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AN ASSESSMENT OF RISKS ALONG THE SWEET POTATO VALUE CHAIN IN GHANA

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ABSTRACT

This study was aimed at examining risks and the various risk management strategies adopted by actors along the sweet potato value chain in Ghana by focusing on Fanteakwa (Southern sector) and West Mamprusi (Northern sector) districts. Data were collected from both primary and secondary sources. Selection of 200 producer respondents was done using the simple random sampling technique whilst a combination of accidental sampling and snowballing techniques were used to select 100 traders and 80 processors of sweet potato. Descriptive statistics were used to identify and analyze risks and management strategies employed by value chain actors. The Random Variability Index (RVI) was used to determine the level of predictability of the various risks. The study results revealed that, risks along the sweet potato value chain were seen to be identical along the chain with wide variations in predictability and management strategies employed by actors. All the levels of the sweet potato value chain identified sudden changes in output price as the most important risk. However, output level variability, market cost variability and variability in post-harvest (rotten) losses were the least predicted at the production, trader and processor levels of the chain respectively. Also, actors generally devised management strategies that mainly reduced the impact of these risks and ultimately maximize their utility. It is therefore recommended that actors should be encouraged to form associations and contract prices in advance since it is seen as being the best risk management tool for dealing with price risk especially when the said risk is seen to be the most important along the entire chain.

Contribution/ Originality: This study uses new estimation methodology of using the RVI in estimating risk predictability.

1. INTRODUCTION

In Ghana, agriculture employs more than 50 percent of the economic active population and contributes more than 30 percent to export receipts and 22 percent of Gross Domestic Product (GDP) (Ghana Statistical Service, 2013). Within the food crop production, diverse crop enterprises are managed in order to improve food security and household income generation. Major among such enterprises are cereals and grains followed by Root and tuber

(R&T) crops (Babaleye, 2005). Root and tuber crop consumption forms between 16 and 31% of per capita daily calorie intake in Ghana (GSS, 2005). The main roots and tuber crops in Ghana are cassava, yam, cocoyam and sweet potato. Sweet potato has seen minimal work on value chain development. However, the crop holds the position as one of the main food security crops in Africa due to its resistance to drought, flexible planting, harvest cycle and tolerance of low-quality soils. Due to the crop's versatility and adaptability, it is ranked as a universal crop and seventh most important food crop next to wheat, rice, maize, potato, barley, and cassava since it contains a substantial source of carbohydrate, carotene and vital vitamins (Classification of Instructional Programs (CIP), 2000; Food and Agricultural Organization (FAO), 2002). The consumption of the crop is mainly in the fresh form by either frying, boiling or roasting; the vegetative parts (vines) are mostly fed to livestock predominantly in areas such as central Kenya where zero grazing management systems particularly in small scale dairying is well established. They may also be utilized by young calves as starter feed and partial milk replacer (Orodho *et al.*, 1995). Notable production areas and sweet potato supply centers in Ghana are Eastern, Central, Northern, Upper East, and Volta Regions; the later three regions coincide with the country's poverty map. The sweet potato value chain in Ghana comprises many actors interlinked by different governance structures which expose them to various risks. In the sweet potato enterprise like most agricultural enterprises, its production and marketing is subject to many risks emanating from weather, technical and institutional constraints. Addressing risks of sweet potato production as well as physical, facilitating and exchange functions of marketing thus promises improvements in poverty and food security. Weather, market developments, hazards and other unforeseen events may not be controllable at the firm level but have direct effects on the returns from agricultural production, marketing and processing activities and all economic and business activities for that matter (Baquet *et al.*, 1997). The spectrum of risks that impact on the returns of sweet potato value chain actors is wide-ranging. The two predominant risks are: price risk, mainly resulting from fluctuations in market prices for the produce and production inputs; and output or production risk, reflecting variations in the quantity and/or quality of the goods/commodities produced and channeled along the value chain. For instance, with inadequate access and inappropriate credit facilities, actors have very little option than to rely on the conventional risk coping strategies which are widely seen as inadequate in reducing the impact of these risks that they are typically faced with. Actors along the sweet potato value chain can use several tools, when appropriate to deal with these multiple sources of agricultural risk. Value chain actors (sweet potato) might make a decision to avoid risk; for example, producers by selecting not to plant specific sweet potato varieties which they deem to be of high risk in terms of output prediction for the region or space in which their farmlands are situated. They can reduce (mitigate) risks by; for example, planting crops only in very conducive environments or improving their infrastructure to develop irrigation or lessen the impact of drought which substantively has a rippling effect on output or do not trade at all in a particular produce on the part of traders (Swiss Reinsurance (Swiss Re.), 2007). Actors along the sweet potato value chain may also mitigate the financial consequences of these risks by creating emergency reserve from returns in good years—a form of self-insurance (Harris and Weiss, 1984). Agricultural risks are not mutually exclusive for only a section of the chain, the entire sweet potato value chain is affected since activities of actors are interconnected (Freshwater and Jette-Nantel, 2008). Every actor along the value chain, from the producer to the final consumer, is subject to these risks. As the interconnection between the sweet potato value chain actors becomes more close and complex, the probability of such outcomes being transmitted along the chain are increasing (Moschini and Hennessy, 2001) For example, the easy perishability of the crop in question after harvest makes it difficult to associate risk to just a specific level (section) of the value chain. Solving the risks at one level still leaves the chain in a vulnerable state particularly in the quest of ensuring food security through the provision of alternative livelihood options. These risks if not critically examined and dealt with can affect the reliability, cost and efficiency of the chain and subsequently hamper the role of sweet potato value chain in improving household livelihood. This issue of food and livelihood security cannot be harnessed especially through the sweet potato value chain among resource poor actors without critically addressing the risks

faced along the sweet potato value chain. This study, therefore sought to carry-out an in-depth risks assessment of the entire sweet potato value chain in Ghana to inform policy and strategy formulation by key stakeholder in the sector.

2. STATE OF THE ART

2.1. The Sweet Potato Value Chain

The sweet potato value chain like any other value chain is one operated by various actors. These actors have their specific roles they play in order to attain an effective value chain performance. The numerous activities that are undertaken to produce various commodities and make them readily available for consumers are applied in the concept of value chain. These systems encompass actors and organizations, functions and products, cash and value that make possible the transfer of goods and services from the producer to the final consumer. According to Bezabah and Nugussie (2011) the major processes involved in the sweet potato value chain comprises of input supply, technical support (extension service), production, processing, trading and consumption. At every stage of the chain, some form of cost is incurred, transactions take place and generally some form of value is added. The key actors in the sweet potato value chain as identified by Kasina and Nderitu (2009) in Tanzania were seen to be farmers, brokers, transporters, wholesalers, vendors/retailers, processors and consumers. However, Rahko (2012) noted that countries that are closer in terms of boundaries could have exporters being part of their value chain although perishability of the crop and the poor nature of the transport and storage systems make the crop difficult to be an active part of international trading activities. Bezabah and Nugussie (2011) stressed that agro-input dealers in the sweet potato value chain basically perform the function of procuring agricultural inputs for onward sales to farmers to ensure the physical production of the crop. Main inputs supplied by these dealers for sweet potato production include fertilizer, chemicals (herbicides, pesticides) and farm tools. However, most input dealers provide technical support to farmers in the form of appropriate chemical recommendation and proper agro-input usage based on instructions since most farmers can hardly read prescriptions on labels for appropriate usage. Also, Mmasa and Msuya (2012) established that the sweet potato value chain in Tanzania is comprised of actors who mainly perform the primary functions as producers who are into the physical cultivation of the crop, rural hawkers basically buy sweet potato from farmers and transport their produce by the aid of a bicycle to known sales centers. He further added that these rural hawkers are mostly resource constrained. Input suppliers, processors, retailers and consumers were also identified to be critical actors of the sweet potato value chain.

2.2. The Concept of Risk

The terms risk and uncertainty are both associated with exposure to events that can result in losses. Risk can be defined as where a firm has *a priori* or fore knowledge of the probabilities, and uncertainty exists when these probabilities are not known – though the terms are often used interchangeably (Knight, 1921; Siegel, 2005). Combination of the likelihood of occurrence of an event or exposure(s) and the severity of the outcome is termed as risk. Deloach (2000) also defines business risk as "the level of exposure to uncertainties that the enterprise must understand and effectively manage as it executes its strategies to achieve its business objectives and create value". A more standard definition of risk is that "risk is the chance, in quantitative terms, of a defined hazard occurring. It therefore combines a probabilistic measure of the occurrence of a primary event(s) with a measure of the consequence of that/those event(s)" (The Royal Society, 1992). Hence, risk is an attribute that reflects both the range of possible outcomes and the distribution of respective probabilities for each of the outcomes. However, in contemporary times, risk has been seen and described by investment economists as the variation from expected outcomes due to imperfect knowledge of investors in decision making such as variations in market prices for agricultural commodities and production inputs and variations in the volume or quality of the commodity produced (Kuyrah *et al.*, 2006; Swiss Re, 2007). Alimi and Ayanwale (2005) however maintained that a situation of defective

(imperfect) knowledge is more pervasive in agribusiness enterprises (such as the sweet potato value chain). Hence, investors (chain actors) face the vulnerability of what they expect *ex-ante* not being achieved *ex-post* (Ndugbu, 2003). For instance each time an investor borrows money for a venture in an agribusiness enterprise, there is the possibility that returns on investment may be less than the cost of borrowed funds (interest rate) due to the myriad of risk the agribusiness investor may be faced with. Also, in this era of global climate change, an investor cannot predict with certainty especially in this part of the world where technology seems to be deficient on the degree of fluctuation in prices of input and output and weather. Obviously, agricultural activities are exposed to greater risk. Agricultural activities are seen to be more susceptible to the physical and natural uncertainties than other enterprises since it entail extensive, direct and continuous contact with the forces of nature (both physical and natural). Value chains are seen to be interconnected in terms of reliance on the various levels for effective and efficient performance which makes transmission of these risks easier. Therefore, a critical decision faced by the actor in the chain is the reduction in the extent of variations in the key variables of performance (output, price, information flow etc.).

2.3. Measurement of Risk

The discussion on the choice problem under uncertainty and risk can be thought of as a choice among distributions (lotteries), with risk-averse agents preferring distributions that are "less risky". This is looked at in the face of the idiosyncratic risk faced by the individual actors along the commodity (sweet potato) value chain. With the interconnection of the activities along the chain, a comparison of these idiosyncratic risk identified will be done to rank which of the levels is more risky to operate using the appropriate measures of risk as reported in literature. Earlier contributions tried to provide such ranking based on a univariate measure of variability, such as the variance or standard deviation. For example, the portfolio theory of Markowitz (1952) and Tobin (1958) relied on a *mean-standard deviation* approach. Studies conducted by Matthews (2010) to determine the rate/level of variability in European Union (EU) prices and world prices for appropriate comparison used the coefficient of variation approach for a period between 1983 and 2010. The study revealed that the most volatile crop in the European Union was wheat and maize rising increasingly above the world price as at 2010. This same approach was used by the European Commission (EC) in 2009 to ascertain the level of variability in the price of wheat and maize in the Unites States of America (US) in comparison with that of the prices in EU with Germany as the proxy country. They realized from the study that wheat and maize prices in the USA were less volatile compared to same in the EU. Also, mean-variance approach was adapted by Mishra *et al.* (2004) to the random utility assumption in determining the factors that influenced the choice of diversification by farmers. This was used to take care of price and output variability that were likely going to influence the choice of diversification. Under the assumptions of the mean-variance approach, an individual's preference ordering depends solely on the mean and variance of returns—an uncertain prospect can be represented fully by its mean and variance. The decision rule used by a farmer to choose the appropriate enterprise mix from among virtually unlimited possibilities is to maximize the utility of income derived from the possible enterprise portfolios, where utility depends only on the mean and variance of returns. The general formula for the calculation of both the mean-variance and mean-standard deviation are stated below.

$$S^2 = \frac{\sum (X_i - \mu)^2}{n-1}$$

$$\sigma = \sqrt{S^2}$$

S^2 = Variance; X_i = observation recorded for each sample; μ =Sample mean; n= Sample size;
σ = Standard deviation

The mean-standard deviation approach was used by taking the square root of the mean variance formula. These measures estimate the level of dispersion of a sample mean in relation to the risk parameters under consideration and which is a measure of how risky the said enterprise is in the period under consideration. These measures were acknowledged by Mathia (1976) but further suggested that an index can be calculated from these variables called Random Variability Index (RVI) and Total Variability Index (TVI) depending on which aspect of risk is being looked at or dealt with. Four sources of variation in the analysis of data categorized as secular trends, cyclical movements, seasonal fluctuations and a component which remains after the first three have been taken into account was identified. The first three are systematic in nature whilst the last component is referred to as the random component of the total variation. The index expresses the standard deviation relative to the recent average levels of the risk parameters under consideration over the said period. Mathia (1976) therefore used both the TVI and RVI to measure total sales and price and yield risks respectively for some major field and horticultural crops in North Carolina. The RVI was then used to determine the level of predictability of these crops in terms of yield, price and sales. The use of the RVI requires the use of serial data so that the deviation from the norm for the period or cycles operated could be tracked in order to appropriately predict how risky the said enterprise could be in terms of any of the risk parameters. A flaw to this method of risk measurement is its inability to properly predict human related risk and for that matter events of discrete or discontinuous nature unless a quantitative definition is apportioned. In such situations arithmetic means are difficult to calculate without such adjustments and subsequently the estimation of the standard deviation. Notwithstanding this flaw, its greatest advantage is the use of a relative figure which makes it easier to predict and interpret compared to the other measures stated.

$$RVI = \frac{\sqrt{Variance}}{Average(\mathrm{r})}$$

Where;

RVI is the Random Variability Index which is a ratio of standard deviation for the average of the risk variable (output risk, price risk etc.) being considered over a period or trip or cycle *r*.

2.4. Types of Risk in the Agricultural Commodity Value Chain

Howell and Hazzard (2012) identified and maintained that there are different tools and strategies used either in isolation or in combination to manage risks and these risks have been classified into five particular types: Production risks which relate to weather, drought, physical hazard to factory site and technological failure of firm. These production-related risks are mostly associated with yield variation (fluctuations), but also can affect the quality of products (especially drought and wind damage and high humidity/excess rain leading to pests/diseases), and consequently disrupt the flow of goods and services along food commodity value chains. Secondly, market/price risks relate to the possibility that you will lose the market for your products or that the price received will be less than expected. This also includes lower prices due to increased supply or decreased consumer demand, loss of market access due to relocation or closing of a processor or other buyer, and lack of marketing power due to the small size of produce sellers and/or buyers relative to others in the market. Generally, market risks are related to issues which affect price, quality, availability, and access to necessary products and services. Of these, price risks are typically the most volatile, particularly in commodity markets where both local and global supply and demand conditions are constantly changing. Market-related risks vary constantly and are rarely associated with only one specific geographic location. Aspects of market risk may directly impact individual actors in a supply chain, and differentially affect producers in a single community and/or producer group. Also, the possibility of having insufficient cash to meet expected obligations, lower than expected profits, and loss of network in the chain thus lead to the occurrence of financial risk. In addition, financial risk may be caused by increases in interest rates,

excessive borrowing, lack of adequate cash or credit reserves and changes in exchange rates. Furthermore, legal and environment risks which he identified relate to fulfilling business agreements and contracts. Another source of legal risk is misdeed liability which means causing injury to another person or property due to negligence. Legal risk is also related to environmental liability and concerns about produce quality, erosion and pesticide use. These risks also have a major impact on the structure of the agricultural value chain and relationships among individual actors and the distribution of rewards and risks within the supply chain and with support service providers and government. These risks have systemic impacts on decision-making and productivity, and market options. Because incentives can change (including the distribution of rewards and risks in the supply chain), these risks can result in changes in yield quantity and quality, and even lead to disruptions in the flow of goods, services, information and cash. Finally, he states that, human resources management/operational risk is one of the pertinent risks in value chain management. This pertains to risks associated with individuals and their relationships to each other, their families and the farm business. Sources of human resource risk include divorce, death or disability of a business owner, manager employee or family member. It also includes risks arising from poor communications and poor management practices. These risks usually directly affect a single chain actor, but can then be transmitted along the value chain. These risks are mostly associated with productivity reductions, and low quality of products, and unreliable delivery (of inputs and outputs, and support services).

2.5. Risk Management Strategies Adopted by Value Chain Actors

Richard (2010) identified that the risk management strategies most used by producers were the following of recommended agronomic practices, diversification and use of multiple market outlet to deal with risks at that level. He also added that traders are more likely to adopt enterprise diversification, trading in multiple markets and the maintenance of procurement flexibility to deal with the risk they are faced with. Finally, he stressed that processors also adopted the use of multiple markets, temporal changes in production mix of inputs and diversification. Decision for managing risk, mitigating its impact or increasing the business's ability to survive under unfavourable conditions are identified unanimously by different authors as seen below even though they maintained that the type of decision to take is dependent on the circumstances the actor finds himself and the key to such decisions is strategic flexibility (Mulcahy, 2003; Ramaswami *et al.*, 2004). A number of risk management strategies have been outlined by a number of authors to be adapted by actors in dealing with the various risks they are faced with. Varieties of crops and livestock may be chosen in preference to the one with variable yields even when the other gives a higher return on average (Siegel, 2005). Here, decisions under such conditions are taken with priority to the ability of the variety to survive (resistant variety) in the condition it is to be planted rather than the potential yield of the crop. Others may also decide to plant in excess capacity of what one can. This means producing more than the economic optimum level of output every year in order to take care of possible losses and unanticipated price drop particularly for easily perishable commodities. This means that in bad years the actor still makes some gains. Production risk can also be reduced by maintaining excess production capacity. Maintenance of operational flexibility is also another means by which value chain actor use in dealing with the risks they are faced with. This refers to the ability to make adjustments in the operations of an actor in response to changing conditions in order to reduce disruption and fluctuation in income (Howell and Hazzard, 2012). Actors may however decide to contract prices in advance so as to deal with any possible fluctuations in the price of the said produce and/or products. Producers in the sweet potato value may however decide to follow strictly recommended agronomic practices meted out to them by innovation/technology agents. It has been found that technological changes disrupt the suppliers stand in supply and value chains (Zsidisin and Ritchie, 2008). Finally, actors may diversify either within the agricultural setup or outside mainly to deal with the uncertainty surrounding the price of the produce or products. However, Richard (2010) stressed that enterprise diversification is the best risk management strategy for dealing

with market risk. By producing more than one crop or trading in more than one commodity or product, actors can reduce the risk of price variability (Sarah, 2009).

3. RESEARCH METHODOLOGY

3.1. Sampling Method and Data

The study was conducted in the West Mamprusi and Fanteakwa districts of the Northern and Eastern regions of Ghana respectively due to their prominence when it comes to the production of the target commodity (sweet potato) and subsequently the immense contribution to the food basket when it comes to the production of the said crop (sweet potato). Also, these areas have seen some interventions when it comes to root and tubers crops utilization (processing) into different forms by RTIP/RTIMP initiatives. Four (4) communities were selected from each of the districts by the use of a simple random sampling technique. Farmers in the selected communities were then selected by way of simple random sampling approach using the village farmers list from the Agricultural Extension Agents (AEAs) and the random number table approach which tends to reduce selection biases significantly. Markets and communities selected for trader and processor respondents were purposively selected with areas of high concentration of the targets (processors and traders) given highest priority. A combination of accidental and snowballing techniques was used to select marketers/traders and processors based on referrals from initial subjects i.e. producers to assemblers/collectors, collectors to wholesalers and so on due to the difficulty in getting a sampling frame at these actors. With this, respondents were interviewed as and when they were identified and willing to participate in the survey. A sample size of one hundred (100) farmers, fifty (50) traders and forty (40) processors were selected from each of the two districts (West Mamprusi and Fanteakwa) making a total of Three Hundred and Eighty (380) respondents for the study. Primary data formed the core of the data used in this study.

3.2. Data Analysis

3.2.1. Sweet Potato Value Chain Risk Analysis

Risk was first identified through FGDs during the preparatory phase of the survey. These risks were therefore presented to actors for them to rank by the use of a five point Likert scale which was on a scale of one (1) indicating a strong agreement to five (5) on the other end indicating a strong disagreement. The risks dominantly agreed upon by actors were sorted using the mean ranks estimated for the various risks after which risk was calculated at each level of the value chain (producer, trader and processor) using a combination of the mean-variation (Swiss Re., 2007), the mean-standard deviation (Kuyrah *et al*., 2006) and the Random Variability Index (RVI) proposed by Mathia (1976).

The Random Variability Index (RVI) which is a ratio of standard deviation to the average (mean score) of the risk parameter being measured over the period under consideration. For instance, if output risk is being calculated, actual output of sweet potato harvested for the past three (3) years is obtained and the average of the three year output together with its variance and standard deviation calculated. Same approach was then used for the other risks identified along the chain but for trader and processors, the duration was for the number of trips and cycles respectively. The RVI therefore is a combination of the first two approaches discussed (i.e. variance and standard deviation) in relative terms. The approach for the mean-variance and mean-standard deviation methods in the measurement of risk is not different from this method. However, after the estimation has been done, because the RVI is a relative measure, the standard deviation obtained is then divided by the mean score over the three year period or number of trips or cycles already estimated. The RVI was selected ahead of the use of both the mean-variance and the mean-standard deviation methods as the final decision making rule because of its convenience since it takes into account relative figures compared to the absolute figures of the former measures. The type of risk management strategy adopted by actors to mitigate risks they are faced with was also analyzed using descriptive statistical tools such as frequencies and percentages.

4. RESULTS AND DISCUSSIONS

4.1. Risk Identification and Risk Management Strategies Adopted by Actors.

Howell and Hazzard (2012) maintained that for proper decision in managing risk, one has to start with identifying the most crucial risks the actors face. Decisions could be made to deal with risk at both the individual (actor) level or cumulatively at the different stages of the chain depending on the kind of risks faced. This study however concentrated on idiosyncratic risk which is the risk at the individual actor level rather than systemic risk which has a covariate effect on all actors mostly to the same degree/extent. Top Five (5) risks with the highest mean ranks were therefore taken as the most important risks identified at that level.

4.1.1. Risk Identification at the Producer Level.

Risks at the producer level have been identified to be in two folds. The producer is faced with production risk stemming from unpredictable weather, pest and diseases which ultimately have an impact on the level of output realized from a particular season. Market (price) risk results from variation/fluctuation in prices of both inputs and output. Table 4.1 presents the various risks identified at the production level in order of severity as predicted by the mean scores of the ranks assigned by producers.

From the results, it was realized the first most important risk faced by producers was sudden changes in the output price of sweet potato mainly owing from the uncertain nature of the market in terms of demand at the time of sale. With a mean score of 1.09 from the pooled sample, farmers in both districts consider output price variability as the most important risk to sweet potato production. Sudden changes in output levels came second in terms of importance to producers mainly due to the uncontrollable nature of the weather and other production variables. Whist farmers in the West Mamprusi district regarded output level variability as the second most important risk (1.30), farmers in the Fanteakwa district saw output level variability as the third most important risk (1.13). This may be due to the comparably stable nature of weather conditions (mainly rains) in the South than in the Northern sector of the country.

Pest and disease related risk was identified to be the third most important risk faced by farmers. Sweet potato suffers from pests and disease attack on the field and after harvest. The mean score for pest and disease related risk was recorded as 1.25. Whereas pest and disease risk was ranked as the second most important risk in the Fanteakwa district, it came as the third most important risk farmers faced in the West Mamprusi district.

Table-4.1. Risks Faced by Sweet Potato Producers

Risks	Fanteakwa (N=100)		West Mamprusi (N=100)		Total(N=200)	
	Mean Rank*	Std. Dev	Mean Rank	Std. Dev	Mean Rank	Std. Dev
Sudden changes in output price	1.07	0.25643	1.11	0.3144	1.09	0.2869
Sudden change in output	1.19	0.39428	1.3	0.48	1.24	0.44267
Pest and disease risk	1.17	0.37753	1.34	0.49	1.25	0.44831
Sudden change in demand	1.36	0.48242	1.34	0.47	1.35	0.47817
Sudden change in input price	1.41	0.51434	1.6	0.5685	1.5	0.54907
Prolonged decline in output price	4.32	0.61759	4.26	0.6608	4.29	0.6387
Transport failure	4.4	0.71067	4.23	0.71	4.31	0.71296
Sudden change in wage rate	4.38	0.72167	4.58	0.5537	4.48	0.64939
Transport cost fluctuation	4.59	0.72607	4.39	0.6947	4.49	0.71586
Risk of fire outbreak	4.74	0.44084	4.63	0.5	4.68	0.47635

*Ranking scale; 1=strongly agree; 2=agree; 3=neutral; 4=disagree; 5=strongly disagree.

Source: Field Survey, 2015

Farmers from the survey also identified changes in the demand of traders as the fourth most important risk that affect their enterprise since the main role of the producers in the value chain is to cultivate sweet potato for

onward supply to traders. Demand changes and its sudden nature have the potential of affecting incomes and effective planning of producers in terms of what quantities to produce and when to harvest. From the pooled sample, it was realized that sudden changes in demand by traders was assigned a mean score of 1.35. Both districts however, ranked this risk as their fourth most important risk. Sudden change in input price was the fifth most important risk rank by farmers with mean rank of 1.50. Generally, farmers in the two districts disagreed that prolonged decline in output price, transport failure, sudden changes in wage (labour cost) rate, transport cost fluctuation and risk of fire outbreak are important risk at the production level.

4.1.2. Risk Management Strategies Adopted by Producers

Producers have a number of options in terms of tools for managing the impact of risk since its occurrence can hardly be avoided. After the identification of the most important risks faced by farmers, the next stage was to find out how these risks are being managed by individual farmers at their levels. Table 4.2 below spells out the risk management strategies adopted by farmers for the identified risks.

Output price variability which was top on the list of risks identified, farmers had three (3) main risk management strategies which they mostly choose from. From the results, majority (65%) of farmers used crop diversification as their main tool in dealing with the variations in prices of their output. Farmers used this tool mainly because of the impact of such fluctuations on their farm budget. The main crop enterprises farmers diversify into include yam, cocoyam and cereals (such as rice and maize). In the case of unexpected decline in price especially from the sales of sweet potato, the other crops which they cultivate would provide a cushion for their farm income. Also, about 12% of farmers indicated that expansion of their production was their main strategy or means of mitigating the impact of output price variations. In the case of an unexpected decline in the price of the commodity, total expected income from the sale of sweet potato would not be seriously hit since his total output would be high. This was however the case for farmers who had the luxury of having large acreages of land who could easily vary their land size based on anticipated low price in the coming season. Marketing of produce through different channels was also an option for farmers since these markets usually have their own established prices for the produce at various times of the season and so farmers tend to vary the kind of traders they sell to. About 23% of farmers reported that they adopt such a strategy although they admit a fair knowledge of the prices in the various markets may be essential.

With the variation in output levels obtained by farmers, it was realized from the study that 44% of farmers followed recommended agronomic practices to mitigate its impact. These recommended agronomic practices followed were practically shown them through field trials and demonstration farms by AEAs. These practices such as periods/times of weeding, pesticide application, maturity period for harvest, farm sanitation, etc. if followed are able to reduce this uncertainty so that the levels of output received is stable and close to the actuals expected by farmers. Also expansion of farm size was a tool that was used by about 36% of farmers to off-set such uncertainty at harvest. With this tool the farmer can be assured of a minimum, output all other things being equal. The study also revealed that pest and disease related risk at the production level of the value chain was mainly dealt with by employing two management tools. Whilst majority (75%) of farmers from the study indicated their reliance on the use of resistant varieties to mitigate the impact of this risk, 25% of the farmers indicated that planting of pest and disease resistant varieties alone could not effectively deal with this risk; thus the adoption of recommended practices. Farm sanitation, if not properly checked could lead to pest and disease infestation although resistant varieties may have been planted.

Table-4.2. Risk Management Strategy for Identified Risk at Production Level

Risk	Risk Management Tool	Fanteakwa (n=100)	West Mamprusi (n=100)	Pooled (N=200)	
		%	%	Freq	%
Sudden Changes in Output Price	Diversification	62	69	131	65.5
	Expansion of Production	11	12	23	11.5
	Marketing through multiple Channels	27	19	46	23
Sudden Changes in Output Level	Follow recommended practices	44	44	88	44
	Expand production	38	35	73	36.5
	Plant resistant Varieties	18	21	39	19.5
Pest and Disease Risk	Follow recommended practices	28	22	50	25
	Plant resistant Varieties	72	78	150	75
Sudden Changes in Demand of Traders	Marketing through multiple Channels	100	100	200	100
Sudden Changes in input price	Follow recommended practices	28	22	50	25
	Plant resistant Varieties	72	78	150	75

Source: Field Survey, 2015

In dealing with the risk associated with sudden changes in demand by traders it was unanimous among all (100%) farmers that marketing through multiple channels is the most effective management strategy. Farmers have limited options since they do not go into production/marketing contract with traders and processors (mostly customers).

The fifth most important risk identified by farmers was the sudden changes in input price. This risk left farmers with two main options of either following recommended agronomic practices or relying on the use of resistant varieties. Due to the perishable nature of the crop and the fact that its sweet tubers attract pest which destroys the crops in the long run, majority (75%) of farmers plant resistant varieties so as not to rely so much on chemical inputs (particularly pesticides) since that is subject to the risk of input price variability. Notwithstanding, some (25%) of farmers used recommended practices and not just relying on the planting of resistant varieties.

4.2.1. Risk Identification at the Trader Level

Unlike producers who are faced with two main types of risk (production and market), traders are mainly faced with risks which are related to the price of the produce they handle. Notwithstanding, they may also be faced with the risk of variation in the quantity of sweet potato obtained from producers at a time. Table 4.3 shows the various risks faced by traders in sweet potato value chain as identified by them.

From the study it was realized that sudden changes in the produce price was the most important risk faced by traders with a mean score of 1.13. This is caused mainly by the imperfect knowledge of the demand and supply situation on the market since markets can be choked or deficient with sweet potato at any time which the trader may not readily anticipate. It was therefore not surprising that the second most important risk identified by traders was the sudden changes in the final consumer demand. This recorded a mean score of 1.36 (pooled) with both districts being unanimous about this risk.

The study also revealed that, the third most important risk faced by traders in the sweet potato value chain was post-harvest (losses) related risk which recorded a mean score of 1.5. Whilst, traders in the Fanteakwa district ranked the risk of post-harvest loss as fourth most important, traders in the West Mamprusi district rated it as the third most important. This was however not surprising since sweet potato in the West Mamprusi district is produced with heavy fertilizer application due to poor soil nature. This increases the rate of deterioration of root and tuber crops in general. This is coupled with the fact that traders would have to handle and move the produce for a considerable long period of time after harvest. Also, with a mean score of 1.52, sudden changes in produce/supply level was identified to be the fourth most important risk at the trader level.

Table-4.3. Risk Faced by Sweet Potato Traders

Risks	Fanteakwa (n=50)		West Mamprusi (n=50)		Pooled (N= 100)	
	Mean Rank*	Std. Dev.	Mean Rank	Std. Dev.	Mean Rank	Std. Dev.
Sudden changes in produce prices	1.18	0.38809	1.08	0.27405	1.13	0.338
Sudden changes in final consumer demand	1.48	0.50467	1.24	0.47638	1.36	0.50292
Post-harvest related risk	1.62	1.04764	1.38	0.49031	1.5	0.82266
Changes in Output Level	1.4	0.49487	1.64	0.48487	1.52	0.50212
Sudden changes in marketing cost	1.7	0.8391	1.4	0.49487	1.55	0.70173
Transport failure	3.76	1.23817	4.1	0.8391	3.93	1.06605
Prolonged decline in commodity purchase price	4.24	0.65652	4.3	0.46291	4.27	0.56595
Sudden changes transport cost	4.52	0.57994	4.56	0.50143	4.54	0.53973
Sudden changes in wage rate	4.58	0.49857	4.74	0.44309	4.66	0.4761

*Ranking scale; 1=strongly agree; 2=agree; 3=neutral; 4=disagree; 5=strongly disagree.

Source: Field Survey, 2015

4.2.2. Risk Management Strategy Adopted by Traders

Traders also use a number of risk management strategies in dealing with the risk they are faced with. Table 4.4 below presents the various risk management strategies adopted by traders. The most important risk identified by traders was sudden changes in the produce price. Traders identified three (3) main management strategies in dealing with produce price risk. With the varying prices in different markets, majority (35%) of traders marketed through different markets by monitoring the prices in markets available so that whenever a particular market experiences unexpected change in the price which may not inure to their benefit, the trader then decides to send the produce to preferable market. Notwithstanding, 34% of traders indicated the use of diversification as a mitigating tool for price risk. Since sweet potato traders mostly trade in more than one commodity, quantities traded at a time for the different commodities depended on the variation between the expected price and the actual price of the commodity at the time of purchase. Traders' maintenance of flexibility in terms of their supplies was not left out as one of the risk management tools adopted by them since 31% of them used this tool as their main strategy to deal with the risk of produce price variability. Here traders actually make procurements for sale based on a carefully studied market trend of price of sweet potato and supply quantities based on that. Finally, risk of transport failure, prolonged decline in commodity purchase price, sudden changes in transport cost and sudden changes in wage rate were not regarded by traders as major risks they faced.

Majority (52%) of traders indicated maintaining of flexibility as their main strategy for dealing with the sudden changes in consumer demand. This is where traders monitor closely to know which quantities to bring to the market at a time to ensure a quick turnover whilst 44% of traders traded through multiple channels when consumer demand in a particular market changes unexpectedly. Also post-harvest related risk was the third most important risk that traders identified and with the two main options to dealing with this risk. Most (65%) of traders spread their purchases over the season. Traders buy same quantities on a weekly basis to ensure that they don't handle a lot of sweet potato at a time to incur such unexpected losses from storage. From the study, majority (50%) of traders maintained flexibility to deal with the risk of sudden changes in output level/supply in that the traders seek to monitor the market and supply specific quantities just to meet the said demand based on interactions with producers to know what quantities are available and to make provision for that subsequently.

Table-4.4. Risk Management Strategies Adopted by Sweet Potato Traders

Risk	Risk Management Tool/strategy	Fanteakwa (n=50)	West Mamprusi (n=50)	Pooled(N=100)	
		%	%	Freq	%
Sudden Changes in Produce Price	Maintaining flexibility	40	22	31	31
	Market through multiple channels	30	40	35	35
	Diversification of product lines	30	34	34	34
Sudden Changes in Consumer Demand	Maintaining flexibility	60	44	52	52
	Market through multiple channels	40	48	44	44
	Spread purchase over season	0	8	4	4
Post-Harvest Related Risk (Losses)	Maintaining flexibility	40	30	35	35
	Spread purchase over season	60	70	65	65
Sudden Changes in Output Supply	Maintaining flexibility	52	48	50	50
	Market through multiple channels	16	40	28	28
	Spread sales over season	32	12	22	22
Sudden Changes in Marketing Cost	Maintaining flexibility	52	60	56	56
	Market in group	30	38	34	34
	Spread and sales over the season	18	2	10	10

Source: Field Survey, 2015

Finally, with sudden changes in the marketing cost of traders, majority (56%) of them maintained flexibility to reduce cost since every procurement is specifically done and all the cost properly catered for before the initiative is taken. It is worth noting however that 34% of traders mitigated this risk by marketing in groups. Here traders will go to production centers in groups and bearing an overall total cost and subsequently sharing the cost based on quantities procured. Although it is also a cost reduction technique, it is also seen by traders as a good tool used to off-set marketing cost in case of unexpected changes in the marketing cost since the change is born by the entire group.

4.3.1. Risk Identification and Management Strategies at the Processor Level

Since processors are at the final stage where sweet potato is handled before it gets to the final consumer in the value chain and mainly in a more convenient form, risks at the producer and trader levels have some ripple effects at the processor level. Tables 4.5 and 4.6 present the various risks identified and the risk management tools adopted by processors along the sweet potato value chain respectively. Four risks were identified to be pertinent at this level of the chain. Produce price variability was identified by processors as the most important risk with a mean score of 1.21. This is not surprising since this risk has been the most important risk from the producer and trader levels and so its ripple effect will also be felt at the final stage of transaction where majority of the produce is expected to be transformed for consumer utilization. Sudden changes in consumer demand was the second most important risk identified by processors recording a mean score of 1.21 from the pooled sample. This was due to the difficult and dynamic nature of consumers whose taste and preference can change at any given period but may be seldom anticipated by the processor. Also, from the study, sudden change in the level of supply was identified as the third most important risk with a mean score of 1.29. Whereas the West Mamprusi district ranked this risk as the third most important risk, processors in the Fanteakwa district ranked this as the first most important risk they are faced with. The fourth most important risk identified by processors in the sweet potato value chain was post-harvest related risk which was not really surprising since processing has a basic function of improving the shelf life of most commodities (including sweet potato). Post-harvest losses (rotten tubers) risk obtained a mean score of 1.43. It is however worth noting that processors from the two districts generally disagreed that transport failure, prolonged decline in product price and sudden changes in transport cost are major risks faced in the sweet potato processing stage of the value chain.

Table-4.5. Risk Faced by Sweet Potato Processors

Risks	Fanteakwa (n=40)		West Mamprusi (n=40)		Pooled (N=80)	
	Mean Rank*	Std. Dev.	Mean Rank	Std. Dev.	Mean Rank	Std. Dev.
Sudden changes in produce prices	1.25	0.43853	1.175	0.38481	1.2125	0.41166
Sudden changes final consumer demand	1.25	0.43853	1.175	0.38481	1.2125	0.41166
Sudden Changes in Supply levels	1.2	0.4051	1.375	0.49029	1.2875	0.45545
Post-Harvest related risk	1.25	0.43853	1.625	0.49029	1.4375	0.49921
Transport failure	4.35	0.69982	4.15	0.36162	4.25	0.56254
Prolonged decline in output prices	4.725	0.4522	4.325	0.47434	4.525	0.50253
Sudden changes transport cost	4.475	0.64001	4.575	0.50064	4.525	0.57313

*Ranking scale; 1=strongly agree; 2=agree; 3=neutral; 4=disagree; 5=strongly disagree.

Source: Field Survey, 2015

Notwithstanding the aforementioned risk as identified by processors, they adopt strategies to mitigate their impact or completely prevent their occurrence. Table 4.16 presents the results of the survey regarding the main strategies adopted by processors to deal with risks. It was realized from the study that majority (50%) of processors adopted product diversification as their main risk management tool to deal with the sudden change in the price of sweet potato which is their primary input. This is because, most of them processed more than one commodity at a time and so tend to consolidate quantities procured with price volatility of their produce on the market. However, about 58% of processors in the West Mamprusi district preferred the maintenance of flexibility of purchases since most of them mainly process only sweet potato during the season.

With regards to the sudden changes in consumer demand, majority (64%) of processors preferred to maintain flexibility in their purchases to mitigate its impact compared to the other risk management tools. It was therefore not surprising when majority (64%) of processors used the same tool in dealing with the variations in supply levels. Maintaining flexibility requires a considerable level of knowledge of the customer demand levels and also the quantities available on the market to be able to meet such demands and incur minimum losses.

Table-4.6. Risk Management Strategy for Identified Risk at Processor Level

Risk	Risk Management Tool	Fanteakwa (n=40)	West Mamprusi (n=40)	Pooled(N=80)	
		%	%	Freq	%
Sudden Changes in Produce Price	Maintaining flexibility	25	57.5	33	41
	Market through multiple channels	7.5	10	7	9
	Diversification	67.5	32.5	40	50
Sudden Changes in Consumer Demand	Maintaining flexibility	65	65	52	64
	Use of different sales point	5	30	14	18
	Diversification	30	5	14	18
Sudden Changes in Supply levels	Maintaining flexibility	65	65	52	64
	Market through multiple channels	5	30	14	18
	Diversification	30	5	25	18
Post-Harvest (rotten losses) Risk	Maintaining flexibility	7.5	32.5	16	20
	Spread purchase over season	92.5	67.5	64	80

Source: Field Survey, 2015

Finally, post-harvest related risk came fourth in terms of its importance as a risk at the processor level of the value chain. In dealing with this risk however, majority (80%) of processors preferred spreading purchase of produce (sweet potato) over the season by buying constant levels at a time which they know they can process

effectively without having to store for days to face the risk of losing some proportions by the time processing of that quantity is done.

4.4. Measurement of Risk and the Extent of Predictability

Table 4.7 below presents the measurement of risk taking into consideration the mean-variance, standard deviation and the RVI which is the ultimate decision making rule.

Output price risk was seen at all three levels as the risk with the least RVIs which indicates a high level of predictability since this is mainly based on the price from the previous season. The level of predictability was however seen to be high at the trader level of the value chain which is not surprising since traders are comparably abreast with price information than both farmers and processors. Variability in terms of output level was seen at the production level as risk with the highest RVI and by extension the lowest predictability level since output realized from a particular season is dependent on a combination of factors of which weather which is highly unpredictable in this part of the world is a major determinant. This coupled with the fact that Ghana's agriculture is rain fed with very little irrigation activity. With an RVI of 1.685, variation in marketing cost was seen as the risk with the least predictability partly due to various market cost incurred by traders. Related cost elements incurred by the trader such as cost of loading and offloading and cost of inputs (e.g. sacs) are highly unpredictable. Predictability of the various risks identified at the processor level was also calculated with the post-harvest (rotten losses) related risk being the least predictable. This was not surprising since processors have to keep the produce for a considerably long period of time. As stated by Freshwater and Jette-Nantel (2008) farmers in value chains are faced with both output and price risks whilst the other actors (particularly the upper part) in the value chain are faced with mainly price related risk. This has been seen to be partly the case for the sweet potato value chain; but at the processor level, predictability was least on the post-harvest (rotten losses) related risk compared to other risks identified. The study however confirms the study by Moschini and Hennessy (2001) who stated the possibility of adverse risk being transmitted along crop commodity value chains due to the interconnections between actors and the fact that risk is pervasive with semi-perishable and perishable commodities like.

Table-4.7. Measurement of Risk and the Extent of Predictability

Production Level Risk Measure	Mean	Variance	Std.Dev	RVI
Output Price Risk	64.713	703.44	26.523	0.407
Input Price Risk	110.129	8340.015	91.324	0.829
Output Level Risk	21.09	279.074	16.705	**0.972**
Pest and Disease Related Risk	1.1545	0.614	0.7856	0.678
Trader Level Risk Measure				
Produce Price Risk	97.0247	1353.352	36.787	0.379
Market Cost Risk	797.262	18044971	1343.492	**1.685**
Supply Level Risk	7.678	101.819	10.0905	1.314
Pest and Disease Related Risk	0.792	0.517	0.718	0.907
Final consumer demand risk	7.0616	79.443	8.913	1.262
Processor Level Risk Measure				
Produce Price Risk	82.823	1749.552	41.828	0.505
Supply Level Risk	1.504	8.943	2.991	1.988
Pest and Disease Related Risk	4.5713	639.155	25.282	**5.531**
Final consumer demand	1.1847	0.82	0.9057	0.764

Source: Field Survey, 2015

5. CONCLUSION

From the study, the most important risks identified at the producer level were variability in output price, input price, output level and incidence of pests and diseases. The risk identified with the lowest predictability at the production level was variability in sweet potato output level with an RVI of 0.972. Farmers used adherence to

recommended agronomic practices, expansion of area under cultivation or planting of resistant varieties to deal with production risks. On the other hand, output price risk was dealt with by adopting either crop diversification, marketing of produce through different channels or expansion of area under cultivation. It is worth noting however that, trader in the sweet potato value chain were found to face the risk of variability in produce price, market cost, high level of post-harvest losses and inconsistency in produce supply. Among these, the risk with the least predictability was found to be marketing cost with an RVI of 1.685. The main risk management strategies employed by traders to deal with these risks are purchase of produce based on realistic sales forecast, marketing through different channels and produce diversification. Variability in produce price, inconsistency in produce supply, post-harvest losses and changes in final consumer demand were the main risks identified at the processor level and the one with the least predictability was post-harvest losses (RVI. 5.531). The main risk management strategies used by processors in dealing with these risks were making purchases based on sales forecast, marketing through different channels and diversification. To deal specifically with post-harvest losses (losses of the tubers after purchase), majority (80%) of processors buy in smaller quantities. This increases transaction cost associated with such multiple purchases and transportation to the processing center. Contractual arrangements and an improved trust-based transaction are therefore recommended for actors along the chain since activities of chain actors are interconnected and an improved coordination could help deal effectively with these risks along the value chain.

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