Rain-fed agriculture risks and management strategies adopted by farmers in two agro-ecological zones in Al-Hasakeh province of Syria

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Abstract

Based on survey data of 319 rain-fed farmers in Al-Hasakeh, Syria, this study analyses rain-fed farmers' risk attitudes and farmers' perceptions of risk and risk management. Furthermore, it analyzes, using multiple regression analysis, the relationship between socio-economic characteristics and farmers' risk attitudes. The results demonstrate that precipitation shortage was the most important risk source that threaten farmers in both zones. Moreover, risks of diseases and pests and natural disasters were highly perceived by farmers in zone 1. Farmers in zone 2 were more concerned about fire damages and lack of government support. The financial strategy related to the producing at lowest possible cost is perceived as an important strategy to manage risk by farmers in both zones. Spraying for diseases and pests and liquidity are perceived as the most effective risk management strategies by farmers in zone 1, whereas farmers in zone 2 considered liquidity and choose good quality materials as an important strategy. The results also show that some farm and farmers' characteristics (e.g. age, experience, education, household size, farm size, family labour, extension contact, off-farm work and Co-op Member) significantly impact the risk attitudes of the farmers in both zones.

Keywords*: Rain-fed crops, Agro-ecological zone, Risk perceptions, Risk management, Syria.*

1. Introduction

Agriculture plays an important role in supporting the Syrian economy at a time when climate changes, changes in Syrian agricultural policies and trade liberalization are a source of risks facing the Syrian farmers (Almadani, 2014).

Syria is a Mediterranean country with a Mediterranean climate, characterized by rainy winters and hot and dry summers. As a result, the dates and distribution of rainfall are a determining factor for agricultural production and agricultural activities (NAPC, 2010). Syria has been divided into five agro-ecological zones (settlement zones) according to the annually rainfall precipitation and the expected probability of rainfall in each zone. Accordingly, these settlement zones used by the government to define the land use appropriateness for cropping pattern that entailing specific support provided by government of Syria for farming within each zone (MAAR, 2016).

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Syria had a declining rate of rainfall from 2003 to 2008 because of the repeated droughts, which influenced adversely both crop production, especially the rain-fed crops. Therefore, the Government has established the Project of Artificial Rainfall, which induced the amount of rain by 6-16% (NAPC, 2010).

Risk is a multidimensional concept with no agreed terms for definitions but rather seen from the perspective of various authors (Fawole and Ozkan, 2018). The risk is the possibility of a loss, or the possibility that the results will be contrary to what the individual expected (AOAD, 2004). The terms "risk" and "uncertainty" can be defined in different ways, and one of these common concepts is that risk is incomplete knowledge in which the probabilities of possible outcomes are known, while uncertainty arises when it is impossible to know these possibilities (Hardaker *et al.*, 2015). Risk attitude refers to the behaviour of the decision maker (the farmer) and how much he or she is willing or unwilling the risk (Pennings *et al.*, 2002).

There are different types of agricultural risks in Syria, namely the price, marketing, production, financial and policy change risks. Farmers face these risks by following a set of measures classified into two main groups, the first is the *ex ante* risk management strategies like crop and income diversification, specialization, precautionary savings and production/marketing contracts. The second group of strategies is the *ex post* risk coping strategies like consumption smoothing, informal and formal credit, asset liquidation and working out of agriculture, supporting programs and welfare policies (Yassin, 2011).

Since risk and risk attitudes of farmers play an important role, many researchers have studied risk in agriculture and their management. The National Agricultural Policy Center in Syria (NAPC) recommended in the last annual report (2010) to give risks, particularly drought, more concern and superiority among the scientific research in the country. The study of risks in rain-fed crops in Syrian in general and Al-Hasakeh Governorate in particular is still of little importance in agricultural research. Therefore, this study aimed to shed light on the risks facing rain-fed farmers in the first and second settlement zones, and the strategies for controlling them. This research can provide useful information regarding risk analysis for farmers in the study area at farm level.

2. Literature reviews

The study of risk is of great importance to the agricultural sector. Previous studies dealt with the sources of risk and management strategies by farmers through the survey of their opinions, and farmers' attitudes towards risk. For example, in Bangladesh, Rahman *et al.* (2020) showed that rice farmers suffer from high production costs and low profit margins due to high labor wages, low soil and water quality, air pollution, low productivity of cultivated crops, and frequent disasters. As a result, these farmers are forced to resort to agricultural loans, which cause their exposure to financial risks. The study concluded that diversification of income sources and contract farming as the most important strategies to mitigate the effects of financial risks.

Raghavendra and Suresh (2018) concluded that the late monsoons, erratic rainfall, and disease and insect infestation were the primary risks for rain-fed soybean farmers in India. The study showed that crop diversification, crop insurance, micro-irrigation, and diversification of cultivated varieties were perceived as the most relevant among farmers.

The results obtained by Ahmad *et al.* (2019) revealed that wheat farmers in Pakistan are generally risk-averse. Rain, storms, hail, high input prices, and wheat diseases were the most important risk sources.

Climate change is a worldwide phenomenon. Drought is one of the most important of these changes that hit many countries. Most world countries, especially in the arid and semi-arid regions, have been seriously devastated by the consequences of climate change (Alrusheidat *et al.*, 2016). Agricultural sector in Syria is the largest sector of the economy, which is responsible for providing the largest portion of food for the population and achieving food security. Agricultural production in Syria is characterized by its dependence on rainfall, where 40-70% of winter crops (mainly wheat and barley) are rain-fed consequently they are highly exposed to the risk of drought as a result of rainfall fluctuations (Yassin, 2011).

Some studies dealt with agricultural risks in Syria, where Almadani (2014) indicated that wheat-cotton farmers are more likely risk-averse than pistachio farmers who could better be described as risk-neutral farmers. Rainfall shortage and fuel price increase are the most important risk sources that threaten both wheat-cotton and pistachio cultivation. On the other hand, farming as a secondary occupation and faming forsaking were the most preferred strategies to cope with risk. The geographical location, education level and information resources have a considerable exploratory power for wheat-cotton farmers' risk attitude and perceptions of risk and risk management. Other studies have shown that agricultural risks in Syria are mainly related to production and price risks and the risks of policy change, as these risks different in intensity and impact according to zones (Farming Systems). Diversification of income sources and cultivated crops are the main strategies adopted by farmers (Yassin, 2011). There is no specific system for agricultural risk management in Syria. the only way applied to help Syrian farmers in case of emergencies is reschedule or respite the credits they got (NAPC, 2007).

3. Data and methodology

3.1. *Study area and sampling design*

The study was conducted in Al-Hasakeh Governorate, which is located in the Northeast part of Syria and spreads over all agro-ecological zones and vulnerable natural disasters such as droughts. The reason for choosing this region is being one of the most important areas in the cultivation of rain-fed crops, which constitutes about 32.72% of Syria's total rain-fed area and agriculture is the main source of income for the population.

This study is based on a survey of rain-fed crop farmers carried out in 2017/2018-2018/2019 in the first and second settlement zones.

(1) First settlement zone: A zone with annual rainfall over 350 mm. It is divided into two areas:
- A-The area of annual rainfall rate over 600 mm. Where rain field crops could be successfully planted.
- B-The area of annual rainfall rate between 350-600 mm. and not less than 300 mm. during the 2/3 of the relevant year i.e. it is possible to get two seasons every three years and its main crops are: Wheat, Legumes and Summer Crops.

(2) Second settlement zone: zone with annual rainfall 250-350 mm. and not less than 250 mm during 2/3 of the relevant year i.e. it is possible to get two barley seasons each three years, and could be planted beside barley, wheat, legumes and summer crops (MAAR, 2016).

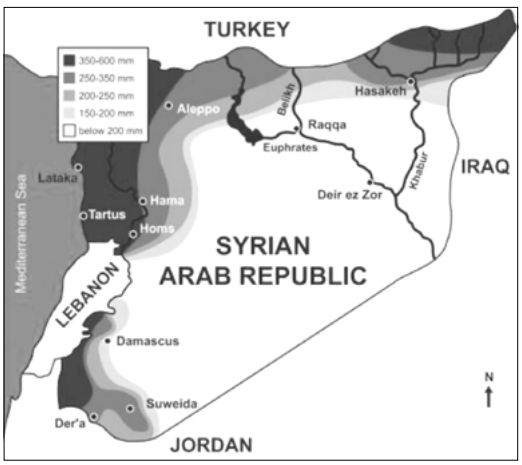
The target population in this study is the rain-fed crop farmers, and the number of available farmers was 39194. The sample size was calculated from the following formula given by (Krejcie and Morgan, 1970):

$$s = X^2NP\,(1 - P) / d^2(N - 1) + X^2\,P\,(1 - P) \quad (1)$$

where:
s = required sample size
X^2 = the table value of chi-square for 1 degree of freedom at the desired confidence level (3.841)
N = the population size
P = the population proportion (assumed to be .50 since this would provide the maximum sample size)
d = the degree of accuracy expressed as a proportion (.05).

Based on the above equation, the sample consists of almost 380 farmers. We had recovered 380 surveys, of which 61 surveys with missing

Figure 1 - Map of study area in Al-Hasakeh Governorate, Syria.



Source: FAO, 2003.

data were removed. Hence, our final sample size counted 319 respondents.

Stratified random sampling was used. In the first sampling stage, 98 villages were selected (58, 40 from the zone 1 and 2 respectively). In the second stage, the rain-fed farmers in these villages were divided into two layers according to agro-ecological zones of the study area; 191 from the zone 1 and 128 from the zone 2.

3.2. *Data collection: instrument and process*

Data for this study were obtained mainly from primary sources. A structured questionnaire was prepared to achieve this study. Most of the questions were of the closed type, mainly in the form of five-point Likert-type scales. The questionnaire included questions about the following: i) farmers' perceptions of risk (including questions on different risk sources); ii) farmers' perceptions of various risk management strategies. In addition the questionnaire includes information regarding socio-economic characteristics of farmers.

Farmers face various risks, each respondent was asked to indicate their degree of agreement or disagreement using a five-point Likert scale (1 = not important; 5 = extremely important) to express how significant they perceived each source of risk. Likewise, a Likert scale was used to determine the importance of various risk management strategies. We used 23 Likert-scale questions for risk sources, and 25 for risk management strategies.

The face-to-face interviews with the farmers were conducted with the help of trained extension service workers who work in the extension units that are spread in the study area. Extension unit plays an important role of agricultural risk management (Yassin, 2011). This made the data collection process easier and the farmers showed more cooperation with the extension agents.

3.3. *Statistical Methods*

3.3.1. *Descriptive statistics*

Descriptive statistics are used to describe data and to summarize the information about the respondents. Farmers' characteristics were examined using (frequency distribution, arithmetic mean and standard deviation).

3.3.2. Testing the difference between groups

The *t*-test and chi-square, are used to reveal the statistical significance between the means of two groups.

3.3.3. *Risk attitude*

Self-assessment scale method was used to assess farmers' attitudes to risk through four sets of statement using a 5-point Likert scale (1 = strongly disagree; 5 = strongly agree). The following statement was used to assess farmers' risk attitude: 'I am willing to take more risks than others with respect to: production, marketing, finance and investment.' (Bishu *et al.*, 2018).

3.3.4. *Regression analysis*

Multiple regression analysis was used to assess the relationship between the socioeconomic characteristics and the risk attitudes of farmers. The equation can be written as follows:

$$Yi = b0 + b1AGE + b2EXP + b3EDU + b4HSIZE + b5FSIZE + b6FLAB + b7EXT + b8OFFW + b9COOP + e \quad (2)$$

where:
Y_i: is risk attitude for farmer *i*
b_i: is the regression coefficient
AGE: is the age of respondent (years)
EXP: is the experience of rain-fed farming (years)
EDU: Education of respondent (1=Illiterate, 2= literate, 3=Primary, 4=Secondary, 6=Institute, 7=University)
HSIZE: is household size (Person)
FSIZE: is farm size (hectare)
FLAB: Family labour (measured by five-point Likert-scales, 1=very infrequently, 2 = infrequently, 3= sometimes, 4= frequently and 5= very frequently)
EXT: is extension contact (Measured by a dummy variable with 0 indicating there is no extension contact, and 1 indicating farmers has extension contact)
OFFW: is Off-farm work (Measured by a dummy variable with 0 indicating there is no off-farm work, and 1 indicating farmers has off-farm work)
COOP: is Membership of cooperative (Measured by a dummy variable with 0 indicating farmer is not member, and 1 indicating farmer is member).

4. Results and discussions

4.1. *Socio-economic characteristics of the farmers*

The main characteristics of the rain-fed farmers groups are compared in Table 1. The age group distribution indicates that the majority of the farmers in both regions were between 40-60 years old. The survey also showed that the majority of the sampled farmers (87%) have spent more than fifteen years in the rain-fed farming with average experi-

Table 1 - Socio-economic characteristics of the rain-fed farmers (n=319).

Item	*Unit*	*Overall (n=319)*	*Agro-ecological zone*		*Test of difference*[a]
			1 (n=191)	*2 (n=128)*	
Farmer age	%				1.178[ns]
Less than 40 years old		18.8	20.9	15.6	
40-60 years old		57.4	57.1	57.8	
More than 60 years old		23.8	22.0	26.6	
Experience in farming	%				1.288[ns]
Less than 15 years		12.9	12.6	13.3	
15-20 years		46.7	42.9	52.3	
More than 20 years		40.4	44.5	34.4	
Education	%				7.45[ns]
Illiterate		20.1	23.6	14.8	
literate		9.7	7.9	12.5	
Primary		32.0	30.4	34.4	
Secondary		22.9	20.9	25.8	
Institute		11.6	13.6	8.6	
University		3.8	3.6	3.9	
Farm size	hectare	11.38	13.09	8.82	8.466[**]
Household size	person	6.74	7	6.35	2.615[*]
Off-farm work	%				0.186[ns]
Yes		60.8	61.8	59.4	
Family labour	%				4.191[ns]
Very infrequently		15.7	13.6	18.8	
Infrequently		13.2	11.5	15.6	
Sometimes		27.0	28.8	24.2	
Frequently		32.9	35.6	28.9	
Very frequently		11.3	10.5	12.5	
Land ownership status	%				2.390[ns]
Private		80.3	81.7	78.1	
Rental		11.5	9.4	14.8	
Other		8.2	8.9	7.1	
Extension contact	%				0.601[ns]
Yes		48.0	49.7	45.3	
Membership of cooperative	%				7.575[*]
Yes		28.8	34.6	20.3	
Production system	%				34.07[**]
Hard wheat		26.6	28.3	24.2	
Soft wheat		21.3	26.7	13.3	
Barley		24.1	13.6	39.8	
Chickpea		7.2	9.9	3.1	
Lentil		10.0	9.9	10.2	
Cumin		10.7	11.5	9.4	

*[a]: Test of differences based on chi-square and independent t test; *P<0.05, **P<0.01. [ns]: not significant.*
Source: Field survey.

ences of about 24 and 23 years in zone 1 and 2 respectively.

Data reflect an increase in education for farmers. As the percentage of farmers who received various forms of education exceeded about 75% in both zones, without significant differences between them.

The average farm size of the farmers in the zone 1 was 13.09 ha. In contrast, farmers in the zone 2 had an average farm size of 8.82 ha. This result indicates that the zone 1 farmers hold average farm sizes larger than zone 2 farmers ($P < 0.01$).

There also appear to be significant differences in household size between the zone 1 and zone 2 farmers. The average household size for the zone 1 and 2 was found to be 7 and 6.35 respectively and was significantly different ($P < 0.05$) between the two zones. Almost 61% of the farmers earned income by non-farm jobs.

The work of some family members outside the farm constitutes an additional source of income that can increase the farmers' ability to bear various risks, as the results in Table 1 indicated that 46% and 41.4% of the family members of farmers in the zone 1 and 2 respectively work outside the farm frequently and very frequently.

Approximately 80 % of the farms were under a private ownership type. Farm land rental rate was relatively high among the farmers in the zone 2. Regarding the farmers' extension visit, the highest share was in zone 1 (49.7%).

Around 34.6 % of the farmers in zone 1 were members of a cooperative, which was significant more than for the zone 2 farmers ($P < 0.05$). Wheat (47.9%) and barley (24.1%) were the major crops in the research area, followed by Cumin (10.7%), lentil (10.0%) and chickpea (7.2%).

4.2. *Risk attitude*

Table 2 and 3 show statistics for respondents' answers about each statement in zone 1 and 2 respectively. Generally, the findings show the lower of average score for risk assessment statements for farmers in zone 2 compared to farmers in zone 1; indicates that those farmers are more towards risk aversion attitude. This may be due to the precipitation shortage in zone 2 compared to zone 1; this poses a greater threat to agricultural production in zone 2.

4.3. *Farmers' perception of various risk sources*

Rain-fed farmers were asked to rate (on a 5-point Likert scale) the potential of the risk to affect their income/profit. In total, 23 risk sources were considered. Cronbach's alpha coefficients calculated for the zone 1 and zone 2

Table 2 - Responses of the rain-fed crop farmers about statements of self-assessment scale in the zone 1 (n=191).

Risk category	*Relative risk aversion[a] (%)*					*Mean*	*SD*
	1	*2*	*3*	*4*	*5*		
Production	6.28	39.27	6.28	28.27	19.90	3.16	1.30
Marketing	0.00	28.27	7.85	55.50	8.38	3.44	0.99
Financial	4.19	20.42	29.36	41.36	4.19	3.21	0.96
Investment	6.28	40.84	24.61	24.08	4.19	2.79	1.01

[a] Relative risk: 1 = strongly disagree 2 = disagree 3 = neutral 4 = agree 5 = strongly agree.
Source: Field survey.

Table 3 - Responses of the rain-fed crop farmers about statements of self-assessment scale in the zone 2 (n=128).

Risk category	*Relative risk aversion[a] (%)*					*Mean*	*SD*
	1	*2*	*3*	*4*	*5*		
Production	0	37.50	12.50	46.09	3.91	3.16	0.98
Marketing	3.13	25.00	25.00	44.53	2.34	3.18	0.94
Financial	11.72	31.25	24.22	28.90	3.91	2.82	1.09
Investment	3.13	53.90	37.50	3.91	1.56	2.47	0.70

[a] Relative risk: 1 = strongly disagree 2 = disagree 3 = neutral 4 = agree 5 = strongly agree.
Source: Field survey.

Table 4 - Ranking of perceptions of sources of risk by sampled farmers in first and second agro-ecological zone in Al-Hasakeh, Syria.

Sources of risk	*Overall (n=319)*			*Agro-ecological zone 1 (n=191)*			*Agro-ecological zone 2 (n=128)*			*Test of difference*[b]
	Mean[a]	*SD*	*Rank*	*Mean*[a]	*SD*	*Rank*	*Mean*[a]	*SD*	*Rank*	
Precipitation shortage	4.26	0.64	1	4.15	0.63	1	4.43	0.61	1	3.91***
Lack of funding	4.00	0.66	3	3.91	0.70	4	4.14	0.57	5	3.17**
Lack of government support	3.88	0.74	9	3.67	0.71	13	4.21	0.68	3	6.75***
Unexpected variability of product prices	3.96	0.78	5	3.83	0.72	6	4.16	0.82	4	3.73***
Natural disasters such as heat, flood, storm	4.01	0.56	2	3.93	0.57	3	4.14	0.51	5	3.43***
Debt situation	3.94	0.68	6	3.90	0.68	5	4.03	0.65	7	1.64ns
Production cost	3.97	0.61	4	3.91	0.60	4	4.06	0.62	6	2.16*
Diseases and pests	3.88	0.79	9	3.96	0.71	2	3.75	0.89	12	2.27*
Fire damages	3.92	0.78	7	3.72	0.78	11	4.22	0.68	2	5.91***
Marketing/sale	3.89	0.76	8	3.77	0.84	8	4.06	0.59	6	3.33**
Credit availability	3.79	0.84	10	3.74	0.79	10	3.85	0.91	9	1.07ns
Lack of automated harvesting	3.71	0.72	12	3.82	0.78	7	3.57	0.62	13	2.95**
Lack of agricultural machinery	3.78	0.71	11	3.71	0.65	12	3.89	0.78	8	2.14*
Unexpected variability of input prices	3.78	0.79	11	3.75	0.70	9	3.82	0.92	10	0.68ns
Security disturbances	3.63	0.80	13	3.53	0.75	15	3.78	0.85	11	2.65**
Future interest rates	3.50	1.07	14	3.51	0.95	16	3.50	1.23	14	0.10ns
Buyers (government, merchant)	3.48	0.74	15	3.54	0.77	14	3.39	0.69	15	1.78ns
Wages of labour	3.33	0.93	16	3.41	0.84	17	3.21	1.04	17	1.79ns
Difficulties for finding labour	3.20	0.90	17	3.15	0.79	18	3.26	1.05	16	1.04ns
Brokers' dominance	3.00	0.96	19	3.15	0.96	18	2.76	0.91	21	3.63***
Cultivation of new varieties	3.06	0.91	18	2.99	0.90	19	3.16	0.92	18	1.62ns
Sale of crop residues	2.75	0.79	20	2.53	0.71	20	3.07	0.79	19	6.34***
Competition from neighbour countries	2.29	0.90	21	2.32	0.87	21	2.24	0.94	20	0.85ns

*[a] Likert scale is employed from 1 (not important) to 5 (extremely important). [b] The mean scores of zone 1 and zone 2 farmers are significantly difference at * P<0.05, ** P<0.01 and *** P<0.001 based on independent samples t test. [ns]: not significant.*
Source: Field survey.

farmers were 0.74 and 0.70 respectively. Table 4 shows the average scores of farmers' perceptions of each source of risk and the standard deviations of the scores.

Precipitation shortage has been identified as the top rated source of risk by the farmers in both zones. The standard deviation of this risk source in each zone is less than 1, indicating a high level of consensus among the farmers. This result is expected due to dependence of agricultural in these two zones on rain water. The production risks related to *diseases and pests*, *natural disasters* and *production cost* were ranked second, third and fourth, among the farmers in zone 1

with mean scores of 3.96, 3.93 and 3.91, respectively. The results reflect that farmers affected by the floods and dust storms that hit the zone during the previous period.

Fire damages, lack of government support and *Unexpected variability of product prices* were ranked second, third and fourth, among the zone 2 farmers. Zone 2 farmers rated the importance of these risks higher than the zone 1 farmers. As of June 8, 2019, the SANA listed on its website the fires that Al-Hasakeh Governorate witnessed during the season 2018-2019 have affected about 17,000 hectares of land cultivated with wheat and barley crops. The volume of support provided by the government (loans, fertilizers, prices, and seeds) also decreased during the crisis period (2011-2020) compared to the support provided before the crisis. Economic sanctions were imposed on Syria, which had a great impact on the agricultural sector, and were a major cause of the increase in the prices of production inputs.

Debt situation and *lack of funding* were ranked the fifth most important source of risk in zone 1 and 2 respectively. This source of risk associated with the ability of the farmer to repay his financial obligations; in order for him to be able to continue his work in agriculture and avoid possible bankruptcy, this also indicates the farmers' keen interest for the financial liquidity on the farm in order to meet the costs of production in light of the high prices arising from the crisis conditions. In addition, *Unexpected variability of product prices*, *lack of automated harvesting*, *marketing/sale*, *Unexpected variability of input prices*, and *credit availability* were considered important risk sources by all farmers. Sources of risk that obtained low mean scores included *competition from neighbour countries*, *sale of crop residues*, *cultivation of new varieties*, *brokers' dominance*, *difficulties for finding labour*.

Comparisons of risk perception between the farmers in the zone 1 and zone 2 showed significant differences in most sources of risk. this result may be attributed to the fact that the sources of risk differ according to the different geographical area, farm type, the environmental impact and the country's political and economic situation (Aditto, 2011).

4.4. *Perception of risk management strategies*

The results of the perceptions of the various risk management responses by the farmers in both zones are discussed in Table 5. According to farmers in the zone 1 and 2, the most important risk strategy was to *producing at lowest possible cost* (4.02, 4.14) respectively. Nearly 54% and 45% of zone 1 and zone 2 farmers reported using this strategy. Farmers in zone 1 perceived *spraying for diseases and pests*, *liquidity-keep cash in hand*, *adopt crop rotation*, *choose good quality materials*, *adopt new technology*, *storage (spread sales over time)*, *leasing farm machinery*, *growing more than one crop* as important strategies to reduce the risk, with scores of 3.79, 3.70, 3.65, 3.61, 3.58, 3.52, 3.48 and 3.46 respectively. In the zone 2 famers, the most effective strategy was to *keep cash in hand* (4.06) followed by the *choose good quality materials* (3.89), *spraying for diseases and pests* (3.84), *growing more than one crop* (3.83), *storage (spread sales over time)* (3.75), *farmer working off-farm* (3.68), *adopt crop rotation* (3.62), *adopt new technology* (3.58), *use of skilled labour* (3.41). Farmers generally did not see *farming forsaking* and *production contracts* as important strategies. Only 15% and 12% of the farmers in zone 1 and 2 respectively had used this strategy to manage risk. This indicates that most farmers do not consider leaving agricultural work as a way to reduce the risk, which confirms their close association with this work, which constitutes their main source of livelihood. The low ranking of *production contracts* could be caused by the lack of an integrated contract farming system in Syria.

Farmer working off-farm and *family members working off-farm* showed significant differences in importance between the farmers in the zone 1 and zone 2 ($P < 0.001$ and $P < 0.01$ respectively). Zone 2 farmers perceived the importance of these two strategies higher than zone 1 farmers. This is because the farmers in the zone 2 get less farm income compared to the zone 1. Cronbach's alpha coefficients for risk strategies in relation to both zones were found to be 0.82 in the zone 1 and 0.77 in the zone 2.

Table 5 - Ranking of perceptions of risk management strategies by sampled farmers in first and second agro-ecological zone in Al-Hasakeh, Syria.

Risk management strategy	*Overall (n=319)*				*Agro-ecological zone 1 (n=191)*				*Agro-ecological zone 2 (n=128)*				*Test of difference*[c]
	Mean[a]	*SD*	*Rank*	*%*[b]	*Mean*[a]	*SD*	*Rank*	*%*[b]	*Mean*[a]	*SD*	*Rank*	*%*[b]	
Producing at lowest possible cost	4.07	0.72	1	48	4.02	0.70	1	54	4.14	0.72	1	45	1.40[ns]
Liquidity-keep cash in hand	3.84	0.79	2	38	3.70	0.68	3	32	4.06	0.91	2	41	1.73[ns]
Leasing farm machinery	3.45	0.94	9	64	3.48	0.93	8	71	3.40	0.95	11	61	0.69[ns]
Farmer working off-farm	3.39	1.01	10	44	3.23	1.01	10	50	3.68	0.95	7	49	3.98[***]
Assurance of bank loans	3.07	1.14	12	15	3.01	1.13	12	14	3.16	1.15	15	21	0.26[ns]
Storage of production inputs	3.21	0.84	11	47	3.10	0.78	11	50	3.36	0.89	12	43	2.69[**]
Family members working off-farm	3.01	1.11	14	34	2.84	1.15	16	39	3.25	1.02	13	32	3.30[**]
Sale of farm assets	2.67	1.06	19	25	2.67	0.95	20	23	2.67	1.21	20	26	0.01[ns]
Spraying for diseases and pests	3.81	0.82	3	49	3.79	0.82	2	58	3.84	0.82	4	41	0.56[ns]
Growing more than one crop	3.61	1.01	7	45	3.46	1.00	9	50	3.83	0.97	5	48	3.24[**]
Adopt crop rotation	3.64	0.92	5	45	3.65	0.97	4	49	3.62	0.85	8	45	0.33[ns]
Adopt new technology	3.58	0.80	8	33	3.58	0.78	6	37	3.58	0.82	9	28	0.05[ns]
Use of skilled labour	3.06	1.07	13	31	2.82	1.00	17	34	3.41	1.06	10	34	4.97[***]
Diversification of farm activities	2.82	1.12	16	20	2.94	1.18	14	26	2.65	0.99	21	13	2.24[*]
Storage (spread sales over time)	3.62	0.89	6	43	3.52	0.91	7	42	3.75	0.86	6	49	2.19[*]
Markets diversification	2.81	0.98	17	32	2.74	0.95	19	36	2.91	0.98	17	25	1.47[ns]
Selling to the consumer	2.84	0.94	15	28	2.97	0.91	13	35	2.65	0.95	21	20	3.02[**]
External marketing	2.73	0.92	18	3	2.59	0.99	21	5	2.78	1.14	19	1	1.58[ns]
Production contracts	2.57	0.97	20	8	2.55	0.91	22	10	2.60	1.05	22	13	0.41[ns]
Choose good quality materials	3.72	0.79	4	50	3.61	0.82	5	49	3.89	0.80	3	44	2.99[**]
Consult with farmers	2.88	0.79	9	33	2.75	0.75	18	33	3.07	0.83	16	31	3.47[**]
Adhere to the agricultural extension	3.00	0.98	15	42	2.84	1.01	16	39	3.23	0.90	14	37	3.49[**]
Join cooperative society	2.82	0.85	16	37	2.82	0.88	17	40	2.82	0.80	18	25	0.06[ns]
Offer incentives to labour	3.01	1.02	14	22	2.91	1.03	15	24	3.16	0.98	15	27	2.18[*]
Farming forsaking	2.36	0.98	21	13	2.42	0.78	23	15	2.27	1.09	23	12	1.33[ns]

*[a] Likert scale is employed from 1 (not important) to 5 (extremely important). [b] The percentage of farmers using each risk management strategy. [c] The mean scores of zone 1 and zone 2 farmers are significantly difference at * P<0.05, ** P<0.01 and *** P<0.001 based on independent samples t test. [ns]: not significant.*

Source: Field survey.

4.5. *Determinants of attitudes based on socio-economic characteristics*

Socio-economic characteristics were regressed against each of zone 1 and 2 farmers' risk attitudes. For all multiple regressions, preliminary analyses were carried out to verify there was no violation of the multiple regression assumptions (normality, linearity, multicollinearity and homoscedasticity). The goodness-of-fit of the models is indicated by R^2 and adjusted R^2. The two models have relatively high R^2 and adjusted R^2, and explained roughly (78%, 59%) of the total variance for zone 1 and 2 respectively.

The results suggest that, for both zones, farmers' education level was positively and significantly related to their attitudes toward risk ($p < 0.01$), indicating that farmers with a higher level of education were found to be less risk-averse. This result is congruent with the conclusion that high educated individuals have been positively associated with risk taking (Aditto, 2011; Almadani, 2014; Bishu *et al*., 2018). This finding contrasts with Al-Tahat (2016), Ullah *et al.* (2015) who argued that more educated farmers tended to exhibit more risk-averse behavior. Farming experience was positively related to zone 1 farmers' risk attitude. This suggests that the more experienced farmers were less risk-averse.

Farmer's age in the zone 1 showed a negative significant relationship with risk attitude. This implies that older farmers were more risk-averse than younger farmers. This finding agreed with Adubi (1992), Aditto (2011), Ullah *et al.* (2015). However, Al-Tahat (2016) showed a positive relationship between a farmer's age and the risk aversion of the farmers in his study.

The household size of zone 2 farmers had a significantly negative relationship with risk attitude. This suggests that farmers with smaller households in this zone are likely to be less risk averse than the larger household farmers. Dadzie and Acquah (2012) and Ullah *et al.* (2015) also reported similar result for the effect of household size on farmers' risk aversion. While the effect of household size was positive and significant for farmers in the zone 1. The finding is consistent with Al-Tahat (2016) who argued that farmers become less risk averse as family size increases.

Table 6 - Results of multiple regressions for farmers' risk attitude scale against socio-economic variables of zone 1 farmers (n=191) and zone 2 farmers (n=128).

Socio-economic variables	*Risk attitude scale*	
	Agro-ecological zone 1	*Agro-ecological zone 2*
Intercept	1.235***	0.922***
Farmer age	-0.013*	0.035***
Farming Experience	0.047***	0.001
Education	0.078**	0.145**
Household size	0.048*	-0.089**
Farm size	0.056***	0.036*
Family labour	-0.106**	0.011
Extension contact	0.123	-0.254**
Off-farm work	0.294**	0.206*
Co-op Member	-0.241**	0.136
F- statistics	76.18***	21.44***
R-Squared	0.79	0.62
R-squared adjusted	0.78	0.59
Durbin-Watson statistics	1.97	1.56
Jarque-Bera statistics[a]	3.15 (0.20)	0.97 (0.61)
ARCH heteroscedasticity statistics[a]	0.17 (0.67)	1.47 (0.23)

** P<0.05, ** P<0.01 and *** P<0.001. [a]: numbers in parentheses are P-values.*

Farmers with larger farms were risk takers relative to those who have smaller farms size. This may be because farmer of a large farm size allows a wide range of diversity in crops production, thus avoiding the dependency on one kind of products (Al-Tahat, 2016). This finding disagreed with Almadani (2014) and Ullah *et al.* (2015).

The Table 6 shows that family labour in zone 1 had an inverse relationship with farmer risk attitude and was statistically significant. This stands to imply that the higher the family members who have off-farm work the less risk preferring the farmers will become. Similarly, Wheat-cotton farmers in Al-Hasakeh who have family members with off-farm work were less likely to accept risks (Almadani, 2014). Perry and Johnson (2000) deduced that the higher the family members who have off-farm work the higher the willingness to take risk due to their income which serves as a substitute in risk threat period.

It is surprising that extension contact is statistically significant and negatively related to risk attitude only in zone 2. This implies that the farmers with more extension contact will be more risk averse. The finding is inconsistent with Ayinde (2008), Ayinde and Obalola (2017) who found that the extension work tends to increase the farming household willingness to take risk.

Off-farm work had a positive and significant coefficient with the risk attitude in both zones. This indicate farmers who have off-farm work were found to be less risk-averse. The result is in agreement with Ullah *et al.* (2015). Higher off-farm incomes may indicate a greater risk bearing capacity and represents a form of diversification that would have an impact on farmers' risk attitude (Velandia *et al.*, 2009).

Membership of cooperative society is negative and significant at 1% level for the zones 1. This indicate that the cooperative society in this zone is not effective. This may be due to the decline in the role of cooperative societies in providing services to farmers, given that they are affected by the circumstances of the crisis in Syria.

5. Conclusions and recommendations

The results indicated that there are significant differences between farmers in the zone 1 and zone 2 in terms of their perception of the sources of risk and its management strategies.

The risks related to the precipitation shortage were the most important and ranked first for farmers in both zones. And it was found that the risks of natural disasters, lack of funding, production cost and debt situation were the most important for farmers in the zone 1. While the risks of fire, lack of government support, unexpected variability of product prices, lack of funding and natural disasters were most important to the farmers of zone 2. The producing at lowest possible cost was the most important and ranked first for farmers in both zones. It was also found that both the strategy of spraying for diseases and pests, keep cash in hand and adopt crop rotation were the most relevant risk management strategies in zone 1. While the farmers zone 2 considered keep cash in hand, choose good quality materials, spraying for diseases and pests, and growing more than one crop were the most important from their point of view. The farmers in zone 1 gave less importance for farmer and family off-farm working; This may be the result of the higher agricultural income that they obtain compared to the farmers in zone 2. Differences in risks and their related management strategies between the study zones are related mainly to the different agro-ecological zones.

In terms of the relationships between risk attitudes and farmer socioeconomic characteristics. Our results suggest that farmers' experience, education, household size, farm size and off-farm work have a positive influence on farmers' risk attitude by lowering their risk aversion. The extension service and cooperative societies should be made more effective, where the results showed a negative and significant effect of agricultural extension and cooperative societies, perhaps due to the security conditions in Syria that affected the work of extension units and cooperative societies.

The result of this study can provide decision makers in Syria with the most important agricultural risks facing farmers in rain-fed zones at the farm level, as well as the most important strategies used by them. Therefore, agricultural policy makers should take in to account the differences between agro-ecological zones when setting pol-

icies, and provide higher support to the farmers of the zone 2, for whom production risks are more important. The results of the study can also be a useful reference for the most important agricultural institutions that were established in Syria for the purpose of supporting the agricultural sector, for example, Agricultural Extension, Peasant Associations, and Agricultural Cooperative Bank. As the function performed by these institutions as risk management institutions needs further reform and development in light of the increasing climatic changes in recent times and the conditions that farmers are currently experiencing.

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