

Farmers' Perception on Risks in Fruits and Vegetables Production: An Empirical Study of Uttar Pradesh*

Jabir Ali and Sanjeev Kapoor*

Centre for Food and Agribusiness Management, Indian Institute of Management,
Lucknow - 226 013, Uttar Pradesh

Abstract

The perceptions of farmers about risks in production of fruits and vegetables have been analysed using structured survey method. The study is based on the survey of a total of 634 farmers, comprising 188 fruit farmers and 446 vegetable farmers, covering six districts of Uttar Pradesh, namely, Lucknow, Allahabad, Gorakhpur, Moradabad, Jhansi and Agra. The perceived priorities of farmers about major sources of risks in production of fruits and vegetables have been reported under 'investment risks', 'socio-economic risks', 'environmental risks', 'production risks' and 'market risks'. In general, the price and production risks have been perceived as the most important sources of risk in production of fruits and vegetables in the area. The study has argued that 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 systems.

Introduction

Agriculture is the dominant economic activity in the state of Uttar Pradesh. The state has experienced rapid structural changes in the process of economic development. The demographic changes along with improving infrastructures, have inflated land values and crop prices, a trend which has converted agriculture into a potentially highly profitable enterprise. Many researchers have reported about the gradual transformation of farmmen into business-men; they have specialized, developed more efficient managerial techniques and utilized the total resources on their farms more intelligently. The transition in agriculture is also

accompanied by globalization of the marketplace, adoption of technological advances and expansion of government policies designed to support agriculture.

Agricultural diversification in the state is highly intensified towards fruits and vegetables production, associated with diversification of diet, meeting the changing domestic market demand and increasing the export potential. Cultivation of fruits and vegetables crops has made rapid strides over the past two decades and has been one of the most rapidly expanding sectors of the state agriculture. The resultant diversification which is due to favourable agro-climatic conditions suitable for cultivation of a wide range of fruits and vegetables, offers a higher income-generating strategy to a large number of marginal farmers of the state (75.6% of the state operational landholdings account for marginal farmers). The state is the second largest horticultural producer in the country, with 11.16 per cent contribution to the national horticultural production

* Author for correspondence, Email: sanjeev@iiml.ac.in

* The paper is based on the primary data collected under an ongoing research project entitled "Demand Assessment of Horticultural Commodities in Uttar Pradesh", funded by U.P. Council of Agricultural Research, Lucknow

and ranks third in vegetables production, contributing around 16 per cent to the country's vegetables production. It ranks first amongst Indian states in the production of fruits (7%) and potatoes (40%) out of their total production in the country. Over the past two decades, there has been a conscious and coordinated effort to diversify the agricultural base to develop domestic markets as well as increase export potential.

This paper provides an assessment of agricultural diversification trends towards fruits and vegetables production in the state of Uttar Pradesh. In the first part, food consumption, crop production patterns and value of output in the region during the past two decades are reviewed. Next, the farmers' perceived risks on a variety of sources and the use of different risk management strategies are discussed. The principal contribution of this paper is drawing of attention towards some neglected aspects of diversification, especially the bio-physical and economic constraints to the process of fruits and vegetables production systems. The flexibility of farmers in responding to diversification opportunities is constrained by farm investment, socio-economic factors, environmental factors and marketing of fruits and vegetables. Crop diversification to fruits and vegetables involves risks due to high resource requirements and perishable nature of the products. Starting from the socio-economic risks, environmental and marketing risks also make it a more complex farming enterprise, as perceived by the farmers.

Data and Methodology

A total of 634 farmers, comprising 188 fruit farmers and 446 vegetable farmers, covering six districts of Uttar Pradesh, viz. Lucknow, Allahabad, Gorakhpur, Moradabad, Jhansi and Agra, were interviewed in the last quarter of the year 2007, to find their risk perception on the cultivation of fruits and vegetables. These districts were selected based on their relative importance in terms of area under fruits and vegetables cultivation. The data related to farmers' perception on various sources of risks in fruits and vegetables cultivation were collected using a pre-tested structured questionnaire. In addition to socio-demographical information about the fruits and

vegetables farmers, a variety of questions were asked to gather responses on risk perception on a five-point Likert scale ranging from 1-5, where 1 meant strong disagreement and 5 meant strong agreement with a particular risk source.

Structural Changes in Agricultural Sector in Uttar Pradesh

Area, Production and Productivity

To assess the change in structure of agricultural production system, annual growth rates during past two decades were estimated for area, production and yield of the selected crops in Uttar Pradesh. Data revealed that there was a sharp decline in growth of area under maize (-1.75%) and oilseeds (-3.69%) production during 1991-92 to 2005-06 (Table 1). The area under rice and wheat production has also experienced a negative growth during 2001-02 to 2005-06. However, during this duration, pulses were grown on more area, as is evident by a moderate growth of 1.17 per cent in their area. The notable growth in area was recorded under vegetables production, which was 2.12 per cent during 1991-92 to 2001-02 and 2.67 per cent during 2001-02 to 2005-06; the highest 3.08 per cent being during 1991-92 to 2005-06. It is clear that shift in most of the crop areas that occurred during 1991-92 to 2005-06 appeared to be diverted towards the production of high-value crops like fruits and vegetables.

It is also evident from the Table 1 that a strong decline in production was experienced by foodgrains (-2.04%) during 2001-02 to 2005-06 and oilseeds (-2.12%) during 1991-92 to 2005-06, as the farmers have been induced to diversify their cropping system towards high-value commercial crops. This structural change in agricultural production is due to the socio-economic and technological adjustments which farmers adopted to maximize their income. The area under foodgrains declined in the state mainly due to diversification of production towards horticultural crops. Production of fruits and vegetables is more profitable in comparison to cereals and other crops. Relative profitability of fruits was more than 8-times higher than other agricultural commodities, which induced the farmers to diversify in their favour for enhancing their income. Cultivation of horticultural

Table 1. Annual growth in area, production and yield of major agricultural crops in Uttar Pradesh: 1991-92 to 2005-06

Major crops	Annual growth rate in area (%)			Annual growth rate in production (%)			Annual growth in yield (%)		
	1991-92 to 2001-02	2001-02 to 2005-06	1991-92 to 2005-06	1991-92 to 2001-02	2001-02 to 2005-06	1991-92 to 2005-06	1991-92 to 2001-02	2001-02 to 2005-06	1991-92 to 2005-06
	Foodgrains	0.83	-0.85	0.35	2.59	-2.04	1.23	2.05	-0.61
Maize	-1.44	-0.79	-1.75	-0.20	-1.46	-1.51	1.25	-0.32	0.29
Oilseeds	-2.60	-3.00	-3.69	-2.80	-0.07	-2.12	0.26	4.72	0.97
Pulses	-0.75	1.17	-0.34	-0.76	-0.36	-0.58	0.01	-1.62	-0.22
Rice	1.65	-1.34	0.77	3.51	-2.73	1.45	1.87	3.51	1.75
Wheat	0.98	-0.28	0.69	2.87	-1.63	1.67	1.99	-0.78	1.26
Fruits	-0.33	1.60	-0.32	0.20	7.23	2.31	0.48	1.73	1.47
Vegetables	2.12	2.67	3.08	3.28	2.71	3.80	1.31	-0.32	0.51

Source: Calculated based on the data given in *Agricultural Statistics at a Glance*, Ministry of Agriculture, Govt. of India, New Delhi.

crops is more suited to the small farm holders, since these crops are labour-intensive and provide regular flow of income. However, the absence of appropriate markets and rise in supply may adversely affect the prices and opportunities for higher income to smallholders (Joshi *et al.*, 2005).

Consumption Pattern of Food Items

The consumption of fruits and vegetables and edible oil grew rapidly as the diet became more modernized and westernized. The demand for high-value food products is expected to grow further with sustained economic growth, rising per capita income, strengthening urbanization trends and increasing awareness about the nutritive value of food products (Bhalla and Hazell 1998; Kumar 1998; Deshingkar *et al.*, 2003; Deininger and Sur 2007; Verma *et al.*, 2007). Table 2 shows that the highest average annual growth rates of per capita consumption of fruits and vegetables products were recorded between 1993-94 and 2004-05 for both rural and urban consumptions in the state. Per capita consumption of fruits (106% in urban areas and 165% in rural areas) grew faster than for any other product. Likewise, vegetables consumption recorded an increase of 41% in urban areas and 144% in rural areas during the same period. Rural areas of the state showed a sharp decline in consumption of cereals

(7%) during the above period. Edible oil and eggs experienced an increase in their respective consumption. This shift in consumption pattern towards high-value products was due to socio-economic changes in the state along with other impacting factors.

Composition of Value of Output from Agriculture

The share of major agricultural crops and livestock in gross value of output from agriculture (including livestock) is listed in Table 3. The crops that experienced declining trends in their shares in the gross value of output from agriculture during 1990-91 to 2002-03 were: paddy (-2.99%), maize (-0.58%), pulses (-2.70%), sugar (-1.05%) and overall cereals (-4.01%). During the same period, significant increase in value share was recorded for fruits and vegetables (5.65%), livestock (5.41%) and spices (0.09%). Potato is the most important agricultural crop of the state having a share of 2.20 per cent in 1990-91, which increased by 0.61 per cent and peaked at 2.81 per cent in 2002-03. The livestock sector contributed about 27.65 per cent in 2002-03 as compared to 22.24 per cent in 1990-91, showing a growing share with time. It is evident from the analysis that value share of high-value commodities, viz. fruits, vegetables, spices, milk,

Table 2. Monthly per capita consumption of food items in Uttar Pradesh

Food Items	Urban			Rural		
	1993-94	2004-05	Change, %	1993-94	2004-05	Change, %
Cereals	10.53	10.94	3.89	13.91	12.91	-7.19
Rice	2.57	2.70	5.06	3.91	4.01	2.56
Wheat	7.96	7.82	-1.76	8.87	8.46	-4.62
Pulses	0.83	0.84	1.20	0.9	0.85	-5.56
Edible oil	0.49	0.56	14.29	0.38	0.47	23.68
Milk & milk products	5.7	5.19	-8.95	5.45	4.67	-14.31
Eggs (Nos.)	0.64	0.98	53.13	0.21	0.41	95.24
Meat	0.28	0.26	-7.14	0.15	0.14	-6.67
Total fruits	0.56	1.16	107.14	0.28	0.74	164.29
Potato	2.22	2.10	-5.41	2.36	2.32	-1.69
Onion	0.43	0.59	37.21	0.39	0.52	33.33
Total vegetables	4.37	6.19	41.65	4.05	9.87	143.70

Source: Calculated based on data given in NSS 61st Round Report No. 509(61/1.0/2), 2004-05 & NSS 50th Round Report No. 404, 1997.

*otherwise specified

meat and eggs in the gross value of agricultural output increased significantly as compared to that of paddy, wheat, pulses and other cereals.

Table 3 also displays the growth pattern of agricultural commodities in terms of value of output in the agricultural (including livestock) sector for the period 1990-91 to 2002-03. A perusal of Table 3 reveals that the growth of horticultural produce was highest (8.7%), followed by fruits & vegetables (7.61%). The livestock and animal products also showed an appreciable increase of 3.70 per cent in their share, with significant contributions of their components, viz. milk (4.32%), eggs (4.13%) and meat (2.40%). The increasing share of high-value commodities, namely fruits, vegetables and livestock, in the value of output in the agricultural sector, represented a structural shift towards these two sub-sectors of agriculture.

Sources of Risks in Fruits and Vegetables Production

Agricultural production takes place in an environment characterized by highly variable bio-physical, economic, political and institutional conditions, which poses several types of risks

(Pingali, 2001; Hanson *et al.*, 2004; Chong, 2005; Ibitayo, 2006; Lourdes *et al.*, 2007; Pokhrel and Thapa, 2007). Risk perceptions play a key role in the production and investment behaviour of farmers. But, only limited attention has been paid to understand its nature and distribution in cash-crop farming such as fruits and vegetables. To get a deeper understanding of the major factors constraining production of fruits and vegetables, an analysis of the farmers' perception on major sources (investment, socio-economic, environmental, production and marketing) of risks in fruits and vegetables was carried out.

Investment Risks

The mean and standard deviations (SD) in farmers' responses towards various drivers of investment risks in production of fruits and vegetables were analyzed separately (Table 4). The rising cost of fuels has been perceived as the most important risk in production of both fruits and vegetables. The other important sources of risk in this category are lack of or poor electric supply, lack of irrigation facilities and deficiency of micro-nutrients.

Table 3. Composition and growth in value of output from agriculture and livestock sector at 1993-94 prices
(in per cent)

Crops	Composition		Annual growth 1990-91 to 2002-03
	1990-91	2002-03	
Paddy	12.77	9.78	2.12
Wheat	17.61	17.89	2.66
Maize	1.11	0.53	-1.19
Total cereals	33.66	29.65	2.20
Total pulses	6.95	4.25	-1.34
Total sugar	15.77	14.72	1.40
Total condiments & spices	0.54	0.63	1.17
Potato	2.20	2.81	4.81
Onion	0.25	0.11	-3.55
Other horticultural crops	4.60	9.50	8.75
Total fruits & vegetables	7.28	12.93	7.61
Total value of output—Crops	77.76	72.35	2.19
Milk	17.31	22.60	4.32
Egg	0.12	0.15	4.13
Meat	2.14	3.05	2.40
Total value of output — Livestock	22.24	27.65	3.70
Total value of output — Crop & livestock	100.00	100.00	2.56

Source: Calculated based on the data from CSO, State-wise Estimates of Value of Output from Agriculture and Livestock, 1990-91 to 2002-03

Table 4. Investment risks in fruits and vegetables production

Investment risks	Fruits			Vegetables			Total		
	N	Mean	SD	N	Mean	SD	N	Mean	SD
Costly fuels/ diesel	185	4.48	0.86	443	4.35	1.00	628	4.39	0.96
Lack of/ poor electricity supply	182	4.16	0.97	434	3.95	1.08	616	4.01	1.06
Water-scarcity/ Inadequate water supply	183	3.87	1.33	440	3.93	1.27	623	3.91	1.29
Lack of irrigation facilities	183	3.79	1.33	440	3.86	1.36	623	3.84	1.35
Micronutrient deficiency	177	3.23	1.28	423	3.33	1.27	600	3.30	1.27
Inadequate and/ or unbalanced manuring	182	3.14	1.31	439	2.99	1.33	621	3.04	1.33
Lack of new varieties/ HVY seeds	184	2.99	1.34	442	2.68	1.27	626	2.77	1.30
Timely unavailability of fertilizers/pesticides	184	2.72	1.39	435	2.46	1.19	619	2.54	1.26
Insufficient seed/shortage	184	2.58	1.57	443	2.18	1.10	627	2.30	1.26
Timely unavailability of seeds	185	2.50	1.30	443	2.14	1.08	628	2.25	1.16

Note: N=Number of respondents

SD = Standard deviation

Socio-economic Risks

Social risks in production of fruits and vegetables are associated with human resources and legal issues. The major sources of social risks are family issues, healthcare, government regulations, laws, liability

and unemployment. In addition, farmers face uncertainty about the economic consequences of their actions due to their limited ability to foresee factors like change in prices and biological responses to different farming practices. The farmers'

Table 5. Socio-economic risks in production of fruits and vegetables

Socio-economic risks	Fruits			Vegetables			Total		
	N	Mean	SD	N	Mean	SD	N	Mean	SD
Weak research and extension linkages	179	4.08	0.73	437	3.78	0.86	616	3.87	0.83
Lack of capital	184	3.85	1.14	441	3.75	1.16	625	3.78	1.16
Lack of storage facilities (cold chain)	183	3.84	0.80	441	3.59	0.99	624	3.66	0.94
Insufficient/Lack of training	185	3.65	1.23	436	3.45	1.27	621	3.51	1.26
Land shortages	184	3.61	1.25	437	3.47	1.23	621	3.51	1.24
Lack of farm credit/financial institution	180	3.65	1.19	433	3.44	1.14	613	3.50	1.16
High population density (high pressures on the land and resources)	184	3.43	1.08	439	3.36	1.07	623	3.38	1.07
Land fragmentation	185	3.52	1.26	432	3.28	2.50	617	3.35	2.20
High post-harvest losses	183	3.28	1.27	436	3.36	1.16	619	3.34	1.19
Poor/Little education	186	3.07	1.17	439	2.79	1.17	625	2.88	1.18
High labour migration (permanent/seasonal)	181	2.89	1.22	437	2.78	1.22	618	2.82	1.22
Inadequate family labour	179	3.02	1.25	434	2.72	1.18	613	2.81	1.21
Old age	183	2.84	1.32	438	2.79	3.94	621	2.80	3.39
Family conflict & violence (presence & frequency)	184	2.76	1.45	436	2.64	2.47	620	2.68	2.22
Inadequate labour (hired)	186	2.80	1.15	438	2.60	1.14	624	2.66	1.15
Poor healthcare	186	2.87	1.36	437	2.55	1.22	623	2.64	1.27

Note: N=Number of respondents

perceptions about the socio-economic sources of risks in fruits and vegetables production are presented in Table 5. Poor linkages in research and extension (mean 3.87) were found to be the top ranked sources of risks, followed by lack of capital (mean 3.78), lack of storage facilities for farm produce (mean 3.66), inadequacy of land (mean 3.51), lack of training facilities (mean 3.51), poor access to credit (mean 3.50) and land fragmentation (mean 3.35).

Environmental Risks

The leading environmental sources of risks in production of fruits and vegetables included weather dependency, insufficient rainfall, soil loss and degradation, salinity, pests and impact of climate change (Tilman *et al.*, 2001). Although weather is an important production factor in agriculture, it can hardly be controlled. In fact, weather risks are the major sources of uncertainty in fruits and vegetables production, as ranked by the highest mean score of 4.32 (Table 6). Impact of climate change is a serious

concern for the farmers which can cause the occurrence of extreme weather events like flood and drought along with temperature differences.

Production Risks

Various drivers of production risks in farming of fruits and vegetables have been presented in Table 7. It is quite clear that farmers are vulnerable to expensive inputs and lack technical knowledge on production, processing and quality control aspects. Risks due to pests and diseases in fruits and vegetables have also emerged as an important concern in farmers' responses.

Market Risks

The marketing of fruits and vegetables has become one of the critical areas where farmers are exploited. Market risks are the result of variations in supply and demand for crops that are not subjected to price controls and the inability of controlled markets to respond timely and efficiently to changes in the market conditions. Variations in the market

Table 6. Environmental risks in production of fruits and vegetables

Environmental risks	Fruits			Vegetables			Total		
	N	Mean	SD	N	Mean	SD	N	Mean	SD
Fallen underground water/ depth of watertable	183	4.38	0.94	438	4.50	0.85	621	4.47	0.88
Seasonality/ weather dependency	185	4.08	0.97	439	4.43	2.22	624	4.32	1.94
Insufficient rainfall/drought/delayed rainfall	183	4.13	0.78	441	4.29	0.87	624	4.25	0.85
Low yield	186	3.54	5.84	441	3.52	2.31	627	3.52	3.72
Climate changes	186	2.92	1.42	441	3.61	1.40	627	3.40	1.44
Lack of canal/tube-wells	186	3.26	1.25	436	3.39	1.38	622	3.35	1.34
Deterioration of water quality	185	2.59	1.19	437	2.65	1.34	622	2.64	1.30
Infertile land /poor soil quality	186	2.09	1.09	436	2.45	1.19	622	2.34	1.17
Flood/high rainfall	183	2.43	1.21	433	2.28	1.16	616	2.33	1.17
Mines & extraction	186	1.52	0.81	441	1.71	0.99	627	1.65	0.95
Landslides	184	1.49	0.82	438	1.65	0.85	622	1.61	0.84

Note: N=Number of respondents

Table 7. Production risks in farming of fruits and vegetables

Production Risks	Fruits			Vegetables			Total		
	N	Mean	SD	N	Mean	SD	N	Mean	SD
Damage by pests and diseases	186	4.38	0.84	438	4.30	0.83	624	4.33	0.83
Expensive inputs	186	4.16	0.93	440	4.12	0.87	626	4.13	0.88
High cost of production	186	4.06	0.91	440	4.05	0.88	626	4.05	0.89
Termites/ Insects attack	183	4.11	0.99	445	3.99	0.97	628	4.03	0.98
Lack of technical knowledge in production, processing, and quality control	184	4.05	3.30	431	3.55	1.01	615	3.70	2.01
Inadequate information	187	3.97	3.32	440	3.53	1.04	627	3.66	2.02
Poor productivity	183	3.32	1.24	439	3.67	2.36	622	3.57	2.10
Decrease in farm-size	186	3.73	1.85	439	3.44	2.45	625	3.52	2.29
High post-harvest losses	183	3.45	1.37	432	3.43	1.35	615	3.44	1.35
Lack of processing techniques	185	3.71	0.97	436	3.19	1.10	621	3.35	1.09
Low quality seed	187	3.48	1.27	439	3.20	1.30	626	3.28	1.30
Poor adaptation of varieties	184	3.45	1.17	438	3.21	1.28	622	3.28	1.25
Infrastructural bottlenecks	182	3.23	1.26	433	3.14	1.30	615	3.17	1.29
Traditional methods of farming	185	3.22	1.16	444	3.00	1.20	629	3.06	1.19
Over-cultivation	185	2.82	1.41	435	3.03	1.33	620	2.96	1.36
Over-grazing	185	2.89	1.56	441	2.98	1.47	626	2.95	1.49

Note: N=Number of respondents

price fetched by the farmers are a reflection of the market risk. Moreover, market risks may be due to factors affecting the timely delivery of produce to markets or quality of produce (e.g. poor feeder roads, non-existence of storage/ transportation facilities, bulk and perishable nature of the produce).

Consequently, the farmers are forced to sell their produce to the traders at cheaper prices. The steep fall in market prices during the harvest season has been the most common grievance of the farmers.

High perishability of fruits and vegetables is the biggest challenge to farmers and has been ranked as

Table 8. Market risks in production of fruits and vegetables

Marketing risks	Fruits			Vegetables			Total		
	N	Mean	SD	N	Mean	SD	N	Mean	SD
Perishability of horticultural produce	179	3.87	0.89	419	3.81	0.86	598	3.83	0.87
Low price for the products	184	3.89	0.99	439	3.62	1.08	623	3.70	1.06
High marketing costs	186	3.58	1.13	441	3.40	1.10	627	3.45	1.11
Lack of discriminatory pricing system based on quality and grades produce	184	3.09	1.17	435	2.91	1.13	619	2.97	1.14
Lack of coordination among producers to increase their bargaining power	186	3.15	1.31	439	2.82	2.43	625	2.92	2.17
Lack of marketing centres/ institutions	185	3.14	1.28	441	2.79	1.16	626	2.89	1.21
Exploitation by middlemen/large number of middleman	186	3.00	1.36	442	2.78	1.24	628	2.84	1.28
Lack of transparency in marketing system	182	3.00	1.18	438	2.76	1.15	620	2.83	1.16
High processing costs	185	3.07	1.07	441	2.73	1.11	626	2.83	1.11
Poor product handling	185	2.97	1.25	438	2.65	1.21	623	2.74	1.23
Poor product packaging	183	3.08	1.19	433	2.55	1.11	616	2.71	1.16
Lack of market information	183	2.87	1.19	442	2.59	1.13	625	2.67	1.15
Lack of marketing infrastructures	186	2.62	1.33	441	2.33	1.52	627	2.42	1.48
Poor market linkages	184	2.62	1.25	441	2.28	1.15	625	2.38	1.19
Lack of markets to absorb the production	184	2.37	1.19	444	2.14	1.08	628	2.20	1.12

Note: N=Number of respondents

the highest risk with a mean score of 3.83 (Table 8). Lack of discriminatory pricing system (mean 2.97) based on quality and grades of produce and lack of coordination among farmers (mean 2.92) are the other highly ranked sources of risks by the farmers. Exploitation by middlemen, lack of transparency in the marketing system, lack of information and marketing infrastructure have also been perceived as sources of market risks, but on a lower scale.

Strategies to Risk Management

The risk management strategies being followed in production of fruits and vegetables have been summarized in Table 9. A majority of farmers (more than 57%) have reported non-adoption of any of the risk management strategies. They are small and marginal farmers, who are not in position to manage such situations due to their poor resources. Only about 6 per cent farmers have reported adoption of new methods of farming to enhance their farm income. As a part of socio-economic risk

management strategy, only 3 per cent farmers have reported formation of a group to deal with adverse situations. Crop planning (1% farmers) and crop diversification (5% farmers) have also emerged as important risk management strategies. The commonly adopted marketing strategy of the farmers is to sell their produce in local or distant mandis at the earliest because of high perishability of fruits and vegetables. A few responses have also been received on processing of produce for better prices.

Crop diversification has been well recognized as a risk management tool (Pope and Prescott, 1980; Blank 1996; Boehlje and Lins, 1998). Traditionally, crop diversification strategies have been adopted by farm households to deal with various risks and maintain food security. It has become a popular strategy for income augmentation and employment generation through maximization of use of land, water and other resources (FAO, 2001). In particular, this strategy is more relevant for enhancing economic opportunities of the small farm households, whose

Table 9. Effective risk management strategies in production of fruits and vegetables

Risk management strategies	N	Response (%)
None	220	57.29
Investment Responses		
Adoption of new farming techniques	24	6.25
Use of HYVs and fertilizers	35	9.11
Use of HYVs	13	3.39
Socio-economic Responses		
Meeting govt officials and complaining	3	0.78
Hardworking	20	5.21
Farming groups to manage adverse situations	14	3.65
Crop planning and time management	4	1.04
Environmental Responses		
Crop-diversification	19	4.95
Constructed/maintained waterbodies for irrigation	3	0.78
Marketing Responses		
Processing of produce for better prices	6	1.56
Sell within village	3	0.78
Sell at low prices due to fear of police and high tax	5	1.30
Sell at low prices due to high perishability	5	1.30
Sell in local mandi	3	0.78
Sell in distant mandi	5	1.30
Maintain relations with traders	2	0.53
Total	384	100.0

Note: N=Number of respondents

economic viability is deteriorating fast due to a number of reasons. Not only their farm-size is small to take advantage of scale economies, their productivity level is also very low. In this context, a close look at farmers' perception on major motivating factors for crop diversification would be important to understand their risk mitigating behaviour.

The crop diversification strategy perceived by the farmers is in line with the view of multi-functionality. The motivation for crop 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 10). Many farmers perceived crop diversification to be a source of generating off-season income (mean 3.26) and employment (mean 3.84). Further, crop 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 fruits and vegetables, as well as for better quality processed food products. Most of the farmers who were facing irrigation constraints have adopted crop diversification to replace water-loving crops by water-saving crops (mean 3.42). Maintaining soil fertility was also one of the reasons for adopting crop diversification (Table 10).

Table 10. Farmers' perceived motivations to crop diversification

Reasons	N	Mean	Mode	SD
Generate additional income	416	4.08	4	0.72
Production of high-value crops in place of low-value crops	416	4.05	4	0.84
Generate off-season income	413	3.26	4	1.36
Employment during off-season	414	3.84	4	0.86
Change from mono-cropping to multi-cropping	413	3.60	4	1.07
Processing and value addition	399	3.08	4	1.26
Water-loving crops to water-saving crops	413	3.42	4	1.13
Maintain soil fertility	414	3.58	4	1.13
Increased benefits due to high demand of produce	415	4.05	4	0.82
Due to climate change	412	3.46	4	1.13

Note: N=Number of respondents

Conclusions

The study has 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 fulfills 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.

Acknowledgements

Authors are thankful to the Managing Editor of AERR and anonymous referee (s) for their invaluable inputs and comments.

References

- Bhalla, G.S. and Hazell, P. (1998) Foodgrains demand in India to 2020: A preliminary exercise, *Economic and Political Weekly*, **32**(52): A150-A154.
- Blank, S. (1996) Preferences for crop insurance when farmers are diversified, *Agribusiness: An International Journal*, **12**(6): 583-592.
- Boehlje D.M. and Lins, D. (1998) Risk and risk management in an industrialized agriculture, *Agricultural Finance Review*, 58:2-15.
- Chong, M. (2005) Perception of the risks and benefits of Bt eggplant by Indian farmers, *Journal of Risk Research*, **8**(7&8): 617 - 634.
- Deininger, D.U. and Sur, M. (2007) *Food Safety in a Globalizing World: Opportunities and Challenges for India*, South Asia Sustainable Development Department, World Bank, Washington D.C.
- Deshingkar, P., Kulkarni, U., Rao, L. and Rao, S. (2003) Changing food systems in India: Response-sharing and marketing arrangements for vegetable production in Andhra Pradesh, *Development Policy Review*, **21** (5&6): 627-639.
- FAO (2001) *Crop Diversification in the Asia-Pacific Region*, Eds: Minas K. Papademetriou and Frank J. Dent, RAP Publication.
- Hanson, J., Robert Dismukes, William Chambers, Catherine Greene and Amy Kremen (2004) Risk and risk management in organic agriculture: Views of organic farmers, *Renewable Agriculture and Food Systems*, **19**: 218-227
- Ibitayo, Olurominiyi O. (2006) Egyptian farmers' attitudes and behaviours regarding agricultural pesticides: Implications for pesticide risk communication, *Risk Analysis*, **26**(4): 989-995.
- Kumar, P. (1998) *Food Demand and Supply Projections*, Indian Agricultural Research Institute (IARI), New Delhi.
- Lourdes, V. Tibig and Felino, P. Lansigan (2007) Coping strategies with agrometeorological risks and uncertainties for crop yield, In: *Managing Weather and Climate Risks in Agriculture*, Eds: Mannava V. K. Sivakumar and Raymond P. Motha, Springer.
- Pingali, Prabhu L. (2001) Environmental consequences of agricultural commercialization in Asia, *Environment and Development Economics*, **6**: 483-502.
- Pokhrel, D.M. and Thapa, Gopal B. (2007) Are marketing intermediaries exploiting mountain farmers in Nepal? A study based on market price, marketing margin and income distribution analyses, *Agricultural Systems*, **94**(2): 151-164.
- Pope, R. and Prescott, R. (1980) Diversification in relation to farm size and other socioeconomic characteristics, *American Journal of Agricultural Economics*, **62**: 554-559.
- Joshi, P.K., Gulati, A., Birthal, P.S. and Tewari, L. (2005) Agricultural diversification in south Asia: Patterns, determinants and policy implications, In: *Economic Reforms and Food Security: The Impact of Trade and Technology in South Asia*, Eds: Suresh Chandra Babu, and Ashok Gulati, Haworth Press, Inc.
- Tilman, D., Joseph, F., Brian, W., Carla, D'Antonio, Andrew, D., Robert, H., David, S., William, H. Schlesinger, Daniel, S. and Deborah, S. (2001) Forecasting agriculturally driven global environmental change, *Science*, **292**(5515): 281-284.
- Verma, M.R., Datta, K.K., Mandal, Subhasis and Tripathi, A.K. (2007) Diversification of food production and consumption patterns in India, *Journal of Agricultural & Food Information*, **8**(3): 87-100.