

Full Length Research Paper

Wheat risk diversification in North Khorasan province: A risk profile analysis

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In this paper application of risk profile in wheat risk management of North Khorasan province has studied. For achieving to risk profile used data of 120 wheat producers for 2005 - 2007 period. Also, for evaluating of losses of each risk, used two indexes of frequency and severity of risk effect and finally risk matrix designed. Result showed that biggest area for wheat was area with low risks. New variety of product and lake of labors were decreased risks of wheat. Wild animals, high cost of credit and use of unsuitable harvest machines were increased risk resources. Regard to results, annually monitoring of risks, control of pests risks through biological control and crop diversification, retraining of harvest machines users for putting machines in order and suitable time of harvesting, considering of risk profile for programming and designing of insurance plans suggested.

Key words: Ranking, loss, insurance, risk matrix.

INTRODUCTION

Agriculture is the most risky business. These risks consist of production risks like bad weather, pests, etc. market risks and price risks. Special characteristic of agriculture is that despite of other business, farmer can not estimate production correctly. In the other word, he/ she deal with production risks. That is affected from weather, pests, illness, etc. Fluctuation of output and inputs prices are main sources of market risks in agriculture that are affected from in and out sector factors. Another part of agriculture market risk related to delivery risks that particularly are serious about corruptible products. This type of risk is affected from infrastructural problems. Some parts of agricultural risks can be classified as financial risk.

These are important in investment and secure primary costs of production, either in liquidity subject to long run of production in agriculture. Other risks in agriculture are institutional and technological risks. Results of "agriculture and agri-food of Canada" study revealed that from view point of 95% of Canadian farmers, the most important risk component was price risk. 91% presented that production risks and 60% said personal health and

safety are the most important risks. Other factors were environmental factors, credits, market acceptance and power problem respect. Blank (1998) study on California farmers showed that most important risk factors from view point of these farmers were market risks and then production risks. Study of Alimi and Wall (2005) showed that major risks of Nigeria farmers are output prices then input price. Other risks are draught, pest and illness, investment unavailability and robbery respect. Bardhan et al. (2006) in a study on Indian dairy farmers showed that major risk sources are: health condition of family, live-stock disease, distant location of Artificial Insemination (AI) centers and lack of extension supports. Phoson et al. (2003) study on Japanese farmers showed that from view point of 43.7% of farmers fluctuation of market price was the major risk of fruit and vegetable production, pests (30.63%) and weather (30.32%). 81.82% of fish producers said decreasing of market price as major risk. Generally and for both group of producers, major production risk was fluctuations of market price that raised from supply surplus and lake of market information. Wyman (2001) study on risk profile and risk management of financial conglomerates introduced "building block" procedure and for risk aggregation, "economic capital". Result of study showed that main procedure in risk profiling was building block procedure. Globalization of agricultural market, innovation in food technologies,

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changes of government programs for agriculture and low price of agricultural commodities change agricultural risks (Bard and Barry, 2001). Existing of risk in agriculture reduce profitability so that because of high fluctuation of inputs and output prices in agriculture and low price of agricultural commodities in contrast with high price of input, the problem severity will be duplicated. On the other hand, it leads to uncertain income in agricultural sector so that farmers will be concern about debts, fixed costs and in many cases in affording of essential cost of family. Finally in contrast with other business, existing of risk in agriculture reduce investment in this sector.

In recent years all sectors of the economy have focused on management of risk as the key to making organizations successful in delivering their objectives whilst protecting the interests of their stakeholders (Keegan, 2004). Risk is uncertainty of outcome and good risk management allows an organization to: have increased confidence in achieving its desired outcomes; effectively restrict threats to acceptable levels and take informed decisions about exploiting opportunities. At risk management 3 steps should be follow:

Step 1- It is necessary that organization know which risks are dealing with?

Step 2- Should assessing likelihood and impact of risks. These two steps create risk profile.

Step 3- Strategies for dealing with risks considered.

In pass of time and with development of sciences and services, agricultural crop insurance designed as one of the risk control tools. As it is said before, first step in risk management is identifying existing risks. On the other hand, this can be useful in designing an efficient insurance system that is important subject to positive effect of insurance on risk taking of farmers (Ahsan et al., 1987; Torkamani, 2001). Subject to this, by determining likelihood of each risk, risk profile could be designed. Risk profile is documentation of risk assessing in step 1 and 2 that lead to: facilitates identification of risk priorities, captures the reasons for decisions made about what is and is not tolerable exposure; facilitates recording of the way in which it is decided to address risk; allows all those concerned with risk management to see the overall risk profile and how their areas of particular responsibility fit into it and facilitates review and monitoring of risks (Keegan, 2004).

Respect to above definition and regard to agricultural insurance fund losses, that is depend on lake of information of risks and their probability, its structure and degree of their effect importance and necessity of risk profile as information compiler for risk management will be revealed. Appointment of risk profile for agricultural products make it possible for insurance fund to have a full imagination of risks that make it possible for them with suitable policy and programs for insurance pricing, minimize its losses and become a profitable agency. On the other hand, establish a study framework so that every

year before premium assessment, risk profile specified and its mobility be considered with full information about changes in risk profile and with respect to new and main risks premium determine and a new price package offered.

Finally risk profile creates necessary area and information for agricultural insurance that program and policy makers could have new insurance system subject to new risks or new risk coverage. North Khorasan province is a risky regions and the important area for producing of Wheat. Geographical conditions caused this province as a region with different risks that affect agricultural crops yield. Regard to this, it is necessary that study risk profile and dynamic of it for designing of insurance programs and management of risks. This study as an applicable research in this area in Iran and innovative look determined and designed risk profile of wheat in North Khorasan province.

MATERIALS AND METHODS

Risk profile and risk matrix design

Risk profile is result of documenting 2 first steps in risk management that is, identifying and assessing of risks (Keegan, 2004). Regard to this, a 5 step process designed for risk profiling (Figure 1):

Step 1- Using attributive studies and literature view all risks in agriculture identified and ranked in 9 groups: production risks, price risks, damage risks, technological risks, labor problem risks, credit risks, institutional risks, technical risks and information risks (Table 1).

Step 2- Identification of dimensions of risks identified (Table 1).

Step 3- Identification of indices for dimensions of risks. Approximately all studies used "likelihood" and "impact" for assessing and evaluating of risks (Hewett et al., 2004; Keegan, 2004; Stoneberner, 2002; UNDP, 2006; West Hertfordshire Hospitals, 2003). While others used indices like "uncertainty in estimations" (Klein and Cork, 1998) and "organization ability in response to risk". Also, indices like "likelihood", "potential effect on project" and "capability and speed of responding to risks" used for risk ranking (Jebel et al., 2007). In this paper likelihood and impact used as risk indices and had equal weights. Risk frequency (likelihood) is percentage of farmers that faced with special risk in special products. Impact is average losses of farmers who experienced risks.

Step 4- This step which evaluate losses of each risks have done through survey study. In this stage a general questionnaire designed that all of identified risks in step 1 with their dimensions considered. Then, sample farmers through discussion meeting with agricultural experts present factors of step 3 for each of risk dimensions evaluated.

Step 5- This step has 3 separate stages:

a) In this stage by using of descriptive statistics analysis for each dimension of risks and for different risks mean of farmers who their crops damaged by special risk and average loss of wheat determined. That respect as frequency and impact of risks supplied essential information for 2 fallow sections that create risk profile. Documenting of risk assessment that creates risk profile could illustrate both in matrix and graphic forms. That each of them discuss below.

b. Risk matrix- is one of common procedure for risk ranking that help to identification, ranking and management of key risks. An ef-

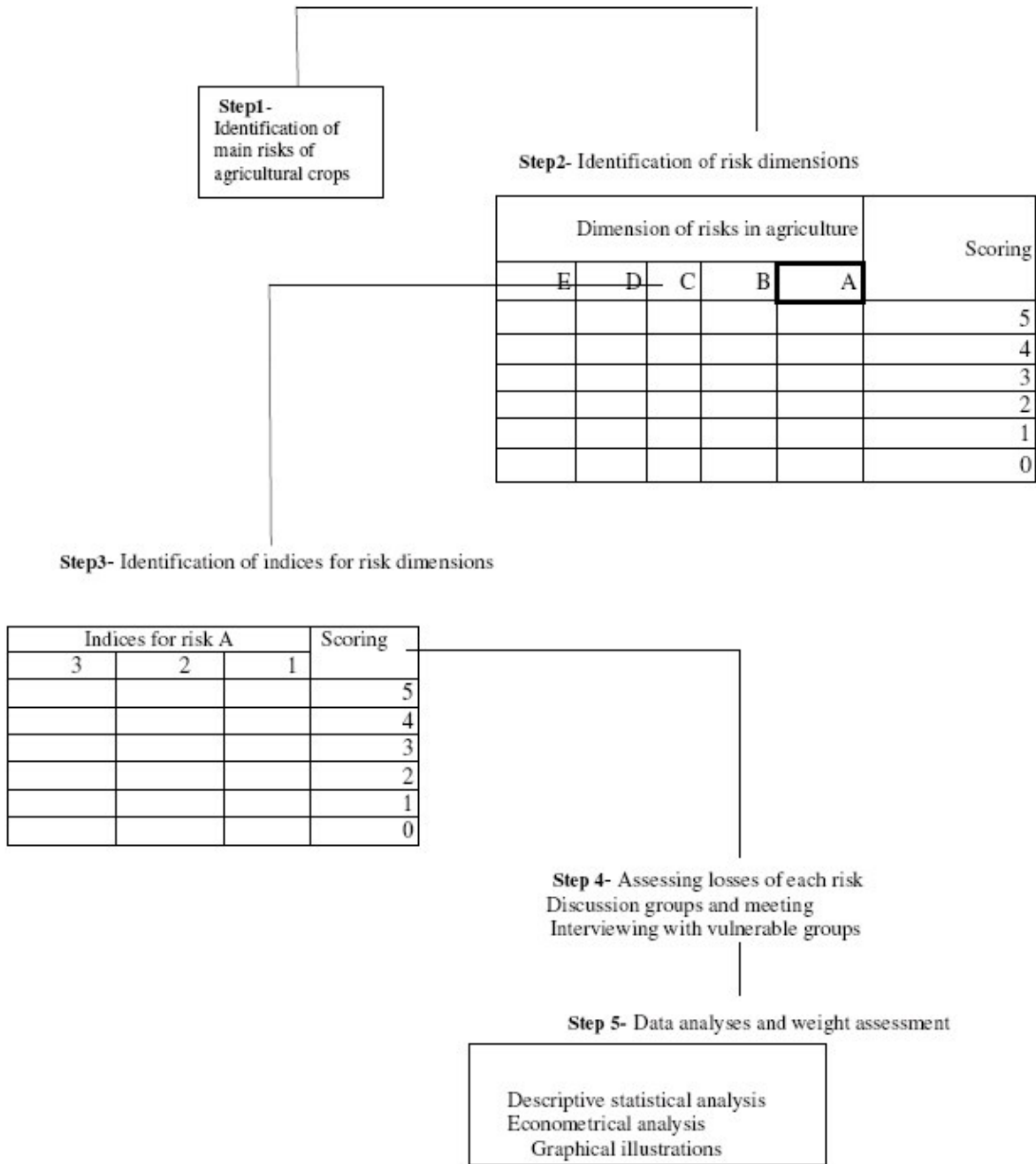


Figure 1. Five steps of risk profile determination.

efficient risk matrix should have follow features:

- Be simple to use and understand.
- Not require extensive knowledge of quantitative risk analysis to use.
- Have clear guidance to applicability.
- Have consistent likelihood ranges that cover the full spectrum of potential scenarios.
- Have detailed descriptions of the consequences of concern for each consequence range.
- Have clearly defined tolerable and intolerable risk level.
- Show how scenarios that are at an intolerable risk level can be

mitigated to a tolerance level on the matrix.

- Provide clear guidance on what action is necessary to mitigate scenarios with intolerable risk levels.

Risk matrix has likelihood ranges in one axes and impact range in other. Each of axes divided to 3 - 5 ranges. These ranges can be expanded in detailed cases. First it should determine what the consequences of interest are. These can include personnel safety, public safety, environmental impact, property loss/ business interruption, corporate image and legal implications. Each consequence of interest may have a different definition for a specified consequence category. For example in this study risk matrices conse-

Table 1. Different dimensions of risks.

Group of risk	Risk dimensions.
Production risks	Flood, hail, flood creating risks, drought, disease, pests, insects like grasshopper, birds like sparrow, weeds, wild animals like boar and little rodents like mouse.
Price risks	Decreasing output price, increasing input price and fluctuations in market and costs.
Losses of risks	Loss to production tools and instruments because of natural factors or robbery.
Technological risks	New variety of crops, new fertilizers and poisons, new machines or new machine models, using of unsuitable machines in farm, maintenance and harvest.
Labor risks	Insufficient labor when it is needed, unskilled labor.
Credit risks	Insufficient credit, high costs of credits, decreasing low cost credits, do not receiving credits on time and fiscal problem of credits.
Institutional risks	Decreasing production subsidies, changes in agricultural sector law and regulations, undesirable offers of experts, being far from input distribution centers, establishing propagation house, changes in management of agricultural organizations, import and export tariffs.
Technical risks	Lack of knowledge about sufficient fertilizer and poisons, lack of doing soil tests and lack of suitable crop pattern.
Information risks	Lack of information about prices specially guarantee prices and market demand.

Table 2. Risk impact in different categories of risks.

Risk categories	Impact criteria
Negligible risks	Don't loss of products.
Low risk	Loss to gross income of one ha of production is 0 - 1%.
Moderate risks	Loss to gross income of one ha of production is 1 - 5%.
High risks	Loss to gross income of one ha of production is 5 - 10%.
Very high risks	Loss to gross income of one ha of production is 10 - 100%.

matrices consequences for different ranges defined as Table 2. In this study impact ranges include loss on gross income of special product in one hectare.

Once the consequence ranges have been defined, the corresponding likelihood ranges can be defined. Likelihood is defined in terms of probability that the potential consequences will be experienced during the life of the item. Each of risk matrix cells named a risk cell that shows a risk level. As risk matrix evaluated each of risks place in one of the risk cells. Three types of risk matrices are commonly used:

- i. A purely qualitative risk matrix will have its bins defined in descriptive or qualitative terms.
- ii. A purely quantitative risk matrix has its bins defined in measurable or quantitative terms. Relative or absolute numerical scales are used on quantitative matrices; scales on qualitative matrices are relative but not numerical.
- iii. A semi-quantitative matrix with one scale (usually frequency) expressed quantitatively, while the other scale is expressed qualitatively.

For a risk matrix, the risk for each block is the product of the frequency bin value (or range) and the consequence bin value (or range). For a quantitative matrix, the risk is then simply expressed as a numerical value or range. The risk for a given block can then be directly compared to the risk for any other block, and regions of similar risk can be defined containing groups of blocks with similar numerical values for risk. The maximum risk associated with each block is shown in each upper right corner. Now, logical criteria for establishing risk can be derived. For example, high risk must have a maximum in each block greater than 100, medium risk must have a

maximum for each block between 10 and 100 inclusive, low risk must have a maximum for each block between 1 and 10 and negligible risk is less than or equal to 1. It may be best to eliminate judgmental labels describing risk regions and to identify them using objective labels (that is, instead of negligible risk, call it risk region 1; instead of high risk, call it risk region 4).

In this study a quantitative 5*5 risk matrix used. 3 matrices for 3 years of study (2005 - 2007) were established. In these matrices 5 level for likelihood supposed that included probability ranges of: 0 - 10, 10 - 20, 20 - 50, 50 - 70 and 70 - 100%. Risk impacts ranked in 5 categories either. These categories were zero percent losses, 1 - 5% losses, 5 - 10% losses and 10 - 100% losses. Then, regard to numerical evaluating, value of each cells determined and 6 risk region distinguished. Region 1 (low risk region) that include value of zero, region 2 include value of 5 - 10, region 3 include value of 70 - 100, region 4 contain value 100 - 500, region 5 include value 700 - 1000 and region 6 (high risk region) contain values more than 1000.

Data

Data collected through questioner and discussion meetings with farmers of North Khorasan province and agricultural experts. At first designed questioner filed to testing it and collecting necessary information for estimating sample size. Then, necessary corrections have done and final questionnaires filed through questioner and discussion meetings with farmers of North Khorasan province and agricultural experts. Samples selected by helping of agricultural organizations and agricultural service centers. Regard to high volume of questionnaires- because of its generality in studying all risks and their dimensions- in some cases more than once referred.

In this study classified random sampling used for sampling. Levels were cities of North Khorasan province (Shirvan, Bojnourd, Maneva- Semelghan and Raz- o- Jargalan) were selected for sampling. All of these cities located in Northern half of North Khorasan province and have same conditions. Sample size estimated 120 and divided equally between different levels. In this study, data collected for 3 years that is, 2005 - 2007. This study is done in 2008.

RESULTS AND DISCUSSION

Sample descriptive

Wheat producers conclude ranges of young and old producers. They have at least 20 years and maximum 82 years old. Average of their age is 46 years. They educated between 0 - 14 years. Average of their educations is 8 years. These farmers concluded small farmers with one hectare to large farmers with more than 200 ha cultivated area. Average of farmers' experiences is 27 years. Their family size is at least 2 and maximum 14 people. They produce minimum 1 and maximum 6 and in average 3 types of crops. They insured in average 6.2 ha of their wheat farms that is half of their wheat area. Therefore, it can be said that crop insurance acted properly about area coverage. Mean yield of wheat was at least 5 t ha⁻¹. Average of selling price of wheat was 2190 Rials kg⁻¹. Finally, wheat producers allocated at least 0.5 and maximum 100 ha of their farms to wheat. That is about half of their farms area. 45.70% of wheat producers had off farm jobs, 65.70% of them had worked on other agricultural activities like horticulture and animal husbandry. 97.10% of them were owner of farmers and only 37.10% of farmers had agricultural machines. 63% of them used out of family labors and 51.40% of them participated in wheat supervisory program.

Risk matrix and risk profile

In this section changes in risk regions, decreased, increased, emerged and disappeared risks discussed.

Changes in risk regions

Regard to risk matrix and risk profile of wheat (Figures 2 - 5) revealed that during years of study biggest risk region was 2nd region and after that 1st region. In this region, there are risks that exist but didn't loss products or their losses were insignificant. In 2005 and 2005 other risk regions were region 3, 4, 5 and 6 respects to their surface that 5th and 6th level didn't conclude any risks. This trend in 2007 was 4, 5, 3 and 6 that region 3 and 6 didn't conclude any risks. Generally many risks of wheat were low risks.

As it is illustrated in risk matrix and profile first risk region increased a little during period of 2005 - 2007. 2nd risk regions decreased from 2005 - 2007. Number of risks in this region was 15 in 2005 and it decreased to 12 in 2006. 3rd region decreased during period of study. There-

fore, it didn't include any risks in 2007. 4th risk region after decreasing in 2005 increased in 2006. 5th region during first and 2nd years of study didn't contain any risks in third year of study contained 2 risks. 6th risk region that is highest risk level didn't contain any risks during study period. In general can say that low risk regions (Region 1 and 2) decreased and high risk regions (4th and 5th regions) increased.

Decreased risks

Decreased risks are risks which transfer from a higher risk region to lower ones during time. This transfer can be because of improving risk management conditions, changes in policies of agricultural sector, climate changes, etc. Decreased risks to first region are: risk of new variety of products and insufficient labor which from 2nd region in 2005 decreased to first region in 2006. Flood from third region in 2005 decreased to 2nd region in 2006.

Increased risks

During time transferred from lower region to higher one. This transfer could be because lack of necessary management for monitoring, limiting and control of risks, climate changes, changes in policies and so on. None of first risk region has increased. Pest and wild animal risk which in first and second years were at 2nd region, in third year transferred to 4th region. Transferring of pest was because of decreasing *Eurygaster intergriceps* Put. In 2007 that was because of drought. About wild animal that in study area it was boar, in one hand because lack of guarding institutions that keep farms from this animal attacks and from other hand problems of environmental conservation control and limiting of this risk resource revealed with serious problems.

In other hand increasing of this risk could be because of rising area that cultivated variety of products that is more attacked by this animal. Respect to 2 levels rising of this risk necessary control and limiting of this risk source should be noticed. High cost of credit from third region in first and 2nd year increased to 4th region in third year. Finance resources include formal and informal resources like debt, forward purchase and credit with high cost credits, etc. Rising credit costs can be because of rising informal credit portion in financing. Use of unsuitable machines in harvest increased from 4th region to 5th region.

This type of risks that in grains is in term of falling in harvest machines, every year led to high percent losses in grains. While in most cases with management strategies and least cost, these risk resources could be controlled. Such as harvest machine owners training, putting harvest machines in order correctly for different kind of grains and for different weather conditions, rising supervisory activities on harvest machines that could be defined as part of wheat supervisor duties. Increasing in-

					10-100
					5-10
	Increasing input price	Using of unsuitable machines in harvest		Floods, high cost of credits	1-5
			Weeds	Pest, birds, wild animals, mouse, insufficient labor, being far away input distribution centers	0-1
	No existence of soil tests		Lack of suitable crop pattern	New fertilizers and poisons New machines	0
	70-100	50-70	20-50	10-20	0-10
	Likelihood (percent)				

Figure 2. Profile (matrix) of wheat in North Khorasan province in 2005.

					10-100
					5-10
		Using of unsuitable machines in harvest		High cost of credits	1-5
			Weeds mouse insufficient credits	Pest, birds, wild animals being far away input distribution centers	0-1
	No existence of soil tests		Lack of suitable crop pattern	Insufficient labor New fertilizers and poisons New machines	0
	70-100	50-70	20-50	10-20	0-10
	Likelihood (percent)				

Figure 3. Profile (matrix) of wheat in North Khorasan province in 2006.

put prices increased from 4th region to 5th region in 2007. These risk resources that during study period were a high risk increasing of that subject to inflation conditions of Iran wasn't predictable while because of government control on wheat market rising wheat price is very low.

For example during 2005 - 2006 production costs raised 23.7% while wheat price increased only 5.3%. This

condition improved with higher price increasing in one hand and lower cost increasing in other hand. During 2006 - 2007, the cost increased 9.8% while price increased 7.5%. Finally, risk increased only in 2007. This gives serious alarms for discovering resources of this increasing and serious control. Also most increases were to regions 4 and 5 and most decreases were to first and

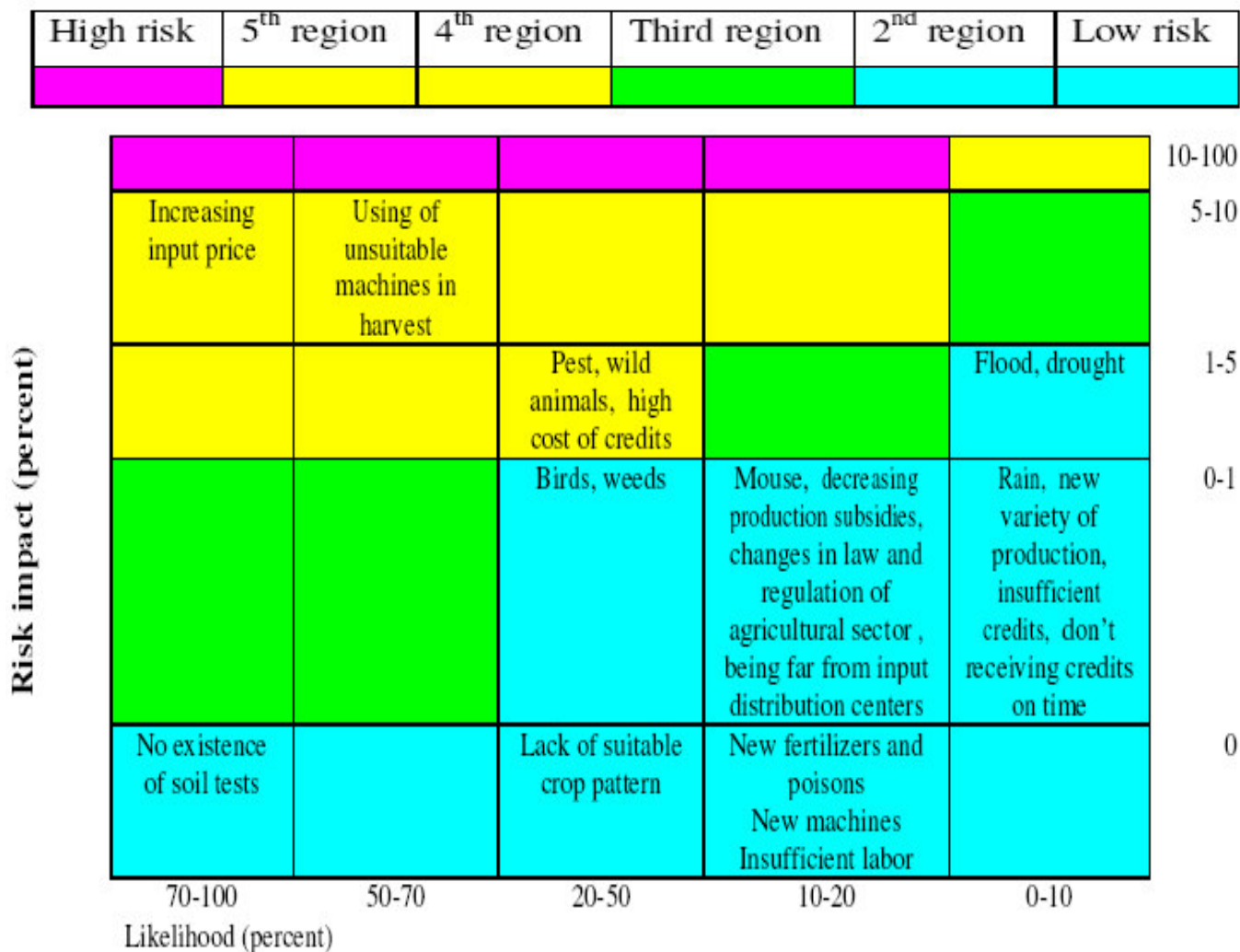


Figure 4. Profile (matrix) of wheat in North Khorasan province in 2007.

2nd level.

Disappeared risks

Hail is one of these risks that disappeared in 2006 and 2007. This resource of risk is kind of risks that emerging and disappearing of that completely depend on weather conditions and management and human factors do not have any effect on it. Do not receive credits on time that exist in 2005 in 2006 did not appear and again emerged in 86. This could be because of changing in bank management conditions or changes in manner and amount of credit in different years. Official problem of credits is one of the risks that existed in 2005 and 2006 and in 2007 disappeared. This could be because of management condition of banks or because farmers experienced this risk before they dispense with this kind of credits. New machines risks existed in first year. Then disappeared in second year and in third year emerged

again. This risk that include purchase of new machines or new machine models depend on some factors like farmer ability and decision for purchasing these inputs or improving agricultural machines technologies in offering new models, or possibility of importing these machines that exposed farmers in new machines risks. But whether these risks could be as an opportunity or a treat depend on how these machines used and amount of information about application of these machines. Increasing input price that exist in first and third year disappeared in 2nd year.

Emerged risks

Decreasing subsidies is one of risks that emerged in 2006 and existed in 2007. This risk that mainly is because of decreasing chemical inputs in 2006, is one of risks that arise from government intervention in agricultural inputs market.



Figure 5. Risk profile (graphical) of wheat in North Khorasan province for 2005 - 2007.

Generally, wheat risks are low risk, in other word wheat producers was deled with many risk resources but their losses was not so high. Increasing of risks was only in 2007 and this reveals that 2007 in contrast with 2 past years was a risky year for wheat. Hail, credits, new machines and price risks are risks resources that in period of study exist in some years and disappeared. And decreasing production subsidies is emerged risk of this product. Results of this paper are not analogous with other studies because this study is done on risk profile of wheat whereas other researchers worked on other area of risk profile or studied on other commodities.

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