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Evaluation on the Efficiency of Crop Insurance in China's Major Grain-Producing Area*

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Abstract

In China, crop insurance is just a pilot program characterized by material cost-based coverage level and government-subsidized premium. To identify the efficiency of the crop insurance, we use the nonparametric density function model and estimate the probability of yield loss rate at 3 proposed levels for grain crop, wheat, corn, rice and cotton respectively from 13 provinces in the Major Grain-Producing Area. Besides, we point out some unfavorable factors for crop insurance management based on the Second National Agricultural Census data (2006). Our finding is: the coverage level is on average no larger than 50% of the per hectare crop production value while the probability of yield loss for each crop approaches to zero if the proposed yield loss rate is larger than 40%, so the yield damage compensations are not necessary unless the huge catastrophes occur with the yield loss rate over 50%. Farmers could buy crop insurance to avoid big crop failure other than to maximize their returns. Therefore, the current crop insurance coverage level under normal years could not create an effective inducement for farmers to purchase insurance contracts. To expand crop insurance participation, we consider that it is necessary to carry out positive and conditional forced insurance, provide a larger portion of premium subsidy to the Major Grain-Producing Area by central government and improve the basic agricultural production conditions.

Key words**:** Major Grain-Producing Area; Crop Insurance; Coverage Level; Risk Loss Probability; Insurance Efficiency

1. Introduction

In the Major Grain-Producing Area (MGPA[‡]) of China, the rural households numbered 121740784, accounting for 65.4% of the national total and 93% were grain producers. The crop sown area is 105272 hectares, accounting for 69.1%. The grain crop sown area was 75628 hectares, accounting for 71.98%. For individual crops such as wheat, corn and rice, 68.4%, 78.7% and 75.3% respectively. The data mentioned are from the Second National Agricultural Census (SNAC, 2006) by the National Bureau of Statistics (NBS). Compared to the other

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‡ Major Grain-Producing Area covers 13 provinces in China: Hebei, Inner Mongolia, Liaoning, Jilin, Heilongjiang, Jiangsu, Anhui, Jiangxi, Shandong, Henan, Hubei, Hunan and Sichuan.

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regions, these MGPA figures exhibit a higher level of spatial farming risk accumulation and larger natural disaster pressures on farmers.

Crop insurance is an important tool to alleviate natural disaster risks. There are three types of crop insurance in the world: cost insurance, yield insurance and revenue insurance, the yield insurance is widely used in about 40 countries. In comparison, China experienced commercial crop insurance for many years and just began to try government-subsidized and material cost-based [§] crop insurance in 2004, which decides the coverage level according to the material cost incurred during crop production. At present, the material cost-based crop insurance has covered all MGPA provinces. Under the current policy of 'low-premium, wide-coverage, low-guarantee and low-indemnity', the insurance program aims to restart the crop production and stabilize farmers' living if the worst-case crop failure happens and not try to maximize their expected returns.

Could the coverage level of material cost-based crop insurance be capable of offering adequate compensation for yield loss from catastrophe or encouraging farmers to purchase crop insurance? With the statistical model and risk factor analysis, this paper is to give a comprehensive evaluation on the efficiency of crop insurance in order to determine whether or not the crop insurance could be feasible.

2. Pilot Program of Material Cost-based Crop Insurance

Owing to the 'Regulations on Central Fiscal Subsidy to Crop Insurance Premium (2008)' by the Ministry of Finance of China, a dramatic growth has occurred in crop insurance participation in China. From Table 1, the pilot crop insurance program provides farmers with plans covering major grain crops（e.g. rice, corn, wheat and soybean）and industrial crops (e.g. cotton, tobacco, cole and peanut). Per hectare material cost is as the baseline to set coverage level which could be larger than or equal to crop material cost. Practically, the provincial coverage level is basically larger than its material cost. The material cost accounts for about 30%-80% of the total production cost, which means a low level of crop loss indemnity, and, the coverage level is on average no more than 50% of the per hectare crop production value. In fact, the actual yield per hectare is rarely less than 70% of the average yield in the MGPA though actual yield varies by year and by region. Therefore, the current coverage level is incapable of offering adequate compensation for yield loss in case of catastrophe. The premium rate is generally set at provincial level in the insurance program. In China, rapid crop insurance development mainly stems from premium subsidy, in detail, the crop insurance premium is shared by farmers and all levels of governments (central, provincial and county administrative levels). Generally, central government' share is 35% the same across the country, provincial and county governments determine their share according to their own fiscal revenues. On average, all levels of governments together shoulder a portion of premium no less than 70% in order to remain affordable for farmers who are needed to pay only 20%-30% of the premium. That is, farmers had to pay for wheat, 30-60 Yuan per hectare; rice, 45-70; and corn, 45-60. Besides, the premiums are decided from past experiences and will be modified annually.

3. Probability of Yield Loss in the MGPA

3.1 Statistical Model

The statistical estimation of yield loss risk follows three steps: 1) To capture the fitted trend yield. For the purpose of this study, this analysis initially considers alternative methods such as moving average, exponential smoothing and time series regression. We elect the following model (in t) for its higher R^2 goodness-of-fit

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[§]According to the Regulations of Central Fiscal Subsidies to Crop Insurance Premiums by the Ministry of Finance People's Republic of China (2008), the material cost includes seeds, chemical fertilizers, irrigation, pesticides, machine tillage and agrofilm, which are used for an insured crop during growing season.

Table 1. Descriptive Analysis on the Material Cost-Based Insurance Program for Selected Crops in the Major Grain-Producing Area of China, 2008

Province	Crop	Coverage Level (Yuan/ha)	Premium rate (%)	Premium Share (%)	Material Cost (Yuan/ha)	Material Cost Ratio (%)	Coverage Level Ratio (%)
		(1)	(2)	(3)	(4)	(5)	(6)
Hebei	Wheat	4500	5	35:25:20:20	4335	61.2	53.3
	Corn	3900	7		2409	68.8	44.5
	Cotton	6000	6.5		4535	48.3	35.4
Inner Mongolia	Wheat	5250	8	35:25:30:10	5323	61.0	50.9
	Corn	5250	10		3437	74.9	60.0
Liaoning (Anshan)	Rice	6000	8	35:25:20:20	4997	41.4	40.7
	Corn	4200	13.4		2645	35.7	43.3
	Soybean	2100	12.6		1698	44.6	20.0
Jilin	Rice	4000	8	35:25:20:20	3677	45.3	31.9
	Corn	3000	10		3190	42.3	36.5
	Soybean	2500	8		1805	49.3	40.6
Heilongjiang	Rice	3000	7.5	35:25:20:20	3240	34.3	22.2
	Corn	2175	10.35		2033	44.9	32.5
	Wheat	1875	11.97		1983	44.4	42.0
	Soybean	1800	12.52		1629	45.3	38.4
Jiangsu (Yangzhou)	Rice	4500	5	35:25:10:20	6000	70.0	31.7
	Corn	4500	5		2635	42.8	50.8
	Wheat	4500	5		3600	56.7	52.9
Anhui	Rice	4500	5	35:25:20:20	4158	54.8	43.4
	Wheat	3900	4		3084	77.3	48.7
	Corn	3600	5		1785	77.6	42.5
Jiangxi	Rice	3000	6	35:25:5:35	3300	45.4	32.0
Shandong	Wheat	4500	5	35:25:20:20	4005	68.5	50.6
Henan	Rice	3630	8	35:25:20:20	3603	47.8	28.5
	Cotton	3375	8		3356	29.7	22.0
Hubei	Rice	3600	5	35:25:10:30	3356	57.3	42.6
Hunan	Rice	4200	6	40:25:10:25	3225	44.3	45.3
Sichuan	Rice	4500	5	35:20:20:25	2367	81.4	50.1
	Corn	4380	5		2463	74.7	62.1

Sources: Data in (1) and (2) from the crop insurance policies of all provinces in the Major Grain-Producing Area, 2008; Data in (3) are the proporition of the premium shared respectively by governments at central-level, provincial-level, county-level and farmer; Data in (4) from the Agricultural Product Cost and Benefit Data Compiles of China, China Statistics Press, 2007; Data in (5) equals (4) divided by the per hectare crop production cost; Data in (6) equals (1) divided by the per hectare crop production value.

measure than other mentioned methods:

$$Y_t = \alpha_0 + \alpha_1 t + \alpha_2 t^2 + \varepsilon_t = \hat{Y}_t + \varepsilon_t \tag{1}$$

Where Y_t is the actual yield in year *t* (*t*=1,2,⋯,24); α_i, the slope coefficient; The detrend yield, achieved by the error term ε_t ($\varepsilon_t = Y_t - \hat{Y}_t$), is regarded as crop yield loss. To get optimal fitted trend yield $\hat{Y}_t$, we diagnose the series ε_t to respectively identify the existence of heteroskedasticity and the nonstationary according to Goldfeld-Quandt test and ADF unit root test and correct them if necessary. 2) To attain the yield loss rate series by the formula $y_t = (Y_t - \hat{Y}_t)/\hat{Y}_t$, so the observed sample set is $y_t = \{y_1, y_2, \cdots, y_T\}$. 3) To estimate the probability of yield loss with nonparameter Kernel density information diffusion model which was used in many academic studies due to its objective basis and stable estimated results [2, 3, 4, 5 and 6]. Let universes of discourse for yield loss rate be:

$$l = \{l_1, l_2, \cdots, l_n\} \quad (l \in [0,1]) \tag{2}$$

Given that the yield loss information y_t diffuses to each point (l_i) according to Gaussian distribution, the information diffusion model can be expressed as:

$$g_t(l_i) = \frac{1}{h\sqrt{2\pi}} \exp[-\frac{(y_t - l_i)^2}{2h^2}] \tag{3}$$

Where *h* is the information diffusion coefficient (bandwidth) and determines the smoothness of density function，the density function is smoother with the larger *h*. Choosing a proper *h* is a critical step for non-parameter Kernel density estimation. There are alterative methods such as cross-validation, Silverman's rule-of-thumb and plug-in to choose *h*. This study adopts Silverman's rule-of-thumb. According to the works of Barry G. K. and Alan P. K. [4]，if the Kernel function follows Gaussian distribution, the optimum smoothing parameter *h* is:

$$h_{\text{opt}} \approx 1.06\delta \cdot n^{-1/5} \tag{4}$$

For equation (4), it is suggested that *h* could lead to better empirical result if the factor 1.06 being reduced to 0.9 [5]. In this study, we choose 0.9 for *h* calculation.

3.2Data and Estimation process

This analysis employs the MGPA provincial yields of rice, wheat and corn published by the NBS during 1985-2008. Let the universe of discourse be $l = \{l_1, l_2, ..., l_n\} = \{0.05, 0.1, 0.15, 0.2, ..., 1\}$, *n*=20. With the calculation procedure shown in Figure 1, we normalize information distribution of y_t by step (2), then step (3), (4) and (5) to achieve the yield loss probability $P(l_i)$, which is presented in Table 2.

3.3Estimation results

As seen in Table 2，the probability of crop yield loss decreases with the increase of proposed yield loss levels: > 20%, > 25% and > 30% and approaches to zero if the proposed yield loss level is over 40% (so it is not listed) in the MGPA, which varies by crop and province. Compared to individual crops, the grain production is not more exposed to fluctuations. For grain crop, the probability with the loss larger than 30% of

$$C_t = \sum_{i=1}^{n} g_t(l_i) \quad (1) \longrightarrow \quad \mu_t(l_i) = \frac{g_t(l_i)}{C_t} \quad (2) \longrightarrow \quad m(l_i) = \sum_{t=1}^{T} \mu_t(l_i) \quad (3)$$

$$\downarrow$$

$$P(l_i) = \sum_{k=i}^{n} p(l_i) \quad (6) \longleftarrow \quad p(l_i) = \frac{m(l_i)}{M} \quad (5) \longleftarrow \quad M = \sum_{i=1}^{n} m(l_i) \quad (4)$$

Figure 1. Calculation Procedure of $P(l_i)$

Table 2. Estimated Probability for Proposed Yield Loss of Selected Crops in the MGPA

Province	Grain Crop			Rice			Wheat			Corn		
	> 20%	> 25%	> 30%	> 20%	> 25%	> 30%	> 20%	> 25%	> 30%	> 20%	> 25%	> 30%
Hebei	6.22	4.55	0.41	7.73	4.65	2.88	13.82	10.23	8.76	13.04	8.36	5.12
Inner Mongolia	2.31	1.03	0.56	5.68	4.83	3.45	21.44	15.30	10.97	15.22	9.74	6.66
Liaoning	12.34	8.79	4.83	10.23	8.78	4.16	16.78	10.43	8.31	18.44	16.05	14.31
Jilin	15.93	8.77	5.45	23.03	17.63	12.15	23.78	16.70	11.23	19.18	14.43	9.64
Heilong Jiang	8.45	4.39	2.36	7.06	4.43	1.03	15.87	12.27	6.59	12.24	7.18	4.02
Anhui	5.54	4.36	2.55	10.48	5.43	1.66	12.26	8.38	5.08	17.34	11.32	8.62
Shandong	3.55	2.21	0.67	9.83	5.34	4.26	5.89	3.14	0.87	5.84	4.74	3.05
Henan	7.66	5.24	3.78	15.62	13.43	10.71	10.13	8.46	2.75	13.42	11.45	8.35
Hunan	5.34	2.20	1.03	5.02	3.17	1.23	7.75	5.31	1.36	14.38	6.86	2.13
Sichuan	7.43	4.33	2.65	6.58	4.53	2.33	3.12	1.33	0.45	5.97	2.86	0.74

Sources: China Statistics Yearbook，National Bureau of Statistics of China, 1986-2009

the grain yield is around 5% in Liaoning and Jilin, below 5% in the other provinces. For rice, 10.71% in Henan, 12.15% in Jilin and below 5% in the other provinces. For wheat, 11.23% in Jilin, 10.97% in Inner Mongolia and for corn, 14.31% in Liaoning, under 10% in the other provinces. It is to say, the yield loss rate is usually not greater than 30% in the MGPA.

4. Adverse Factors for Crop Insurance in the MGPA

Based on the data from the Second National Agricultural Census of China, we could point out some adverse factors the crop insurance is faced with especially in the MGPA.

4.1 Unfavorable basic conditions for insurance management

4.1.1Small farm size. As shown in Table 3, the cultivated area per rural household is not up to 0.5 hectares in 9 provinces, the top largest ones are in Heilongjiang, Inner Mongolia and Jilin, respectively, 3.14, 2.2 and 1.65 hectares, which are divided into 2 to 10 pieces due to the poor and fertile land collocation among rural households. Anhui province is very typical for 9.5 pieces out of 0.46 hectares on average. Obviously, small farm size hinders the use of modern agricultural sciences and technologies, enlarges production risks and enhances insurer's management costs.

4.1.2Serious information asymmetry. As the SNAC shows, the grain producers were 93% of 121740784 national rural households in the MGPA, the lowest is 84% in Liaoning and the highest, 96% in Anhui, which indicates that the insurers have to be faced with numerous farming households of heterogeneous preferences and different risk levels and the existence of serious adverse selections and moral hazards. This situation leads to a high insurance management cost for crop insurance companies.

4.1.3Poor anti-adverse conditions. Fragile production conditions leave crop growth vulnerable to meteorological disaster attacks. In China's agriculture, the frequency of disasters was 12.5% in the 1950s and increased year after year, 79% during 1980-2006 and almost 100% since 1990s. Of the disaster affected sown area, the drought stricken area usually accounts for about 50%. In the MGPA, the disaster level is higher than that of the national average. In 2006, the proportion of drought stricken sown area was more than 50% in 9 provinces, especially, up to 84% in Sichuan province. It is revealed from Table 3 by the SNAC that the village-level water conservancy facilities can explain some about the drought and flood disaster damages. The MGPA field condition is obviously better for the rate of sloping cultivated land with slope degree 0~15° in the most MGPA provinces is larger than the national level as well as the rate of sloping and terraced land with the slope 0-15° and the paddy and irrigated field rate, which seems to be an advantage to resist drought and flood hazards. Besides, the lower village rates without water resource for irrigation and with water safety in normal years are advantages. However, the low village rate with irrigation and drainage stations is probably a major cause under extreme weather conditions which occurs in recent years.

Table 3. Risk Features on Crop Production Conditions, 2006

MGPA	Farm Size		Conditions of Drought and Flood Prevention					
	Cultivated Area (ha/ household)	Cultivated Land Subdivision (piece/ Household)	Rate of Paddy and Irrigated Land (%)	Rate of Sloping Cultivated Land with Slope Degree 0~15° (%)	Rate of Terraced Field with Slope Degree 0~15° (%)	Village Rate without Sources of Irrigation (%)	Village Rate with Water Safety in Normal Years (%)	Village Rate with Irrigation and Drainage Stations (%)
Hebei	0.48	5.0	57.9	15.9	82.1	7.0	87.2	7.8
Inner Mongolia	2.20	3.3	26.7	99.3	0.0	10.9	77.1	4.9
Liaoning	0.72	1.9	19.7	88.1	9.6	2.9	92.4	13.1
Jilin	1.65	3.2	13.9	97.4	0.0	3.4	90.6	9.9
Heilongjiang	3.14	(NA)	11.6	99.1	0.0	8.3	85.4	6.8
Jiangsu	0.38	3.7	75.5	99.7	0.0	2.8	94.9	73.0
Anhui	0.52	9.5	49.6	86.4	10.2	1.7	92.2	29.4
Jiangsu	0.44	6.0	86.3	14.3	70.7	1.2	87.6	31.1
Shandong	0.40	4.6	62.1	87.9	10.4	2.8	93.3	10.1
Henan	0.43	3.2	48.8	90.5	8.2	9.4	84.3	7.5
Hubei	0.56	7.1	59.9	61.6	21.5	7.8	80.5	39.0
Hunan	0.34	(NA)	78.3	48.0	41.7	3.7	78.9	26.0
Sichuan	0.39	9.1	49.1	33.7	34.9	7.9	79.9	25.1
National	0.61	(NA)	44.9	66.6	20.9	11.0	79.5	18.0

Sources: Calculated by authors using data from the Comprehensive Summary of the Second National Agricultural Census (China Statistics Press, 2008) and the project 'Survey of Grain Reserves' with a sample size of 7500 rural households in China by the Centre for Rural Development Policy (China Agricultural University, 2004)

Note: NA represents no data available

4.1.4High farming specialization. In China, the grain crop sown area decreased from 81.1% of the national total in 1996 to 75.9% of the national total in 2006, the difference is 5.2%. For individual crops, rice sown area decreased by 2.1% and wheat, 4%. In contrast, the sown area for corn, soybean and cotton increased by 3%, 0.5% and 1.3% respectively. In the MGPA, the overall crop sown area increased from 67.7% to 69.1% of the national total. The grain crop sown area changed from 70% to 72%; rice, from 63.8% to 68.4%; wheat, from 74.9% to 78.7% and corn, from 76.7% to 75.2%. With the change for crop planting structure, the MGPA's share in the national crop sown area rose.

4.2 Low Application level of Agricultural Science and Technology

The use of agricultural machinery, chemical fertilizers and pesticides plays an important role in reducing natural disaster in busy farming season. During the period 1996-2006, we expanded the national machine ploughed area rate from 40.8% to 58.6% of the cultivated land; electromechanical irrigated area remained almost unchanged; machine sown area and machine harvested area were increased by 16.4% and 12.9%. Besides, the sprinkling and drip irrigation area accounted for a small proportion of cultivated land, only 1.8% and 0.8% respectively. Agrofilm, chemical fertilizer and pesticide use increased rapidly during the 10 years. Chemical fertilizer consumption grew annually by 2.2%. Pesticide application increased annually at the speed of nearly 10%. Chemical fertilizers, pesticides and fertilizer inputs have been close to or exceeded the application levels in some

Table 4. Application Levels of Agricultural Science and Technology, 2006

Region	Cultivated Area		Sown Area					
	Machine Ploughed Rate (%)	Electromechanical Irrigated Rate (%)	Machine Sown Rate (%)	Machine Harvested Rate (%)	Agrofilm Coverage Rate (%)	Coverage Rate by Small and Medium-sized Plastic Green Houses (%)	Fertilizer Purchase (kg/ha)	Pesticide Purchase (kg/ha)
Hebei	82.1	67.2	65.6	33.0	8.4	0.27	667.5	9
Inner Mongolia	68.0	20.7	58.5	17.3	6.7	0.03	327.0	1.95
Liaoning	58.5	15.1	29.9	0.7	1.5	0.17	696.0	8.7
Jilin	62.0	11.8	33.1	2.5	3.9	0.04	541.5	5.85
Heilongjiang	87.1	7.4	73.2	29.6	0.3	0.07	237.0	2.7
Jiangsu	82.3	59.9	20.2	58.6	2.2	0.19	994.5	17.6
Anhui	79.6	32.7	36.9	49.4	1.1	0.15	658.5	11.6
Jiangsu	29.7	16.2	0.1	12.8	0.7	0.15	580.5	17.6
Shandong	88.9	66.7	48.2	35.9	11.9	0.38	898.5	13.4
Henan	86.4	50.0	48.4	39.3	1.6	0.09	697.5	7.5
Hubei	34.1	29.3	1.3	19.5	1.5	0.10	846.0	14.1
Hunan	31.4	14.7	0.1	18.8	1.2	0.04	612.0	17.7
Sichuan	10.5	9.8	0.4	5.2	3.1	0.13	637.5	7.7
MGPA	66.9	35.2	34.8	16.1	3.4	0.15	643.5	10.1
National	58.6	26.7	30.8	23.3	4.8	0.14	640.5	10.4

Source: Comprehensive Summary of the Second National Agricultural Census, China Statistics Press, 2008

developed countries. Agrofilm coverage area increased annually by 0.9% and the small and median-sized agrofilm green house coverage area increased greatly but remained at very low level. In the MGPA, the agrofilm and green house coverage rate were slightly higher than or the same as the national level. Only the proportions of machine plagued, electromechanic irrigated and machine sown area were higher than the national level.

4.3Tight income constraint

Over the many years, per capita net income on national average for rural household remains little, only 1926 Yuan in 1996 and 4140 Yuan in 2008. During the same period, per capita disposable income for urban household grew from 4838.9 to 13785.8 Yuan. The absolute income difference between the rural and urban expanded from 2912.9 to 9645.9 Yuan. Compared the income level with other sectors in 2006, the net income for rural household is only 25.5% of the national average earning for employed persons in all sectors, 26.2% in mining, 31.3% in construction and 27.8% in services to households and other services. As for the per capita net income composition for rural household, in the period 1996- 2006, the proportion of farming income dropped from 48% to 32.2% and the proportion of wage income rose from 23.4% to 38.3%.

Table 5. Economic Restraints for Rural Households, 2006

Province	Per Capita Annual Net Income			Per Capita Consumption Payout (Yuan)
	Total (Yuan)	Farming Earning's share (%)	Wage's share (%)	
Hebei	3801.82	39.2	39.8	2495.33
Inner Mongolia	3341.88	(NA)	17.7	2771.97
Liaoning	4090.4	35.0	36.7	3066.87
Jilin	3641.13	56.6	16.6	2700.66
Heilongjiang	3552.43	(NA)	18.4	2618.19
Jiangsu	5813.23	17.2	53.4	4135.21
Anhui	2969.08	(NA)	39.9	2420.94
Jiangsu	3459.53	45.5	41.7	2676.6
Shandong	4368.33	(NA)	38.3	3143.8
Henan	3261.03	(NA)	31.4	2229.28
Hubei	3419.35	(NA)	35.1	2732.46
Hunan	3389.62	(NA)	42.8	3013.32
Sichuan	3002.38	44.0	40.6	2395.04
National Average	3587.04	32.2	38.3	2829.02

Source：1．China Statistical Yearbook，National Bureau of Statistics of China, 2007.
Note: NA represents no data available.

Table 5 lists the per capita net income and consumption payout in a rural household of the MGPA in 2006. We can see that farming income and wage income constitute the overwhelming share of the total net income. Wage income contribution is significant and keeps increasing with the rural labour force' transfer to non-agricultural fields. In addition, rural household's remaining income is little after deducting daily family consumption. The remaining is only 758 Yuan for national average; 900.8 Yuan for the MGPA; Jiangsu, with the peak of 1678 Yuan; Hunan, the least, only 376.3 Yuan, which affects farmers' demand for crop insurance.

4.4 Low level of Farmer Organization

In order to alleviate information asymmetry risk, expand crop insurance coverage, reduce management costs and thereby enhance the efficiency of crop insurance, a favourable way is to organize the numerous farmers by some "organizers" as government, strong leading enterprises or specialized cooperative economic organizations. As we known, in Japan, almost 100% of the farmers are the member of some cooperative economic organizations [7]. According to the SNAC in 2006, 12723 rural towns built specialized cooperative economic organizations, of which 5636 were entities, accounting for 36.6% and 16.2% of the total towns respectively. Therefore, about 63.4% of the total towns did not have any organizations. In the MGPA provinces, the indicator was 40% on average, slightly higher than the national average, and varied across provinces, as in Jiangsu, the highest, 70%; Shandong, 54.3%; Jilin, 51.8%; Anhui, 49%; Hebei, the lowest, 22.7% and the others, approximately 40%. The proportion of towns with entity is 45% in Jiangsu, 28.3% in Shandong, 26.4% in Jilin, 23.6% in Anhui, only 8.9% in Hebei and the others， under 20%. These data reveal that farmers' organization degree universally remains low, the majority of farmers make their production decisions at family-level.

5. Efficiency Evaluation of the Crop Insurance

In the crop insurance practice, it is essential to determine proper coverage level and affordable premium. By positive analysis, we could illustrate that the policy-oriented crop insurance is not only questionable, but probably results in inefficiency, unfairness and financial problem etc.. We give basic judges to the insurance participators: government, farmers and insurance companies.

(1) Government at all levels. Because subsidy could reduce the premium payment and hence encourage more farmers to purchase crop insurance, the government-subsidized crop insurance is an acceptable policy alternative. However, as aforementioned, the central fiscal's share of premium rate equals 35% the same for all provinces in China. As a result, the MGPA provinces unfairly burden more insurance premium due to greater crop planting acreage. In fact, the provincial and county-level premium subsidies are faced with fiscally insufficient in the MGPA.

(2) Farmers. In the MGPA, farmers get a larger portion of income from crop production, therefore, unstable yields make farmers' lives more fluctuant thereby the government support becomes more essential, the policy-oriented crop insurance is potentially demanded. But under the current low-premium and low-indemnity policy, the coverage level is set 30%-80% of the crop production cost. Following Funing Zhong's work [1], there is no damage indemnity for cotton or grain crops if the coverage level is at 50%, and a little damage indemnity, at 70%, which are consistent with the conclusion drawn from Table 2. For farmers who have knowledge about usual yield loss rate, the coverage level isn't high enough to induce them to participate in crop insurance.

(3) Insurance companies. Insurance companies control risks by collecting large amount of independent and identically distributed risk units. In the MGPA, one big problem the insurance companies are faced with is the low participation rate and high loss indemnity. The systematic risks in high frequency partly come from the poor agricultural infrastructure and high planting index. And, the high management cost results from numerous crop planters, small farm size, low farmers' organization level and serious moral hazard and adverse selection. Unfavorable insurance operation circumstances bring insurers great financial pressure.

6. Conclusion and Implications

This study shows that China's pilot crop insurance is characterized by the material cost-based coverage. The levels of both premium and indemnity are quite low, the yield damage compensations are not necessary unless the huge catastrophes occur with the yield loss rate over 50%. Therefore, farmers mainly buy crop insurance to avoid the great crop failure other than to maximize their returns. Meanwhile, due to the fixed premium, unfair premium burden and unfavorable insurance conditions, the crop insurance policy lacks an effective incentive which leads to passive insurance supply and participation. Here are some implications to enhance the efficiency of crop insurance:

(1) Reasonable subsidy policy slope should benefit crop insurance in the MGPA. For an increasing portion of grain production in the MGPA, farmers are faced with greater risks, which means more potential demand for crop insurance and more burden of premium subsidies on governments at all levels. Therefore, it is reasonable for central government to give the MGPA more premium subsidy to reduce local fiscal pressure and balance unfair burden.

(2) It is a necessary consideration to adopt conditional and compulsory crop insurance policy. Using for reference the successful experiences in Japan, the compulsory crop insurance is a suboptimum choice for expanding insurance coverage. In the MGPA, along with special grain production supporting policies, such as microfinance and direct grain allowance, the compulsory crop insurance is expected to improve the situation of low participation rate if major crops, such as wheat, corn and rice, are required to be insured under some well designed policies.

(3) Crop production conditions should be improved to optimize the circumstances of crop insurance. From the perspective of reducing the hazard indemnity, irrigation and water conservancy facilities are the top important measures needed to be emphasized for the frequent and serious drought and flood disasters. Another key way is to induce more farmers into cooperative economic organizations, in some degree, to promote the efficiency of crop insurance and ensure its sustainable and stable development.

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