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Analysis of Risk and Risk Management Strategies: The Case of Vegetable Producer Farmers in North Eastern Ethiopia

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ABSTRACT: *In Ethiopia, smallholders' farmers and agricultural cooperatives produce vegetable crops in various agro-ecological zones across the country through the commercial initiative. Vegetable productions take place in a highly biophysical and economic environment, which poses various types of risks. As follows, this study identifies measures and analyses the key sources of risks in vegetable production, based on vegetable farmers' perceptions. A simple random sampling technique was used in the selection of 394 smallholder vegetable farmers in North Eastern Ethiopia. Primary data collected through structured questionnaires and secondary data were preferentially used. Data collected were analysed using frequency distribution, arithmetic mean, and likert scales. This study recommends the training for vegetable farmers on risk management mechanisms, price supports mechanisms, providing the required infrastructure and the use of vegetable varieties that tolerates for natural disasters and pests/disease resistance.*

KEY WORDS: risk, risk analysis, vegetable production, risk management

Introduction

Farming is a risky business because it is affected by uncertain factors such as weather, diseases and market conditions. Agricultural activities carry out in an environment that is always varying. For agriculture to be a sustainable source of income and food, it is a must to understand the resources at the disposal of the smallholders and resource allocation decisions under risk. The risks that farmers face result from numerous sources of change or uncertainty. Thus, risks can be associated with production, price, casualty and technological risk. In every growing season producers must consider numerous factors that influence their management decisions (SE Visagie *et al*., 2004). Within the agricultural sector, vegetable production plays an important and varied nutritional as well as socio-economic role (Ntow, 2008). Various types of vegetable crops are grown in Ethiopia under rain-fed and or irrigation systems (Alemayehu *et al*., 2010). Vegetables have a special place in farming system because of the intensive nature of the crops.

They provide an abundant and inexpensive source of energy, body-building nutrients, vitamins and minerals. They can give high yield per unit area of land compared to cereals and hence generate high income for the farmers because of high market value and profitability. They also have high nutritive value compared to cereals. As a matter of fact, farming activities in general take place in a highly variable biophysical and economic environment which poses numerous types of risks. There are quite a lot of complex production and technical constraints that limit the expansion of the sector in the country. In vegetable subsector, these includes low genetic potential, lack of high yielding and high quality cultivars for domestic and export markets, poor management practices, low level of disease and insect pest control measures, inadequate quality seed supply, low level of post-harvest technology, weak research and technology dissemination (EARO, 2000).

Many of the vegetables are low yielders, and they are highly perishable. Hence, undertaking research on vegetable production risks would help in selecting optimal mix of agricultural enterprises, resource allocation and identification of appropriate technologies that may minimize risk. South Wollo Zone is one of the major vegetable producing areas in Amhara National Regional state. So far, however, allocation of resources among enterprises and decision of size and combination of enterprises were made by farmers without proper study. The various risks management strategies farm households use to withstand the adverse influence of vegetable production risks have not also been very well studied and documented in the study area. In the absence of such type of studies, one of the basic concerns of smallholder farmers, the design and implementation of effective risk management strategies to increase farm productivity and ultimately to ensure food security in the area could be problematic.

Managing risk and choosing profitable mix of enterprises is an important part of farming and its management is a concern for those governments which include this as one of their agricultural policy objectives. This study therefore aims to indicate optimal agricultural enterprises, identify the major risk management strategies in vegetable production and the determinant of pesticides use as risk management strategy.

Most farm decisions are made under conditions of risk and uncertainty. Researchers in the agricultural economics discipline have increased their research efforts in finding convenient methods of incorporating risk directly in farm decision making models. MOTAD (Minimization of Total Absolute Deviation) developed by Hazell is an important result of these efforts and it has become a common method of incorporating risk in farm analysis (Zainal, 1991). But most researches lack to model the risky Ethiopian agriculture and recommend for which profitable enterprises that farmer should allocate their resources.

The need to take risk into account in a farm planning problem allows the decision-maker to consider the trade-off between risk and profitability of the strategies selected for implementation. According to the researchers' assessment, there is no any empirical study on resources allocation under risk, risk management and determinants of choice of risk

management strategies in among vegetable producer farmers in South Wollo Zone. Thus, the aim of conducting this research is to explore and fill the existing gap of knowledge on under risk and risk management strategies.

RESEARCH METHODOLOGY

Description of the Area

This study was conducted in vegetable producer Districts of South Wolo and Oromia Special Zones. South Wollo Zone consists of 18 districts including Dessie and Kombolcha city administrations and Oromia special zone has 5 districts. Among these districts; T/derie, Woreilu, Albko, Kalu, kombolcha, D/zuria, Borena and Ambasel are the most potential producers of vegetables. Dewa harwa, Dewa Chefa, Jile timuga kemisse and Bati are also the potential vegetable producer woredas in Oromia special administrative Zone. Potato, Onion, Tomato, Cabbage and Carrot are the major vegetable crops produced in South Wollo Zone. There are also organized associations in Mekdela, Kelala and Albko Districts that are engaged in producing and supplying vegetables in the Zone.

Sampling Techniques

The study was undertaken in South Wollo and Oromia Special Administrative Zones. It was employed a two-stage purposive sampling technique to select sample respondents. In the first stage, potential vegetable producer districts were purposively selected from South Wollo Oromia Special Administrative Zones. In the second stage, vegetable producer farmers were purposively selected proportional to the number of vegetable producer famers available in the sample districts.

The formula provided by Yamane (1967) will be used to determine the required sample size at 95% confidence level and 5% level of precision.

$$n = \frac{N}{1 + N(e)^2}$$

Where: n = Sample size N = Size of population e = Level of precision.

The distribution of the sample respondents among sample kebeles was determined by the following formula.

$$n_i = \frac{nN_i}{N}$$

Hence, a total of 394 sample respondents were selected from the two zones for interview and 100 respondents were selected for focus group discussion. The same 394 respondents were interviewed in two rounds.

Data type and method of data collection

The study was used both primary and secondary data sources to collect qualitative and quantitative data. To capture both *meher* and *belg* season resource allocation patterns and production, the data collection was undertaken in two rounds. Therefore, the same 400 respondents were interviewed in two rounds.

The primary data on demographic, socio-economic and institutional factors was collected from sample households of South Wollo and Oromia Special Administrative Zones using semi-structured questionnaire and 12 focus group discussions (FGD) involving 10 purposively participants selected in each group. The FGDs were included model farmers, development agents, district officials and elders. A pilot study was first undertaken for pre-testing the questionnaire and the questionnaire was revised in light of the results of the pilot study. Secondary data was collected from documents of different offices in South Wollo, Oromia Special Administrative Zones and sample districts.

Method of data analysis

Descriptive statistics were used to provide a summary statistics related to variables of interest. It was used to give some insight about the characteristics of sample units for the study. It was employed for the description of different demographic, socioeconomic and institutional characteristics of adopters and non-adopters of the sample respondents. The mean, percentage, standard deviation, frequencies, minimum and maximum values were used to analyze the household's characteristics. Descriptive statistics (frequency distribution, arithmetic mean, and standard deviation) and likert scale were employed to describe farm, vegetable farmers' characteristics, farmer business, and vegetables marketing characteristics

RESULTS AND DISCUSSION

Descriptive Statistics Results

Descriptive Analysis of Continuous Variables

Age of the household is one of the important factors which determine the farming experience of the farmer. Diminution in the size of cultivated area and subdivision of holding are phenomena of long period. Age of household is important to study such a long period phenomenon, related with the change in farm size and extent of subdivision. All these contribute in determination of individual farm efficiency. The survey result showed that, the average age of the sample household heads was 47.28 years. Their age ranged from 23 to 72 years with standard deviations of 11.99. Education enhances the acquisition and utilization of information on improved technologies by farmers. Education together with increased experience could guide farmers to better manage their farm activities. Education upgrades the ability and changes the attitude of person in a given society. Educated farmers were expected to adopt new agricultural technologies and had better managerial skill. An attempt was made to assess the educational status of the sample households who had informal and formal education. In the study area, the average years of formal schooling of sample farmers were found to be 2.99 years with standard deviations of 2.46. The maximum educational achievement for the sample farmers was grade 12. From the total sample household heads, 53.3% of the total sample household heads have attended formal level of schooling. Total numbers of individuals within the household determine the availability of labor power needed in the farm production. Family labor plays an important part in the success of a small- scale farming practices in that the farmer does not need to spend

too much money on labor costs. In the study area, average household size for the sample farmers was about 4.31 adult equivalents per household. The largest household size was being 8.9 while the smallest size was 1.7 adult equivalents per household with standard deviation 1.49.The average size of total cultivated land, area under vegetable cultivation, vegetable production experience, distance to cultivated land, livestock size and income of the respondent were 1.28, 0.41, 13.43, 4.94 and 18293.64 respectively.

Table 1: Summary statistics of continuous variables

Variables	**Mean**	**SD**	**Min**	**Max**
Age	47.28	11.99	23	72
Education	2.99	2.46	0	12
Family size (adult equivalent)	4.31	1.49	1.7	8.9
Farm size	1.28	0.78	0.25	2.5
Area under vegetable cultivation	0.41	0.32	0	1
Vegetable production experience (years)	13.43	0.92	2	18
Distance to CL	2.49	1.65	1	6
TLU	4.94	3.39	0	18.35
Income	18293.64	13663.75	1500	3900

Sours: Own survey, 2021

Descriptive Analysis of Discrete Variables

This section also presents different discrete variables like sex of the household head, farmer to farmer extension, access to information, labor shortage, credit utilization, off/nonfarm activity. It is summarized in the following table following the possible explanation.

The survey result indicated that 16.75 percent of households are female-headed. It is understood that female-headed households face greater challenges in the agricultural production and marketing compared with their male-headed counterparts. This is due to the fact that female household heads in the rural Ethiopia hold various tasks including collecting of fire wood from the field, fetching water, childrearing and household management obligations. In addition, they have farm management tasks that increase the burden. Such multiple tasks combined with less resource accesses and ownership lead to more frequent and perhaps severe economic and social shocks particularly poverty and food insecurity. In order to give effective extension service to the farmers, the region assigned three DAs in each *Kebele*. The DAs are graduates of different ATVET colleges specializing in three agricultural streams such as, crop production, animal husbandry and natural resource management. In this study, 89.34% of the sample respondents reported that they have been receiving extension services about vegetable production. As indicated in Table 2, from the total sample households, 65.74% of the respondents' reported labor shortage as a problem while 34.26% of them reported labor shortage was not a problem. Access to credit is one way of improving farmers' access to new production systems in which agricultural output increases. Farmers who have access to credit can minimize their financial constraints and buy inputs more readily. The results of credit use indicate that out of the farmers

surveyed 52.54% had obtained credit from formal institution. Of the total households surveyed only 37.56%, of the respondents reported that they have engaged in off/nonfarm activities and the rest 62.44% were not.

Table 2: Result of descriptive analysis of discrete variables

Variables		**N**	**%**
Sex	Female	66	16.75
	Male	328	83.25
	Total	394	100
Extension service	No	42	10.66
	Yes	352	89.34
	Total	394	100
Access to information	No	69	17.51
	Yes	325	82.49
	Total	394	100
Labor Shortage	No	135	34.26
	yes	259	65.74
	Total	394	100
Credit Utilization	No	187	47.46
	Yes	207	52.54
	Total	394	100
Off/nonfarm Activity	No	246	62.44
	Yes	148	37.56
	Total	394	100

Sours: Own survey, 2021

Perceptions of Sources of Risk and Risk-Taking Ability

Understanding farmers' perceptions of risk allows us to identify risk-aversion levels and suggest the most appropriate management strategies. Farmers' perceptions of risk-taking ability were categorized by the different facets inherent in agricultural activities: crop production, marketing of crops, and finance and investment, in addition to a category capturing general risk-taking ability. In a series of four questions, respondents were asked to rate on a scale of 0 to 10 how willing they are to take risks in the aforementioned categories (Fig. 1). All respondent's answers were then averaged to determine the average score of self-perceived risk-taking ability as shown here.

The highest average score, representing the greatest level of risk-taking ability, was risk-taking in finance and investment. The lowest average score, representing the lowest level of risk-taking ability, was general willingness to take risks. This is interesting since it would be expected that general risk-taking ability would fall somewhere near the average of the three other categories. It is possible the three specific categories scored higher because they are areas in which respondents are well versed and have a good understanding of the relevant risks. This may likely explain why the scores for production and marketing are higher than general risk-seeking.

However, since it is generally assumed that financial literacy is low among the rural poor, it might be expected that rural farmers would be most adverse to financial and investment risks. Therefore, it is surprising to see that growers responded to being most open to taking risks in finance and investment as they are likely to have less familiarity and exposure to the associated risks. Furthermore, despite the substantial difference in farm size and income between respondents, no notable difference was identified in the perceptions of farmers towards risk. This suggests farmer perceptions towards risk are not dependent on farm size or income farmers.

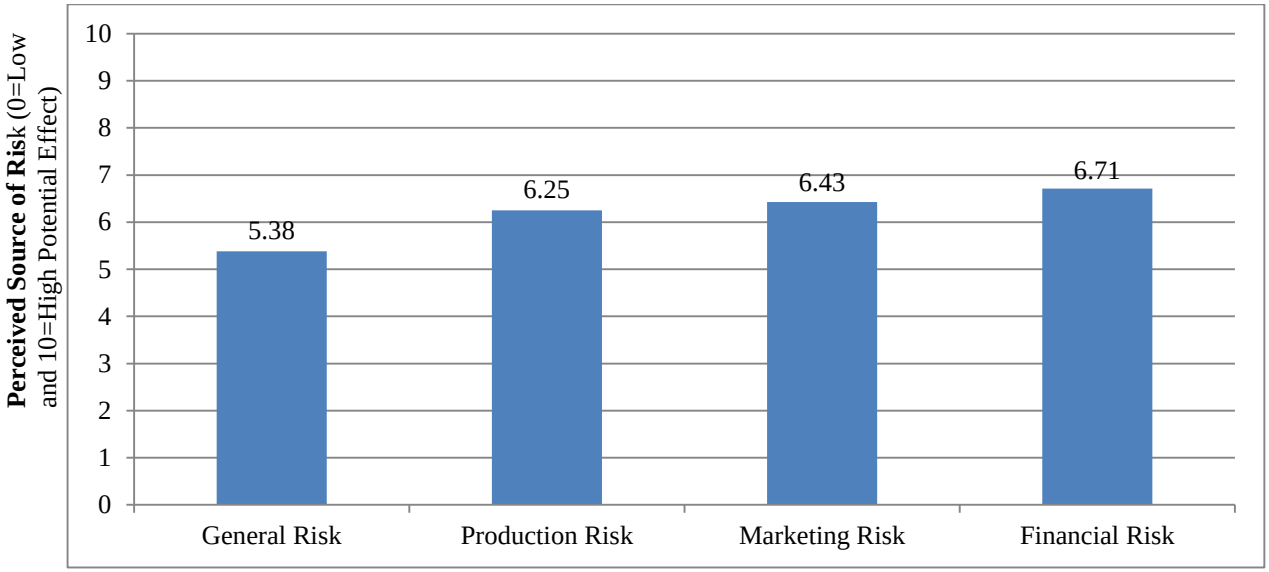

Figure 1. Self-Perceived Risk-Taking Ability. Average scored response of vegetable growers pertaining to risk-taking ability in agriculture as determined by four questions ascertaining degrees of risk-taking (where 0=Not Risk-Seeking at All and 10=Very Risk-Seeking).

Growers in north eastern Ethiopia face risks on several fronts. Therefore it was important to capture potential risks faced and the degree to which these risks are a concern to growers. Realizing the most critical risk sources will enhance our ability to recommend applicable strategies to mitigate these risks. Assessing discontinuities between areas of risk-taking ability and actual risks faced is another important reason why this information is important to gather. If a misalignment of risk-taking ability and risks exists, then management and training practices will be of even greater importance to bring awareness and action in alleviating these risks. Twenty sources of risk were considered in the questionnaire in order to ascertain the most burdensome risks growers encounter. Respondents were asked to score their perception of these nineteen sources of risk on a scale of 0 to 10 in terms of their potential to affect farm income. Scores from all respondents were averaged and reported in categories grouped by related source of risk: price, production, financial, marketing, and personal risks (Fig. 2).

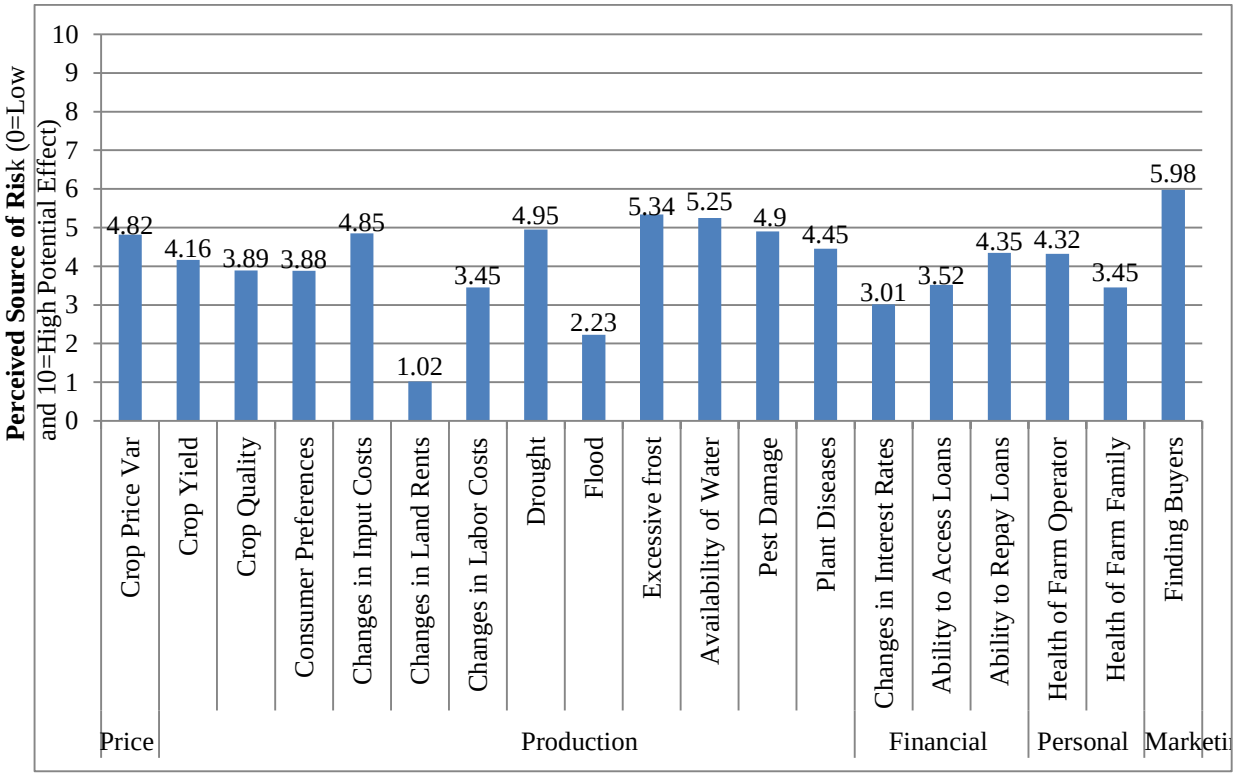

Figure 2. Perceived Sources of Risk to Vegetable Farming

Sources of risk that received an average score of 5 or above with the inclusion of their standard error were considered highly relevant risks and those falling below five were considered irrelevant. Farmers perceived the most relevant sources of risk to be finding a buyer (score 5.98) and excessive frost (score 5.34). Other relevant sources of risks included: availability of water (score 5.25), drought (score 4.95), pest damage (score 4.90), and changes in input costs (score 4.85). These risks mainly pertain to extreme weather events likely to worsen in north eastern Ethiopia as climate change brings higher temperatures to the area for longer periods of time as well as exogenous prices the growers cannot affect as price-takers. Finally, other relevant sources of risk include: crop price vary (score 4.82), plant diseases (score 4.45), ability to repay loan (score 4.35), and health of farm operator (score 4.32). It is interesting to note that crop yield as a risk source is lower than many of the sources that directly cause crop loss. The remaining nine risk sources were deemed irrelevant. Interestingly, it seems that financial sources of risk were viewed as irrelevant, potentially due to the inability of producers to access financial resources. Whereas, growers stated they would be most willing to take risks associated with finance and investment. Perhaps growers are more willing to take risks in this area as the available set of financial risks are likely to significantly alter income levels. From these results, it seems that the highest scoring sources of risk centre around frequently faced exogenous factors associated with both production and marketing such as weather, pests, price volatility, and

transaction costs. Understanding these results will help to inform the appropriate risk management strategies to incorporate.

Current Engagement with Risk Management Strategies

This section details the current usage of each risk management strategy. It is important to understand what strategies are currently being leveraged and their availability to growers. Additionally, we seek to identify if growers rely heavily on traditional risk management strategies or if there is local institutional capacity for alternative risk management strategies. Respondents were asked to state whether or not they currently engage in each of 11 risk management strategies. Table 5 below displays the current use of these strategies.

Table 3: Current Engagements of Vegetable Growers with 11 Risk Management Strategies

No.	Risk Management Strategies	Engagement in Risk Management Strategy (%)
1	Vegetable Diversification	97%
2	Enterprise Diversification	81%
3	Off-farm Work	53%
4	Producer Group	42%
5	Social Networks	39%
6	Formal Credit Institutions	30%
7	Savings Group	25%
8	Precautionary Savings	18%
9	Contract Farming	11%
10	Crop Insurance	9%
11	Inventory Credit System	0

All respondents were pre-selected on the basis of vegetable production and therefore it comes as no surprise that 100% of respondents grow a diverse set of vegetables as vegetables can be highly seasonable, forcing growers to plant different varieties to provide year-round income. Enterprise diversification has also been adopted by 80% of respondents. Enterprise diversification mainly came in the form of rice production or the raising of poultry, fish, or ruminants both for income and family consumption. Respondents had moderate engagement with the traditional risk management strategies of off-farm work, and social networks, while having low engagement in precautionary savings. Respondents listed lack of access to savings and capital or an inability to repay loans as the primary reason for not engaging in these strategies. In terms of alternative risk management strategies, respondents had moderate engagement in producer groups and formal credit institutions, and low engagement in savings groups and contract farming. Respondents primarily stated that these alternative strategies were unavailable to them and secondarily stated unawareness of these strategies. The use of inventory credit systems and crop insurance is non-existent as these risk management tools are currently unavailable to growers. While many of the alternative risk management strategies currently have

low engagement rates, attitudinal assessments should be conducted to determine if usage rates would change if these strategies were made available.

Attitudes towards Risk Management Strategies

We seek to understand the attitudinal assessments of risk management strategies by growers to allow insights into their current awareness and receptiveness of these strategies. If levels of awareness are low while interest and comfort in using the strategy are high, farmer trainings can be leveraged in order to facilitate understanding of the strategy. Additionally, it would be evident that those receptive to adoption while displaying low levels of awareness may be more likely to adopt the strategy if it is made aware and available to growers. Respondents' average attitudinal assessments of risk management strategies are displayed below in table 4. In terms of awareness of strategies, results are grouped into clusters of high, moderate, and low levels of awareness. The high awareness cluster includes vegetable diversification and enterprise diversification which received average scores of 6.1 and 5.6 respectively.

As these strategies had the highest levels of engagement it is not surprising to see this result. The moderate awareness cluster ranged from 3.5-4.5 and includes the traditional risk management strategies of off-farm work, precautionary savings, and social networks. The moderate awareness cluster also included the alternative risk management strategies of contract farming, savings groups, and producer groups. The low awareness cluster ranged from 1-3 and includes the alternative strategies of formal credit institutions, crop insurance, and inventory credit systems. It is not surprising to see formal credit institutions in the low awareness cluster as its use is rather low and it is viewed as the riskiest strategy.

Crop insurance and inventory credit systems likewise are not offered at all which also explains their low awareness. It is surprising to note that savings groups and precautionary savings were in the low awareness cluster. It is likely that survey respondents did not have access to financial tools such as savings accounts and indeed it seems that growers rarely have savings in the first place. However, the idea of setting some money aside for hard times does not appear to be something they actively engage in. Savings groups had a rather low level of use according to survey respondents but it is surprising to see the level of unawareness of this strategy. Several growers responded that they did not belong to a savings group but knew that groups existed nearby.

Table 4: Attitudes toward Risk Management Strategies

No.	Risk Management Strategies	**Attitudes toward Risk Management Strategies**		
		Awareness	Interest	Comfort
1	Vegetable Diversification	6.1	7.2	7.7
2	Enterprise Diversification	5.6	6.1	6.4
3	Off-farm Work	4.4	4.6	49
4	Producer Group	4.0	5.7	6.3
5	Social Networks	3.6	2.3	2.6
6	Formal Credit Institutions	3.0	2.4	2.4
7	Savings Group	3.4	4.5	5.1
8	Precautionary Savings	3.7	4.5	4.9
9	Contract Farming	4.2	5.9	6.0
10	Crop Insurance	1.3	4.1	4.6
11	Inventory Credit System	1.7	4.9	5.3

Interest in risk management strategies can again be grouped into high, moderate, and low interest clusters. The high interest cluster ranges from 6.5-7.5 and includes the traditional strategies of vegetable diversification and enterprise diversification as well as the alternative strategies of contract farming and producer groups. High interest levels in contract farming and producer groups are unsurprising as they are actively being implemented in these communities. The moderate interest cluster ranges from 4.0-5.0 including the traditional strategies of off-farm work, precautionary savings and the alternative strategies of inventory credit systems, crop insurance, and savings groups. Inventory credit systems and crop insurance both exhibit the highest difference in awareness and interest (3.2 and 2.8 respectively) suggesting these strategies may have high adoption rates if implemented. Finally, the low interest cluster ranges from 2.0-2.5 and includes social networks and formal credit institutions suggesting to adverseness to loans and indebtedness.

Perceived comfort follows a very similar pattern with interest in risk management strategies. The high comfort cluster ranges from 6.0-8.0 and includes vegetable diversification, enterprise diversification, producer groups, and contract farming. Vegetable and enterprise diversification have the highest levels of engagement so it is unsurprising to see that growers are comfortable in using them. Producer groups and contract farming are the two alternative strategies that have been presented to farmers with active implementation. The middle comfort cluster ranges from 3.0-5.5 and includes inventory credit systems, savings groups, off-farm work, precautionary savings, and crop insurance. Again the difference between awareness and comfort in inventory credit systems and crop insurance are larger than any other strategy, suggesting high adoption if these strategies are made available to growers. The low comfort cluster ranges from 2-3 and is made of up of social networks and financial credit institutions, just as in the interest category. The vegetable diversification strategy perceived by the farmers is in line with the view of multifunctionality. The motivation for vegetable diversification is laid in the idea of higher returns and management of risk and uncertainty. It has been found that the primary objective of many farmers was to increase the households' income, as scored by high mean value of 4.08 (Table 5). Many farmers perceived vegetable diversification to be a source of generating

offseason income (mean 3.26) and employment (mean 3.84). Further, vegetable diversification was being adopted not only for a change in cropping pattern (mono- to multi-cropping) but also, often more importantly, for meeting the consumption demands (mean 4.05). The drastic increase in annual income has been accompanied by demand for diet diversification towards vegetables, as well as for better quality processed food products. Most of the farmers who were facing irrigation constraints have adopted vegetable diversification to replace water loving crops by water-saving crops (mean 3.42). Maintaining soil fertility was also one of the reasons for adopting vegetable diversification (Table 5).

Table 5. Farmers' perceived motivations to vegetable diversification

Reasons	Mean	SD
Generate additional income	4.08	0.72
Production of high-value vegetables in place of low-value vegetables	4.05	0.84
Generate off-season income	3.26	1.36
Employment during off-season	3.84	0.86
Change from mono-cropping to multi-cropping	3.60	1.07
Processing and value addition	3.08	1.26
Water-loving crops to water-saving vegetables	3.42	1.13
Maintain soil fertility	3.58	1.13
Increased benefits due to high demand of produce	4.05	0.82
Due to climate change	3.46	1.13

CONCLUSIONS AND RECOMMENDATIONS

The existing vegetable sector in Ethiopia is underdeveloped and poorly managed, and prone tobe affected by exogenous shocks. The Ethiopian government is trying to assist local growers to access more of the domestic market and take advantage of this perception and window of opportunity before production standards in neighbouring countries improve and production costs decrease. However, Ethiopian vegetable growers are exposed to exogenous production, market, and personal shocks that can greatly impact yields, prices, and incomes of these smallholder operations and it necessary to examine current and potential risk management strategies to properly safeguard vegetable growers and secure long-term economic self-sufficiency.

This study examined attitudes towards, knowledge and use of eleven traditional and alternative risk management strategies in order to determine which practices are under-utilized, have the potential for high rates of adoption, can increase grower income, and induce farmers into transitioning into vegetables production. We find the implementation of producer groups and savings groups will allow growers to decrease input costs, increase economies of scale, promote information-sharing and problem-solving, and offer greater financial savings and access. The employment of contract farming and crop insurance are low-hanging fruit in that they are used infrequently as few channels exist for farmers to assess these risk management strategies.

We also recommended that the government of Ethiopia develops a crop insurance program that subsidizes insurance for growers and makes coverage affordable to farmers. Additionally, it is necessary to establish an environment that promotes business opportunities where producers and marketers can coordinate and streamline production of safe-vegetables. These directions will likely increase the use of contract farming, reduce production risks and positively impact vegetable growers. The Ethiopian government can simultaneously achieve its goal of meeting domestic vegetable demand while increasing grower incomes and reducing poverty, and thus increase social welfare overall.

The study has also revealed that the annual growth in production of high-value crops, viz. fruits, vegetables along with livestock products, has increased to augment income and manage risks and uncertainties. Cultivation of high-value crops involves risks and uncertainty due to high resource requirement and high perishability. Thus, farmers' adoption of crop diversification practices requires a favourable environment that fulfils resource requirements and effective policy support for reducing their risks. It has been found that farmers have developed coping strategies to face the constraints they encounter in crop production. Public intervention can facilitate better risk management through improved information system, development of financial markets and promotion of market-based price and yield insurance schemes, thus ensuring that the marginal farmers are able to benefit from these interventions as well as participate in the emerging system.

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