

2 **Status Of Postharvest Operations In Upper East Region of Ghana:**
3 **The Case Of Maize Producers**
4
5
6

7 **ABSTRACT**

8 **A baseline survey was conducted in the Upper East of Ghana to assess**
9 **current postharvest practices and factors influencing long and bulk**
10 **storage of maize. The research tools employed were field survey, farm**
11 **visits and key informant interviews. Twenty farmers were randomly**
12 **selected from each community making a total of 120 farmers. Household**
13 **structure on average is made up of 7±5 individuals, mean age of household**
14 **heads was 45-47 years compared to their wives 35 to 38 years. Maize is**
15 **mostly stored in polypropylene sacs and jute sacs on raised platform in**
16 **household stores. Majority of respondents indicated that post-harvest**
17 **losses during storage are critical challenges to production and household**
18 **food security. The main causes of loss were insect pest, rodents and grain**
19 **moulds. Majority of farmers store maize for 5-8 months. Though some local**
20 **and synthetic grain protectants were used, post-harvest losses in 1 year**
21 **of storage were still beyond acceptable limits. However, there was high**
22 **willingness to adopt new efficient methods of crop protection like**
23 **biological control. The idea of community storage methods was still not a**
24 **technology farmers may adopt; due to a myriad of socio-cultural reasons.**
25 **The results of the baseline study will guide the implementation of the**
26 **project as well as serve as reference point for future impact assessment.**
27 **Overall, integrated strategies involving clean farm operations, use of**
28 **appropriate storage technologies and provision of improved storage**
29 **structures are required to reduce current losses.**

30
31 **Key words: Maize farmers, postharvest losses, storage and biological control**
32
33
34

35 **INTRODUCTION**

36 Maize (*Zea mays* L.) has become an important staple food crop in all parts of Ghana. Currently, maize
37 based cropping systems have become dominant in drier northern savanna areas of Ghana where
38 sorghum and millet were the traditional food security crops. According to SRID (2011), maize is the
39 most cultivated in Ghana, occupying up to 1,023,000ha on arable land compared to rice (197,000ha),
40 millet (179,000ha), sorghum (243,000ha), cassava (889,013ha), yam (204,000ha) and plantain
41 (336,000) (SRID, 2012). Currently, Ghana is net-importer of maize even though it has great potential
42 to be self-sufficient and net-exporter. Per capita consumption of maize is estimated at 44
43 kg/person/year (FAOSTAT, Feb 2013). Declining yields of maize are now observed due to decreasing
44 soil fertility and high cost of fertilizer. Over the last 2 decades, a myriad of maize varieties, cultivars
45 and hybrids have been released. These genotypes possess traits such as early maturing, drought

46 resistance, diseases and pest resistance, striga resistance, as well as additional nutritional values
47 such as quality protein, yellow and sweet corn. Grains of these genotypes possess diverse textural,
48 physical and compositional characteristics which relate differently to light, moisture and temperature
49 as well as susceptibility to pests and disease pathogens; particularly during prolonged storage. This
50 requires commensurate postharvest techniques and strategies to contain harvested surpluses. Also,
51 due to intensification and productivity increase, the need for bulk and prolonged storage has become
52 critical. This increase can be attributed to government and donor assisted projects such as providing
53 subsidies on agricultural inputs. Nonetheless, current storage methods are suited for small-holder
54 farmers requiring storage of less than 1 ton. Interventions to introduce large storage units such as
55 community warehousing, community grain banks or metal silos which can contain several tons of
56 grain is still constrained by national agricultural policies as well as low adoption from farmers.
57

58 One of the challenges faced by African countries in achieving food security is high postharvest losses.
59 It has been estimated that the value of postharvest losses in sub-Saharan Africa is about US\$48
60 billion a year. In Ghana, for example, postharvest losses for maize, cassava and yam are estimated to
61 be 35%, 35% and 24%, respectively (CTA 2014). According to the World Bank (2011) important
62 volumes of cereals are lost after harvest in developing countries which worsens the hunger situation.
63 In addition to the lost in volumes, quality of grain is also compromised resulting in lower market
64 opportunities and nutritional value. In fact, in 1975, the United Nations brought postharvest storage
65 losses into international focus when it declared that "further reduction of postharvest food losses in
66 developing countries should be undertaken as a matter of priority" (FAO 1981).
67

68 Generally, stored maize can be damaged by insect pests if they are not properly conditioned and
69 protected (Obeng-Ofori, 2008). It has been found with maize in Ghana that for every 1 percent
70 damage above 5 percent (damage referring to grains with insect holes), the value decreases by 1
71 percent. So if undamaged grain is worth US\$1.00/kg, then grain with 10 percent damage is worth only
72 US\$0.95/kg, and with 20 percent damage it is worth only US\$0.85/kg. These potential losses in value
73 can make a substantial difference to a family's livelihood (DFID Crop Postharvest Program) FAO. This
74 challenge may be exacerbated due to cropping intensification and introduction of hybrid cultivars.
75 Maize is harvested towards the cessation of the rainy season and stored during the drier months of
76 the year. Maize is often stored on cobs in traditional grain silos or shelled into jute and polypropylene
77 sacs with or without protection for storage. However, pest infestation is a perennial constraint; the
78 conditions favorable for grain storage are as well suitable for insect pest reproduction.
79

80 On-farm infestation of notorious storage pests such as larger grain borer (*Prostephanustruncatus*),
81 lesser grain borer (*Rhyzoperthadominica*), maize weevil (*Sitophiluszeamais*), granary weevil (*S.*
82 *granarius*) as well as mycotoxins accumulation, are a threat in grain storage. Indiscriminate use of
83 common grain protectants such as Actellic (Pirimiphos methyl), bioresmethrin (pyrethroid) phostoxin
84 and Gastox (Aluminium phosphate) is widespread among small-holder farmers (Sugri, et al 2010).
85 Most farmers acquire agro-chemicals from non-accredited input dealers without any training on
86 appropriate use. There is the need to integrate production and postharvest practices to achieve
87 quality food for consumers. Integration of good agronomic operations, pest management and
88 appropriate storage techniques to minimize pest damage is therefore very essential. This project
89 seeks to improve agricultural productivity and farm family livelihoods by deploying improved storage
90 and handling practices to reduce postharvest losses of smallholder farmers in the Upper East Region
91 of Ghana (Osei-Agyeman et al 2014).
92

93 As part of activities of a project titled 'containing productivity increases of maize in Northern Ghana
94 through large-scale storage methods', a baseline study was initiated to generate relevant information
95 to describe the prevailing socioeconomic conditions in the project communities. The results of the
96 baseline study are expected to guide the implementation of the project and to serve as a data base
97 (reference point/measuring scale) against which progress can be measured. The study will also
98 measure the levels of key project indicators to inform the setting of targets. This will also help in the
99 design of the indicator performance tracking table (IPTT). Moreover, it will provide the basis for future
100 impact studies. More specifically the baseline study will; Assess crop (maize) production system in the
101 project Communities, identify maize postharvest challenges and the causal factors, inventor the
102 existing maize storage methods and rank them in order of importance, assess the level of awareness
103 of using biological control methods in maize storage, assess the willingness to adopt biological control
104 method of maize storage, and estimate the rates of adoption of existing maize storage methods and
105 determine the factors affecting adoption of improved maize storage methods.

MATERIALS AND METHODS

106
107
108
109
110
111
112
113
114
115
116
117
118
119
120

Study Area

The Upper East Region (UER) of Ghana lies between longitude 1015'W to 005'E and stretch from latitude 10030'N to 1108'N. The region lies in the Sudan savanna agro-ecology, which forms the semi-arid part of Ghana. The area is part of what is sometimes referred to as interior savanna and is characterized by level to gently undulating topography. Important crops include millet, sorghum, maize, rice, sweet potato, groundnut, cowpea, soybean, cotton onion and tomato. The sheanut tree grows wild and it is an important cash crop. It has alternating wet and dry seasons with the wet season occurring between May and October during which about 95% of rainfall occurs. Maximum rainfall occurs in August-September, and severe dry conditions exist between November and April each year. Annual rainfall ranges from 800-1200 mm. There is wide fluctuation in relative humidity with as low values as 30% in dry season and above 75% in the wet season (www.ghanadistricts.com).

Approach

The study used different data collection methods. These included both quantitative methods (questionnaires) and qualitative (participatory rural appraisal tools, focus group discussions, key informants interviews) methods. Besides that, some secondary data were obtained through desktop research of literature on existing studies already done on similar subjects. Semi-structured questionnaire was developed and administered to multi-phase purposive and randomly selected farmers within the project district to enable us obtained data from them.

Focus group discussions (Chambers, Robert 1993) were carried out with randomly selected farmers within the project districts. This was aimed at collecting qualitative data to support the data gathered by the farmer questionnaire and also serve as a means of triangulation to ensure that the data is realistic and reliable. This was guided by a pre-printed checklist tailored to meet some of the information needs of the study.

Sampling Technique

The population of interest for the study included all farmers in Bawku East, Binduri and Pusiga District of the Upper East Region of Ghana. The unit of study is the farmer who we define for purposes of this study as an individual who lives and farm within the selected communities. A purposeful and multi-stage sampling approach targeting maize producing communities and households was adopted. This procedure allowed us to take a representative sample with characteristics that can be generalized for the entire population which it represents.

The sample size was determined using the following formula:

$$N = (Z^2PQ \div D^2).$$

Essentially three factors determine the size of the sample for a survey within a population:

Estimated prevalence of the variable studied – in this case, farmers in the community. The confidence level aimed at the acceptable margin of error.

N: required size of the sample

Z: confidence level of 95% (standard deviation of 1.96).

P: estimated prevalence of farmers in the project area (80%), i.e. the proportion of the target population with a given characteristic.

Q: 1-P.

D: margin of error of 5 % (standard deviation of 0.05).

$$N = 3.8416 \times 0.8 (0.1/0.0025) = 122$$

A total of 122 farmers were randomly sampled from a purposive sample of two communities in the three districts of the Upper East region. The communities were selected because of their attitude to farming and response to project requirement.

Data was collected from farmers using structured questionnaires in a face-to-face interview. Questions covered household demographics including age, household size, education and gender of household members. Household assets were inventoried to include both agriculture and non-agriculture assets and, crops and livestock inventories. An agricultural system module surveyed crop production and agricultural land use, storage methods, post-harvest trainings, etc. The data was analyzed using SPSS software.

RESULTS AND DISCUSSION

Demographic Information

Table 1-4 provide a summary of the demographic structure of the households sampled. In all, 42% of respondents were female farmers and 58% male farmers (Table 4). Household structure on average was made up of 7±5 individuals (Table 2). The mean age of household heads was 45-47 years compared to their wives whose mean age was 35 to 38 years. The results also showed that migration of household members was not common during the rainy season but up to 10% migrate down south when agricultural activities decline. The observations indicate that most of the household heads (99%) were involved in crop production. The annual agricultural related household income for about 26% of farmers ranged from 100.00- 2,000.00 GHS as the lowest category whereas the biggest category of 8100 -10,000.00 GHS constituted about 18.5% of farmers surveyed. Farmers within the income brackets of 4,000.00 – 8,000.00 constituted about 43% of farmers surveyed.

179 **Table 1: Gender of Respondents**

Gender	Frequency	Percentage
Female	50	42
Male	70	58
Total	120	100

180

181 **Table 2: Composition and age of households sampled**

Description	Variable	Mean	Standard Deviation	Minimum	Maximum
Head (N = 120)	HH size	7	3	2	22
	Age (HHH)	47	14	26	78
	Age (WHH)	38	10	18	70
Partner (wife) (N = 120)	HH size	7	3	1	17
	Age (HHH)	45	14	27	75
	Age (WHH)	35	10	19	65

182

183 **Table 3: Income status of households**

Income (GHS 00)	Frequency	Percentage
1-20	31	26.1
21-40	14	11.8
41-60	26	21.8
61-80	26	21.8
81-100	22	18.5
Total	119	100

184

185 Majority of respondents (63%) had no formal education, only 26% had basic education and 10% had
 186 post-basic education (Table 4). Livestock rearing is considered as an occupation by very few
 187 households (1%). Majority (84.2%) of the respondents were crop farmers, 2.5% were students, a few
 188 were engaged in various forms of trade, and only 4% unemployed (Table 5).

189

190

191

192

193 **Table 4: Educational Status of respondents**

Education level	Frequency	Percentage
None	75	63
Primary	15	13
JHS/Middle school certificate	16	13
SHS/Technical school	12	10
Non-formal	2	1
Total	120	100

194

195 **Table 5: Primary Occupation of Respondents**

	Frequency	Percentage
Student	3.0	2.5
Unemployed	4.0	3.3

Farmer	101.0	84.2	196
Teacher	1.0	8.0	197
Nurse	1.0	8.0	198
			199
Retired	1.0	8.0	200
Self employed	5.0	4.2	201
Pastor	1.0	8	202
Kente weaving	3.0	2.5	203
Total	120.0	100.0	204
			205

206
207
208
209

Cropping Systems

211 Majority (89%) of respondents were engaged in crop production while a little minority were involved
212 in animal (7%) and tree (4%) production as the main livelihood strategies (Table 6). Major livelihood
213 crops include maize, sorghum, millet, soybean, cowpea, rice, sweet potato and vegetables (Table 7).
214 Maize is cultivated on up to 4 acres and a maximum land size of 15 acres. The range for cowpea is 2-
215 12 acres, while Bambara beans, groundnut and sweet potato recorded the least production area of
216 1, 2 and 2 acres, respectively.
217

218 **Table 6: Main farming systems in the study area**

Farming type	Frequency	Percentage
Crop production	107	89
Tree crop Production	5	4
Livestock marketing	8	7
Total	120	100

219
220
221
222

Table 7: Main crops and acreage of production

Crops	Acreage Mean	(Ha) Min.	Max.
Maize	4	0	15
Sorghum	1	0	4
Soyabeans	2	0	5
Cowpea	2	0	12
Vegetable	2	0	3
Pearl Millet	2	0	9
Groundnut	1	1	2
Bambarabeans	1	1	1
Sweet Potato	1	1	2
Total land size of HH	8	1	45

223
224

Maize Post-Harvest Operations and Losses

225 In Table 8 below, 95.8% perceive high levels of post-harvest losses in recent times while 4.2 % of the
226 respondents were adamant. The main causes of maize grain damage were insect pests (69.2%),
227

228 rodents (16.2%) grain moulds (6.7%), weight loss (5.7%) and loss of flavor/nutrition (1.7%). Only 1.7%
 229 of the respondents recorded no incidence of post-harvest losses and pest infestation at storage
 230 (Table 9). Dzisi et al. (2007) identified field and post-harvest losses as the most important constraints
 231 limiting maize production in Ghana. They reported losses in the field and post-harvest sectors as 5-
 232 10% and 15-20% respectively. Edusah (2006) reported losses of 15 to 30%. This supports the fact
 233 that majority of our farmers has their losses ranging from 15-25%.
 234

235

236 **Table 8: Incidence and estimated maize postharvest losses under farmer storage**

Incidence of produce infestation at storage			Quantities of losses incurred (%)		
	Frequency	Percentage		Frequency	Percentage
Yes (incidence)	115	95.8	0 - 8	29	24.2
No (incidence)	5	4.2	10 – 25	67	55.8
			27 - 60	24	20
			TOTAL	120	100

237

238

239 **Table 9: Description of major causes of maize postharvest losses**

Main causes of losses	Frequency	Percentage
Insects infestation	83	69.2
Rodents	20	16.7
Grain moulds	8	6.7
Weight loss	5	4.2
Quality (taste/ aroma/colour)	2	1.7
No incidence	2	1.7
Total	120	100.0

240

241

242 **Maize Storage Methods**

243 Table 10 describes the various storage methods used in the study area. Majority of farmers, 40% and
 244 27.3%, store maize in poly-sacs and jute sacs respectively. The use of poly-sacs has gradually
 245 replaced jute sacs due to low cost and readily availability. Though, the use of PICS sacs has recently
 246 been introduced, only few champion farmers opt for them apparently due to high initial cost. Up to
 247 16.7% of farmers store their maize for 1-4months, 64.2% store maize for 5-8months, and 17.5 store
 248 up to 12months (Table 11). Only 1.7% store maize store maize beyond 12 months confirming that
 249 they produce in small quantities for subsistence. Only small quantities 1-3bags are stored by 37.5 %
 250 of respondents and up to 37.5% store 4-10bags, only about 8.3% stored more than 25bags of maize
 251 (Table 11).
 252

253 **Table 10: Maize storage methods**

Maize storage methods	Frequency	Percentage	Ranked	Reasons for selection
Bare floor	15	12.6	3	Easy to store, affordability
Stored in jute sacs	33	27.3	2	Availability, durability,
Stored in poly-sacs	48	40.3	1	Availability, durability, low cost
Stored mud silos	10	8.4	5	Common traditional method, regulate grain use
Stored in maize ban	14	14	4	Regulates use of maize/ reduce wastage
Total	119	100		

254

255 Poly-sacs was ranked the most preferred storage method. This is supported by a study by **USAID**
 256 **PHHS Final Report (2012)**. The reason for that rank is that it is not expensive, readily available and
 257 durable. Jute sacs was ranked second most preferred and the reason was that it is available and
 258 durable. Bare floor, maize ban and mud silos were ranked 3rd, 4th, and 5th respectively. A survey
 259 concluded in Northern Ghana by ADRA and OIC demonstrated that that mud silos offer the benefits of
 260 improved food security by reducing storage losses and that they enable crops to be stored for longer,
 261 thus giving greater marketing flexibility. However the use of this technology is very low in the upper
 262 east region of Ghana.

263
264
265
266

Table 11: Duration of maize at storage

Duration of storage			Volume of produce stored		
Storage period	Frequency	Percentage	Bags	Frequency	Percentage
1-4 months	20	16.7	1-3bags	45	37.5
5-8 months	77	64.2	4-10bags	45	37.5
9-12 months	21	17.5	11-25bags	20	16.7
1-2 years	2	1.7	Above 25 bags	10	8.3
Total	120	100	Total	120	100

267
268
269
270



Polypropylene



Jute sacs



acs

271
272
273
274
275
276
277
278
279
280

Pest Management Strategies Adopted by Farmers

281 Results from focus group discussions indicated that farmers' prior knowledge on the type, severity
 282 and time of pest infestation in different commodities guided their choice of pest management. Table
 283 12 provides a summary of approximate time of pest infestation and management options for different
 284 crops. Close to 44.2% of the respondents noticed pest infestation within 1-4 months, 33.3% within 5-
 285 months, while 12.5% noticed no pest incidence. From the group discussions, over 50% of
 286 respondents alluded that, except in cowpea and Bambara nuts, pest infestation occurred late at 6
 287 months after storage. Farmers therefore applied postharvest chemicals few months after storage or
 288 when some level of infestation was noticed. Where storage was anticipated above 4 months, over
 289 50% of farmers used some kind of protection. The use of biological control was not a familiar term;
 290 probably this control measure has not been introduced into the area. Only 1.7% of farmers resorted to
 291 the use of botanicals such as *neem* products, pepper, *mahogany* bark, *Jethropha* and other local oils.
 292 Majority use insecticidal dust (43.3%) and phostoxin (13.3%) for pest management. It was realized
 293 that only 1 respondent use ash to actually prevent pest attack. The common grain protectants were
 294 *Actellic* (Pyriphos methyl), *bioresmethrin* (pyrethroid) *phostoxin*, *Gastox* (Aluminium phosphate),
 295 *Wander77 powder*.

296
297
298
299

Table 12: Period of pest infestation and common pest management strategies

Months after storage	Frequency	Percentage
----------------------	-----------	------------

1-4	53	44.2
5-8	40	33.3
After 8	12	10
No pest incidence	15	12.5
Total	120	100
Methods of maize grain protection	Frequency	Percentage
Only drying	48	40
Botanicals (neem, mahogany etc)	2	1.7
Photoxin tablet	16	13.3
Insecticidal dust	52	43.3
No measure taken	1	0.8
use of ash	1	0.8
Total	120	100

300
301
302
303
304
305
306
307
308
309

Farmers expressed their willingness to adopt both the poly-tank storage method and the biocontrol storage method. Those who indicated they will agree to adopt the poly-tank method were about 45% while those who strongly agreed also scored 45.5%. 55.5% of the farmers indicated they will agree to adopt the biological control method while 31.1% said they strongly agree to adopt the biological control method. From all indications the farmers are willing to adopt both the poly-tank and biological control method of maize storage in the Bawku municipality as shown in table 13 below.

Table 13: Willingness to adopt new storage techniques

I will adopt a new poly-tank storage method		
	Frequency	Percent
Strongly Disagree	1	0.8
Disagree	1	0.8
Neither agree nor disagree	9	7.5
Agree	54	45
Strongly agree	55	45.8
Total	120	100
I will adopt biocontrol storage method		
Strongly disagree	1	0.8
Disagree	2	1.7
Neither agree nor Disagree	13	10.9
Agree	66	55.5
Strongly agree	37	31.1
Total	119	100

310
311
312
313
314
315
316
317
318
319
320

Conclusion and Recommendation

In all, 42% of respondents were female farmers and 58% male farmers. Household structure on average is made up of 7±5 individuals, mean age of household heads was 45-47 years compared to their wives 35 to 38 years. Majority of the household heads and their wives had no education and their primary occupation was crop production. Household wealth was largely concentrated on livestock inventory. Maize is mostly stored in polypropylene sacs (48%) and jute sacs (33%) on raised platforms in household stores. Close to 95.8% of respondents indicated that post-harvest losses during storage are critical challenges to production and household food security. The main causes of loss were insect pest (69.2%), rodents (16.2%), grain moulds (6.7%), weight loss (5.7%) and loss of flavor/nutrition (1.7%). Up to 16.7% of farmers store their maize for 1-4 months, 64.2% store maize for

321 5-8months, and 17.5% store up to 12months. Only 1.7% store maize beyond 12 months; confirming
322 that they produce in small quantities for subsistence.

323
324 Poly-sacs was ranked the most preferred storage method. The reason for that rank is that it is not
325 expensive, readily available and durable. Jute sacs was ranked second most preferred and the
326 reason was that it is available and durable. The idea of community storage methods is still not a
327 technology farmers may adopt; due to a myriad of socio-cultural reasons. The results of the baseline
328 study was expected to guide the implementation of the project as well as serve as reference point for
329 future impact evaluation. Overall, integrated strategies involving clean farm operations, use of
330 appropriate storage technologies and provision of improved storage structures are required to reduce
331 current losses.

332
333 Major crops produced include: maize, millet, peanuts, Bambara nuts, soy beans, rice, and cassava.
334 Though some local and synthetic grain protectants were used, post-harvest losses in 1 year of storage
335 were still beyond acceptable limits. However, there was high willingness to adopt new efficient and
336 effective methods like biological control and poly-tank storage methods being introduced to them.

337
338 It is recommended that integrated strategies involving clean farm operations, use of poly-tank and
339 biological control storage technologies are used by farmers to reduce current postharvest losses in
340 the area.

341
342
343 We wish to acknowledge the USDA- Scientific Cooperation Research Program for supporting this
344 study.

345 346 347 **References**

- 348
349 1. SRID. Statistic Research and Information Department of the Ministry of Food and Agriculture,
350 Ghana. 2012.
- 351
352 2. SRID. Statistic Research and Information Department of the Ministry of Food and Agriculture,
353 Ghana. 2011.
- 354
355 3. FAO. Food Agriculture Organization Statistics. Feb 2013.
- 356
357 4. Obeng-Ofori, D. Major stored product arthropod pests In: Post-harvest Science and Technology
358 (Cornelius, E.W and Obeng-Ofori, D. eds.), Smartline Publishing Limited, Accra. 2008: pp67-91.
- 359
360 5. Osei-Agyeman Y, Nutsugah SK, Komkiok JM, Sugri I, Bidzakin JK and
361 Naanwaab C. Containing productivity increases of maize in Ghana through large-scale
362 storage methods. Annual Report of the USDA/North Carolina A&T State Univ., and CSIR-
363 Savanna Agricultural Research Institute, Ghana and USDA- SCRP Project. 2014: pp1-23.
- 364
365 6. Sugri I. Review of crop storage practices and estimate of postharvest losses in Upper East
366 Region of Ghana. In Annual Report of CSIR-Savanna Agriculture Research Institute, Tamale
367 Ghana. 2010: Pp209-211.
- 368
369 7. Chambers, Robert. "Methods for analysis by farmers: The professional challenge," *Journal for*
370 *Farming Systems Research Extension*. 1993: Vol. 4, No. 1. pp. 87-101.
- 371
372 8. www.ghanadistricts.com (accessed on 14/08/2014).
- 373
374 9. CTA. Analysis of the Postharvest Knowledge system in Ghana Case study of cassava.
375 <http://knowledge.cta.int/>, accessed on "10/12/2014"
- 376
377 10. Dzisi, K. A., Addo, A., and Bart-Plange. Strategies for the Development of Good Maize
378 Processing, Handling and storage Systems in Ghana. In: Nsiah- Gyabaah, K., Agyepong M.,
379 Amoako, C., Nyamaah-Koffour, K., Adu, V., Okyere-Boateng, S., Nsiah, M. K., and Aning, S.

- 380 K. (eds.). Proceedings of Sunyani Polytechnic Lecture Series II. Qualitytype Ltd., P. O. Box AN
381 7314, Accra-North. 2007.
- 382
- 383 11. Edusah, S. E. Agriculture, Science and Technology for Wealth Creation and Sustainable
384 Development of Ghana: The Role of Small-Scale Industries in Food Processing and
385 Preservation in Ghana. In: Nsiah- Gyabaah, K., Agyepong M., Amoako, C., Nyamaah-Koffour,
386 K., Adu, V., Okyere-Boateng, S., Nsiah, M. K., and Aning, S. K. (Eds.). Proceedings of
387 Sunyani Polytechnic Lecture Series II. Qualitytype Ltd., P. O. Box AN 7314, Accra-North. 2007
- 388
- 389 12. USAID Post-Harvest Handling And Storage (PHHS) Project Final Report (2012)
- 390
- 391 13. FAO, "Food loss prevention in perishable crops." *FAO Agricultural Services Bulletin*. 1981.
- 392
- 393 14. *World Bank Report, Responding To Global Food Price Volatility And Its Impact On Food*
394 *Security (2011)*