
Agriculture Risk Management by Using Weather-Based Crop Insurance Scheme

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Abstract

Agriculture is a risky activity, so farmers are faced with different weather risks, pests, disease, market risks and raw material. Every year farmers are concerned about paying loans and prices of life because of having an uncertain income. Of course risk, is and unavoidable element but it can be managed in business and agriculture productions. There are different kinds of risk management tools which cover wide range of risks and have been used in developed and developing countries. But insurance is an expensive tool and so designing new insurance patterns which in one hand stabilize the producers income and in the other hand reduce insurance implementation cost should be one of the important issues of researchers in risk management and agriculture crops insurance. Insurance systems associated with lots of problems due to asymmetric information, Adverse Selection and moral hazard. In this paper, different kinds of current pattern of agriculture crops insurance in Iran and world has been introduced. According to problems of traditional pattern of agriculture crops insurance like implementation costs and asymmetric information problems, insurance plan which based on climate-indexes is one of the efficient tools in agriculture risk management.

Key words: risk management, agriculture risk insurance, weather-based scheme, product functions, asymmetric information

Introduction:

Agriculture is a risky activity, so farmers are faced with different weather risks, pests, disease, market risks and raw material. Every year farmers are concerned about paying loans and prices of life because of having an uncertain income (Skess et al, 1999). There are lots of natural and unnatural risks in agriculture activities which cause that agriculture producers faced with uncertain situations and therefore, their income from agriculture production would be instable (Ray, 1967). Wide ranges of risks are effective on income of agriculture production. Some of these risks include the production risks, market price, financial risks and human risks. The role and importance of each risk source in each area are different according to the time and place

circumstances and different government policies. However, two risks of price and production are the most common risks. The definitions of each risk are as follows (Bielza et al, 2008):

-Function or production risk: the function risks means, variability in crop yield which in most cases is caused by changes in weather conditions. However, the variability of yield for one crop in different regions is different and depends on type of soil, climate and the production method.

-Price risk: weather and other natural risks can cause price fluctuations. The price risk means, reduce or increase crop price, changing the price of agriculture equipment and raw material.

-Financial risk: whenever farmers get loans, it is possible that in future his income not to be enough to repay the debt.along with increasing the ratio of debt to capital, financial risk of an agriculture unit will be increased.

-Human risk: disease or even death of farm worker effect on farming activities.so risk factors (such as price and functions) effect on producers behavior and this effect is more on crops income and decision of farmers in using of inputs and product supply. Risk, is and unavoidable element but it can be managed in business and agriculture productions. Change in product function and market prices have a significant impact on farmer's incomes and this caused to complexity in short-term production and long-term planting. This situation cause that farmers always decide about whether decrease and increase their production, whether invest in fixed assets or not, whether change the combination of agricultural raw materials or not. Generally, remaining in agriculture activities or out of it is the most important decision of a farmer.

The basic question is what are the ways for control and reduce the risk effects? In other words, what is the attractive ways for producers in order to risk management and what policies the government can do to reduce the harmful effects of risks? There are several ways to reduce the farmer's income risk. Two important strategies in agriculture risk management are as follow:

-The strategy which used in the process of planting: product selection with less risks, select the product that have shorter planting period, implementation of diversity in planting crops.

-Risk sharing strategy: market contracts, production contracts, future contracts, participating in mutual funds and insurance.

Developing different ways of agriculture insurance along with extension the Commodity exchange markets are the tools of reduction of risk which covers a wide range of risk and have been used in most developed and developing countries. Agriculture crops insurance is a mechanism for participation in risk acceptance that through participating of producers in risk acceptance during the risk, prevent from damage of producers or can stabilize his income. But insurance is an expensive tools and so designing new insurance patterns which in one hand stabilize the producers income and in the other hand reduce insurance implementation cost should be one of the important issues of researchers in risk management and agriculture crops insurance.

Insurance systems associated with lots of problems due to asymmetric information, Adverse Selection and moral hazard. Adverse selection occurs when people with high risk taking, buy insurance. Moral hazard occurs when insured men increase buying insurance after damage

occurs. in other words, in agriculture insurance, farmers who have insurance are more risk taking than farmers who are not. Insurance companies use special techniques to reduce such a behavior.

-Deductible: the insured must pay part of damage (fixed amount or a percentage of total damage)

-Reward for no damage

-Determine warily activities in order to prevent occurrence of damage. Insurance companies can find out whether insured follow these activities or not by controlling them.

-Standards of damage pay should be based on index which is not affected by interference of insured (OECD, 2001) Weather-Based Crop Insurance Scheme is one of the new insurance plans which solve many problems of traditional insurance. The major advantage of this insurance scheme is eliminating problems of adverse selection and moral hazard. The purpose of this article is to introduce agriculture crops insurances based on area function and index insurance based of weather.

1. Review of previous studies

Miranda and Vednov provide a method in order to design and pricing the index insurance contract in an article named " index insurance Rainfall of agriculture products". They stated that index insurance performance is based on the relation between indexes and crops function. Karuaihe et al, 2006 provide the weather index insurance of African countries based on three criteria of rainfall, temperature and daily temperature. Index insurance can be design based on one or set of indexes. The introduced the whether based insurance one of the efficient plans because whether risk is one of the important risks in agriculture. They determine expected compensation function to determine as set of factors which can impact on farmer's demand from index insurance (such as the impact of basis risk, the level of risk avoiding and premium surcharge factor).

Goodwin and et al (2008) have emphasized on variability incomes of farmer which caused by change in price, reduce of product performance or both in an article that named "modeling of structural depends on design of insurance contract of whole farm based on defined function". They modeled the production of corn and soybeans. They stated that in order to develop the multivariate models, with having marginal distribution, defined functions are very efficient to describe the simultaneity behavior of variables. They used defined functions to measure structure between variables. They investigated different defined functions in order to modeling of dependence structure of price variables structure and product performance and finally used selected detailed function to compute premium contract. Therefore, to provide a simultaneity distribution insurance plan performance and price of both products are important. Using defined function is regarded in order to determine multivariate distributions.

Lebois and Quirion studied agriculture crops insurance scheme based on weather indexes. They stated compensation structure and how to calculate the premium of agriculture insurance based on weather indexes in the article which entitled " agriculture insurance based on weather indexes: the methodology in Agenda". In one part of this article they explained experiences of different countries like India and Malawi and Ethiopia in implementing agriculture insurance based on

weather indexes. They introduced a number of weather indexes like rainfall and drought indexes and in each case explain how to measure them. In addition, they design compensation structure and calculate premium of contract. At the end they explain their results in Agenda.

2. Risk and insurance management

According to the basic principle that people in each level of wealth are one of these three modes of risk-averse, risk taker or neutral, risk factor imported in the analysis. The concept of risk-averse does not mean that people are not willing to take risks, but it means that risk-averse people, for receiving more benefits of an activity simultaneously risk should pay more money as premium ratio to an activity with complete trust.

According to Skees and Barnett beliefs, a risk can be insured that have at least five features:

- Likelihood of an incident should be definable.
- The amount of damage should be measurable.
- The possibility of damage should not be large that insurance be unavailable.
- occurring accident and damage should not be caused by moral hazard of insured
- Risk should be independent from insured. If there is dependence, certain criteria should be considered.

Insurance schemes (private, public and shared) are risk management tools. Existential philosophy of risk is Risk Pooling. Risk Pooling means that policyholders are each other partner in risk by paying premium. In agriculture, there are various private insurance schemes. These insurance schemes cover damages of crops by hail, fire or theft agricultural property, death and disability of farmer or farm workers. Natural disasters and epidemics diseases can cause particular problems for insurance. If Natural disasters as a systematic risk occur, can affect an entire region. There are several reasons that why such risk insurance are difficult. First, in the absence of reinsurer, the insurance company must determine a high premium to cover the damage that certainly is not affordable for farmers. Also, since the natural disease happens rarely, so the insurer does not have enough information to calculate exact premium. So, insurance companies use reinsurances in order to cover systematic risks which cause high damages. Because otherwise, in order to pay such damages, the insurance company must save a lot of malignance that requires determining high premium (Bielza et al, 2008).

3. History of agriculture insurance in Iran

In Iran agriculture insurance was started by organization of relief and villager's fund, which approved in 1353(1976), and the plan of establishing agriculture insurance fund which approved in 1355(1978). But its official activities began in 1363(1983).

Thus after Islamic revolution, start of insurance activities was reapproved as inevitable need and was decided that the necessary steps start again in order to realize this idea. So, from September 1360, the first group working to formatting agriculture insurance in Iran in the Ministry of agriculture was formed and necessary activities took place to applying rules about agriculture

insurance and providing new implementation pattern which be compatible with the agricultural sector. So according to provide an action plan from experts and assignment suggest of implementation activity to a powerful financial organization in region, namely agricultural bank which was it largest privileges in terms of implementation guarantee and its continuity, finally the rule of establishing the agricultural insurance fund in 1362 and then in 1363 were approved in parliament and immediately from that year implementation activities of agricultural insurance were started (introduction of agricultural insurance system in Iran , 1388(2008)).

3-1. different kinds of agriculture insurance in Iran- production cost insurance

In this kind of insurance, the product will be covered against specific risk factors. The maximum payment obligation calculated based on the costs (production cost). In case of danger, the amount of compensation will be calculated and paid commensurate with the development point of agriculture actions and costs. The purpose of this kind of insurance is to keep producers to remain in production field.

-Production value insurance

In this type of insurance, the product performance is covered against specific risk factors. In the case of danger, the damage will be evaluated by valuator and appropriate compensation will pay to farmers. The base price for paying of compensation is the guaranteed price which was approved by Council of the economy. Now, this kind of insurance is doing for the majority of products.

-production guarantee insurance or performance insurance

In this kind of insurance, whole risks that will effect on production and will lead to reduce the product will be guaranteed and if the reduction in production happen, compensation will be calculate and pay in accordance to the event. This insurance has a significant impact on the stability and security of agriculture production. This method is currently implementing in a pilot basis in two provinces of Kermanshah and Kordestan (introduction of agriculture system of Iran, 1388).

4. Agriculture insurance in the world

Insurance programs are different in different countries according to sponsored levels of government and type of covered risks, the diversity of crops and growing conditions. In some countries, insurance scheme which are government backed cover agriculture crops against all of the risks, while other private insurers insure just limited number of products (Shams, 2005). The United States and Europe are the biggest predictor and consumer of agriculture products. In recent decades farmers have increased their agriculture products. This increase is a result of using new technology, gaining new skills in farm activity management. Also, developing countries are using public-private agriculture insurance programs that can compete with the schemes of developed countries. Private insurers are not able to deal with systematic risks which result from natural disasters that affect a wide range of an area. From 1990s simultaneity with reduction of state support of agriculture, using of insurance agriculture products introduced as a powerful management tool among the insurers and foreign supports.

4-1. different types of insurance of agriculture products in the world

4-1-1. Actual Production History

This type of insurance, the crops will be supported against losses that caused by natural factors. Producers insured their crops in the average performance of 50 to 85 percent. If the actual performance of the farmer be less than the guaranteed performance, the amount of paying of insurer is obtained by multiplying the average reduction performance from average performance in selected price.

4-1-2. Group risk plan

Group risk insurance plan, support manufactures against all elements that cause crops damage. If the average performance of an area be less than target performance, regardless of the performance of each farm, farmers receive compensation. Insurance policies sold at expected average levels of 70 to 90 percentages.

4-3-1.Revenue insurance

There are three kinds of revenue insurances:

-crop revenue insurance

The first policy or revenue insurance program in term of scope and accessibility is own to United States that started since 1996. This insurance product was implementing in 36 states in 1999. This type of insurance scheme uses the actual history of production. The average daily future market prices in planting season are considered. Multiplying of the planting time price in the actual history of performance of production represents the expected revenue which is called guarantee revenue (Trigger level).the revenue coverage levels are 50,55,60,70,75 percentage of expected revenue. Expected revenue again calculated by using the price of harvest time. If the revenue of harvest time be more than the minimum guaranteed level in time of planting, the amount of expected revenue without any additional premium will be the calculation criteria in order to pay the compensation to the farmer. If the actual pure revenue of the farmer which is multiplying of actual performance in the price of the harvest time be less than guaranteed revenue, the compensation will pay to farmer.

-revenue protection

Revenue protection is another revenue insurance that based on actual performance of producer when his revenue is less than guaranteed level because of reduction of performance or price, so the producer will be supported and will be paid the compensation. However, revenue protection insurance program is like the crops revenue coverage, but it uses the future price in planting time (predicted price) to calculate the guaranteed revenue level and like revenue coverage policy it uses the higher price of plant or harvest time. Also, compensation paid when every hectare of crops (actual performance multiplied to price at the harvest time in future markets) is less than the guaranteed level. In other word, these policies are the same as policies of crops revenue coverage with two major differences. First, the level of guaranteed revenue in this policy is only determined based on future prices of crops in stock markets. It means, unlike the crops revenue

coverage insurance, if the price be higher at the harvest time, again the criteria of calculation is future prices of crops. In this case, it is possible that farmer buys the revenue protection insurance accordance to price at the harvest time, while in this policy the level of guaranteed revenue will not increase even if the prices at the harvest time be higher than prices at the planting time. The second difference is that this policy just uses of 100 percent of future prices and there is no possibility to use 95 percent of prices.

Income Assurance

This policy offers farmers and growers the income insurance simultaneity for several crops. Guaranteed income levels, actual incomes and compensation payment for policy of income protection calculated in the same way of income protection policy using the basic prices (future). Therefore this insurance scheme on one hand is similar to income protection insurance but on the other is similar to crop income insurance. It means that the producer is able to choose the level of guaranteed income based on cash prices in planting season or future prices in planting time. The level of guaranteed income is determined based on current prices in future market for the crops or is based on future price for the crops and the producers can choose one of these.

4-1-4. Group Revenue risk Production

Group revenue risk protection is based on performance of a specific area like cities or provinces. In other word, in this type of revenue insurance, there is no need to register the actual performance of producers and so there is no need to declare the losses by policyholders. This policy insures the product revenue of producers against the reduction of performance or products prices. When the predicted performance of next years in the area declared by the responsible devices, the revenue of every hectare of the crops for last year of planting season will calculate by using the predicted revenue prices. This insurance scheme uses the province's performance so there will be some adverse selection problem. It means that it's possible that the revenue of crops of one producer is less than the guaranteed level and so the producer is not paid.

4-1-5. Crop-yield Insurance

There are two kinds of yield insurance: hail insurance and multi-risk insurance.

Hail insurance covers the damage caused by hail, while multi-risk insurance covers damages caused by most of natural factors. Multi-risk coverage level is in level of 50 to 75 percentage of APH with deviation of 5% (Bastian, 1999).

4-1-6. agriculture crops insurance scheme based on weather-related

Agriculture crops insurance scheme based on weather-related designed in order to cover the damages of crops. Such schemes are only based on weather indexes specially indexes that are highly correlated with crop yield. For example (Aziz Nasiri, 2010) measure the dependence structure between climate indexes using the defined functions and between three indicators of cumulative rainfall, droughts and reduced rainfall selects drought indexes which has the highest correlation as index insurance in designing. so paying attention to the correlation between weather index with yield, in designing agriculture insurance based on weather indexes is very

important. Compensation is based on indexes not based on yield. In follow we will introduce indexes insurance scheme.

5. The use of index insurance scheme

Insurance system requirements are as follows:

- should be desirable and be available for all the society including the poor community
- be able to implement with a limited number of information
- having the ability of implement by private sector without government support or with least government support
- having the ability to avoid moral hazard and adverse selection problems

Index insurance schemes such as Area-based crop yield insurance and weather-based insurance (rainfall or other weather indicators) cover all requirements. The basic tip in area-based crop yield insurance is that contracts are designed against the certain hazards (such as drought or flooding). Insurance contract sold in Standard Unit Contract (e.g. 10 or 100\$).insurance rates and compensation in the case of damage for per SUCT is the same for all insured. Insurers have full authority to purchase as many contract as they want (Skees et al, 1999).

Attractive features of area-based crop yield insurance are as follow:

- since insurer pay equal premium for every SUC in a region and pay equal compensation in the event of damage, so the amount of payment for each insured is appropriate to their risk aversion. Also management decisions after planting crops caused by such a scheme will prevent from problems of adverse selection and moral hazard.
- Due to lack of individual contracts for each farmer, no require for inspections of every farm and also no need of assess the damage for every insurer, the implementing costs will reasonably reduce.
- should be easily applicable by the private sector
- Until buying insurance be optional and without government support, insurance is only welcomed that have the least cost and considered as an effective tool in risk management among current strategies.
- Existing of secondary markets for insurance contracts allow policyholders to make cash their contracts in per SUC at any time that they want (Skees et al, 1999)

5-1. weather-based agriculture insurance scheme

-market development

Since early 1999 weather-based agriculture insurance is discussed widely as an alternative solution for development of agriculture economy in scientific fields. In 2002, financial support starts in order to emulate these ideas; for example World Bank's Commodity Risk Management

with the allocation of public funds of Netherland and Switzerland attempted to run the weather index insurance for farmer in order to manage prices risk in commodities markers. World Bank's Commodity Risk Management had participated in many technical projects of weather risk management in commercial units in developing countries; for example, the first weather risk management activity was implemented in India in June 2000 as the first weather index insurance project. Since 2003 many projects were implemented in different countries like Ukraine, Ethiopia, Malawi, Kenya, Tanzania, Thailand and Central America. Achievement like market growing in India proved that weather risk management is possible for farmers with using insurance tools in developing countries (Bryla & Syroka, 2007).

5-2. designing weather index insurance

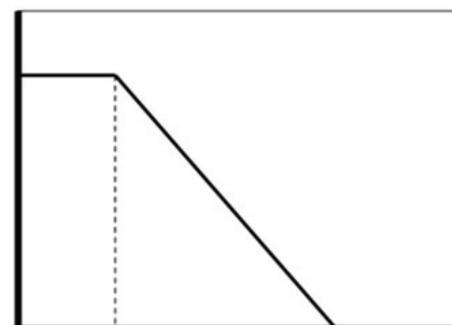
Weather-based agriculture insurance schemes are is a new approach among the traditional agriculture insurance for farmers in existing markets. Such products are weather-based and of course based on ideally indexes that have high correlation with performance, most of the time rainfall and temperature indexes are used. While in some areas of India, rainfall index alone will suffice as an effective index in crop performances; it is possible that rainfall index be unsatisfactory in areas that have significant drought. So sometimes it becomes necessary to replace several weather indexes instead of one (Karuaiha et al 2006).

Index insurance has Trigger level and limit. It means that a range will be determined and the compensation is done in this range. Trigger level insurance, is the starting point of payment. The payment will be start from this point and when it gets closer to limit, the amount of damage will increase, for example, in the index insurance contract which has been signed for drought risk transfer, when the rainfall get to the bellow point of trigger level in a period of time, the payment will start. With every millimeter of rainfall reduction, the amount of damage increases and this increase continues until it reaches to the agreed limit. The maximum amount of compensation is paid when the rainfall amount is less than or equal to limit point. Amount of payment in index insurances regardless of the amount of loss that they had is equal for all the policyholders that have such a contract. Trigger level and limit amount of receive compensation depends on the amount of purchased commitment.

Figure 1 shows the payment structure in a hypothetical contract. The horizontal axis is weather index and the vertical axis is the commitment of insurer. The payment rate is proportional, it means that for every millimeter of rainfall reduction between the trigger level and limit point, an equal amount is intended to compensation.

When the amount of reduce reach the trigger level, regardless of the type of index which the contract is concluded, amount of payment is not based on the actual losses of the insurer, but is based on the amount of index according to the predetermined trigger level (depending on the limit level) and the amount of purchased commitment. The payment may be less or more than the insurer's loss. The following example presented a structure of an index insurance contract to cover the drought risk. In this contract, the compensation starts when the amount of rainfall is 100 mm or less. The maximum payment of compensation is when the amount

Figure 1. The structure of index insurance payment



of rainfall in the season reaches to 50 mm or less. Assuming that the purchased commitment by the insurer is 5 million Rial we will have the following values:

- Trigger level = 100mm
- Limit = 50 mm
- Index variable = total accumulated rainfall which is measured by local meteorological station for a farming season
- The payment rate = $(\text{limit} - \text{trigger level}) / (\text{actual value} - \text{trigger level})$
- The amount of compensation = the payment rate \times purchased commitment by insurer

According to the example we have:

- The payment rate = $(50 - 100) / (\text{actual value} - 100)$
- The amount of compensation = the payment rate \times 5000000 Rial

Table 1 has shown the amount of paid in different situations of contract. The amount of compensation in per mm reduction of rainfall is calculated by the paid rate factor in the amount of purchased commitment. The trigger level of 100 mm means that the farmer is considered as lost person when the amount of rainfall is less than this amount.

Table 1 . payment due to rain fluctuate rain

Total rainfall	Paid compensation
100 mm	No compensation payment. reduction amount did not reach to trigger level
80 mm	2000000 Rial
50 mm	5000000 Rial
40 mm	5000000 Rial

For example, when the rainfall amount reach to the 80 mm, paid compensation (according to table 1) is as follows:

$$2000000 \text{ Rial} = 5000000 \text{ (Rial)} \times [(80-100) / (50-100)] = \text{the amount of paid compensation}$$

5 - 3. Index insurance benefits

In traditional agriculture insurance scheme, the compensation will pay to farmers whenever the crops injured by factors like drought, glacial and hail (like agriculture Multi-risk Crop Insurance). Since most of the agriculture insurance schemes are affected by asymmetric information problems, so these conditions are good for farmers. Because farmer's information and knowledge about actual yield of their crops are always more than insurer's. such a behaviors leads to increase in premium rates, more accurate assessments on damages and ensure about controlling the programs and the insurer must evaluate more costs in order to assess some part of damage. Weather-based agriculture insurance eliminates the perverse incentives. In some cases, farmers prefer to destroy their crops so that they can receive compensation. By using the index insurance, compensation payment to farmers is not depends on survival or failure of crops, so farmers are doing their best to survive their crops. Relying on factors that are out of farmers control, will

reduce the moral hazard and adverse selection problems. Moreover, unlike traditional schemes in compensation payment, insurance companies do not need to visit farms in order to determine premiums or assess damages and the compensation will be paid whenever the amount of rainfall is less than the target amount. Such costs in traditional agriculture schemes are strongly supported by the government; for example in 2004, the average subsidy for all multi-risk yield insurance crops and the income which implemented by US Federal Crop Insurance Program was 59 % of the total premium. Unfortunately in developing countries, the government does not have enough funds to help such schemes in large-scale. Weather-based insurance does not have such disadvantages. Because insurance scheme is based on a reliable and identifiable index independently. It is also possible that insurance companies transfer part of their risk to the international market and use reinsurances (Leblois & Quirion, 2010).

5-4. Index insurance limit

Index insurance or especially weather-based agriculture insurance, will not pay the compensation of damages caused by factors other than the intended index. Such issues are in index insurance schemes as basic risk. Basic risk occurs for different reasons. For example when recorded rainfall information in Meteorological stations is different with actual amount of rainfall or there is an obvious difference between paid compensation and the actual damage of individual farmers; for example if a farmer who has rainfall index insurance, loses his crops as a result of drought but local meteorological station shows a good deal of rainfall, the compensation will not be paid to the farmer. In index insurance it is also possible that a farmer receive compensation while he did not suffer from any damage. Some of risks that are not able to be insured are not even available in traditional schemes. Since the compensation payment occurs every 4-7 years by the insurer and it is possible that no effective solution was available to cover all the damages so there are many years that there is no appropriate compensation to cover damages. Appropriate risk insurance and risk management are the important factors in successful index insurance. Basic risk reduction alone is not important but the basic risk should be completely identified. So that farmers do not suffer any damage caused by risks that are not covered by the insurance.

6. Conclusion

Agriculture is full of risks. In this activity natural, social, economic and deliberate hazards are gathered and provide a fragile collection to the manufactures. In economics based on agriculture, weather condition is an important factor in economic growth. In areas where rain fed agriculture is done, climate change is the most affective factor in production amount. Previous research and experiences shows that farmers often choose the low-risk so low-yield activities to avoid or to minimize the effects of climate risks. Financial institutions may limit the amount of loan to farmer's family. This strategy can effectively reduce the risk, but the result of this reduction is to lose the opportunities of growth and development. While many of the methods that used for weather risk management by farmers especially in low-income countries are inefficient and does not match with long-term economic growth goals, but rarely some sustainable alternative methods are created. In this paper agriculture insurance introduced as a strong management tool in agriculture risk management. As stated, insurance programs are different according to the level of government-sponsored and sort of covered risks, diversity in planting crops and growing conditions in different countries. It should be noted that except the hail insurance, most of the

agriculture traditional insurance use heavy subsidies to reduce the cost of premiums. So high costs that are related to the traditional agriculture risk management programs and financial supports of government caused to use new risk management methods with least support of government, especially in developing countries that the government has the limit ability to support the damage. So such schemes can replace with traditional schemes with least financial problems for the government. Also such schemes solve problems that causes the traditional schemes in rural parts of developing countries be inapplicable. Another main problem in using traditional insurance, are adverse selection and moral hazard that as mentioned in the article is the most important advantages of index insurance in solving problems. Generally, unique feature of index insurance that made it to be different with traditional crops insurance, is that compensation is based on values that determined based on an index and this index serves as an alternative to losses. Because of that determining the compensation is not based on the damage of the insurer it means therefore the intended index is determined based a measurement criteria (e.g., rainfall, temperature).

7. Suggestions

-According to the successful result of weather-based agriculture insurance in developing countries it is recommended that this insurance scheme design and implement as an effective strategy in agriculture risk management in Iran.

- Since insurance programs is different according to the level of government-supported, type of covered risks, diversity in planting crops and growing condition in different regions, it is recommended to examine carefully about choosing the appropriate insurance schemes according to the previous experiences, physiological growth levels in that region and weather conditions.

- Appropriate risk insurance and basic risk management should be considered for insurers in implementing index insurance.

- It is recommended that in weather-based agriculture insurance implementing, the effective potential use in private insurance companies in Iran.

References

1. Aziz ,N., Smaneh (2014). weather-based agriculture insurance as an effective tool in agriculture risk management in Iran, Thesis, Allame Tabatabaei University, echo insurance.
2. Enjolras, G., Capitanio, F., & Adinolfi, F. (2012). The demand for crop insurance: Combined approaches for France and Italy. *Agricultural Economics Review*, 13(1), 5.
- 3., Bastian, C. (1999). Crop Insurance as a Tool. *Risk and Resilience in Agriculture, University of Wyoming, Cooperative Extension Service*, 1-7.
4. Diaz-Caneja, M. B., Conte, C. G., Dittmann, C., Pinilla, J. G., & Stroblmair, J. (2008). Agricultural Insurance Schemes. *European Commission, Joint Research Center (JRC) Institute for the Protection and Security of Citizens, Ispra, Italy*.

5. Bryla, E., & Syroka, J. (2007). Developing index-based insurance for agriculture in developing countries. *Sustainable Development Innovation Brief*, (2).
6. Karuaihe, R. N., Wang, H. H., & Young, D. L. (2006, August). Weather-Based Crop Insurance Contracts for African Countries. In *Contributed paper prepared for presentation at the International Association of Agricultural Economists Conference*.
7. Lehmann, E. L., & D'abrera, H. J. (1975). *Nonparametrics: statistical methods based on ranks*. Holden-Day.
8. Leblois, A., & Quirion, P. (2013). Agricultural insurances based on meteorological indices: realizations, methods and research challenges. *Meteorological Applications*, 20(1), 1-9.
9. Vedenov, D. V., & Miranda, M. J. (2001, May). Rainfall insurance for midwest crop production. In *Selected Paper, AAEE Annual Meetings, Ames, IA*.
10. Molini, V., Keyzer, M., van den Boom, B., & Zant, W. (2008). Creating safety nets through semi-parametric index-based insurance: A simulation for Northern Ghana. *Agricultural Finance Review*, 68(1), 223-246.
11. Bielza, M., Stroblmair, J., Gallego, J., & Conte, C. O. S. T. A. N. Z. A. (2007, July). Agricultural risk management in Europe. In *Conference proceeding: 101st EAAE Seminar: Management of climate risks in agriculture, Berlin* (pp. 05-06).
12. Ray, P. K. (2013). *Agricultural insurance: principles and organization and application to developing countries*. Elsevier.
13. Shams, H. (2005), *Risk management in the agricultural sector, the role of agricultural insurance*. Second Agricultural Insurance Conference . Iran, 2005
14. Skees, J. R., & Barnett, B. J. (1999). Conceptual and practical considerations for sharing catastrophic/systemic risks. *Review of Agricultural Economics*, 21(2), 424-441.
15. Skees, J., Hazell, P. B., & Miranda, M. (1999). *New approaches to crop yield insurance in developing countries* (No. 55). International Food Policy Research Institute (IFPRI)
16. Zhu, Y., Ghosh, S. K., & Goodwin, B. K. (2008, July). Modeling Dependence in the Design of Whole Farm Insurance Contract---A Copula-Based Model Approach. In *annual meetings of the American Agricultural Economics Association, Orlando, FL* (pp. 27-29).