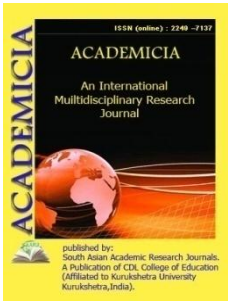
ACADEMICIA

ISSN: 2249-7137 Vol. 11, Issue 10, October 2021 Impact Factor: SJIF 2021 = 7.492

ACADEMICIA
An International Multidisciplinary Research Journal
(Double Blind Refereed & Peer Reviewed Journal)




**DOI: 10.5958/2249-7137.2021.02342.9**

# COMPARATIVE ANALYSIS OF RISK PERCEPTION AND RISK MANAGEMENT STRATEGIES AMONG VEGETABLE GROWERS IN PUNJAB STATE, INDIA AND NAKURU COUNTY, KENYA

**Carolyne Cherotich*; Dr. Manmeet Kaur****

[1,2]Punjab Agricultural University,
Punjab, INDIA
Email id: ronohcarolyne@gmail.com, manveerkaur@pau.edu

**ABSTRACT**

*Vegetable growers are faced with wide range of risks that have to be managed, especially in developing nations. The risks are on a trajectory due to rise in trading of agricultural produce globally, ravages of climate change and emerging pandemics that jeopardise vegetable production enterprises. This study presents results of an investigation into risk perception by vegetable growers in two regions; Punjab State, India and Nakuru County, Kenya. Few studies have carried out a comparative investigation across two regions touching on risk perception among vegetable growers, risk management strategies adopted and barriers that prevent successful mitigation of the risks. Using descriptive and inferential statistics, data from 200 respondents was analysed and market risks was ranked as the leading source of risks. Improved agricultural practices was the main risk management strategy employed by (77%) of the growers in Punjab and (79%) in Nakuru. (63%) of growers in Punjab and (62%) in Nakuru also used market survey as a strategy. Lack of information on pests and diseases (53%), marketing challenges (50%) and lack of access to extension services (31%) were the major barriers to risk management strategies among vegetable growers in Punjab; compared to lack of access to capital (57%), lack of information on plants and diseases (47%) and lack of access to extension services (27%) in Nakuru. This study seeks to provide an understanding to existing risk challenges and suggest areas of improvement to support efforts for risk management and reduction.*

**KEYWORDS:** *barriers, risk, risk management strategies, risk perception, risk sources.*

## 1. INTRODUCTION

Vegetable cultivation among small scale farmers has a key role in agricultural productivity. It has the potential to improve the social and economic condition of small scale and marginal farmers compared to other crops since its cultivation is considered to result in higher yields and higher economic returns within a short period of time (Mohammad et al., 2020). Vegetable production however occurs in highly variable biological, physical and economic conditions, mostly characterised by lots of uncertainty misfortune and loss (Harwood *et al* 1999; Huirne, 2003). This results from natural calamities and catastrophic events (Veber 2014); biotic factors such as diseases and pests (Anastacia *et al* 2011; Toroitich *et al* 2014; Wright *et al* 2016); technological changes, regulations and social concerns and also human factors (Belaineh& Lars, 2005). It is therefore necessary that growers recognize the risks involved in the vegetable cultivation so as to easily plan for their prevention and management (Drollette 2009).

Farmers generally make decisions on the basis of expectations, projections, and even on the basis of what they fear or hope is possible (Patt, 2001). Risk sources for vegetable growers should be understood in order to develop action plans towards crop management and adaptive systems. To understand how vegetable growers make decisions in risky and uncertain conditions, an analysis of their perception and reaction in risky situations is of utmost importance. Farmer perception on risk source and the subsequent response have bearings on the type of intervention strategies that would be considered across households and ecosystems (Sjoberg, Moen, and Rundmo, 2004; Váchal et al. 2013; Veber 2014).

India is ranked as the second highest vegetable producer in the world after China (Nasim, Sinha *et al* 2018). It has witnessed a rise of 59-61percent in the overall horticultural production sector and an annual 2-3 percent increase in demand (Govil, 2013; Sinha *et al* 2018). The ripple effect of the expansion in vegetable production has brought about an ensuing increase in vegetable cultivation in Punjab State; from an initial area of 100 thousand to over 208 thousand hectares, and a production of 168502.90 thousand metric tonnes per hectare (Anonymous 2016; Nair and Barche, 2014).

Vegetable production in Kenya has also continued to grow at an average annual rate of 5.11 percent (KENDAT, 2015), with over 90% production by small scale farmers and with a 96% local consumption (KNBS, 2019, FPEAK, 2021). The impressive growth has witnessed a consequent increase in vegetable production performance in Nakuru County, mostly for export farmers, while leaving out a vast majority of small scale growers ( Francesco and Hanne, 2019).

The increase in vegetable production in the two regions can be attributed to changing habits and need for a diversified nutrition, use of the latest technology, availability of technical training and easier access to markets (Hazell et al 2007; Kadenyi, 2017; FPEAK, 2020).Despite the apparent remarkable achievement in production of vegetables, the increase in supply has not met the ever-increasing demand due to several challenges in cultivation (Aseto et al.,, 2020; Sunny & Sanjay, 2019). Vegetable production is at a point of stagnation in Punjab due to depleted water levels, decreasing land holdings, multiplication of insects and diseases (Singh, 2017); while in Nakuru, high dependence on rainfall patterns for production and harvesting cycles; small landholdings; a lack of the necessary knowledge and skills among most smallholder farmers, poorly organised marketing system has introduced an aspect of unreliability in production (AGRA, 2017; WFP,

2015; Aseto et al., 2020). There is need therefore to address these challenges in order continue exploiting the ever increasing rise in demand.

## 2.0 REVIEW OF LITERATURE

Vegetable growers generally experience and cope with risks from different sources (Huirne, 2003). The risks can lead to adverse effects on production such as decrease in yield and income, financial ruin, famine and even farmer health challenges (Komarek et al., 2020). The dependence on rain fed agriculture, small sizes of land and lack of access to financial aid and technical information makes them highly vulnerable to risks from different sources including; weather and climate change risk (Greiner et al., 2008; Rejesus et al., 2013; Harvey et al., 2014; Schreinemachers et al., 2017; Harvey et al., 2018); market risk (Musser and Patrick 2002; Manek& Ghosh, 2019); institutional risk (Lien et al., 2003; Flaten et al., 2005); financial risk (Palinkas and Székely, 2008; Musser and Patrick 2002; Jain and Parshad 2006; Pelka, 2015); production risk (Goodwin and Mishra 2000; Holt &Chavas 2002; Anju, 2017); human risk (Dercon et al., 2005) and bio-security threats (Heymann 2005; FAO, 2013). These risks can simultaneously affect a farmer, thus showing a need for in-depth efforts to address them because risks can be a barrier or a trigger for growth and expansion in vegetable production (Marra*et al* 2003).

Risk perception is the subjective evaluation of the chances of a specific type of misfortune occurring; and the level of preparedness for the outcome (Sjoberg, Moen, and Rundmo, 2004). Risk source perception aids in quantification of the negative and positive variations from planned outcomes (Váchal et al. 2013; Veber 2014); and also aids in prevention and management of potential risk (Harwood, Heifner, Coble, Perry &Somwaru, 1999). It is critical to understand how vegetable growers perceive risk in order to develop and implement programs and policies that support their management (Greiner et al. 2009). Research has shown that there is often a disconnect between risks which are perceived and the actual risks (Botterill and Mazur 2004); that the aim to change behaviour does not always lead to actual change in behaviour regardless of an individual's risk assessment and risk perception (Niles *et al* 2016). Menapace*et al* (2015) also shows that the mental acceptance of existence of a risk factor; such as a first-hand experience with crop loss gives an explanation as to why some farmers perceive risks more than others. Some farmers are also risk averse and perceive risks differently from those who are neutral (Sulewski and Kłoczko-Gajewska, 2014). It is therefore imperative that the two categories are considered when assistance in decision making is being provided. Farmers from different countries live within different agro-ecological and institutional conditions, which can have an influence on risk perception. There is therefore need to establish whether risk perception differs based on vegetable growers' domicile.

Strategies related to risk reduction and risk transfer can significantly augment vegetable farmers' capacities to with stand shock. This therefore makes early detection of risks and their effective management paramount (Jankelova, Masar, Moricova 2017). Choice of risk management strategies is often influenced by farmer socio-economic characteristics (Velandia*et al* 2009; Carer*et al* 2018; Ullah*et al* 2015; Tudor *et al* 2014); hence affecting the decision making on ways of mitigation (Palinkas and Szekely, 2008). Vegetable growers employ different management strategies ranging from simple practices at the farm level to legally bound ones

such as insurance and contracting (Lin, 2011; Gillespie and Mishra, 2011; Kisaka-Lwayo, and Obi, 2012). The suitability of the different coping mechanisms is at times of doubtful authenticity mostly due challenges of contextualisation. The current study therefore attempts to establish the suitability and authenticity of some of the risk management strategies among vegetable growers in two different regions.

There are a range of barriers to successful management of risks among vegetable growers. Literature shows that barriers differ based on whether the agri-enterprises are in developed or in developing nations (Legesse and Drake, 2005; Ilberyet al., 2013). Small scale vegetable growers can experience difficulty in their productive process due to lack of access to information and technical knowledge, financial challenges, and poor production technologies (Legesse and Drake, 2005; Mannon, S.E. 2005 ); hence limit their productive capacity.

## SIGNIFICANCE OF STUDY

While the existing literature has discussed different sources of agricultural risks for individual crops in different countries, those that cover individual crops in different countries in the context of agricultural risks, risk perception, risk management strategies and the barriers to the different strategies are few, if any. This study therefore seeks to fill this gap.

## OBJECTIVES/HYPOTHESIS

The aims of this study are, therefore, to (1) assess risk perception, risk management strategies and barriers among vegetable growers, (2) identify the socio-economic factors that affect vegetable growers' perceptions and management strategies. The hypotheses guiding the study are (1) there is a difference in risk perception; risk management strategies and barriers to management (2) socio-economic factors have no effect on perception among vegetable growers.

## RESEARCH METHODOLOY

### STUDY AREA

The study was conducted in two different countries, Punjab State in India (Fig. 1) and Nakuru County in Kenya (Fig. 2). The selected sites are among the leading areas for agricultural production both in India and Kenya and have embraced diversification into vegetable production (Singh et al 2009; Sharma et al 2014). They are areas with high vulnerability to weather shocks, large poor and vulnerable populations, and high dependence on rain-fed agriculture for Nakuru and high dependence on irrigation for Punjab.


**Fig.1 Punjab State (source2020 Government of Punjab)**

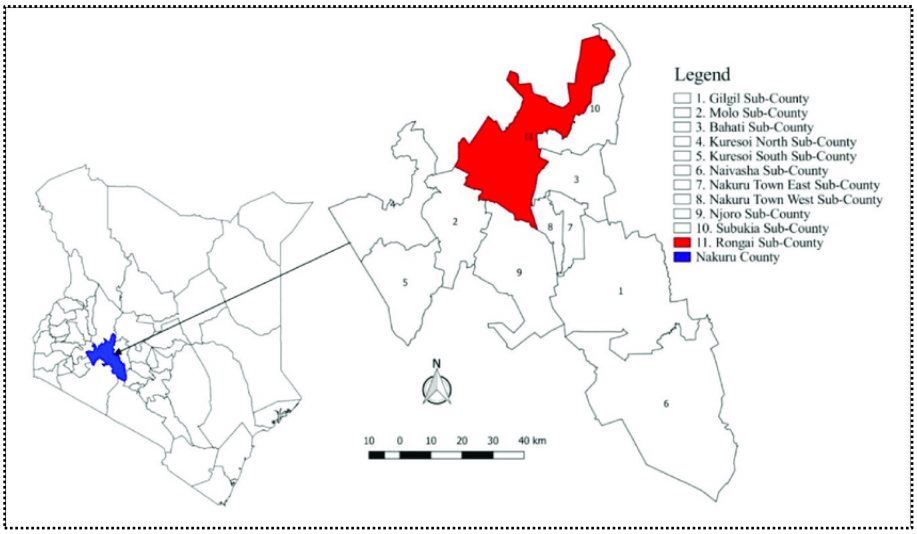



**Fig. 2: Nakuru County (Source; Kiplagat et al, 2020)**

## DATA COLLECTION AND DATA ANALYSIS

Semi-structured questionnaires were used to elicit vegetable growers' socio-economic characteristics, their risk perceptions, risk management strategies and barriers to management. The schedule had statements which were categorized into market risk, financial risk, production risk, institutional risk, human risk, weather and climate change risk and bio-security threats. Respondents' perceptions were to the risks were expressed in terms of a three-point continuum of critical, major and minor. Risk perception was categorized into critical, major and minor with a score of 3 for critical risks, 2 for major risks and 1 for minor risks. To calculate the scores, total points and maximum points were used. Friedman's test was used to find differences in rankings of the risk as perceived by the vegetable growers after it was established that the data met all requirements.

In order to document different strategies adopted by the farmers, thematic analysis of data was used to develop a list of eight strategies from qualitative data. These were then dichotomized into

a score of 1 if the respondent followed the strategy and 0 if the respondent did not follow the strategy. Multiple Response in SPSS was then used to calculate percentage number of cases for each choice. To calculate barriers to the different strategies, thematic analysis of data was used to develop a list of ten barriers from qualitative data. These were dichotomized into a score of 1 if the respondent faced the barrier and 0 if the respondent did face the barrier. Comparative analysis of socio-economic characteristics of the vegetable growers' in Punjab and Nakuru was done using Mann-Whitney u test. Multiple regression analysis of risk perception on socio–economic characteristics was also carried out after the data was found to have met the multiple regression assumptions.

## RESULTS AND DISCUSSIONS

### SOCIO-ECONOMIC CHARACTERISTICS

The sample population consisted of 200 farmers: 100 from Punjab and 100 from Nakuru. The findings were as shown in Table 1below. Majority of the farmers were middle age in Punjab (75%) as well as in Nakuru (61%). (100 %) were males in Punjab compared to (77%) in Nakuru. As regards education, (47%) of the respondents in Punjab had secondary education compared to (37%) in Nakuru; matrice level was (19%) in Punjab and (24%) in Nakuru; and, graduate level at (18%) in Punjab and (11%) in Nakuru. The highest percentage of the sample (66%) and (64%) in Punjab and Nakuru respectively had 10-20 years farming experience; while (72 %) in Punjab and (61%) in Nakuru had less than 10 years vegetable growing experience in farming. (64%) of the farmers in Punjab and (99%) of those in Nakuru operated farm sizes of less than 2.5 acres. (83%) of the growers in Punjab leased land for vegetable cultivation compared to (99%) in Nakuru. The income from vegetable sales was high in Punjab (82%) with farmers earning above 7 lakhs than in Nakuru where the majority (47%) earned below 4 lakhs. Majority of the vegetable growers in Punjab sold their produce to wholesalers compared to in Nakuru; while majority (44%) of the farmers in Nakuru sold their produce to retailers.

**TABLE 1. VEGETABLE GROWERS' SOCIO-ECONOMIC CHARACTERISTICS**

| S. No | Parameters | Category | Punjab (n=100) | | Nakuru (n=100) | |
|---|---|---|---|---|---|---|
| | | | *f* | *%* | *f* | *%* |
| 1 | **Age (years)**[#] | Young (18-30) | 24 | 24.0 | 26 | 26.0 |
| | | Middle (31-50) | 75 | 75.0 | 61 | 61.0 |
| | | Old (>50) | 1 | 1.0 | 13 | 13.0 |
| 2 | **Gender**[#] | Male | 100 | 100.0 | 77 | 77.0 |
| | | Female | - | - | 23 | 23.0 |
| 4 | **Level of Education**[#] | Illiterate | 6 | 6.0 | 1 | 1.0 |
| | | Primary | - | - | 16 | 16.0 |
| | | Middle | 9 | 9.0 | 11 | 11.0 |
| | | Matric | 19 | 19.0 | 24 | 24.0 |
| | | Secondary | 47 | 47.0 | 37 | 37.0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | Graduate | 18 | 18.0 | 11 | 11.0 |
| | | Post Graduate | 1 | 1.0 | - | - |
| 6 | **Vegetable growing experience#** | Low (< 10 years) | 72 | 72.0 | 61 | 61.0 |
| | | Medium (10-20 years) | 27 | 27.0 | 36 | 36.0 |
| | | High (> 20 years) | 1 | 1.0 | 3 | 3.0 |
| 7 | **Operational Land holdings (acres)#** | Marginal (<2.5) | 64 | 64.0 | 97 | 97.0 |
| | | Small (2.5-5) | 36 | 36.0 | 3 | 3.0 |
| | | Semi-medium (5-10) | - | - | - | - |
| | | Medium (10 -25) | - | - | - | - |
| | | Large (>25) | - | | - | |
| 8 | **Land leased for vegetables#** | Marginal (<2.5) | 83 | 83.0 | 99 | 99.0 |
| | | Small (2.5-5) | 16 | 16.0 | - | - |
| | | Semi-medium (5-10) | 1 | 1.0 | 1 | 1.0 |
| | | Medium (10 -25) | - | - | - | - |
| | | Large (>25) | - | - | - | - |
| 9 | **Annual income** | Low (< 4 lakhs) | 4 | 4.0 | 47 | 47.0 |
| | | Medium (4-7 lakhs) | 14 | 14.0 | 20 | 20.0 |
| | | High (>7 lakhs) | 82 | 82.0 | 33 | 33.0 |
| 10 | **Market Outlet#** | Direct consumers | 3 | | 28 | 28.0 |
| | | Retailers | 34 | 34.0 | 44 | 44.0 |
| | | Wholesalers | 84 | 84.0 | 37 | 37.0 |
| | | Exporters | 3 | 3.0 | - | - |
| | | Processors | - | - | 7 | 7.0 |
| | | Govt. Corporation | - | - | 1 | 1.0 |
| | | Cooperative society | - | - | 1 | 1.0 |
| | | Agrochemical Companies | - | | 34 | 34.0 |

**Data represented in frequency (percentages)*

**COMPARISON OF SOCIO-PERSONAL PROFILES OF VEGETABLE GROWERS IN PUNJAB AND NAKURU**

A comparative analysis of the socio-personal profilesof the vegetable growers was done to determine any there differences between the two regions. The results are shown in Table 2

**TABLE 2: COMPARISON OF VEGETABLE GROWERS IN PUNJAB AND NAKURU BASED ON THEIR SOCIO-PERSONAL PROFILES**

| S. No. | Socio-personal profile | *U* | *Z* |
|---|---|---|---|
| 1 | Age (years) | 4855.50 | -.354 |
| 2 | Gender | 3850.00 | -5.085** |
| 3 | Education Level | 3920.00 | -2.764** |
| 4 | Vegetable growing experience | 4427.00 | -1.705 |
| 5 | Operational Land Holdings (acres) | 3348.50 | -5.877** |
| 6 | Land leased for vegetables | 4476.50 | -1.511 |
| 7 | Annual Income (rupees) | 1613.00 | -8.529** |
| 8 | Direct consumers | 3844.00 | -4.625** |
| 9 | Retailers | 4232.00 | -2.188* |
| 10 | Wholesalers | 2742.00 | -6.505** |
| 11 | Exporters | 4841.00 | -1.082 |
| 12 | Processors | 4350.00 | -3.717** |
| 13 | Government Corporation | 4650.00 | -2.686** |
| 14 | Cooperative society | 4650.00 | -2.686** |

**Mann-Whitney u test* Note.* p<.05, ** p<.001

Age scores of vegetable growers in Punjab (*Mdn* =38) were equal to that of vegetable growers in Nakuru (*Mdn*=35). This shows that majority of the vegetable growers in the two regions fell into a category which was almost equal, which from Table 1 was found to be middle age group. Singh et al., (2006) and Mohammad et al., (2020) have also reported findings that majority of farmers in their studies fell into the middle age groups. The gender scores in Punjab (*Mdn* =1) were less than those for Nakuru (*Mdn*=1). A Mann-Whitney test indicated that this difference was statistically significant, ($U\ n_1=n_2= 100$ = 3850.00, $z$ = -5.085, $p<.001$).This is because there were no female respondents; thus collaborating previous observations by Munshi, (2020), Singh & Vinay (2013), Munmun&Arindam (2014), Bala, (2010) and Amekawa et al., (2021) that though several women are engaged in agricultural activities in Asia, a large number of them have remained "invisible" and are mostly not considered during decision making in farm activities. Comparatively, female vegetable growers in Nakuru was (23%), a figure which is quite low but supports reports by Anonymous (2014) that women in Kenya make up 46% to 65% in agriculture, but often play a subordinate role (Muriithi and Matz, 2014) mostly underpinned by customary laws (Otieno, 2019).

Education level for vegetable growers in Punjab (*Mdn* =5) differed significantly from that of vegetable growers in Nakuru (*Mdn*=4). A Mann-Whitney test indicated that this difference was statistically significant, ($U$= 3920.00, $n_1 = n_2 = 100$, $z$ = -2.764, $p<.001$). This shows that a higher percentage of vegetable growers in Punjab (66%) had secondary education and above compared to (48%) in Nakuru. The reasons for the lower percentage in Nakuru could be due to most people who have post-primary education moving out to other occupations (Lewin, 2007). The works of Adebayo (2012) and Mohammad et al (2020) have also found similar results that most of the small scale farmers possess higher education level. Vegetable farming experience did

not differ significantly, among vegetable growers inPunjab (*Mdn* =1) and Nakuru (*Mdn* =1), (*U*= 4427.00, $n_1 = n_2 = 100$, $z$ = -1.705, $p>.05$); however, several respondents had low vegetable growing experience. This can be attributed in Punjab to recent changes in farming patterns towards vegetable production as farmers diversify (Singh, 2017); while in Nakuru, it could be attributed to a negative perception of unprofitability in vegetable cultivation due to low farm gate prices; hence fewer farmers diversifying to vegetable production (Abdulai, Nimoh, Darko-Koomson, &Kassoh, 2017).

Operational land holding scores of vegetable growers in Punjab (*Mdn* =2) differed significantly to that of vegetable growers in Nakuru (*Mdn*=2), (U = 3348.50, $n_1 = n_2 = 100$, $z$ = -5.877, $p<.00$; compared to the distribution for land leased, of which there was no significant difference; Punjab (*Mdn* =0) and Nakuru(*Mdn* = 0), (*U*= 4476.50, $n_1 = n_2 = 100$, $z$ = -1.511, $p>.05$). This could be attributed to pressure on land and shrinking land sizes which pushes most to hold marginal farms; a condition far more prevalent in Nakuru than in Punjab. Lack of difference on the farm leased shows that majority of the farmers could be diversifying into vegetable production given their potential as a source of higher income (Mohammad et al., 2020; Joshi et al., 2003; Bashangwa et al., 2020, Mahajan, 2016). Farmers therefore resort to leasing more land to boost productivity.

Annual Income among vegetable growers in Punjab (*Mdn*=12) differed significantly from that in Nakuru (*Mdn*=6) (*U*= 1613.00, $n_1 = n_2 = 100$, $z$ = -8.529, $p<.001$)., where majority of the vegetable growers had an income of over 7 lakh compared to Nakuru where the majority earned an income below 4lakh from the vegetable sales. Navjot& Poonam (2014) have reported similar findings of higher income from vegetables in Punjab; while Kealeboga et al., (2017), and Muyanga & Jayne, (2014) reported similar in Kenya. Marketing of vegetables differed between the two countries. Vegetable growers in Punjab (*Mdn*=0) sale of produce to direct consumers, differed significantly compared to that of Nakuru (*Mdn*=0), (*U*= 3844.00, $n_1 = n_2 = 100$, $z$ = -4.625, $p<.001$); compared to sale to retailers, (*U*= 4232.00, $n_1 = n_2 = 100$, $z$ = -2.188, $p<.05$).Sales to wholesales also differed significantly for Punjab (*Mdn=1*), and Nakuru (*Mdn=0*), (*U*= 2742.00, $n_1 = n_2 = 100$, $z$ = -6.505, $p<.001$); compared to sale to exporters in Punjab (*Mdn=0*), and Nakuru (*Mdn=0*), (*U*= 4841.00, $n_1 = n_2 = 100$, $z$ = -1.082, $p>.05$); processors *in* Punjab (*Mdn=0*), and Nakuru (*Mdn=0*), ( $U$ = 4350.00, $n_1 = n_2 = 100$, $z$ = -3.717, $p<.001$); government corporations inPunjab (*Mdn=0*), and Nakuru (*Mdn=0*), (*U* = 4650.00, $n_1 = n_2 = 100$, $z$ = -2.686, $p<.001$); *and* cooperative societies in Punjab (*Mdn=0*), and Nakuru (*Mdn=0*), (*U* = 4650.00 , $n_1 = n_2 = 100$, $z$ = -2.686, $p<.001$). This shows that there is potential for market expansion to embrace processors and even export.

## VEGETABLE GROWERS' PERCEPTIONS OF RISK PERCEPTION

A summary of vegetable growers' perceptions of risks is presented below;

**TABLE 3: VEGETABLE GROWERS' PERCEPTIONS OF RISKS**

| S.NO | Punjab / Category | Risk perceived | Ranking | Nakuru / Category | Risk Perceived | Ranking |
|---|---|---|---|---|---|---|

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | Market risks | 6.17 | **1** | Market risks | 5.41 | **1** |
| 2 | Institutional Risks | 5.89 | **2** | Weather/ climate change risks | 5.12 | **2** |
| 3 | Weather/ climate change risks | 4.10 | **3** | Production risks | 3.85 | **3** |
| 4 | Financial risks | 3.80 | **4** | Financial risks | 3.58 | **4** |
| 5 | Production risks | 3.65 | **5** | Institutional Risks | 3.55 | **5** |
| 6 | Human Risks | 2.68 | **6** | Human Risks | 3.34 | **6** |
| 7 | Bio- security threats | 1.72 | **7** | Bio- security threats | 3.17 | **7** |
| | $\chi^2_{(6)}$=338.733 $p$<.05 | | | $\chi^2_{(6)}$=102.850 $p$<.05 | | |

Results of the Friedman's analysis indicated that there was a differential rank ordered perception for the seven sources of risks, $\chi^2_{(6)}$ =338.733, $p$<.05 in Punjab and in Nakuru $\chi^2_{(6)}$ =102.850, $p$<.05. The respondents perceived the most important risk factor both in Punjab and Nakuru as market risk (mean value 6.17 and 5.41 respectively), while the least was bio-security threats (mean value 1.72 and 3.17 respectively). The mean values for the other five risk factors were as follows; 5.89 (institutional risks) in Punjab and 5.12 (weather/climate change risks), in Nakuru; 2.2 (hail) and 2.6 (poor overwintering and spring frosts)

The results indicated that there were significantly more favourable rankings for market risks over all other risks in the two regions, similar to findings by Hardaker et al., (2015) and those from a global review on risk perception study by Duong et al., (2019) which revealed that 55% of the articles frequently mentioned market risks. There was also a highly significant difference in how participants evaluated sources of risks. Bio- security threats, though an emerging risks in agriculture is ranked last, a divergent view from findings by Waage& Mumford (2008) and Duong et al., (2019).

### 4.4 Influence of demographic characteristics on vegetable growers' risk perception

Results of multiple regression analysis on Table 4 revealed that the variables statistically significantly predicted market risk, F (9, 90) = 3.358, p <, .05, $R^2$ = .251 with one variable (operational landholdings) statistically adding significantly to the prediction, p < .05 in Punjab. For Nakuru, the variables also statistically significantly predicted market risk, (F (10, 89) = 5.362, p <, .05, $R^2$ = .376, p < .05), with two variables (age and land leased) adding statistically significantly to the prediction. The socio personal variables in Punjab did not statistically significantly predict financial risk (F (9, 90) = 0.625, p 0.773, $R^2$ = 0.059), whereas in Nakuru, the variables statistically significantly predicted financial risk (F (10, 89) = 2.139, p .029, $R^2$ = .194, p < .05), with two variables (age, land leased) adding statistically significantly to the prediction.

The variables also did not statistically significantly predict production risk F (9, 90) = 0.331, p 0.963, $R^2$ = 0.032 in Punjab, while in Nakuru the variables statistically significantly predicted production risk (F (10, 89) = 3.963, p .000, $R^2$ = .230, p < .05) with two variables (age and land leased) adding statistically significantly to the prediction. The socio-economic characteristics did not statistically significantly predict institutional risk (F (9, 90) = 1.070, p 0.392, $R^2$ = 0.097) compared to Nakuru where the variables statistically significantly predicted institutional risk (F (10, 89) = 4.150, p .000, $R^2$ = .318, p < .05). Only two variables (age and land leased) added statistically significantly to the prediction.

The socio-economic variables statistically significantly predicted human risk in Punjab (F (9, 90) = 2.482, p .014, $R^2$ = .199) and Nakuru (F (10, 89) = 2.508, p .011, $R^2$ = .220, p < .05) with one variable (age) adding statistically significantly to the prediction in Punjab and two variables (family size and operational land) adding statistically significantly to the prediction in Nakuru. The variables did not statistically significantly predict climate risk (F (9, 90) = 541, p .841, $R^2$ = 0.051) in Punjab whereas they significantly predicted climate risk (F (10, 89) = 2.711, p .006, $R^2$ = .234 p < .05) in Nakuru, with only one variable (land leased for vegetables) adding statistically significantly to the prediction. The socio personal variables did not statistically significantly predict biosecurity risk both in Punjab (F (9, 90) = .541, p .841, $R^2$ = 0.051) and in Nakuru (F (9, 90) = 1.596, p .121, $R^2$ = 0.152).

Similar findings on age and land significantly predicting perceived risks have been made by Kisaka-Lwayo& Obi (2012) and Nmadu et al., (2012); which significantly differs from those of Borges & Machado (2012) who found that age did not significantly affect farmers' risk perceptions in Brazil.

**TABLE 4: RISK PERCEPTION-MULTIPLE REGRESSION ON SOCIO-PERSONAL VARIABLES OF VEGETABLE GROWERS**

| S. No. | Source of Risk | Punjab | | | Nakuru | | |
|---|---|---|---|---|---|---|---|
| | | $R^2$ | *d.f.* | *F, α* | $R^2$ | *d.f.* | *F, α* |
| 1 | Market Risks | 0.251 | (9,90) | 3.358, <.05 | .376 | (10,89) | 5.362, <.05 |
| 2 | Financial risks | 0.059 | (9,90) | 0.625, 0.773 | .194 | (10,89) | 2.139, 0.029 |
| 3 | Production risks | 0.032 | (9,90) | 0.331, 0.963 | .308 | (10,89) | 3.963, <.05 |
| 4 | Institutional risks | .097 | (9,90) | 1.070, 0.392 | .318 | (10,89) | 4.150, <.05 |
| 5 | Human risks | .199 | (9,90) | 2.482, 0.014 | .220 | (10,89) | 2.508, .011 |
| 6 | Climate risks | .051 | (9,90) | 0.541, 0.841 | .234 | (10,89) | 2.711, .006 |
| 7 | Biosecurity risks | .098 | (9,90) | 1.088, .380 | .152 | (10,89) | 1.596, .121 |

**Multiple Regression*

**Comparison Of Vegetable Growers Based On Risk Management Strategies**

From the results, majority of vegetable growers in Punjab (77%) and Nakuru (79%) used improved agricultural practices as their risk management strategies, similar to findings by Jin et al., (2015) and Chang & Tsai (2015). Market survey was used by (63%) in Punjab and (62%) vegetable growers in Nakuru. Search for information on diseases, pests and new agricultural technologies proved to be another popular strategy with (17%) vegetable growers in Punjab and Nakuru (27%) engaging in it. Crop diversification, credit facilities as well as crop insurance turned out to be the least used strategies with (4%), (3%) farmers using the first two respectively; while (4%) , 15% and (3%) used these strategies in Nakuru.

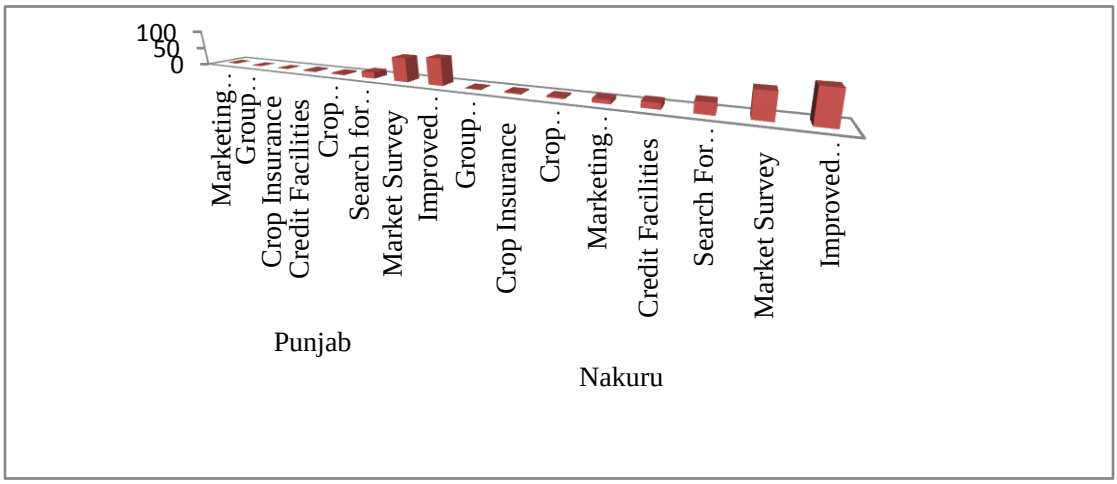



**Fig. 1 Distribution of vegetable growers on basis of risk management strategies**

## BARRIERS TO PERCEIVED RISK MANAGEMENT STRATEGIES

Lack of information on pests and diseases (53%) was the major barrier in Punjab followed, by marketing challenges (50%), lack of access to extension services (31%), lack of access to capital (4%), land fragmentation (1%) and post-harvest challenges (1%). In Nakuru, the majority of vegetable growers experienced barriers from lack of access to capital (57%), lack of information on plants and diseases (47%), lack of access to extension services (27%), marketing challenges (26%), use of conventional farming practices (18%), high production costs (14%), harsh weather (5%), land fragmentation (3%), post-harvest challenges (3%) and labour (2%). Studies which have identified almost similar barriers include Baruwa et al., (2015); Panneerselvam et al., (2011); Harvey et al., (2014), and Ullah, Shivakoti& Ali (2015).

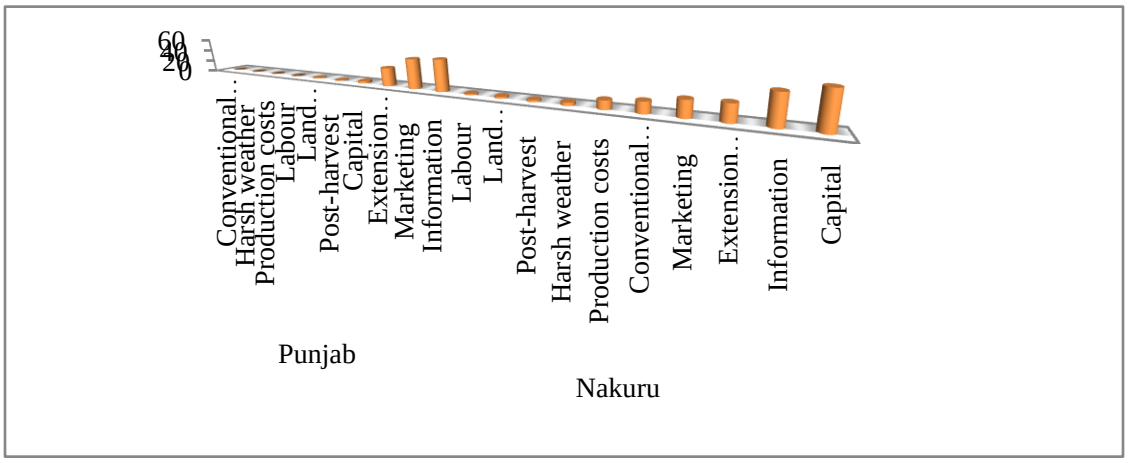



**Fig. 2 Distribution of vegetable growers on basis of barriers to risk management**

## FINDINGS AND RECOMMENDATIONS

Results obtained in this paper have established that vegetable growers from the two regions have almost similar socio-economic characteristics, risk perception and approach to risk management. Vegetable growers still face immense marketing challenges and mostly rely on improved agricultural practices to counter the risks faced. The findings have important implications to policy makers because they reveal the need for new technological innovations to improve agricultural practices; strengthening of marketing services and greater access to extension services. New ideas in risk management strategies such as crop insurance, crop diversification, and marketing contracts are yet to take hold among the vegetable growers. On the basis of this study, it is suggested that it is important to continue supporting current smallholder vegetable growers' ways of managing risk even as the novel ideas through crop insurance, crop diversification and use of market contracts are explored. One way of support could be through strengthening of extension services and access to more information on vegetable cultivation.

## ACKNOWLEDGEMENTS

The authors wish to thank the vegetable growers, personnel of the Ministry of Agriculture in the two countries and the enumerators who were actively involved in the research process.

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