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The Importance of Public-Private Partnerships in Agricultural Insurance in China: based on Analysis for Beijing

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Abstract

To establish a healthy and sustainable policy-driven agricultural insurance scheme, a discussion of the importance of Public-Private Partnerships (PPPs) is timely in light of the challenges that governments are facing against the backdrop of increasing scale and frequency of major agro-related natural disasters across the globe. Most recently in 2008, it is reported a total of 137 natural catastrophes led to overall economic losses of USD258 billion in the world. Moreover, as complexity and costs escalate, neither group - public nor private - can meet the challenge alone. This is particularly true for agricultural industry and rural areas in emerging economies that lack sufficient funds to deal with the increasing frequency and severity of natural disasters. Public private partnerships (PPPs), especially those involving reinsurance and capital market solutions, can improve risk management and prepare stakeholders for the consequences of uncertainties. A recent example is the agricultural reinsurance contract signed by the Beijing Municipal Government and Swiss Re.

In 2007, Beijing imposed a new agricultural insurance policy for local farmers to promote the development of urban agriculture. Under the new policy, the Beijing municipal and district governments subsidized farmers up to 75% who buy agricultural insurances for certain crops/livestock, and 50% of management costs of the participating insurers are shouldered by governments. The municipal government also set up a protection funds for agro-related natural catastrophe events and regulated the loss ratio of 160% as an attachment point to start up the fund. In this paper, we apply the non-parameter information-diffusion model to stimulate possibility of different loss incurred in Beijing using time-series combined loss ratio data of historical agricultural insurance business. The results show that the current attachment point of protection fund, 160%, will impose additional financial burden to local government comparing to higher or lower points. It proves the necessity for government introducing reinsurance in the system to diversify risks and improve efficiency simultaneously. The paper also outlines the overall framework of Beijing agricultural insurance scheme for each stakeholder including direct insurers and reinsurers.

Keywords: Policy-driven agricultural insurance scheme; Non-parametric information-diffusion model; Public-Private Partnerships (PPPs); Beijing Municipality

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1. Introduction

After nearly two years' theoretical researches and field work, Beijing municipality government formally put forward in 2007 the policy-driven agriculture insurance. The assessment of the policy-driven agriculture insurance catastrophe risk is carried out annually by the leading policy-driven agriculture insurance group. This group also makes a third-party auditing to the each insurance company. Based on this, the leading group assesses the performance of the policy-driven agriculture insurance operated by different commercial insurance companies.

(1) When the annual combined loss ratio is below 100%, the insurance companies will pay using the premium income and the operation subsidy granted by the government. The annual surplus will be put on the companies' catastrophe risk reserve fund, to check computations separately and use them accumulatively;

(2) when the insurance companies' annual combined loss ratio is between 100% and 160%, then the insurance companies can pay by the risk reserve fund accumulated in the past years and make full use of the domestic and foreign capital markets to construct a company-level agriculture catastrophe risk coping mechanism through reinsurance, catastrophe bond, emergency reserve fund and the other forms;

(3) When the combined loss ratio is above 160%, then the government will launch the governmental catastrophe risk fund compensations[b] (see Fig. 1) (leading group of Beijing municipal policy-driven agriculture insurance, 2007).

The ratio (160%) is established mainly on the basis of the advices of the experts on agriculture insurance, and the insurance companies' agriculture insurance combined loss ratio[c].

Based on historical data of Beijing municipal agriculture insurance, this paper will compute the disaster occurrence probability through the nonparametric information diffusion model, take both the major interest bodies – the government and the insurance companies - in the catastrophe risk sharing mechanism into consideration, simulate the influence that the EXL ratio has on the sustained management capacity of the commercial insurance companies and the protection capacity of the government's catastrophe risk reserve fund, so as to hopefully provide a scientific and practical basis for the construction of the agriculture insurance catastrophe risk sharing mechanism in Beijing and other areas.

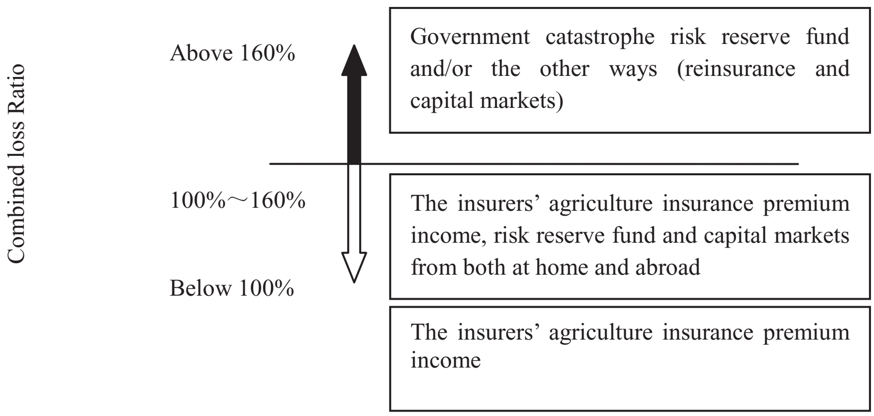

Fig. 1 An illustrated diagram of Beijing municipal agriculture catastrophe risk sharing mechanism

[b] The computation and withdrawing of the agriculture catastrophe risk reserve fund: each year, the government puts the 1‰ of the previous year's added agriculture value on the catastrophe risk reserve fund, to open an account and check computations separately and use them accumulatively.

[c] The combined loss ratio of the agriculture insurance is the sum of the simple combined loss ratio and the additional expense ratio, that is, (insurance claim payment + loadings)/premium income. The loadingsis usually 30% of the premium income, including 20%'s management fees, 8%'s handling fees and 2%'s other fees.

2. Models and data processing

2.1 Introduction to the models

The nonparametric information diffusion model is a kind of product that combines the nonparametric statistic method and fuzzy mathematic method together. Huang *et al.* (1995, 2005) put forth the optimization processing technology for fuzzy information to make use of group fuzziness to analyze and deal with the small sample problems; Shang *et al.* (2002) applied this method to the intensive computation of insurance; Xing (2004) used this model to evaluate the major crops' production risks in China's plantation industry. She divided the production risks of different crops into three different levels – low, medium and high levels - according to the provincial administrative area; Zhang *et al.* (2007) made a systematical introduction to the application of the nonparametric information diffusion model in measuring the crops' production risks; Lei *et al.* (2004), Jing *et al.* (2006) and Zhang (2007) also separately used this model to simulate the occurrence rate of flood disasters in Aksu River areas, flood and drought disasters in Henan province and typhoon & storm disasters in China's coastal areas. They analyzed the risk degrees and provide a basis for effective prevention and reduction of the natural disasters. This paper using this model to compute the agriculture insurance EXL ratio is mainly out of the flowing considerations:

While the nonparametric information diffusion model takes the small sample as the fuzzy subset in the whole sample space. Therefore, in the computation process, it can distribute the information of sample points into the whole sample space, making the whole sample information distributed in the specific place.

Supposing that the loss rate of the crop production is l , obviously, $l \in [0,1]$ and it is a continuous variable in this interval. For the convenience of computation and description, make production loss rate discrete, that is, to divide it in [0, 1] into several equal parts: $0 = l_1 < l_2 < l_3 < ...... < l_n = 1$

In certain area, the sample observation data of the real production loss rate in the tth year is $x_t, t = 1,2,3,........T$. Supposing that the information of x_t according to the normal distribution rules diffused to each sample point l in the sample space [0, 1], its information diffusion model is:

$$g_{x_t}(l_i) = \frac{1}{h\sqrt{2\pi}} \exp[-\frac{(x_t - l_i)^2}{2h^2}] \quad (1)$$

In formula (1), $g_{x_t}(l_i)$ is l 's probability density function; "h" is the information diffusion coefficient; exp (.) is a natural exponential function. Therefore, the probability (that is, probability distribution) $\mu_{x_t}(l_i)$ of sample observation data x_t of the real production loss rate in the interval [l_{i-1} , l_i]:

$$\mu_{x_t}(l_i) = \frac{g_{x_t}(l_i)}{\sum_{i=1}^{n} g_{x_t}(l)} \quad (2)$$

Therefore, $p(l_i)$ is the cumulative probability distribution of the real production loss rate of the sample observation value x_t in the interval [0, 1], that is:

$$p(l_i) = \sum_{t=1}^{T} \mu_{x_t}(l_i) \quad (3)$$

In the practical operation, the diffusion coefficient "h" can be obtained through the following empirical formula according to the number of the samples "m" and the maximum value "b" and the minimum value "a" in the sample data:

$$h = \begin{cases} 1.6987(b-a)/(m-1) & 2 \le m \le 5 \\ 1.4456(b-a)/(m-1) & 6 \le m \le 7 \\ 1.4230(b-a)/(m-1) & 8 \le m \le 9 \\ 1.4208(b-a)/(m-1) & 10 \le m \end{cases} \quad (4)$$

2.2 Data processing

From the formula above we can see that nonparametric information diffusion model usually adopts loss rate data. However, lacking of continuous data records of damages in agriculture production disasters in China, it is not easy to acquire the production loss rate data. In the agriculture insurance practice, usually, the agriculture insurance combined loss ratio data is used to reflect the risk level of the insurable agriculture production and the insurance companies' compensation capacity. However, the combined loss ratio data is within the [0, ∞]. It cannot use the nonparametric information diffusion model unless being converted. Therefore, this paper converts the combined loss ratio data by the method in Tab. 1, making it fall in [0, 1]. The rules are as follows:

(1) If the combined loss ratio is < B, then the converted combined loss ratio "X" is counted as 0;

(2) If the combined loss ratio is > (B+100%), then the converted combined loss ratio "X" is counted as 1;

(3) If the combined loss ratio is between B and (B+100%), then the converted combined loss ratio "X" is counted as this value minus 1 (see Tab. 1). Because the agriculture insurance is systematic risks, the combined loss ratio is relatively high. During some years, the combined loss ratio for some crops is even higher than 200% (Swiss Re, 2009). Therefore, set B as any numerical value above 100% and establish a corresponding data treatment group.

Tab. 1 Conversion rules of the agriculture insurance combined loss ratio

Agriculture insurance combined loss ratio (Y)	Converted Agriculture insurance combined loss ratio (X)
Y＜B*	X=0
B≤Y≤（B+100%）	X=Y/100-1
Y＞（B+100%）	X=1

Note: for simulation, B can be any numeric value above 100%.

All converted agriculture insurance combined loss ratio "X" are distributed in the interval of [0, 1]. According to the nonparametric information diffusion model from formula (1) to formula (4), we can figure out the insurance companies' cumulative occurrence probability $p(Y_i)$ for different losses (that is, the agriculture insurance combined loss ratio). This research chooses the agriculture insurance combined loss ratio data from PICC Beijing branch in Beijing municipality in 1983 - 2004 and 2007. It works out the occurrence probabilities of the agriculture catastrophe risks according to the above formula to assess whether the government EXL ratio is proper or not.

2.3 Assessment of the risk degree of Beijing municipal agriculture

First, let's have a look at the occurrence frequency of Beijing municipal agriculture insurance combined loss ratio in all intervals in 1983-2007 (see Fig. 2). In Fig, 2, the horizontal axis refers to the interval of the agriculture insurance combined loss ratio (that is, the sub-interval of the agriculture insurance combined loss ratio in the scope of 0-32%, a division for each 20% interval). The left axis refers to the frequency and the right axis refers to the cumulative probability. We can see that in the past 23 years, there are 9 years when the agriculture insurance combined loss ratio falls in 0-100%, 5 years in 100%-200% interval, and 9 years over 200%. The agriculture insurance combined loss ratio takes on the feature of "more in the two ends and less in the middle".

We can see that in 1983-2007, Beijing municipal agriculture insurance combined loss ratio was in the interval of 0-320%. In order to have a better look at the occurrence probability of the agriculture insurance combined loss ratio in different points, this paper adopts four treatment groups to make an analysis, that is, as is shown in Tab. 1, to make B equals to 100%, 160%, 180% and 200%. Place the converted agriculture insurance combined loss ratio in formula (1)-(4), and figure out the occurrence probability of different agriculture insurance combined loss ratio. As for the result, please see Tab. 2.

(1) In the 100% group, the cumulative probability is 24.9% when the combined loss ratio is below 160%;

(2) In the 160% treatment group, the cumulative probability is 31%when the combined loss ratio is below 160%.

(3) None of their cumulative probability overpasses 50%. In other words, the cumulative probability is around 30% when the combined loss ratio is less than or equals to 160%, and the cumulative probability is around 70% (100%-30%) when the cumulative probability is over 160%.

(4) The probability for the government to use the catastrophe risk reserve fund is around 70% when the combined loss ratio is over 160%.

That's to say, when the EXL ratio is 160%, the probability that the government needs to use catastrophe risk reserve fund is two times every three years or even three times every four years, which does not go with the government's original intention to establish the catastrophe insurance reserve fund: to "avoid the relatively large amount of risk compensation and to construct a catastrophe risk 'Fire Wall'". In particular, as the insurance industry's management capacity and technical level improved and with the qualifications of the practitioners, the current additional expense rate (30%) of the agriculture insurance will be reduced continuously. In addition, the government provides premium subsidy for the peasants and improves the peasant households' rate of joining insurance, which not only increases the agriculture insurance's premium income, but also reduces the overall risk level that the insurance companies take. All these factors will bring down the combined loss ratio. Therefore, from the above analysis we can see that currently it is regulated in Beijing municipal policy-driven agriculture insurance catastrophe risk sharing system that if the agriculture insurance combined loss ratio is above 160%, the government shall provide the EXL protections. This ratio is relatively low and is not good for the government's catastrophe risk reserve fund accumulation. The standard should be raised a little bit higher.

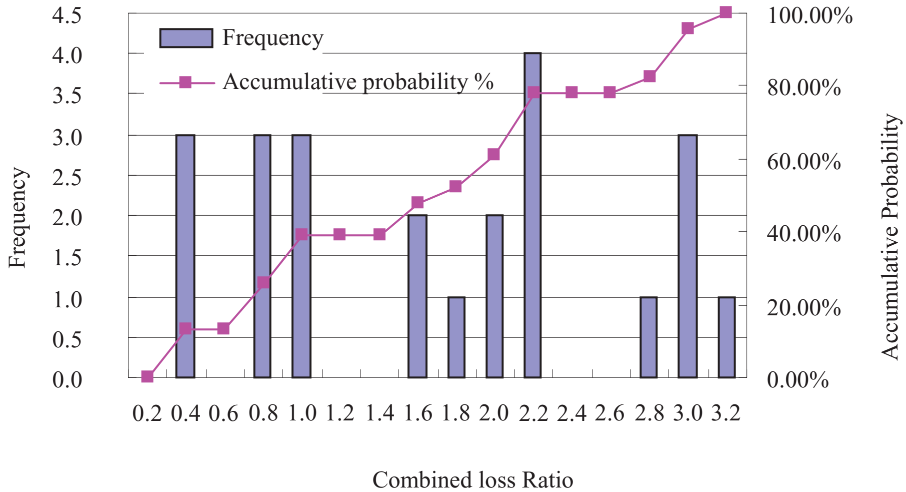

Fig. 2 distribution of Beijing agriculture insurance combined loss ratio

From Tab. 2 we can see that there are differences in cumulative probability gained in different treatment groups:

(1) in the 100% group, the cumulative probability of the 160% combined loss ratio is 24.9%;

(2) in the 160% group, the cumulative probability corresponding to the 160% combined loss ratio is 31.0%. Likewise, in the 160% group, the cumulative probability corresponding to the 210% combined loss ratio is 62.3%;

(3) in the 180% group, the cumulative probability corresponding to the 210% combined loss ratio is 62.0%;

(4) in the 200% group, the probability corresponding to the 210% combined loss ratio is 59.6%.

Tab. 2 Cumulative probability of treatment groups in different combined loss ratio (%)

Combined loss ratio [a]	100% group [b]	160% group	180% group	200% group
0.0%	15.7	31.0	34.4	42.6
10.0%	20.4	42.0	49.1	59.6
20.0%	20.6	44.9	58.0	61.8
30.0%	20.6	49.7	62.0	61.9
40.0%	21.8	58.3	62.2	61.9
50.0%	24.2	62.3	62.2	62.1
60.0%	24.9	62.5	62.2	64.2
70.0%	26.2	62.5	62.5	67.1
80.0%	28.4	62.7	64.7	71.9
90.0%	44.9	67.7	70.6	76.6
100.0%	100.0	100.0	100.0	100.0

Notes:

[a] Here it is the converted agriculture combined loss ratio. The real combined loss ratio = combined loss ratio + B. For example, in the fifth line under the 160% treatment group, "58.3%" means the cumulative probability corresponding to the real combined loss ratio (which is less than or equals to 200%) (40%+160%) is 58.3%. Explanations to the rest are the same.

[b] "100% treatment group" refers to the data group gained after being dealt with by method in Tab. 1, with 100% as the B point. The cumulative probability of the points under the 100% treatment group is the cumulative occurrence probability when the combined loss ratio is between 100% and 200%. For example, "21.8%" in the 5th line under the 100% treatment group means the corresponding cumulative probability is 21.8% when the combined loss ratio is less than or equals to 140%. Explanations to the rest are the same.

Whether the difference in cumulative probability caused by data processing is obvious or not will have an influence in choosing the EXL ratio. Therefore, the 95% confidence interval coupled t-Test is implemented separately to the three couples of treatment groups - 100% and 160% treatment group, 160% and 180% treatment group, 180% treatment group, and 200% treatment group. As for the result, please see Tab. 3, we can see that:

(1) The significance probability in the DT t-Test of 100% treatment group and 160% treatment group is 0.04, the original assumption is rejected, which means that there are obvious difference between the 100% and 160% treatment group. This might be because when making the data normalization dispositions, the interval in between the data treatment group is relatively far and the common part between the treatment groups is relatively small.

(2) The significance probability in the DT t-Test of 160% treatment group and 180% treatment group is 0.04. When the significance probability is 0.05, the original assumption is accepted, which means that there are no obvious differences between the 160% treatment group and 180% treatment group.

(3) The significance probability in the DT t-Test of 180% treatment group and 200% treatment group is 0.16. When the significance probability is 0.05, the original assumption is accepted, which means that there are no obvious differences between the 180% treatment group and 200% treatment group. The above illustration to the choosing of EXL ratio for Beijing municipal policy-driven agriculture insurance catastrophe risk has no obvious difference between the 160% & 180% and 180% & 200% treatment groups; while between the 100% and 160% data treatment groups, there are obvious differences.

Tab. 3 t-Test: mean value analysis of the coupled samples

	Group 1 test		Group 2 test		Group 3 test	
	100% treatment group	160% treatment group	160% treatment group	180% treatment group	180% treatment group	200% treatment group
mean value of the probability	0.31	0.42	0.59	0.57	0.63	0.60
square deviation	0.01	0.01	0.01	0.01	0.00	0.01
P value (DT Test)	0.04		0.14		0.16	

3. Policy effect's Simulation Analysis

Generally speaking, the framework of the policy-driven agriculture insurance system guided by Beijing municipal government and operated by the commercial insurance companies is proper in its overall design. It is good for the agricultural development, peasants' income increasing and the rural areas' stabilization (Xing Li et al., 2008). But from the above analysis we can see that to set the government EXL ratio at 160%'s agriculture insurance combined loss ratio is not proper. The standard is on the low side, not good for the achievement of the systematic goal and it is especially of no good to the establishment and accumulation of Beijing municipal agricultural risk catastrophe reserve fund. Taking the existing policy-driven agriculture insurance system implemented in Beijing municipality into consideration, based on the historical data of Beijing municipal agriculture insurance compensation rate, with the two principal interest holders - the insurance companies and the government in agriculture insurance - "bearing risks together and achieving stable operations", this paper makes a policy simulation to the insurance companies' sustained management and the government's balanced expenditure of the catastrophe risk reserve fund. The result is shown in Tab. 4.

3.1 Analysis of the insurance companies' sustained management

From the results of the policy simulation we can see that during the period from 1983 to 2004 before the policy-driven agriculture insurance was started, the premium income of Beijing municipal agriculture insurance was 7.2997 million Yuan and the claim settling expenditure of the agriculture insurance was 133.3285 million Yuan. Due to the data availability, we suppose that since 1986 the government has begun to compute and withdraw the agriculture catastrophe risk reserve fund according to the existing methods, that is, to compute and withdraw at the ratio of 1‰ of the previous year's agriculture added value. Then for 19 years the government can accumulate catastrophe risk reserve fund 118.57 million Yuan.

If setting 160% as the government agriculture insurance EXL ratio, then among the 22 years from 1983 to 2004, there are 12 years when agriculture catastrophe risk reserve fund needs to be initiated (that is, the occurrence ratio is 54.5% when the catastrophe risk reserve fund needs to be initiated, it is the same as bellow); the total payment is 33.3229 million Yuan; and the insurance companies' real claim settling expenditure is 100.5056 million Yuan; and the annual agriculture insurance combined loss ratio is 137.7% on average (10,050.56/7,299.7). Besides of the premium income, insurance companies need to collect an extra capital of 27.5086 million Yuan for compensation;

If setting 180% as the government agriculture insurance EXL ratio, then among the 22 years there are 11 years when agriculture catastrophe risk reserve fund needs to be initiated (the occurrence ratio is 50.0%); total payment for the agriculture catastrophe risk reserve fund is 23.9239 million Yuan; the insurance companies' real claim settling expenditure is 109.9046 million Yuan; and the annual agriculture insurance combined loss ratio is 150.6%. Besides of the premium income, insurance companies need to collect an extra capital of 36.9076 million Yuan;

In 2007, Beijing initiated the policy-driven agriculture insurance, that is, the governments at the municipal and district (county) levels will separately give the peasant households who has taken part in the agriculture insurance some ratio of premium subsidy. This has to a large extent promoted the development of the agriculture insurance, enlarged the scale of the agriculture insurance and thus decreased the insurance companies' insurance accepting risks. From the data we can see that during only one year in 2007, the agriculture insurance premium income was nearly doubled of that in the previous 22 years. While the claim settling expenditure increased by only one third. According to the catastrophe risk reserve fund computation and withdrawing methods, a capital of 147.38million Yuan in all can be accumulated within 23 years.

If setting 160% as the government agriculture insurance EXL ratio, then among the 23 years there are 12 years when agriculture catastrophe risk reserve fund needs to be initiated (the occurrence ratio is 52.2%). The agriculture catastrophe risk reserve fund's total payment is 33.3229 million Yuan, and the insurance companies' real claim settling expenditure is 145.4326 million Yuan, the annual agriculture insurance combined loss ratio was reduced to 103.4%. Besides of the premium income, insurance companies need to collect an extra capital of 4.8136 million Yuan for the claim settling expenditures. Only 17% of the amount that needs to be collected 22 years ago when the policy-driven agriculture insurance was initiated.

If setting 180% as the government agriculture insurance EXL ratio, then among the 23 years there are 10 years when agriculture catastrophe risk reserve fund needs to be initiated (the occurrence ratio is 43.5%). The agriculture catastrophe risk reserve fund's total payment is 23.9239 million Yuan, and the insurance companies' real claim settling expenditure was 154.8316 million Yuan, the annual agriculture insurance combined loss ratio was 110.1%. Besides of the premium income, insurance companies need to collect an extra capital of 14.2126 million Yuan for the claim settling expenditures.

If the EXL ratio of the government catastrophe risk is 210%, then among the 23 years there are 5 years when agriculture catastrophe risk reserve fund needs to be initiated (the occurrence ratio is 21.7%). The total payment was 12.9475 million Yuan; the insurance companies need to bear 165.808million Yuan's claim settling expenditures; the annual agriculture insurance combined loss ratio was 117.9%. Besides of the premium income, insurance companies need to collect an extra capital of 25.1890 million Yuan.

If making full use of the domestic and foreign capital markets or using the reinsurance method to transfer the agriculture catastrophe risk, then the insurance companies' sustained management capacity will be improved further.

3.2 Analysis of the balanced expenditure of the agriculture catastrophe risk reserve fund

According to the systematic design, the agriculture catastrophe risk reserve fund is computed and withdrawn at 1‰ of the agriculture added value in the previous year. For the reason of the data, this research computed that since 1986, each year, if compute the agriculture catastrophe risk reserve fund at the ratio of 1‰ of the agriculture added value, then in 1983-2004, Beijing municipality can compute and withdraw all together agriculture catastrophe risk reserve fund of 118.57 million Yuan; and in 1983-2004 and 2007, the agriculture catastrophe risk reserve fund that can be computed and withdrawn was 147.38 million Yuan in all. Whether adopting the combined loss ratio of 180% point or 210% point as the EXL ratio in the government agriculture insurance, the agriculture catastrophe risk reserve fund had a rich capital and was totally capable of insuring the sustainable development of Beijing municipal policy-driven agriculture insurance. This is because the risk of agriculture production in general is low in Beijing municipality (Xing, 2004). However, seen from the experiences of China and all other countries in the world in agriculture insurance development, the accumulation of the agriculture catastrophe risk reserve fund needs a long-term process. The damage compensation for just one widely and deeply spread catastrophe can use up all catastrophe risk reserve fund accumulated for many years. Therefore, we must strengthen the management and improve the application efficiency of the catastrophe risk reserve fund.

Under the policy-driven agriculture insurance framework, if the establishment of the EXL ratio of the agriculture catastrophe risks does not have a big influence on the reserve fund's support capability to the agriculture catastrophe risk, then the insurance companies sustained management capacity becomes the key important thing in choosing EXL ratio of the agriculture catastrophe risks. Therefore, to set 180%'s compensation rate as the government's agriculture insurance's EXL ratio can reserve certain stimulation space for the insurance companies and achieve the business goal that the policy-driven agriculture insurance can reach a balance between the profit and loss or even can have a small surplus.

4. Conclusions and policy implications

Through the risk distribution and transfer, agriculture insurance system strengthens the farmers' risk resistance and disaster recovery capacity as well as the government's disaster relief capacity. It also reduces the government's fiscal burdens. For this reason, many industrialized countries take the efficient agriculture insurance system as a long-term safeguard mechanism to stabilize their social and economic development (Swiss Reinsurance Company, 2007). As regulated by WTO, it is a kind of "green box" policy permitted by WTO for the government to support the agriculture insurance so as to reduce the damages that disasters may bring (Tuo *et al*, 2003). Public-private partnerships (PPP) are deemed as the best mode to improve the efficiency and sustainability of the agriculture insurance system (World Bank, 2007). Under this mode, the main role that the government plays is to function as a regulator - to establish a proper legal framework, to provide the premium subsidy and encourage the farmers to take a share in insurance, to examine the content of provisions in the guaranteed warranty, and to verify the process as the insurance rate is regularized. In the meanwhile, to avoid the significant damage that the agriculture catastrophe risk has brought to capitals, the government also associates with the commercial insurance companies to initiate the insurance pool and collect reserve fund to mitigate heavy losses (Swiss Reinsurance Company, 2008).

In 2008, China's insurance industry accepted insurance for 532 million Mu crop plants; peasant households involved added up to 90 million; it provided for peasants 239.74 billion Yuan risk protection; written premiums reached to 11.07 billion Yuan; more than 97% of the agriculture insurance business gained premium subsidies from governments at all levels; agriculture insurance had covered all the provinces (autonomous regions and directly governed city regions - Beijing, Tianjin, Shanghai and Chongqing - in China (Research Headquarter of ANBOUND Group). Some areas also established the agriculture catastrophe risk reserve fund system in accordance with their actual conditions, and made rules for the agriculture insurance's EXL (excess of loss) protection system, which is about the compensation responsibility that the insurance companies and the government would bear in shoulder as the catastrophe occurred. For example, an insurance pool was established in Zhejiang, with the People's Insurance Company of China as the leading institution, and the provincial government providing catastrophe reinsurance for damages whose agriculture insurance combined loss ratio was between 200% and 500%; Beijing municipality regulated that when the agriculture insurance combined loss ratio was above 160%, the municipal government should provide for its policy-driven agriculture insurance EXL protection.[d]

Policy-driven agriculture insurance is a systematic project. To establish a healthy and sustainable policy-driven agricultural insurance scheme, a discussion of the importance of Public-Private Partnerships (PPPs) is timely in light of the challenges that governments are facing against the backdrop of increasing scale and frequency of major agro-related natural disasters across the globe. Most recently in 2008, it is reported a total of 137 natural catastrophes led

[d] Agriculture Insurance EXL Protection refers to the compensation provided by the government and/or the commercial (re)insurance companies after the agriculture insurance combined ratio has reached a certain amount. According to the research of Swiss Reinsurance Company's "Sigma", one of the features about China's agriculture insurance is that it is usually the government that bears the Agriculture Insurance's EXL risk, that is, to provide the EXL Protection (Swiss Reinsurance Company, 2008).

to overall economic losses of USD258 billion in the world. Moreover, as complexity and costs escalate, neither group - public nor private - can meet the challenge alone. This is particularly true for agricultural industry and rural areas in emerging economies that lack sufficient funds to deal with the increasing frequency and severity of natural disasters. Public private partnerships (PPPs), especially those involving reinsurance and capital market solutions, can improve risk management and prepare stakeholders for the consequences of uncertainties. A recent example is the agricultural reinsurance contract signed by the Beijing Municipal Government and Swiss Re.

From the analysis to the government's EXL ratio in Beijing municipal policy-driven agriculture insurance we can see that to coordinate well interests between the two risk bearers - insurance companies and the government - is very important in insuring the healthy and sustainable development of the agriculture insurance system. Indications we gained from Beijing municipal policy-driven agriculture insurance system and its catastrophe risk sharing system mainly include the following three points:

(1) Sound and efficient agriculture insurance system shall involve the regional (like Beijing) agriculture insurance fund system for catastrophe risks. Although it needs further discussion about whether the government should be the final bearer of the agriculture insurance risks and that above what EXL ratio should the government take the compensation responsibilities, one thing is for certain, the regional agriculture insurance catastrophe risk reserve fund system is of great help in transferring and reducing the regional agriculture catastrophe risks.

(2) As for the establishment of the reserve fund for the agriculture catastrophe risks, in the preliminary stage, the government can give fiscal support and gradually reduce the direct disaster relief burdens; the government can also encourage the insurance companies to spare certain ratio of their agriculture premium income to the reserve fund for the catastrophe risks so as to achieve the sustainable development of the reserve fund for the catastrophe risks.

(3) To scatter the agriculture catastrophe risks, the government should make full use of the professional technologies of the reinsurance companies from both at home and abroad or take advantages of the international capital markets to buffer the volatility of the agriculture insurance compensation and raise the commercial insurance companies' enthusiasm to participate in the agriculture insurance.

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Tab. 4 Policy simulation result for Beijing municipal agriculture catastrophe risk sharing mechanism 10,000 Yuan

Year	Agriculture insurance premium income (1)	Agriculture insurance claim settling expenditure (2)	Catastrophe risk reserve fund computed and withdrawn by the government (3)	EXL ratio of the government agriculture insurance catastrophe (4)	Government catastrophe risk reserve fund payment (5)	The insurance companies' real claim settling expenditures (6) = (2) – (5)	Capitals that the insurance companies need to collect (7) = (6) – (1)
1983-2004 Total	7,299.70	13,382.85	11,857	160%	3,332.29	10,050.56	-2,750.86
				180%	2,392.39	10,990.46	-3,690.76
				210%	1,294.75	12,088.10	-4,788.40
1983-2004 and 2007 Total	14,061.90	17,875.55	14,738	160%	3,332.29	14,543.26	-481.36
				180%	2,392.39	15,483.16	-1,421.26
				210%	1,294.75	16,580.80	-2,518.90

Notes: Data of the catastrophe risk reserve fund that can be computed and withdrawn from (3): to compute starting from year 1986, each year, the government put 1‰ of the agriculture added value in the previous year to the catastrophe risk reserve fund, to open an account and check computations separately and use them accumulatively; Amount of the payment for the agriculture catastrophe risk reserve fund (5) = the total expenditures of the part that the combined loss ratio in the previous years is higher than the EXL ratio simulated by the government for the catastrophe risk; The insurance companies' real claim settling expenditures (6) = the total expenditures of the part that the combined loss ratio in the previous years is lower than the EXL ratio simulated by the government for the catastrophe risk; In the table, there are two kinds of year totals, because in 1983-2004, the data is before the policy-driven agriculture insurance was initiated; in 2007, Beijing municipal policy-driven agriculture insurance was initiated in full swing. Compared with the data in the previous years, data in 2007 had a relatively bigger difference. In case of affecting the analysis result, there are two total items.

Data source: The data of the agriculture premium income and the insurance claim settling expenditure in 1983-2004 is provided by the People's Insurance (Property) Company- Beijing Sub-branch. The data of the agriculture premium income and the insurance claim settling expenditure in 2007 is provided by Beijing municipal Commission on Agriculture. The catastrophe risk reserve fund data that can be computed and withdrawn was figured out according to the "Year Book of 2008 Beijing Agriculture Statistics" (edited by Beijing Municipal Statistic Bureau, State Statistics Bureau Survey Office in Beijing, 2008).