Nwabiagya	99
2.	Atwima-Mponua	114
3.	Asante Akim North	112
4.	Asante Akim South	73
5.	Offinso-North	164
	Sub total	562
	Western Region	
6.	Bibiani-Ahwianso-Bekwai	139
7.	Sefwi-Wiawso	48
8.	Prestea-Huni Valley	39
	Sub-total	226
	Total (N)	788

comprehensive documentation. Following this the data was transformed into Microsoft Excel format with accompanying data encoding. The data from the focus group discussion was transcribed and casted in the form that is responsive to the objectives of the study. The data obtained from the in-depth interviews were likewise treated.

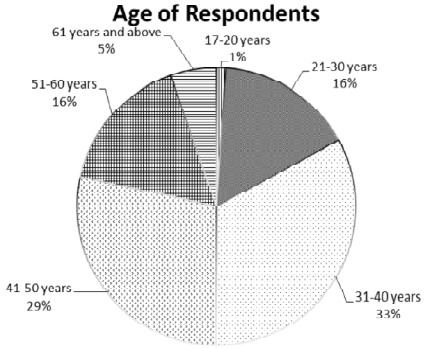
RESULTS AND DISCUSSIONS

Socio-economic characteristics of sampled respondents

The age of respondents ranged from 18 years to 80 years. Grouping the ages, about 1% were between 17 to 20 years old (Figure 1) and about 50% were aged between 21 to 40 years.

The size of this active age group holds promise for integrated cocoa and vegetable cultivation in the study area. This age profile is similar to that found by Makarau *et al*. (2013) for Kaduna State in Nigeria.

Figure 1
Age of Respondents



Most of the respondents were males (Table 2). Since the bulk of the respondents (81.3%) are heads of households (Table 3), it is reasonable to conclude that cocoa and vegetable production in the study areas are male dominated. The gender distribution in favour of males (78.1%) is perhaps not surprising as cocoa-based farming in most parts of Ghana (Adebisi-Adelani, *et al.* 2011; Drechsel *et al*., 2013; Makarau *et al*., 2013; Takane, 2002) as well as world agriculture in general is a male dominated activity (FAOSTAT, 2015).

Table 2
Gender of respondent

	Frequency	*Percentage*
Male	613	78.1
Female	172	21.9
Total (N)	785	100.0

Table 3
Relation to respondent of household head

	Frequency	*Percentage*
Self	641	81.3
Spouse	125	15.9
Other	22	2.8
Total (N)	788	100.0

As noted earlier, the criteria for choice of population is vegetable growers in the cocoa belt of Ashanti and Western Regions of Ghana. Therefore, the possibility existed that some vegetable growers may not be cocoa growers hence the importance of the question 'do you grow cocoa?' More than 60% (63%) of the households grow cocoa (Table 4). Therefore, this proportion of households can be targeted with cocoa-vegetable integration and/or diversification interventions. Close to 90% of the households are male-headed (Figure 2). This result correlates with earlier outcome of male domination in cocoa-based systems vis-a-vis vegetable production in the study areas (Table 4).

Figure 2
Household Type

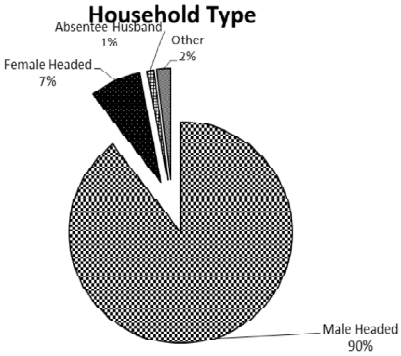
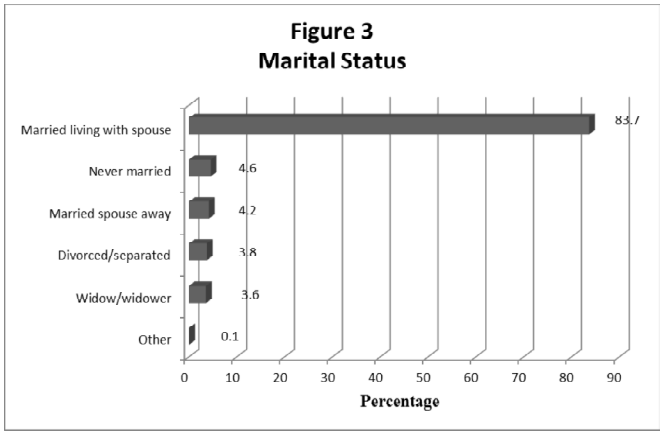


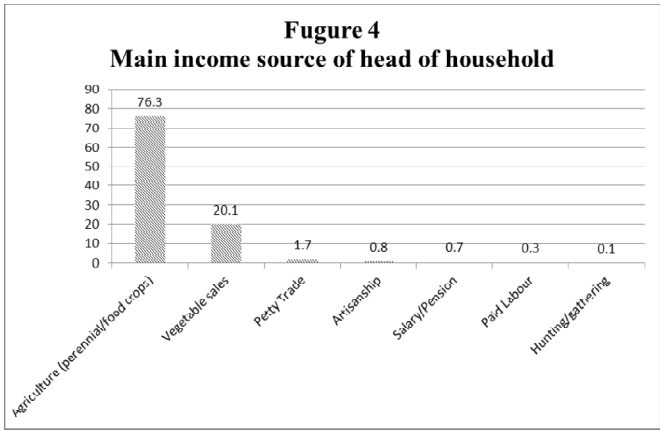
Table 4
Cultivation of cocoa

	Frequency	*Percentage*
Yes	496	63.0
No	291	37.0
Total (N)	787	100.0

About 84% of heads of household are married and living with spouse (Figure 3). Relating this to the majority of heads of households in the economically active age group, one can suggest that cocoa and vegetable growing households are families. These household characteristics should be useful for future farming interventions aimed at improving the nutritional status of households in the cocoa belt of the humid tropics of Ghana.

Perennial and/or food crops are the main source of income for 76.5% of them (Figure 4). For 20.1% of





the household heads, their main source of income is from the sale of vegetables.

This result implies that any production and marketing challenges encountered in the vegetable and perennial and food crop sub-sectors will impact significantly on these households. On the other hand, any intervention that improves incomes of these households would make a positive impact on them.

The educational background of heads of households captures persons with tertiary education (2%) engaged in cocoa and vegetable farming (Table 5). The single highest percentage of categories is those who never had any formal education. These constitute 30.3% of the respondents. Together about 70% of the heads of households do not have secondary education. This large proportion of farmers with less or no education suggests they may be unable to read and appreciate information of vegetable seeds packs for example. Their ability to keep farm related records may also be negatively affected. There will therefore be the need for effective agricultural extension support that requires the use of language and literacy techniques that are suitable to them. The findings of this study are consistent with that of Makarau *et al.* (2013), who found that lack of farmer awareness and technical information on production and marketing is a major limiting factor to vegetable production in the Kaduna state of Nigeria.

Table 5
Level of formal education of household head

	Frequency	*Percentage*
Never	231	30.3
Primary dropped	130	17.1
Primary completed	123	16.1
Secondary dropped	119	15.6
Secondary completed	100	13.1
Tertiary	15	2.0
Other	44	5.8
Total	762	100.0

Tables 6 show the age profiling of households. In the age group below 16 years, there are more males than females. However, with the economically active age group, 16 years to 60 years, there seem to be more females than males in households surveyed. There is slightly more females than males aged 60 years and above.

On the basis of an examination of the differences within age groupings, the percentage frequencies of those aged below 16 years and 16 years to 60 years are almost the same. Those aged above 60 years are few. Adding the frequencies of those above 60 years to those below 16 years shows that the dependency group is more than the latter economically active groups. This age profiling calls for greater support to those in the economically active age group. Integrating vegetables into cocoa cultivation can be in the context of crop diversification. Since livelihood diversification has more positive attributes than negative (Ellis, 2000), efforts directed at enhancing this diversification is important and would significantly impact these households.

Assess the current situation of existing vegetable farming systems vis-a-vis the potential for vegetable integration and/or diversification

The farmers interviewed produced indigenous and indigenised vegetables (Figure 5). More than 90% of the farmers cultivated tomato (*Lycopersicon esculentum*), hot pepper (*Capsicum annum*), garden eggs (*Solanum aethiopicum, S. anguivi* and *S. macrocarpon*), and okra (*Abelmoschus esculentus*). Exotic vegetables such as cabbage, cucumber and carrot were not popular among the farmers sampled. Also, traditional leafy vegetables were not popular with the farmers sampled. The popular vegetables found in this study were included in the findings of Makarau

et al. (2013). This implies that vegetables grown in African countries can differ markedly hence policies to promote and or address concerns about vegetables need to be product specific.

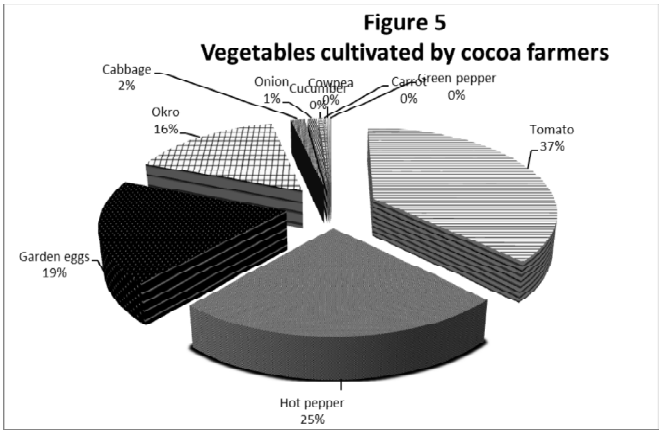
A number of cocoa farmers integrate vegetable farming into their cocoa cultivation. Out of the 653 who responded that they grow both cocoa and vegetables, 56.5% cultivated cocoa whilst the rest did not cultivate cocoa (Table 7). Nine vegetables were integrated with cocoa. The most popular is tomato (24.7%) followed by pepper (21.6%), garden eggs (19.2%) and okra (17.0%).

Table 6
Distribution of household members by age group and gender

Number children (<16 years)						
	Male		*Female*		*Combined*	
No. of persons	*Frequency*	*Percentage*	*Frequency*	*Percentage*	*Frequency*	*Percentage*
0	252	32	285	36.2	537	34.10%
1-5	530	67.3	498	63.2	1028	65.20%
6-10	6	0.8	5	0.6	11	0.70%
Total	788	100	788	100	1576	100.00%
Number of persons (>=16 years and <=60 years)						
	Male		*Female*		*Combined*	
No. of persons	*Frequency*	*Percentage*	*Frequency*	*Percentage*	*Frequency*	*Percentage*
0	265	33.6	229	29.1	494	31.30%
1-5	507	64.3	537	68.1	1044	66.20%
6-10	16	2	22	2.8	38	2.40%
Total	788	100	788	100	1576	100.00%
Number of elderly (>60years)						
	Male		*Female*		*Combined*	
No. of persons	*Frequency*	*Percentage*	*Frequency*	*Percentage*	*Frequency*	*Percentage*
0	771	97.8	768	97.5	1539	97.70%
1-5	15	1.9	18	2.3	33	2.10%
6-10	2	0.3	2	0.3	4	0.30%
Total	788	100	788	100	1576	100.00%

Table 7
Vegetables cultivated by those who grow cocoa[1]

			Do you grow Cocoa?		*Total*
			Yes	*No*	
Vegetables on plot[a]	*Okra*	*Count*	*108*	*36*	*144*
		% of Total	*17.0%*	*5.7%*	*22.7%*
	Tomato	Count	157	177	334
		% of Total	24.7%	27.9%	52.6%
	Garden Egg	Count	122	45	167
		% of Total	19.2%	7.1%	26.3%
	Pepper	Count	137	63	200
		% of Total	21.6%	9.9%	31.5%
	Beans	Count	3	1	4
		% of Total	0.5%	0.2%	0.6%
	Cabbage	Count	7	0	7
		% of Total	1.1%	0.0%	1.1%
	Carrot	Count	1	2	3
		% of Total	0.2%	0.3%	0.5%
	Cucumber	Count	1	2	3
		% of Total	0.2%	0.3%	0.5%
	Onion	Count	2	3	5
		% of Total	0.3%	0.5%	0.8%
Total		Count	359	276	635
		% of Total	56.5%	43.5%	100.0%



Most of the cocoa farmers used the larger part of the land cultivated for cash crops (including cocoa). This is expected as crops such as cocoa have wider standard spacing of 3 m x 3 m and hence with lower plant population per ha compared to vegetables which might be 5-10 times lower depending on the type. Therefore, those who grow cocoa use 64% of their land for cash crops including cocoa (Table 8). Vegetables occupy 28.5% of the land whilst 7.5% is used for food crops. The statistically significant tests of association statistics lend credence to this result.

An assessment of association between land used for cocoa production and for vegetables showed that for those who grow cocoa, 79.2% of them sell or give out vegetables as gifts (Table 9). It was impossible to disentangle sales and gifts at the analysis stage. However, as would be seen in the Figure 6, less than

Table 8
Cocoa growing and main land occupancy

			Column		*Total*
			Yes	*No*	
Row	Food crops	Count	37	32	69
		% of Total	4.7%	4.1%	8.8%
	Cash crops	Count	314	14	328
	(Precise)	% of Total	40.2%	1.8%	42.0%
	Vegetables	Count	140	244	384
		% of Total	17.9%	31.2%	49.2%
Total		Count	491	290	781
		% of Total	62.9%	37.1%	100.0%

Chi square test of association

	Value	*df*	*Level of significance*
Pearson Chi-Square	269.007[a]	2	0.000
Likelihood Ratio	315.568	2	0.000
Linear-by-Linear Association	118.543	1	0.000
N of Valid Cases	781		

Table 9
Cross tabulation of vegetable use with growing cocoa

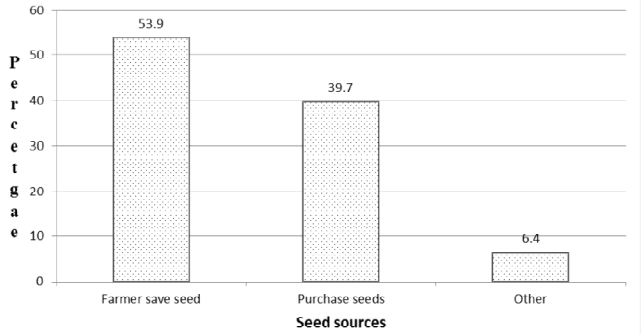
			Column		*Total*
			Yes	*No*	
Column	Consumption	Count	77	8	85
		% of Total	11.6%	1.2%	12.8%
	Sales/Gift	Count	300	275	575
		% of Total	45.1%	41.4%	86.5%
	Seed production	Count	2	3	5
		% of Total	0.3%	0.5%	0.8%
Total		Count	379	286	665
		% of Total	57.0%	43.0%	100.0%

Chi square test of association

	Value	*df*	*Level of significance*
Pearson chi-Square	45.176[a]	2	0.000
Likelihood ratio	53.041	2	0.000
Linear-by-linear association	43.826	1	0.000
Number of valid Cases	665		

7% of farmers obtain seeds from other sources including gifts. Therefore, the portion of gifts in sales and gifts should be negligible. The next important use of vegetables is for home consumption (20.3%). This is devoid of the portion for sale. Less than 1% of respondents use vegetables for seed. This finding is supported by the statistically significant chi square test statistics. The predominant use of vegetables as sale products, explains the preference for vegetables over food crops for land use.

Figure 6
Preference for vegetable seed sources



The production for sale shows the importance of vegetables in the livelihood of those who integrate vegetables into cocoa farming. This also suggest that the income from cocoa may be inadequate in supporting households around the year. Therefore, vegetables may be an important source of income to support households in time of needs, augment existing income from cocoa and essentially provide resources to acquire food and for poverty alleviation.

Current focus of government and related bottlenecks

Lack of farmer access to high quality seeds of improved vegetable cultivars is one of the major constraints to the successful expansion of the vegetable industry in sub-Saharan Africa including Ghana. Consequently, the increased use of poor quality vegetable seeds mainly obtained from informal sources (including farmer-saved seeds) by the majority of farmers in the region has compromised yields and productivity and rendered serious challenges to the success of crop productivity and improvement initiatives within the sub-sector. Principally, the status and effectiveness of the vegetable seed sector in Ghana is influenced by the legal and regulatory framework, capacity of development partners and farmer awareness of and demand for high performance vegetable cultivars.

Ghana operates the Minimum Standards Certification. The crops covered are: cereals such as maize, rice, sorghum, millet; legumes such as cowpea, groundnuts, bambara groundnuts, and soybean; vegetables such as garden egg, onion, tomato, pepper and okra; roots & tubers such as cassava, yam and sweet potato and cocoyam; and fruit & tree crops such as mango, citrus and pineapples. Ghana's seed certification has provisions for situations where the Quality Declared system can be applied (MOFA, 2013). Seed quality assurance in Ghana is under the mandate of the Ghana Seed Inspection Division (GSID) established within the Plant Protection and Regulatory Services Directorate (PPRSD) of the Ministry of Food and Agriculture. The GSID provides technical support for the development of internal and external quality assurance systems. The GSID operates a National Seed Testing Laboratory at Pokuase, near Accra, and has regional satellite laboratories sited in six locations in the country.

From the foundation seed stage up to the sale of certified seeds, seed industry quality standards are enforced through regulations by the GSID. The challenge facing quality assurance and seed legislation in general is that the institution required to lead in the quality assurance function and implement the recently introduced seed legislation is yet to attain adequate level of resources and structures to be able to conduct an effective nation-wide and industry-wide quality assurance programme. There is inadequate mobility, ill-equipped regional satellite laboratories, limited number of trained personnel (inspectors, samplers, analysts) to undertake various quality assurance activities. Another inadequacy is inadequate knowledge, of some law enforcement agencies like the police and customs officials. Further, inability to prosecute violators of the Plants and Fertilizer Act, 2010 (ACT 803) including those involved in physical and verbal threats on quality assurance officers. Finally, inadequate awareness and sensitisation of stakeholders on the Plants and Fertilizer Act, 2010 (ACT 803) and its regulations and absence of quality assurance systems in breeder seed production.

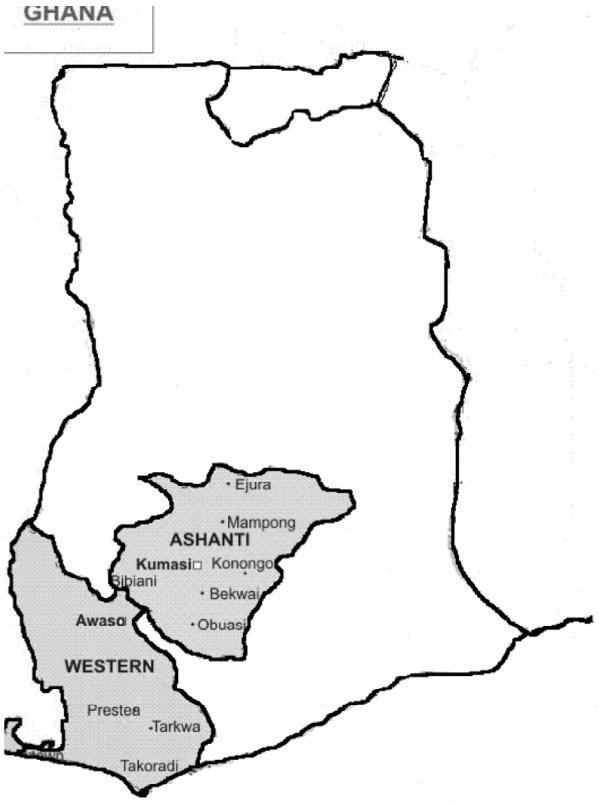
Another notable challenge of the vegetable seed and distribution systems is related to the capacity of development partners, namely; government, NGO, private seed companies and entrepreneurs to develop/identify, release, and maintain superior, adapted vegetable cultivars, scale-up production of high quality seed. Also, the inability to develop timely

seed marketing and distribution channels is a constraint.

Farmer awareness of and demand for high performance vegetable cultivars is an important constraint to vegetable production in Ghana. The challenges outlined above can be viewed within the general development challenge of many developing countries in sub-Saharan Africa that have led to a development goal aimed at improving overall agricultural productivity, and transforming the lives of rural poor in the humid tropics region, through systems research in the framework of Integrated Agricultural Research for Development.

CONCLUSIONS AND POLICY RECOMMENDATIONS

A study was undertaken within the humid tropics agro-ecological zone in cocoa belt of Ghana to identify the potential for vegetable integration and diversification into cocoa-based farming systems while examining the production and marketing constraints. Also investigated is the utilisation pattern of vegetables and current government focus on vegetable seed supply and distribution systems and related bottlenecks. The most common vegetables produced in the two regions were tomatoes, pepper, garden eggs and okra, although cabbage and onion are also cultivated by a few farmers. Carrots, amaranth, and beans, were found on a small scale in Ashanti Region. Vegetable cropping systems were sole cropping, relay intercropping or multiple cropping where different vegetables were cultivated on separate plots. A sizable number of farmers integrated these vegetables into cocoa production either on separate fields or on the fringes of the cocoa fields. About 80% of vegetable growers sold their produce whilst 20% used vegetables for home consumption. A major observed production constraint is lack of farmer access to high quality improved vegetable seed cultivars. Production and increased consumption of vegetables, particularly nutrient-dense traditional African vegetables are critical for improving household nutrition. Additionally, diversification of cocoa farming households into vegetables constitutes an important agricultural livelihood diversification strategy. Together, these will contribute to attaining income and nutritional related Sustainable Development Goals. The knowledge of production, utilisation patterns as well as current government focus on vegetables and related bottlenecks will provide policy makers opportunity to address them.



Appendix 1: Map of study area

ACKNOWLEDGEMENTS

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NOTE

1. The vegetable farmers mostly grow cocoa on fields separate from that of cocoa.

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