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Full Length Research Paper

Measuring risk and designing risk management strategies for dry onion growing farms: A case study for Amasya Province of Turkey

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The aim of this study was to measure the risks and to design appropriate risk management strategies for dry onion growing farms in Amasya Province of Turkey. The data used in the study belong to the 2007-2008 production period and were obtained through questionnaires from 101 farms, selected by stratified sampling method. Operational and financial risks exposed by farms were measured using probability distribution functions of crop prices and yields. According to operational and financial risks estimated for farms, it was determined that risk decreased in larger farms. Total risk for the first group of farms was estimated to be 76%, while those of second and third groups were 30 and 6%, respectively. Based on risk management principles, risk control strategies such as diversification of production activities or income sources can be suggested for the first group farms, and risk transfer strategies such as establishment of cooperatives, contract farming and agricultural insurance can be recommended for the second group farms. The third group of farms, on the other hand, has no options but to accept the risks involved.

Key words: Dry onion production, risk, risk measuring, risk management strategies, Amasya/Turkey.

INTRODUCTION

Farmers cannot predict the harvest because of the fluctuations in variables that cannot be controlled such as rainfall, temperature, diseases, frost and wind. In addition, variations in the prices of crop products and inputs lead to fluctuations in income among years. As a result, farmers make decisions in a continuously changing and risky environment. Therefore, studying the decision making processes under the conditions of risk and uncertainty and determining the attitudes of farmers towards risks would help to take better decisions (Akçaöz, 2001). Decisions will depend on risk behaviors of farm owners, operations of the farms and degree of risks exposed (Bozoğlu et al., 2001).

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While planning for the future in agricultural production, it is necessary to take into account the risk factors inherent in the nature of agriculture and to measure them. In order for farmers to take rational decisions, analysis of the risks involved and adoption of proper risk management strategies suitable for the structure of the farm based on the analysis is critical.

There are many studies about risks in agricultural production in the world (Ortmann et al., 1995; Deary et al., 1997; Patrick and Musser, 1997; Jones et al., 1998; Martin and Mcleay, 1998; Patrick and Musser, 1999; Patrick et al., 2000; Zeuli and Skees, 2001; Miller et al., 2004; Du and Wang, 2004; Nabradi et al., 2004). However, studies about risks in agricultural production in Turkey are rare but some studies started to appear on this issue (Akçaöz, 2001; Bozoğlu et al., 2001; Akçaöz and Özkan, 2005; Akçaöz et al., 2006; Hazneci, 2009).

This study was conducted on dry onion producers in

Amasya Province with the idea of helping to design rational policies for the risky conditions of agricultural sector. Agriculture is the most important sector for Amasya Province, which has a significant potential for both crop production and animal husbandry. Amasya Province has 219,520 ha of cultivated farmland (Anonymous, 2010) and is one of the leading provinces of Turkey for dry onion production. It is ranked first in 2008 for both acreage and production, while first in acreage and second in production in 2009. Of 60,558 ha of dry onion acreage, 8,159 ha (13.47%) belongs to this province. Amasya produces about 303,000 tons (16.35%) of dry onion (Anonymous, 2011).

In the present study, a risk analysis for dry onion producing farms was carried out. The results of this study could guide the future studies for the area studied, facilitate the decision making by dry onion producers working under risky conditions, and help farmers to decide the risk management strategies through providing them with valuable information.

MATERIALS AND METHODS

The primary data of the study came from a questionnaire conducted over 101 dry onion growing farmers in Amasya Province selected based on layered sampling method in 2007-2008 production period. Questionnaires were conducted via face-to-face method by the authors. In addition, secondary data from other studies and formal statistics from Food, Agriculture and Livestock Office of Amasya, Turkish Statistical Institute (TÜİK) and Tokat Soil and Water Resources Research Institute were also used.

Risk assessment of the farms studied was conducted based on farm size. Average values calculated for different size of farms in economical analysis were used in risk assessment. First, "operational risk" and "financial risk" that farms exposed to were assessed. Thereafter, risk management strategies were developed based on the degree of risks and size of the losses incurred.

In the investigation, yield fluctuations caused by differences in climatic conditions, diseases and production techniques and fluctuations in farm income caused by changes in crop and input prices were considered "operational risk" while interest payments for external capital within the total capital of farm were considered "financial risk" (Bauer and Bushe, 1993).

In the economical analysis of farms, it was found that 86% of the gross vegetative production value belonged to dry onion, wheat, sugar beet, barley, sunflower and corn. Therefore, for the risk assessment, yield and prices of these crops as well as their input prices for 1994-2008 period in the experimental area were used. The prices were first converted to 2008 real prices using Wholesale Price Index. Then, the highest, the lowest and typical values for crop and input prices and yields obtained through expert ideas and questionnaires over farmers and time series values were converted to secondary data using the following formula (Hardaker et al., 1997):

$$g(n)_{ij} = E[g(s)_j] + \{g(h)_{ij} - E[g(h)_j]\} \times \left\{ \sqrt{s_j^2} \Big/ \sqrt{h_j^2} \right\}$$

In the formula, $g(n)_{ij}$ is the yield, crop price or input price subjectively ordered for j^{th} activity in i^{th} year; $E[g(s)_j]$ is subjective mean for variable of interest for j^{th} activity calculated in triangular distribution; $g(h)_{ij}$ is value for variable of interest in i^{th} year and j^{th} activity; $E[g(h)_j]$ is real mean for the variable of interest for j^{th} activity; $\sqrt{s_j}$ is standard deviation calculated subjectively for j^{th} activity; $\sqrt{h_j}$ is standard deviation for time series for j^{th} activity.

For calculation of $E[g(s)_j]$ in the formula, triangular distribution was employed. This was a subjective distribution based on expert and farmer opinions, and had three parameters; that is, the lowest, highest and typical. Triangular distribution is obtained through the following formula: The first moment of triangular distribution is equal to the mean and was calculated by formula $E(x) = (a+m+b)/3$ while the second moment is equal to the variance and was calculated by formula $V(x) = [(b-a)^2 + (m-a)(m-b)]/18$. In these formulas, "a" is the lowest value, "b" the highest one and "m" the typical one (Hardaker et al., 1997; Holloway, 1979, Bozoğlu et al., 2001).

For the calculation of operational risk, mean values of secondary data obtained using the synthesis of data from expert and farmer opinion and time series were considered normal yield (NY) and normal price (NP). One standard deviation lower than the mean values were taken as low yield (LY) and low price (LP), and one standard deviation higher than the mean values were taken as high yield (HY) and high price (HP). Probability values calculated from normal probability distribution were used for them. Then, as representations of operational risk for each farm group, conditional probabilities obtained by the multiplication of yield and price probabilities were calculated separately for nine different combinations (LY-LP; LY-NP; LY-HP; NY-LP; NY-NP; NY-HP; HY-LP; HY-NP; HY-HP) (Bozoğlu et al., 2001).

For assessment of the risk exposed by farms studied, "operational risk" was defined as probability of loss against the total investment in the farm. On the other hand, probability of losses higher than the highest loss on the total investment due to the costs of debts was considered "financial risk" (Bauer and Bushe, 1993).

Returns of farm size group were calculated using farm income tables. Then, total capital and equity returns were calculated as per cents based on the following formula (Bozoğlu et al., 2001).

Total capital return (%) = (Total capital return / Total capital) × 100

Equity return (%) = Total capital return (%) + Debt ratio[1] (Total capital return % - Interest rate of debt %)

Risk management strategies were developed based on the results of calculated risks of farms studied. Risk management strategies can be grouped into four groups: risk transfer, risk avoidance, risk control and risk acceptance.

If the risk exposed is high but the probability of this risk to realize is low, then a risk transfer strategy should be employed. For this purpose, agricultural insurance, contract-based production, cooperativization and marketing contracts are advised. However, if the risk is small but its probability is high, a risk avoidance strategy should be implemented. On the other hand, if the risk is big and its probability is high, a risk avoidance strategy should be used. When a small risk with a high probability is involved, risk controlling strategies such as pesticide use, some farming methods, diversification of production, non-agricultural activities, and lower loan ratios are advised. If the risk and its probability are small, a risk acceptance strategy should be adopted (Bauer and Bushe, 1993; Hardaker et al., 1997). In addition, it is possible to use more than one risk management strategies in farms (Bozoğlu et al., 2001).

[1] Debt ratio was calculated as the ratio of loans used by the farm over equity.

Table 1. Conditional probabilities showing price and yield fluctuations in dry onion growing farms in Amasya Province of Turkey.

Yield fluctuations	Low price (LP) (0.16)	Normal price (NP) (0.68)	High price (HP) (0.16)
Low yield (LY) (0.16)	0.0256	0.1088	0.0256
Normal yield (NY) (0.68)	0.1088	0.4624	0.1088
High yield (HY) (0.16)	0.0256	0.1088	0.0256

Table 2. Incomes of farm groups from dry onion selling (US$).

Crop	Group I farms				Group II farms				Group III farms			
		LP	NP	HP		LP	NP	HP		LP	NP	HP
Dry onion	LY	2,779.21	5,053.11	7,453.33	LY	7,897.35	14,358.83	21,179.28	LY	27,750.82	50,456.03	74,422.65
	NY	3,418.12	6,214.76	9,166.78	NY	9,712.88	17,659.77	26,048.16	NY	34,130.43	62,055.33	91,531.62
	HY	4,058.05	7,378.28	10,882.97	HY	11,531.31	20,966.02	30,924.87	HY	40,520.29	73,673.25	108,668.05

Table 3. Incomes of farm groups from wheat selling (US$).

Crop	Group I farms				Group II farms				Group III farms			
		LP	NP	HP		LP	NP	HP		LP	NP	HP
Wheat	LY	4,547.99	4,851.19	5,154.39	LY	6,160.89	6,571.62	6,982.35	LY	9,072.02	9,676.82	10,281.63
	NY	5,786.98	6,172.78	6,558.58	NY	7,839.28	8,361.89	8,884.51	NY	11,543.47	12,313.04	13,082.60
	HY	7,041.08	7,510.48	7,979.89	HY	9,538.12	10,174.00	10,809.88	HY	14,045.06	14,981.40	15,917.74

FINDINGS

Risk assessment for dry onion growing farms was carried out based on farms size groups. Operational and financial risks were separately measured. Based on economical analysis, area devoted to dry onion, wheat, sugar beet, barley, sunflower and corn was 84% in Group I, 86% in Group II and 90% in Group III farms. Similarly, gross vegetable production income came dominantly from these six crops in all three farm groups. Of all gross vegetative production, these six groups had a share of 81, 82 and 89% in Group I, II and III farms, respectively. Therefore, in the risk assessment of farms these six crops were taken into account. Yield and prices of other crops were assumed to be fixed. In terms of input items, labor, fertilizers, diesel, seed, pesticides and irrigation water prices were used in risk assessment, and the prices of other inputs were assumed not to change.

Conditional probabilities that reflected the risks of farms and were obtained by multiplying price and probabilities are given in Table 1. Based on this data, probability of a normal yield and normal price occurrence was the highest (0.46). In normal probability distribution function, probability of prices one standard deviation higher or lower than the average prices was 0.16 while the probability of prices within one standard deviation higher and lower interval was 0.68. The sum of the probabilities thus was 1 (Argyrous, 1997; Patrick, 1985; Bauer and Bushe, 1993). Probabilities were calculated in the same way for yields (Table 1).

Incomes from dry onion marketing for nine combinations based on farm groups are given in Table 2. According to this data, Group I farms earned US$2,779[2] when they experienced low yield and low price, and US$10,883 when they experienced high yield and high price. These values were US$7,897 and 30,925 for Group II and US$27751 and 108668 for Group III farms, respectively. Incomes from wheat were US$4,548 and 7,980 for the Group I farms, US$6,161 and 10,810 for Group II farms, and US$9,072 and 15,918 for Group III farms for low yield, low price and high yield, high price conditions, respectively (Table 3). Sugar beet incomes were US$2,342 and 4,570 for the Group I farms, US$3,274 and 6,390 for Group II farms, and US$6,517 and 12,718 for Group III farms for low yield, low price and high yield, high price conditions, respectively (Table 4). Incomes from barley when the yields and prices were low and when the yield and prices were high were US$553 Group II farms, and US$897 and 1,475 for Group III and farms, respectively (Table 5). Group I farms had no909 for the Group I farms, US$546 and 897 for sunflower

[2] Average dollar exchange ratio in 2008 was 1.30 Turkish Lira and calculations were based on this value (Anonymous, 2012).

Table 4. Incomes of farm groups from sugar beet selling (US$).

Crop	Group I farms				Group II farms				Group III farms			
		LP	NP	HP		LP	NP	HP		LP	NP	HP
Sugar beet	LY	2,342.00	2,767.82	3,193.63	LY	3,274.25	3,869.57	4,464.88	LY	6,517.24	7,702.18	8,887.14
	NY	2,846.79	3,364.39	3,881.99	NY	3,979.98	4,703.62	5,427.25	NY	7,921.96	9,362.32	10,802.68
	HY	3,351.58	3,960.97	4,570.35	HY	4,685.72	5,537.66	6,389.62	HY	9,326.69	11,022.45	12,718.22

Table 5. Incomes of farm groups from barley selling (US$).

Crop	Group I farms				Group II farms				Group III farms			
		LP	NP	HP		LP	NP	HP		LP	NP	HP
Barley	LY	552.98	582.88	627.72	LY	545.82	575.32	619.57	LY	897.25	945.75	1,018.51
	NY	675.87	712.41	767.21	NY	667.11	703.16	757.25	NY	1,096.65	1,155.92	1,244.84
	HY	800.95	844.25	909.18	HY	790.56	833.29	897.39	HY	1,299.60	1,369.85	1,475.22

Table 6. Incomes of farm groups from sunflower selling (US$).

Crop	Group I farms				Group II farms				Group III farms			
		LP	NP	HP		LP	NP	HP		LP	NP	HP
Sunflower	LY	0.00	0.00	0.00	LY	549.32	625.08	700.85	LY	828.76	943.08	1,057.38
	NY	0.00	0.00	0.00	NY	653.04	743.11	833.18	NY	985.24	1,121.14	1,257.03
	HY	0.00	0.00	0.00	HY	756.75	861.13	965.52	HY	1,141.72	1,299.20	1,456.68

Table 7. Incomes of farm groups from grain corn selling (US$).

Crop	Group I farms				Group II farms				Group III farms			
		LP	NP	HP		LP	NP	HP		LP	NP	HP
Grain corn	LY	273.55	284.95	296.35	LY	234.48	244.25	254.02	LY	1,086.78	1,132.06	1,177.35
	NY	334.89	348.85	362.79	NY	287.05	299.01	310.97	NY	1,330.44	1,385.88	1,441.32
	HY	395.68	412.17	428.65	HY	339.15	353.28	367.42	HY	1,571.95	1,637.45	1,702.95

acreage, but incomes from sunflower were US$549 and 966 for Group II farms, and US$829 and 1,457 for Group III farms in low yield, low price and high yield, high price conditions, respectively (Table 6). Incomes from grain corn when the yields and prices were low and when the yield and prices were high were US$274 and 429 for the Group I farms, US$234 and 367 for Group II farms, and US$1,087 and 1,703 for Group III farms, respectively (Table 7).

Total selling incomes of farms from dry onion, wheat, sugar beet, barley, sunflower and grain corn for nine combinations based on farm size groups are given in Table 8. Group I farms had US$10,496 income from these six crops under low yield, low price conditions, US$16,813 under normal yield, normal price conditions and US$24,771 under high yield, high price conditions. These values were US$18,662, 32,471 and 50,355 for Group II farms, and US$46,153, 87,394 and 141,939 for Group III farms, respectively.

Incomes on total capital and equities in Group I farms are given in Table 9. As can be seen in this Table, total capital and equity returns were US$11,601 and 12,242 under low yield, low price conditions, US$1019 and 1,660 under normal yield, normal price conditions, and US$11,202 and 10,562 under high yield, high price conditions, respectively.

Calculated returns on total capital and equities for Group I farms and their probability of realization are given in Table 10. As can be seen from this table, for Group I farms, returns on total capital and equities were 5.56 and

Table 8. Incomes of farm groups from dry onion, wheat, sugar beet, barley, sunflower and grain corn selling (US$).

Crop		Group I farms				Group II farms				Group III farms		
		LP	NP	HP		LP	NP	HP		LP	NP	HP
Dry onion + Wheat + Sugar beet + Barley + Sunflower + Grain corn	LY	10,495.74	13,539.95	16,725.42	LY	18,662.10	26,244.66	34,200.95	LY	46,152.87	70,855.93	96,844.65
	NY	13,062.66	16,813.19	20,737.35	NY	23,139.33	32,470.55	42,261.32	NY	57,008.18	87,393.62	119,360.08
	HY	15,647.35	20,106.15	24,771.05	HY	27,641.62	38,725.38	50,354.68	HY	67,905.32	103,983.60	141,938.84

Table 9. Incomes on total capital and equities in Group I farms (US$).

Income	LY, LP	LY, NP	LY, HP	NY, LP	NY, NP	NY, HP	HY, LP	HY, NP	HY, HP
Dry onion incomes	2,779.21	5,053.11	7,453.33	3,418.12	6,214.76	9,166.78	4,058.05	7,378.28	10,882.97
Wheat incomes (+)	4,547.99	4,851.19	5,154.39	5,786.98	6,172.78	6,558.58	7,041.08	7,510.48	7,979.89
Sugar beet incomes (+)	2,342.00	2,767.82	3,193.63	2,846.79	3,364.39	3,881.99	3,351.58	3,960.97	4,570.35
Barley incomes (+)	552.98	582.88	627.72	675.87	712.41	767.21	800.95	844.25	909.18
Grain corn incomes (+)	273.55	284.95	296.35	334.89	348.85	362.79	395.68	412.17	428.65
Other incomes (+)	8,979.94	8,979.94	8,979.94	8,979.94	8,979.94	8,979.94	8,979.94	8,979.94	8,979.94
Gross income (=)	19,475.68	22,519.88	25,705.36	22,042.60	25,793.13	29,717.28	24,627.29	29,086.09	33,750.98
External labor costs (-)	2,266.01	2,266.01	2,266.01	1,984.35	1,984.35	1,984.35	1,702.69	1,702.69	1,702.69
Fertilizer costs (-)	2,164.12	2,164.12	2,164.12	1,660.15	1,660.15	1,660.15	1,156.18	1,156.18	1,156.18
Diesel costs (-)	3,056.05	3,056.05	3,056.05	2,406.35	2,406.35	2,406.35	1,756.63	1,756.63	1,756.63
Seed costs (-)	1,780.54	1,780.54	1,780.54	1,132.25	1,132.25	1,132.25	483.95	483.95	483.95
Pesticide costs (-)	1,272.52	1,272.52	1,272.52	794.26	794.26	794.26	316.01	316.01	316.01
Irrigation water costs (-)	1,384.03	1,384.03	1,384.03	975.32	975.32	975.32	566.61	566.61	566.61
Other costs (-)	9,385.99	9,385.99	9,385.99	9,385.99	9,385.99	9,385.99	9,385.99	9,385.99	9,385.99
Net income (=)	-1,833.58	1,210.62	4,396.10	3,703.93	7,454.46	11,378.62	9,259.24	13,718.04	18,382.93
Equivalent of family labor costs and management (-)	10,408.36	10,408.36	10,408.36	9,114.63	9,114.63	9,114.63	7,820.90	7,820.90	7,820.90
Return on equity (=)	-12,241.95	-9,197.74	-6,012.26	-5,410.70	-1,660.17	2,263.98	1,438.34	5,897.14	10,562.03
Loan interests (+)	640.75	640.75	640.75	640.75	640.75	640.75	640.75	640.75	640.75
Total capital return (=)	-11,601.19	-8,556.98	-5,371.51	-4,769.95	-1,019.42	2,904.74	2,079.09	6,537.89	11,202.78

Table 10. Returns on total capital and equities (%) and their probability of realization in Group I farms in the area of investigation.

Variable	Total capital return (%)	Equity return (%)	Probability of realization (%)	Cumulative probability* (%)
LY, LP	-5.56	-6.04	0.03	0.03
LY, NP	-4.10	-4.54	0.11	0.13
LY, HP	-2.58	-2.98	0.03	0.16
NY, LP	-2.29	-2.68	0.11	0.27
NY, NP	-0.49	-0.84	0.46	0.73
NY, HP	1.39	1.09	0.11	0.84
HY, LP	1.00	0.69	0.03	0.87
HY, NP	3.14	2.88	0.11	0.97
HY, HP	5.37	5.18	0.03	1.00

* Cumulative probability differences result from the decimals.

6.04% under low yield, low price conditions, 0.49 and 0.84% under normal yield, normal price conditions, and 7.37 and 5.18% under high yield, high price conditions, respectively. Based on this, in Group I farms, probability of loss in proportion to total capital, that is operational risk, was 73%, and probability of incurring losses higher

Table 11. Incomes on total capital and equities in Group II farms (US$).

Income	LY, LP	LY, NP	LY, HP	NY, LP	NY, NP	NY, HP	HY, LP	HY, NP	HY, HP
Dry onion incomes	7,897.35	14,358.83	21,179.28	9,712.88	17,659.77	26,048.16	11,531.31	20,966.02	30,924.87
Wheat incomes (+)	6,160.89	6,571.62	6,982.35	7,839.28	8,361.89	8,884.51	9,538.12	10,174.00	10,809.88
Sugar beet incomes (+)	3,274.25	3,869.57	4,464.88	3,979.98	4,703.62	5,427.25	4,685.72	5,537.66	6,389.62
Barley incomes (+)	545.82	575.32	619.57	667.11	703.16	757.25	790.56	833.29	897.39
Sunflower income (+)	549.32	625.08	700.85	653.04	743.11	833.18	756.75	861.13	965.52
Grain corn incomes (+)	234.48	244.25	254.02	287.05	299.01	310.97	339.15	353.28	367.42
Other incomes (+)	11,956.25	11,956.25	11,956.25	11,956.25	11,956.25	11,956.25	11,956.25	11,956.25	11,956.25
Gross income (=)	30,618.35	38,200.91	46,157.19	35,095.58	44,426.80	54,217.57	39,597.86	50,681.63	62,310.93
External labor costs (-)	7,380.25	7,380.25	7,380.25	6,462.91	6,462.91	6,462.91	5,545.57	5,545.57	5,545.57
Fertilizer costs (-)	3,223.34	3,223.34	3,223.34	2,472.70	2,472.70	2,472.70	1,722.06	1,722.06	1,722.06
Diesel costs (-)	4,577.68	4,577.68	4,577.68	3,604.48	3,604.48	3,604.48	2,631.27	2,631.27	2,631.27
Seed costs (-)	2,642.75	2,642.75	2,642.75	1,680.52	1,680.52	1,680.52	718.30	718.30	718.30
Pesticide costs (-)	2,645.40	2,645.40	2,645.40	1,651.17	1,651.17	1,651.17	656.95	656.95	656.95
Irrigation water costs (-)	2,538.48	2,538.48	2,538.48	1,788.86	1,788.86	1,788.86	1,039.23	1,039.23	1,039.23
Other costs (-)	14,176.38	14,176.38	14,176.38	14,176.38	14,176.38	14,176.38	14,176.38	14,176.38	14,176.38
Net income (=)	-6,565.95	1,016.62	8,972.90	3,258.56	12,589.78	22,380.55	13,108.11	24,191.88	35,821.18
Equivalent of family labor costs and management (-)	10,080.34	10,080.34	10,080.34	8,827.38	8,827.38	8,827.38	7,574.42	7,574.42	7,574.42
Return on equity (=)	-16,646.28	-9,063.72	-1,107.44	-5,568.82	3,762.41	13,553.18	55,33.68	16,617.45	28,246.75
Loan interests (+)	1,539.15	1,539.15	1,539.15	1,539.15	1,539.15	1,539.15	1,539.15	1,539.15	1,539.15
Total capital return (=)	-15,107.13	-7,524.57	431.72	-4,029.66	5,301.56	15,092.33	7,072.84	18,156.61	29,785.91

than the loss on equities within total investment (-5.56%), that is financial risk, was 3%. Total risk exposed by Group I farms was 76%, and 73% of it was operational risk and the remaining 3% was financial risk (Table 10). Total amount of risk exposed by this group of farms was US$12,242. Of this, US$11601 was operational risk and US$641 was financial risk, which was the difference between the highest loss on equities and the highest loss on total investment (Table 9).

The maximum loss of US$12,242 that could be exposed by Group I farms constituted 5.87% of total capital and 6.40 of equities. Besides, this amount was 47% of gross return (US$25,793) under normal yield and normal price conditions. Therefore, the amount of loss was relatively high, but the probability of realization of this risk (76%) was quite high in Group I farms.

Incomes on total capital and equities in Group II farms are given in Table 11. Total capital and equity returns were US$-15,107 and -16,646 under low yield, low price conditions, US$5,301 and 3,762 under normal yield, normal price conditions, and US$29,786 and 28,247 under high yield, high price conditions, respectively.

Returns on total capital and equities as percentage and their probability of realization for Group II farms are given in Table 12. Total capital returns on total capital and equities were 4.53 and 5.24% under low yield, low price conditions, 1.59 and 1.12% under normal yield, normal price conditions, and 8.93 and 8.76% under high yield, high price conditions, respectively.

Based on this, in Group II farms, probability of loss in proportion to total capital, that is operational risk, was 27%, and probability of incurring losses higher than the loss on equities within total investment (-4.53%), that is financial risk, was 3%. Total risk exposed by Group II farms was 30%, operational risk being 27% and financial risk being 3% (Table 12). Total amount of risk exposed by this group of farms was US$16,646. Of this, a part of US$15,107 was operational risk and US$1,539 was financial risk, which was the difference between the highest loss on equities and the highest loss on total investment (Table 11).

The maximum loss of US$16,646 that could be exposed in Group II farms constituted 4.99% of total capital and 5.73 of equities. In addition, the possible amount of loss was 37% of gross return (US$44,427) under normal yield and normal price conditions. The amount of loss was relatively higher, and the probability of its realization (30%) was lower than Group I farms and higher than Group II farms.

Incomes on total capital and equities in Group III farms are given in Table 13. As can be seen in this table, total capital and equity returns were US$-12,550 and -14,610 under low yield, low price conditions, US$40,710 and 38,411 under normal yield, normal price conditions, and

Table 12. Returns on total capital and equities (%) and their probability of realization in Group II farms in the area of investigation.

Variable	Total capital return (%)	Equity return (%)	Probability of realization (%)	Cumulative probability* (%)
LY, LP	-4.53	-5.24	0.03	0.03
LY, NP	-2.25	-2.88	0.11	0.13
LY, HP	0.13	-0.40	0.03	0.16
NY, LP	-1.21	-1.79	0.11	0.27
NY, NP	1.59	1.12	0.46	0.73
NY, HP	4.52	4.17	0.11	0.84
HY, LP	2.12	1.67	0.03	0.87
HY, NP	5.44	5.13	0.11	0.97
HY, HP	8.93	8.76	0.03	1.00

* Cumulative probability differences result from the decimals.

Table 13. Incomes on total capital and equities in Group III farms (US$).

Incomes	LY, LP	LY, NP	LY, HP	NY, LP	NY, NP	NY, HP	HY, LP	HY, NP	HY, HP
Dry onion incomes	27,750.82	50,456.03	74,422.65	34,130.43	62,055.33	91,531.62	40,520.29	73,673.25	108,668.05
Wheat incomes (+)	9,072.02	9,676.82	10,281.63	11,543.47	12,313.04	13,082.60	14,045.06	14,981.40	15,917.74
Sugar beet incomes (+)	6,517.24	7,702.18	8,887.14	7,921.96	9,362.32	10,802.68	9,326.69	11,022.45	12,718.22
Barley incomes (+)	897.25	945.75	1,018.51	1,096.65	1,155.92	1,244.84	1,299.60	1,369.85	1,475.22
Sunflower income (+)	828.76	943.08	1,057.38	985.24	1,121.14	1,257.03	1,141.72	1,299.20	1,456.68
Grain corn incomes (+)	1,086.78	1,132.06	1,177.35	1,330.44	1,385.88	1,441.32	1,571.95	1,637.45	1,702.95
Other incomes (+)	19,616.18	19,616.18	19,616.18	19,616.18	19,616.18	19,616.18	19,616.18	19,616.18	19,616.18
Gross income (=)	65,769.05	90,472.12	116,460.84	76,624.37	107,009.81	138,976.26	87,521.50	123,599.78	161,555.02
External labor costs (-)	18,680.42	18,680.42	18,680.42	16,358.49	16,358.49	16,358.49	14,036.57	14,036.57	14,036.57
Fertilizer costs (-)	5,867.05	5,867.05	5,867.05	4,500.75	4,500.75	4,500.75	3,134.45	3,134.45	3,134.45
Diesel costs (-)	9,914.67	9,914.67	9,914.67	7,806.83	7,806.83	7,806.83	5,698.98	5,698.98	5,698.98
Seed costs (-)	4,365.78	4,365.78	4,365.78	2,776.20	2,776.20	2,776.20	1,186.62	1,186.62	1,186.62
Pesticide costs (-)	5,793.75	5,793.75	5,793.75	3,616.27	3,616.27	3,616.27	1,438.78	1,438.78	1,438.78
Irrigation water costs (-)	3,757.91	3,757.91	3,757.91	2,648.18	2,648.18	2,648.18	1,538.45	1,538.45	1,538.45
Other costs (-)	23,093.15	23,093.15	23,093.15	23,093.15	23,093.15	23,093.15	23,093.15	23,093.15	23,093.15
Net income (=)	-5,703.68	18,999.38	44,988.11	15,824.50	46,209.94	78,176.39	37,394.50	73,472.78	111,428.02
Equivalent of family labor costs and management (-)	8,906.01	8,906.01	8,906.01	7,799.02	7,799.02	7,799.02	6,692.02	6,692.02	6,692.02
Return on equity (=)	-14,609.68	10,093.38	36,082.10	8,025.48	38,410.92	70,377.38	30,702.48	66,780.76	104,736.00
Loan interests (+)	2,059.74	2,059.74	2,059.74	2,059.74	2,059.74	2,059.74	2,059.74	2,059.74	2,059.74
Total capital return (=)	12,549.95	12,153.12	38,141.84	10,085.22	40,470.66	72,437.12	32,762.22	68,840.50	106,795.74

US$106,796 and 104,736 under high yield, high price conditions, respectively.

Returns on total capital and equities as percentage and their probability of realization for Group III farms are given in Table 14. As can be seen from this table, total capital returns on total capital and equities were -2.44 and -2.97% under low yield, low price conditions, 7.88 and 7.70% under normal yield, normal price conditions, and 20.78 and 21.04% under high yield, high price conditions, respectively.

Based on this, in Group III farms, probability of loss in proportion to total capital, that is operational risk, was 3%, and probability of incurring losses higher than the loss on equities within total investment (-2.44%), that is financial risk, was 3%. Total risk exposed by Group III farms was 6%, and half of it was operational risk and the remaining half was financial risk (Table 14). Total amount of risk exposed by this group of farms was US$14,160. Of this, a part of US$12,550 was operational risk and US$2,060 was financial risk, which was the difference between the highest loss on equities and the highest loss on total investment (Table 13).

Table 14. Returns on total capital and equities (%) and their probability of realization in Group III farms in the area of investigation.

Variable	Total capital return (%)	Equity return (%)	Probability of realization (%)	Cumulative probability* (%)
LY, LP	-2.44	-2.97	0.03	0.03
LY, NP	2.36	2.00	0.11	0.13
LY, HP	7.42	7.23	0.03	0.16
NY, LP	1.96	1.59	0.11	0.27
NY, NP	7.88	7.70	0.46	0.73
NY, HP	14.10	14.13	0.11	0.84
HY, LP	6.38	6.15	0.03	0.87
HY, NP	13.40	13.41	0.11	0.97
HY, HP	20.78	21.04	0.03	1.00

* Cumulative probability differences result.

The maximum loss of US$14,610 that could be exposed in Group III farms constituted 2.84% of total capital and 3.13 of equities. In addition, this amount was 14% of gross return (US$107,010) under normal yield and normal price conditions. Both amount of loss and the probability of its realization were low in larger farm groups. The amount of the loss and its probability of realization (6%) was the lowest in Group III farms.

DISCUSSION

The methods used to eliminate or lower the impact of risk factors in agricultural production are referred to as risk management strategies (Akçaöz et al., 2006). For a good risk management, aims of farms should be first clearly defined. Then, the sources and magnitude of the risk to be exposed should be determined considering the nature of the operations and risk attitudes they have (Bozoğlu et al., 2001).

It was observed that the aim of the farms was to obtain incomes sufficient at least for their sustainability and for the subsistence of the farm owner. Based on risk measurement, financial risk was not a major source of risk in all three groups of farms since it was only 3% in all farm groups. The most significant source of risk was operational risk. However, the probability of realization for operational risk was not the same in all farm groups. Operational risk exposed by the farms was lower in larger farm groups. Therefore, it was concluded that different risk management strategies should be adopted for different size of farms depending upon the magnitude and probability of realization for the risk.

The research suggested that the production risk is more important risk sources than financial risk for the research area due to the capital structure of the investigated farms. Since most of the sample farms conducted their activities by using own capital, the effects of the financial risk component was relatively low. This finding confirmed the results of the previous studies. Bozoğlu et al. (2001) measured the total risk and decomposed the production and financial risk for dairy farming in Tonya district of Trabzon, Turkey. They stated that the total risk was 57% and 50% of it was production risk while the rest was financial one. Similarly, Hazneci (2009) suggested that financial risk was 3% and production risk was 73% for the dairy farms in Amasya province of Turkey.

Risk measurement showed that operational risk and financial risk was 73 and 3% in Group I farms, respectively. The maximum risk of US$12,242 that could be exposed in Group I farms was 5.87 and 6.40% of total capital and equities, respectively. This amount was 47% of total gross return under normal yield and normal price conditions. Accordingly, strategies that could be used by Group I farms are to avoid the risk and to control the risk. These farms can select one of these two strategies or can use both of them at times. As risk control strategies, diversification of production activities or diversification of income could be suggested.

Diversification is performing more than one operation in a farm. When the farm diversifies its production activities, no significant fluctuations will take place in farm income since yield and prices of different crops will fluctuate in different times. The most common reason for diversification is irregularities in yield and price and, consequently, in income. Besides, having one or more products in the farm whose production is continuous throughout the year will provide a more regular income flow (Akçaöz, 2001). For this group of farms, a decrease in dry onion production, which has high price risk, and an increase in fodder crops, fruits and vegetables in production design can be suggested. Having new crops in the production design will decrease both the fluctuations in income and the risk from changing input prices. Results showed that idle family labor was high in the region. Therefore, farms in Group I could make use of idle family labor through income diversification.

Farm operator's or family members' engagement in non-agricultural income-providing activities may eliminate the threats to family income posed by the risks in agricultural production. In addition, a regular cash flow will be provided to the farm, and income fluctuations will be lowered as a result of income diversification (Akçaöz, 2001). Although non-agricultural income possibilities are limited in Amasya, income diversification is another risk management strategy for the farms in Group I.

Based on the risk analysis conducted, calculated operational risk was 27% and financial risk was 3% in Group II farms. The maximum loss of US$16,646 in Group II farms was 4.99% of total capital, 5.73% of equities and 37% of gross returns under normal yield-normal price conditions. Therefore, a risk management strategy that could be used by Group II farms is to the risk transfer. Based on risk management strategies, cooperativization, contract-based growing and agricultural insurance could be suggested for these farms as risk transfer strategies.

Farms in Group II should establish cooperatives to control the fluctuations in crop and input prices. Cooperativization as a risk management strategy can be useful in three ways: first, by starting a cooperative, farmers can reduce the risk of failure to obtain input in the market. Second, cooperatives can lower the technological risk experienced by farmers through providing the technical information to their members and transferring new technology. Finally, farmers make sure of selling their produces and getting better prices, reducing or eliminating the market and price risks (Ceyhan, 1995). Thus, farms in Group II can reduce the fluctuations both in input and produce prices and solve marketing problems. Another risk transfer strategy that could be suggested for this group of farms is contract-based growing. In contract-based growing, farmers have a warranty for selling the produce. Thus, farmers could sell the produces before the harvest, eliminating the price risk. In this production system, the farmer is protected against price fluctuations, and risk factor is shared by each party. This can also control the price and market risk to some degree (Hazneci, 2009). Another risk transfer strategy that could be suggested for this group of farms is to get the crops grown insured. Thus, the crops can be protected against the risks, and possible fluctuations in the income of producers could be reduced to minimum levels.

According to risk analysis conducted, Group III farms had equal operational and financial risks of 3%. The maximum possible risk of US$14,610 in Group III farms was 2.84 and 3.12% of total capital and equities in farms, and 14% of gross return under normal yield and normal price conditions. Since both the amount of losses and the probability of its realization were low, the strategy that could be used for this group of farms is to accept the risk.

Based on the results of the previous researches, different strategies were suggested associated with the geographic conditions and the type of farm. Bozoğlu et al. (2001) suggested the off farm income for dairy farms. For the mixed farm in the Mediterranean region, Akçaöz (2001) suggested the strategies such as arranging credit, off farm income, crop diversification and marketing contract. In Antalya, diversification, off farm income, marketing, planning and social security program were offered by Akçaöz and Özkan (2005). In addition, same authors suggested credit management, marketing management and capital management apart from the strategies suggested in 2005 in greenhouse production (Akçaöz et al., 2006). For the dairy farms in Amasya, Hazneci (2009) proposed the strategies of crop diversification, cooperation, income diversification and contract farming.

Conclusion

This study dealt with the assessment of the risks for dry onion growing farms in Amasya Province of Turkey and determination of risk management strategies using primary and secondary data. A randomly layered sampling method was used and 101 farms were studied. For assessment of the risk of farms, operational risk and financial risk were calculated as risk sources from production activities. Total risks were also calculated from them. It was found that risks for farms were smaller as the farm size increased. Total risk was 76% (73% operational risk and 3% financial risk) for the Group I farms, 30% Group II farms (27% operational risk and 3% financial risk) and 6% for Group III farms (3% operational risk and 3% financial risk).

The rate of the largest amount of risk on total farm capital in Group I farms was 6%. In other words, these farms risked 6% of their capital. Group II farms risked 5% and Group III 3%. Since the risk decreased by farm size, strategies to be used by farms for risk management were determined separately for farm size groups. Accordingly, the best strategies for Group I farms is to escape from the risk or to control it. Group I farms can opt for one of these two strategies or could use both at times. Based on risk management strategies, these farms are advised that diversification of production activities or incomes is a risk control strategy. The strategy that could be used for the Group II farms is to transfer the risk. They can use cooperatives, contract based production and agricultural insurance as risk transfer strategy. Since both amount and the probability of the risk in Group III farms is small, risk acceptance is the best strategy for them.

Although the local farmers operate under many risk factors, they usually disregard the risk factors in agricultural production. In the interviews with the farmers, it was observed that they were not well informed about risks involved in agricultural production. Therefore, the

farmers should be trained about risks and strategies that can be developed against them. In addition, they should be informed about the results of the studies like the present one.

The number of studies about the measurement of risks in farms and about determination of risk management strategies should be increased. Such an effort could reduce the negative effects of risks in agricultural production.

Finally, an increase in the number of such studies in agricultural production area where risks and uncertainties are high would benefit farmers, local economy and general economy of the country at large.

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