Chapter 3

Agricultural Production and Business Risks Identification

The agriculture is the foundation of the national economy, and is also a weak industry of bringing more risks. Studying the stability problem of agricultural system, first we should inspect the risk and the uncertainty in the agricultural development. Only recognizing risk, then we can against the risk. Risk identification need to be initiatively implemented from the uncertainty of agricultural production, taking the system science and theory of the agricultural economics management as the instruction. This chapter will concentrate on the discussion of agricultural production management risk identification problems, as well as some important concepts, methods and principles involved in the process.

3.1 Introductions to China Agricultural Risks and Uncertainty

The agriculture is a typical risk industry. Roughly, the agricultural risks can be classified into in two big categories. One involves the agricultural production process, which is called the natural risk, and the other mainly refers to agricultural business process, which is called the market risk. To the entire agricultural development, other environmental factors or the exogenous factors of agricultural, such as political system, law, policy, social factors and so on, have profound influence to the agricultural development. This book supposes, under the specific historical background, and the current economic system and the policy environment, we begin to study on operational risk system of China agricultural production. That is to say, Chinese socialist market economic system has been established since of 1992, after 10 years in the 21st century China joined WTO. Which it accompanied era is of the knowledge economy and the rapid development of information network technology. Its emerging scenery is a global scientific innovation tide and the world economic integration. Under this kind of major prospect, we come to discuss agricultural production and business risks management and related subject of decision-making.

3.1.1 Agricultural Natural Disasters

I. The Recorder of China Natural Disaster

Agricultural production is constrained by natural condition, environmental variation and the developmental mechanism of zoological and botanical growth. These gusty or the random events come from the nature, possibly leadiing to economic loss of the agricultural production, which named as the agricultural natural disasters. Natural risk is essentially refers to the natural disaster occurring magnitude, time and uncertainty probability distributions. The situations of some main natural disasters and the agricultural resource loss in China are shown by Table 3.1.

The natural disaster and the accident are the main origins of creating the agricultural natural disasters. The natural disaster is harmful, because of the natural environment gusty events and certain factor change usually brings to loss in agriculture. The natural environment generally refers to the material geography space of non-artificial creatures. The natural factors are the sunlight, the air, the water, the soil, the wild animals, the natural plants and so on, which are all the natural material without the human creation, and formed the fundamental elements of natural environment. The natural resource and the environmental condition is not only for an agricultural producer first directly rely on, but also is the material base for whether a national agricultural production has superior natural endowment.

Table 3.1 *Main Natural Disasters and Loss Situation of China Agriculture from 1990-2014 (Unit: Million Hectares).*

Years	Typhoon		Wind hail		Freezing	
	Disaster Covered	**Disaster Affected**	**Disaster Covered**	**Disaster Affected**	**Disaster Covered**	**Disaster Affected**
1990	5.16	-	9.53	5.12	3.21	1.49
1991	-	-	6.37	3.03	2.57	0.94
1992	-	-	5.23	2.32	3.71	2.06
1993	-	-	6.63	3.64	4.72	2.23
1994	1.58	0.78	3.79	2.14	1.92	0.67
1995	1.30	0.37	4.48	2.08	3.58	1.79
1996	2.24	0.97	4.15	2.12	2.05	0.90
1997	1.72	0.68	4.49	2.95	2.29	0.83
1998	0.21	0.10	4.74	3.13	8.67	3.10
1999	0.59	0.32	3.59	2.04	6.63	2.69
2000	1.72	1.08	2.28	1.14	2.80	1.03
2001	1.10	0.65	3.63	2.06	2.98	1.78
2002	0.85	0.47	7.48	3.83	4.21	2.29
2003	1.17	0.72	4.79	2.93	4.48	2.11
2004	0.69	0.21	5.80	2.19	3.71	1.67
2005	4.45	1.97	2.98	1.64	4.43	1.84
2006	2.95	1.67	4.39	2.14	4.91	2.84
2007	2.99	1.42	2.99	1.42	4.07	1.51
2008	2.31	0.94	4.18	2.12	14.70	8.72
2009	1.15	0.48	5.49	2.94	3.67	1.45
2010	0.34	0.17	2.18	0.92	4.12	1.44
2011	1.55	0.36	3.31	1.35	4.45	1.29
2012	1.62	0.79	2.78	1.37	3.49	1.66
2013	2.67	0.99	3.39	1.68	2.32	0.89
2014	2.48	1.15	3.23	2.19	2.13	0.93
Average	1.70	0.78	4.40	2.15	3.30	1.40

Table 3.1 *Continue.*

Years	Plant disease		Grass evil		Rat Damage	
	Occurrence Area	Prevention Area	Occurrence Area	Prevention Area	Occurrence Area	Prevention Area
1990	336.59	305.02	64.25	32.36	27.30	21.50
1991	360.70	345.25	71.28	35.69	30.32	20.93
1992	219.76	222.04	45.11	27.07	21.13	14.20
1993	239.54	251.57	53.80	30.33	21.45	15.55
1994	230.22	241.56	55.82	39.31	23.49	16.06
1995	248.07	269.28	60.66	41.80	28.44	19.86
1996	253.87	266.98	62.56	44.75	31.27	21.75
1997	257.87	289.25	61.63	47.28	26.53	19.20
1998	299.72	328.96	73.85	58.01	30.02	22.66
1999	295.76	323.57	74.23	60.78	27.77	19.96
2000	276.09	307.65	74.02	27.23	27.23	19.17
2001	244.32	298.58	72.02	26.32	25.13	18.17
2002	238.41	289.91	75.31	25.31	24.32	19.17
2003	299.88	321.93	74.27	63.22	27.08	18.07
2004	291.78	318.83	73.36	65.72	26.07	16.04
2005	342.84	399.38	78.81	71.72	27.53	19.59
2006	352.76	419.20	79.54	76.27	29.06	21.18
2007	365.34	443.60	81.43	78.12	30.51	21.80
2008	367.98	449.05	83.58	85.83	27.85	20.25
2009	367.77	447.63	88.89	91.18	26.89	20.38
2010	367.37	444.92	91.34	94.12	26.16	18.59
2011	355.69	437.93	90.62	95.65	24.03	18.20
2012	384.62	481.69	94.22	100.50	25.04	19.62
2013	359.53	445.99	97.47	105.77	25.57	19.34
2014	348.42	449.14	99.97	106.85	24.66	17.71
Average	308.20	351.96	75.12	61.25	26.59	19.16

Source: "China Agricultural Yearbook". China Agriculture Press (1991-2015) [36]

Yet, the natural disaster has been a vital reason for China agricultural resource losing and the ecologic environmental damaging. Although the nation is abundant in natural resources, but the problem of soil erosion and destroying environment is very serious. At present, China soil erosion area is 3.67 million

square kilometers, occupying 38.2% of the land area. These including the water erosion, the soil lose every year the approximately 50 hundred million tons, washed away nutrients and nitrogen, phosphorus, potassium approximately one hundred million tons, as well as the wind erosion and the desertification influenced, merely the fertility loss calculated every year more than over ten hundred million dollars, the question is very serious.

China is one of the most serious natural disaster countries in the world. The disaster are lots of types, area broad, proportion high. The main natural disaster bring factors have reached over 40 kinds, mainly include flooding, rainstorm, hail, drought, gale, spring cold wave, in May low temperature, cold dew wind, frozen, plant disease, landslide, mud-rock flow, earth cracks, avalanche, Tsunami and so on. According to the related historical data records [16], from 206 B. C. to 1949, in China big floods occurred 1029 times, droughts 1056 times. From the founding of P. R. China established in 1949 to 1988, there had been 5 big flood, each caused disaster area over 6 million hectares, and 6 times bigger droughts each of caused disaster area over 12 million hectares. After 1960s, continual great drought caused disaster area over 20 million hectares, this situation was from 1970s continuing to 2009. In the 1990s, two big flooding disasters happened. In 1991 flooding disaster area amount to 14.614 million hectares, in 1998 it was 13.785 million hectares; in 2003 it was 12.29 million hectares, moreover some big droughts and the waterlogged disasters yearly occurs alternately. Generally, in China the yearly drought area was bigger than the waterlogged damage, but individual years, the drought and the waterlogged disaster occurred at the same time are possible. Due to the natural disasters influence, China’s grain loss to approximately occupied the yearly average grain ultimate output 5%, and the agricultural yearly average disaster rate reached as high as 14.5%. Incomplete statistics show that from

1952 to 2014, in China, areas affected by agricultural disasters of droughts and floods are listed by Table 3.2.

Table 3.2 *China Agricultural Drought and Flood Disaster Situation (Unit million Hectares).*

Years	Drought covered	Drought affected	Flood covered	Flood affected
1952	4.24	2.59	2.80	1.84
1957	17.25	7.40	8.08	6.03
1962	20.81	8.69	9.81	6.32
1965	13.63	8.11	5.59	2.81
1970	5.72	1.93	3.13	1.23
1975	24.83	5.32	6.83	3.47
1978	40.17	17.97	2.85	2.01
1979	24.65	9.32	6.76	2.87
1980	26.11	14.17	9.15	6.07
1981	25.69	12.13	8.63	3.97
1982	20.70	9.97	8.36	4.46
1983	16.09	7.59	12.16	5.75
1984	15.82	7.02	10.63	5.40
1985	22.99	10.06	14.20	8.95
1986	31.04	14.77	9.16	5.60
1987	24.92	13.03	8.69	4.10
1988	32.90	15.30	11.95	6.13
1989	29.36	15.26	11.33	5.92
1990	18.17	7.81	11.80	5.60
1991	24.91	10.56	24.6	14.61
1992	32.98	17.05	9.42	4.46
1993	21.10	8.66	16.39	8.61
1994	30.42	17.05	17.33	10.74
1995	23.46	10.40	13.06	7.63
1996	20.15	6.25	18.15	10.85
1997	33.51	20.01	11.41	5.84
1998	14.24	5.06	22.29	13.79
1999	30.16	16.61	9.02	5.07
2000	40.54	26.78	7.32	4.32
2001	38.47	23.70	6.04	3.61

Years	Drought covered	Drought affected	Flood covered	Flood affected
2002	22.21	13.25	12.38	7.47
2003	24.85	14.47	19.21	12.29
2004	17.25	8.48	7.46	3.75
2005	16.03	8.48	10.93	6.05
2006	20.74	13.41	8.10	4.57
2007	29.39	16.17	10.46	5.10
2008	12.14	6.80	6.48	3.66
2009	29.26	13.20	7.61	3.16
2010	13.26	8.99	17.52	7.02
2011	16.30	6.60	6.86	2.84
2012	9.34	3.51	7.73	4.15
2013	14.10	5.85	8.87	4.90
2014	12.27	5.68	4.72	2.70
Average	23.58	10.91	10.81	5.72

Source: "China Agriculture Yearbook" (1991-2015), China Agriculture Press [36].

II. Analysis on Agricultural Natural Meteorological Disasters Tendency and Mitigation

United Nations (UN, 1992) defined the disaster as "a serious disruption of the functioning of society, causing widespread human, material or environmental losses which exceed the capacity of the affected society to cope using only its own resources." It was a suitable interpretation that could be used by agriculture. For agricultural natural disasters usually assumed that disasters only affected the project by reducing yield, although additional costs may be incurred as a result of changing in cost. In China, the record of disasters in the average crop losses is up to 10% to compare with the previous year. "To assume that the primary impact of disasters on the project's net benefits is through the impact on agricultural yields" (Mohan Munasinghe & Caroline Clarke, 1995) [37], the best is to deal with the agriculture sustainable development. The disaster covered area and affected area is essentially the same meaning, according to our recently study on title "The Trend Analysis on China's Agricultural Natural Risks and

Improvement of the Ability of Disaster Mitigation"[5], under background of uncertainty it mainly analyzed the five kinds of meteorological disasters, such as waterlogged, drought, hailstorm, winterkill, and typhoon. As for disaster, the covered area refers to crops in 10% losses, and the affected area refers to crops over 30% losses. As Figure 3.1 showing, some kinds of natural disasters regional distribution, if crop losses in excess of 30% mean that more serious disaster, to reach 70% of the loss shall be no harvest.

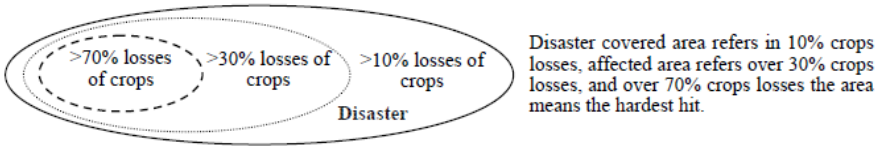

Figure 3.1 *Taking Crops Harvested Area in Percentage to Define the Concepts of Disaster Degree.*

In China, on five kinds main meteorological disasters during 1994 to 2014, annually in average covered disaster area was nearly 43.38 million hectares, but the disaster finally affected nearly 22.76 million hectares. The average disaster finally affected was higher than half of the disaster covered. From area schematic of Figure 3.2, we are easy to find that natural disasters drought covered area is bigger than flood covered. However, the drought area tended to reduce a little, the flood and freezing areas tended in increase. Typhoon statistics as a new-recorded natural disaster of China since 1994, but its influence to Chinese agriculture has been increasing. We can say, the natural environmental hazards and uncertainties are in increasing.

[5] The paper "The Trend Analysis on China's Agricultural Natural Risks and Improvement of the Ability of Disaster Mitigation" was published by Sciedu Press in "Research in World Economy" [J]. Vol. 4, No.1; 2013. More detail about the analysis see WWW.sciedu.ca/rwe.

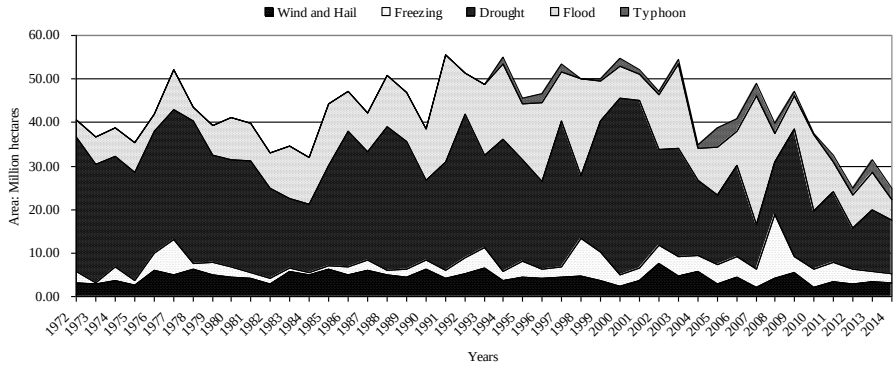

Figure 3.2 *Five kinds of main agricultural natural disasters yearly covered area.*

Disaster mitigation purposes are to prevent hazards from turning to disasters altogether or to reduce the effects of disasters, as well as the effort to reduce loss of life and property by controlling the impact of disasters. Thus, as regional distribution of natural disasters and the degree of the losses are changed in gradient, the disaster coverage area should neither exceed the ultimate disaster affected areas, or the disasters covered areas should bigger than its affected areas. That means the disasters have been reduced. Mitigation measures that focus on protecting the most vulnerable elements and activities-the weakest links-in the different sectors of the economy will help protect the achievements of economic development. "Mitigation means taking actions to reduce the effects of a hazard before it occurs. The term mitigation applies to a wide range of activities and protection measures that might be instigated from the physical, like constructing stronger buildings to the procedural, like standard techniques for incorporating hazard assessment in land-use planning" [38] (A. W. Coburn, R. J. S. Spence, & A. Pomonis, 1994).

In Figure 3.3 illustrates, even the disasters covered area has a tendency of going up, but the total disaster affected area has a tendency of sloping down. This may show as the natural disasters to enter into a highly occurring new period, however, the disaster reduction capacities of China have also reached a new level.

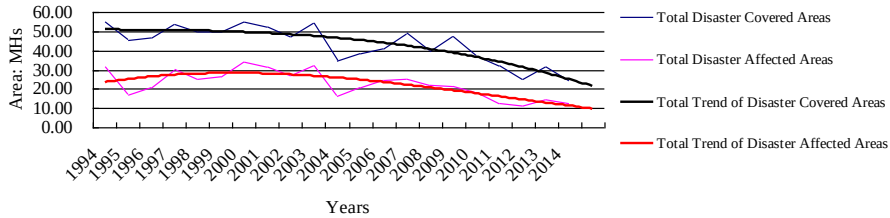

Figure 3.3 *Total five natural disasters covered and affected area and their tendencies.*

As a complementary, taking the main disasters drought and flood as examples, because since 1952 China has those long term records, we can use the polynomial regression trend curves to describe the changes of drought and flood by covered areas and affected areas, which Figure 3.4 shows the long period disasters tendency for over 40 years.

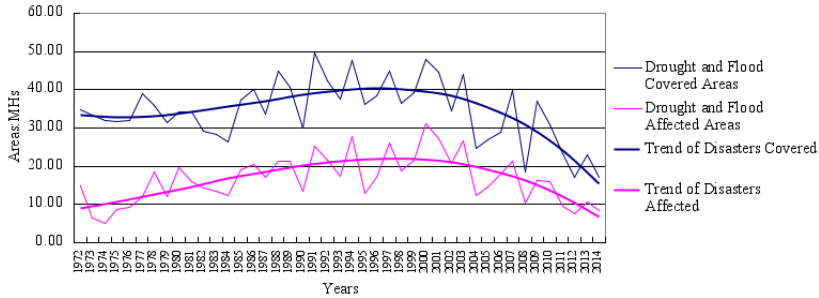

Figure 3.4 *A long-term Tendencies for the Main Disasters Drought and Flood Since 1972.*

Except natural disasters influences, the human factors also influence the ecological environment and the stability of agricultural production. The entire natural ecosystem has come now under humanity serious influence, besides the atmosphere greenhouse effect, the earth's climate warming relates to the humanity activities, only regarding the agricultural production to ecological environment influence and the destruction looked that is also very serious. At present, China air pollution farmland amounts to 5.333 million hectares; the three wastes pollution farmland amounts to 10 million hectares; farmland

polluted by chemicals amounts to 9.067 million hectares, the agricultural use water quality drops the pollution which creates also to amount to 3.333 million hectares, equals the approximately 27.733 million hectares.

3.1.2 Agricultural Market Risk

The market risk refers to the production operation unit in the actual movement process, the departing possibility of the producer's actual profit with anticipated profit, owing to the market accidental factors or the social economy environmental change. The price fluctuation is one of the market risks main performance is also called the price risk.

Farm price fluctuation is mainly influenced by the changes in the market supply and demand, such as seasonal fluctuation in production cycle, production technology improvement, stock adjustment cost variation and so on. If considering the change of the farm price risk from the subjective measures method, we may regard the price risk to be actual price and the subjective anticipated deviation, namely $R=|P_t^*-P_o|$ in the formula, R as the price risk, P_t^* as the t time price expectation, P_o as the t time actual price. Looking from the year of 2005 to 2014, the Hebei province current market grain price situation, in Table 3.3 shows the tendency of the grain price risk.

Table 3.3 *The Market Price of Main Crops in Hebei Province from 2005-2014 (Yuan/Kg).*

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
wheat	1.53	1.48	1.46	1.61	1.66	1.88	2.11	2.05	2.13	2.44
Rice	1.7	1.85	1.97	1.88	1.91	2.28	2.81	3.02	2.98	3.55
Corn	1.15	1.09	1.15	1.42	1.51	1.41	1.76	1.98	2.05	2.05

Source: Hebei Economic Yearbook" Hebei Economic Publishing House (2005-2014) [39].

The situation, which Figure 3.5 demonstrates, that the anomalous changes of price risk make farmers enlarge unreasonable anticipation about price. The trend

of price risk escalation simultaneously increases the sense of insecurity of the agricultural production management.

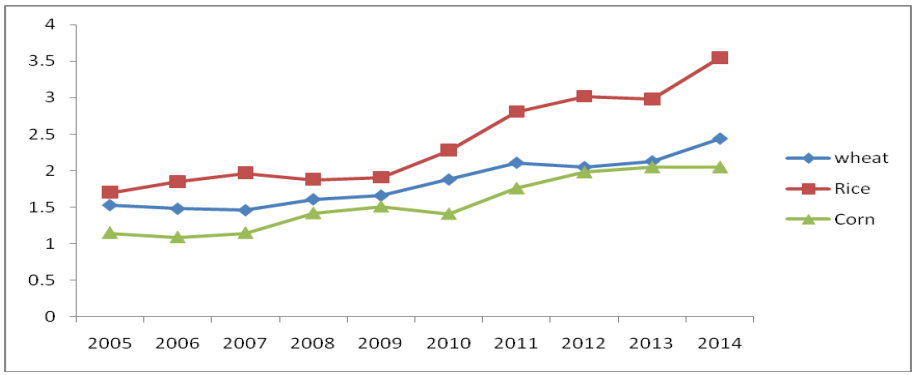

Figure 3.5 *Trend of Main Food Market Price in Hebei Province from Year 2005-2014.*

3.2 Analysis of Environmental Impacts on Agricultural Production and Business Risk

The stability of agricultural production directly influenced by market supply and demand, it used to bring the product and the factor prices fluctuation. It is also influenced indirectly by industrial structure changes of other departments and the policy changes. This is decided by the attribute of agriculture social and economic reproduction. Today, China agricultural natural and social economic environmental become more complex, besides domestic and international markets influences, it also receives the domestic and foreign political context, the industrial structure, the agricultural advance in technology, the labor power condition as well as environmental changes, law and energetic culture influences. National income level in certain time, the marketability construction, technical, cultural, political, and legal, the domestic and foreign industrial structure and the international level of trade development constitute specific socio economic environment of agricultural production. Agriculture natural resources and ecological environment is the basis of agricultural production,

however, at following, we only discussed market relations of agriculture industrial, international trade circulation and eco-economic system risks etc as basic problems to identify risk sources.

3.2.1 Market Relations between Agriculture and Other Industries

In system structure of national industry, the main performance of agricultural product is the final consumption market. The Figure 3.6 illustrates the agricultural production in the process of social economic system, which the agricultural production mainly related to the two product market demand realization, one is the upstream product market pulling for agricultural demand, and the other is the downstream producer goods and the technical market giving impetus to the agricultural production development. At the same time, agro processing developed chain links extending is the important ventures in agriculture industrialization. The processing ventures of agro industry directly provide goods and services used for improving quality of the family and their social life. In addition, the agriculture also provides the raw materials for the downstream industry, namely the light industry. The agricultural market service is also one of the great potential markets, but the Figure mainly describes the cyclical process of the agricultural production physical distribution.

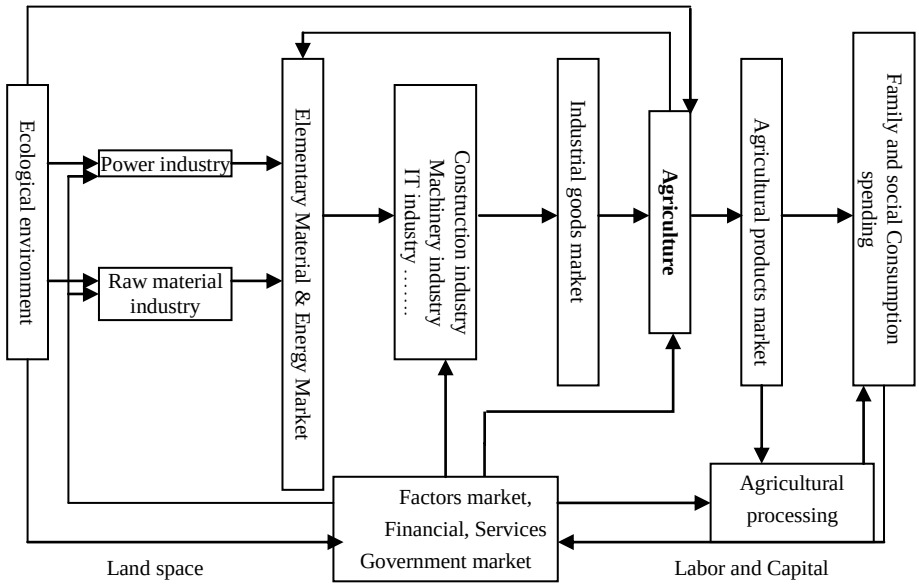

Figure 3.6 *Market Relations between Agriculture and other Industries.*

Table 3.4 shows the existence of the huge demand potential of the agricultural market. The tendency of the main input production factors have been increased year by year. The agriculture played a vital role in the production-factors market, due to its fundamental action in the national economy. In China out of 1374.62 million populations, at present the farmers is occupying more than 53%, partially engaged in the agricultural production in the countryside, the labor force have nearly 728.5 million. In 2014 the labor force from the agriculture shifted to non-agricultural industry (Rural enterprises, cities and other places) have approximately 2.69 hundred million people, the question is 4.6 hundred million farmers in rural, which annual still has over 70 million of them need to be transferred or solved by state. The agriculture not only has provided the human resources for the national economic development, but also accumulated the fund for the national economic development. The rural resident deposit (unit: hundred million Yuan): in 1980 was 117, 1990 was

1841.6, 1994 was over 8000, until 2001's 13,821.4 reached the level of national agro GDP. The countryside market purchasing power enhances unceasingly, the personal average net-income of farmer household, from the reform beginning at 1980 was 138.1 Yuan, enhanced to 2014's 9892 Yuan (Ma Jiantang, 2015). The countryside and the agriculture have provided a massive market to other national economic departments, like the construction, the machinery, the information, the chemical industry, the light industry and so on.

Table 3.4 *The Relationship between Agricultural Input and Output.*

Year	Total output (100 million Kg)	Yield (Kg/hectares)	Sown area (10000 hectares)	Effective irrigation area (10000 hectares)	Chemical fertilizer use amount (10000 tons)
1978	3047.6	2527.5	12058.7	4496.5	884.0
1982	3545.0	3124.5	11346.0	4417.6	1513.4
1984	4073.1	3609	11288.0	4445.2	1740.1
1993	4564.8	4131	11050.9	4872.8	3151.9
1996	5045.3	4483.5	11254.8	5038.1	3827.9
2005	4840.2	5224.5	10427.8	5502.9	4766.0
2006	4980.4	5310	10495.8	5575.1	4928.0
2007	5016.0	5320.5	10563.8	5651.8	5108.0
2008	5287.1	5548.5	10679.3	5847.2	5239.0
2009	5308.2	5446.5	10898.6	5926.1	5404.4
2010	5464.8	5524.5	10987.6	6034.8	5561.7
2011	5712.1	5707.5	11057.3	6168.2	5704.2
2012	5895.8	5824.5	11120.5	6303.6	5838.8
2013	6019.4	5893.5	11195.6	6335.1	5911.9

Year	Countryside use electric quantity (100 million)	Farm machinery total power (100 million kilowatts)	Government agricultural expenditure: (hundred million Yuan)
1978	253.1	11749.9	150.7
1982	397.0	16614	120.5
1984	464.1	19533	141.3
1993	1244.8	31816.6	440.3
1996	1812.7	38546.9	700.4
2005	4375.7	68397.9	2323.7
2006	4895.8	72522.1	2749.9
2007	5509.9	76589.6	3403.5

Year	Countryside use electric quantity (100 million)	Farm machinery total power (100 million kilowatts)	Government agricultural expenditure: (hundred million Yuan)
2008	5713.2	82190.4	5064.5
2009	6104.4	87496.1	6894.9
2010	6632.3	92780.5	7923.1
2011	7139.6	97734.7	8757.8
2012	8105.0	102559	10996.4
2013	8549.5	103907	13478.8

Source: China Statistical Yearbook. [M]. China Statistics Press. (1978-2013). [40]

3.2.2 Agricultural Ecological Economic System

I. Agro Ecosystem Is an Important Composition Part of Natural Process

From the perspective of eco-economic system emphasis on the ecological balance, in agricultural eco-economic system, the agricultural production carries on in which the artificial ecology and the natural ecology coordinately interweave complex. It is an open complex system with carrying on the material, the energy and the information exchange unceasingly with the external environment. The relations of agro ecosystem energy dissipative process are shown in Figure 3.7.

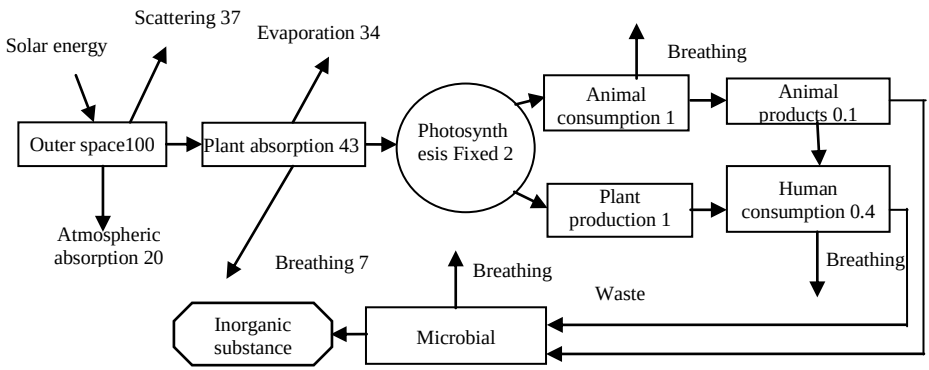

Figure 3.7 *Schematic Drawing of Agro Ecosystem Energy Dissipation.*

This figure explained that the essence of the agricultural ecological economy coordinated development is transforming energy from the solar 1.9k/cm^2/min,

progressive carries on fixed, the transmission, and the dissipation through the agro ecosystem, simultaneously, through the photosynthesis carries on the synthesis, the transformation and the utilization to the biological materials. Therefore, on the earth the actual obtaining energy is limited, now how to reduce the waste of ecological resources to realize sustainable development. Generally, saving energy, and reasonably utilazing and developing and the circular ecology resources, can alleviate the crisis of sustainable development, which are owing to deficiency of anticipated energy and the exhausted of resources bringing for us.

In the agricultural system, various factors are constituted orderly according to the strict rank and level. The green plants are the first-level producer, the herbivorous are the second-level producer, and the carnivorous animals are the third-level producer. These three have formed the food chain, as well as the material and the energy transformation along the food chain. The solar energy will pass each nutrition hierarchy, from the primary transforming into higher level the energy flux must reduce greatly, the energy and the biomass forms the pyramid distribution. Therefore, the agricultural ecological economic system is a dissipation structure system, in the system the energy transfer is a dissipative and fixed process, the majority of materials may circulate using again. The humanity both cannot produce the material and not be able to the production capacity can only use the green plants fixed solar energy. The manual intervention ecosystem’s goal lies in providing a negative entropy flow, reduces system's entropy to increase and to cause it become the order, and improve this system’s transfer efficiency and maintenance system’s reproductive property.

In the natural environment, non-biotic factor as well as the biotic factor is the mutual relation, mutually controlling and depending on each other, by these complex factors constitute inalienable comprehensive body is called the natural ecosystem. Because constitution of the natural environmental factors is

mutually linked, restricted and dependent on each other, that means they are natural. Therefore, if some certain factors have changed, other factors will have a series of chain-reactions. That thus causes the natural environmental change.

II. Artificial Influence to Natural Process

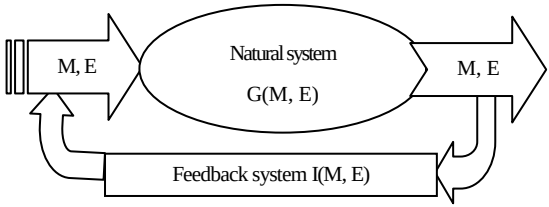

Figure 3.8 *Socioeconomic Ecosystem.*

Human and the society have joined the ecosystem, artificial interruption and participation with the natural process, which makes the system toward a unified development, and former as a new system named socioeconomic ecosystem. Human use their social practice skills, experience and knowledge accumulated (I), and by way of a feedback system to regulate the material (M) and energy (E) inputs and outputs of natural process, this model is shown in Figure 3.8.

Pulley Groin once gave an example to say "on the earth, the solar radiation had entropy to increase; this kind of entropy increased is the photon form spread generally, simultaneously, still had the negative entropy production, displayed for the life production and the extension" [41]. Therefore, may reduce system's entropy using the biotic factor to increase, may reduce the uncertainty using the wisdom factor, only then the two coexist can form the new system from the organization and negative entropy flow. Pulley Groin once wrote the above relations as.

$$\frac{dis}{dt} = \underset{>0}{\text{The generation of photons}} + \underset{<0}{\text{The generation of biological molecules}} \geq 0$$

Due to the agro ecosystem is an artificial influenced system, assume its risk (R) may regard as a function of the ecosystem entropy (S) and the related

information (I). Using dissipative structure theory, for an open system its inner entropy is always in increasing, as presented by (dis), and the exchange entropy (des) partially rely on the human behaviors, such as labor and creation. Supposed ds=dis+des>0, where require dis>0, and des<0, as front knowledge we know $R \propto S$. If we defined R=f (S)=f(dis, des(I)), then through total differential to analyze the risk in time variations. It proved only when the exchange entropy has a negative value, hereby information increased that makes the risk reduce.

$$dR = \frac{\partial f}{\partial (dis)} \frac{\partial (dis)}{\partial t} dt + \frac{\partial f}{\partial (des)} \frac{\partial (des)}{\partial I} \frac{\partial I}{\partial t} dt.$$

Therefore, reduces the ecosystem risk measure to reduce system entropy increasing, namely the reduced system energy dissipation, should enhance ecosystem information. For further analysis, as Figure 3.8 illustrated, if the risk is defined as system effect (dR), thus the entropy increasing is system cause (dS), such as, $dR \propto dS$. In above described socioeconomic ecosystem, we think the risk is controllable by using information as the feedback process. If the risk augment less than the entropy increasing, this is required

$$dR \Big/ dS = \frac{G}{1 - I \cdot G} < 1.$$

Thus 1-I G>1, also means G_f=1-I G<G. So that, we can say the information feedback should pursue the action of negative entropy. Thus, we get an important conclusion, that information is negative entropy for a system stable development.

3.2.3 Agriculture Participates in the Circulation of International Economy

Through reform and trade development, the domestic agricultural market becomes more open. The open system is the complicated system and the coordination is needed to maintain the system stability. And the coordinated

relations may use Figure 3.9 to describe the agricultural market and explain that the domestic and the international agricultural production markets formed an equilibrium economic circulation [42].

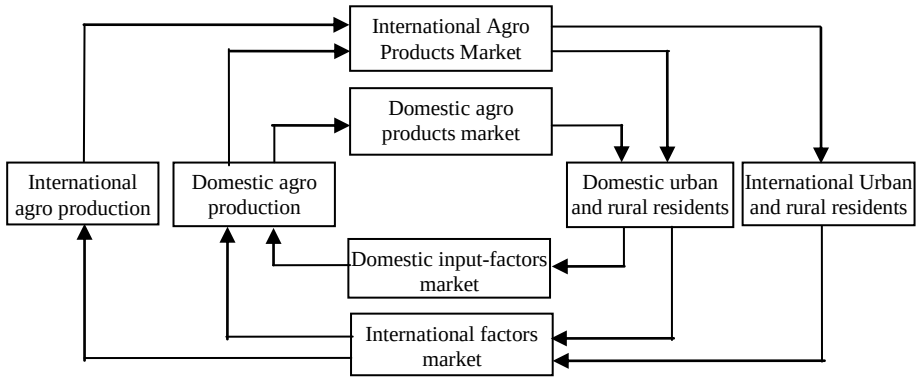

Figure 3.9 *Agricultural Economic Circulations under Open Economic Condition.*

We can use a formula to express the equilibrium as: Domestic agro products production = Agro products domestic demand + Agro products export - Agro products import. According to this balanced relationship in opening economy, the key of economic regulation should guarantee that the agricultural products domestic demand unceasing growth, makes the domestic consumption, the agricultural products processing, the domestic trade and the stocks items must satisfy the demand for the agro products.

Therefore, domestic and the international agro production and the consumption, through the products and the input factors have formed two markets between native and outside. Goods production and consumption can distinguish from domestic and international markets lie in goods sources, tariff quota, product quality, consumption habit, market price differences and so on. The resources comparative advantage is actuating the economic transaction process, and displaying two markets to the resources optimized allocation function, and encouraging continually to adjust agricultural industrial structure.

Now, China hopes to play its advantage in international trade participating world economic integration. Pursuing to realize the win-win trade result, thus can improve the social welfare level. Simultaneously, in another aspect, for price signals distortion, asymmetrical information, transaction cost increasing and international monopoly will have some disadvantage factors, then about the latter will relate us how to treat the risk and the uncertainty question.

Looking from the present agricultural products market situation, due to the trade cost, exchange rate of world market bring the change of price creates more uncertainty factors, the production and the market information asymmetry will also increase the decision-making risk. Especially for agricultural trade management question, the production general far from the agro world market, the production and transaction mutually apart. Small-scale, low productivity, low level of the organization, leading to the agriculture is lack of international competitiveness. When the agriculture developing with economic globalization, at the same time it also withstand the pressure of external commodity competition risk. Farmer household cannot grasp the market and not more care about international market, which make agriculture overall lower commodity rate and additionally weak competitive power. If only the trade and the production departments separately regulative production, this formed for a certain extent to China agriculture international and modernization development restriction.

Moreover, the customs quota is a safety valves, is also the anticipated fluctuation factor. The customs quota is the double-checked customs duty which the Uruguay round proposed in General Agreement on Tariffs and Trade, namely some kinds of import cargoes is stipulated that in quantity is suitable to the low customs duty, surpasses this amount to extra import part to enhance the customs duty, but many high customs duties are to suppress the import. General the agricultural product customs quota determined beforehand, such as in 2004 the Chinese agricultural product customs duty dropped 17% equally from

original 45%, the key agricultural product customs duty will drop to 14.5%. The wheat, the corn, the rice three kind of grain pledges import quota quantity respectively was 930, 720, 5.300 million tons. In 2005, the wheat of low customs duty specified quota was 8% of the China domestic consumption. The rice and the corn each quota merely was 4% of Chinese related total consumption quantity. In that significance, if China does not need to import the massive grain, the tariff quota quantity is an advantageous element for the stability of agro products international trade, and it also reduces the risk.

3.3 Main Existence Forms of Agricultural Production Operational Risks

3.3.1 Agricultural Market Risk as One of the Main Risk

(i) The agricultural natural hazards gradually give way to the agricultural market risk and becomes the main risk of the agricultural production management. In the planned economy system or the growth of the market degree, the main risk of the agriculture is the natural hazards, next possibly is the system risk which the product backlog or short production because the plan cannot respond completely to the market. In the market economy, the agricultural production operational risk mainly produces the fluctuation of the market price, the natural hazards will finally transform the market risk through the supply and demand change caused the price fluctuation.

(ii) The characteristics of the agricultural production operational risk have close relation with the agricultural production and product performance. Agricultural production cycle is long, production and decision-making on product sales cannot be synchronized on time, the time difference is the material basis which formed the adjustment of lag of prices of agricultural products. Since price control lags and production periodic changes, when the agricultural

product supply and demand cannot adapt mutually, creates the market price fluctuation inevitably, causes the economic loss to avoid from difficulty.

(iii) The agriculture risk management is the risk that mainly occurs in the agricultural product circulation realm. Since bright agricultural product is easy to rot, we must take certain measure in the circuit to the warehousing grain, we must measure the humidity regularly, carrying on ventilates, drying, for convenience transportation, storing and sale, we also need to carry on activities and so on product classification, processing, reorganization can guarantee that it confirms with the quality requirement to enter the expense process. The above measure and the subsequent activity cause the agricultural production official ranks group produced products circulation to have the production continuous nature and stronger property special-purpose. If these processes are not solved well, it will possibly reduce the market competitiveness of agricultural product and bring market risk.

(iv) China agriculture now is still the family small-scale operation scheme as a main body, this causes the agro production and consumption very scatter. As a result of market information which disperses the people with difficulty comprehensively and grasp the market supply-demand relation and the collaborator, competitor's situation accurately, this kind of information is not completely asymmetrical with the information, possibly causes the moral hazard and the reversion choice, thus cuts the market efficiency, causes the agricultural operator to be the inferior position in the market competition. Especially, when China's agricultural production structure diverse degree is lower, the management lacks the flexibility, very easy to receive the market fluctuation initiation risk.

(v) After China joined WTO, the challenges and opportunities coexisting, the agricultural market risk does not reduce but increases. First, in big background of the economic globalization and under the market liberalization, the sources of agricultural markets risk are more, the possibility of risk occurs being bigger,

the scope which affects being broader, the degree of the loss being more serious, the uncontrollably being stronger. Under the agricultural product buyers' market condition, the farmers income and the anticipated income are not steady will cause the operator to adopt the short-term behavior, will not be favor for forming the mechanism of order market competition. Next along with the rural industrialization and urbanized levels enhancement, the industry and the city competition further intensifies for agricultural resource and the human capital, agriculture is facing with bigger resources and high environment pressure, Once more, the large-scale agriculture management and the level of industrial production are very low, farmer's organization degree is not high, the agricultural scientific innovation, the scientific and technical payoffs transformation, promoted dynamics insufficiently will hinder the agriculture to move toward the international market.

3.3.2 The Market Risk and the System Risk Intertwine Mutually in Agriculture

The system risk and the market risk intertwine mutually which influences agricultural production, becomes a major character of the agricultural risk. The process of the market economy transform include system's vicissitude, the system risk is the possibility, which in the process of the system (either policy) vicissitude (or implementation) the real return of system (or policy) and the prospective return occurs departs from because its result's unpredictable.

The institutional innovations and the system vicissitude are process continuously, it is for the market growth, grew and consummates has created the condition. The original land and the system of planned economy have been broken, but the new institutional framework and the market economy system not yet completely established. For example, the land should not become the public goods, but must entrust with the price signals, formation property rights. If the domain of the agricultural economy has the transitional unbalanced

condition, many latent system conflicts which stimulates will affected the market various behavioral pattern, restricts the normal display of the market function, causes the efficiency of resources deployment and the loss will form the system conflicts by bringing about market risk. At the same time, the market growth also requests to adapt the new system, when the agricultural economy domain has the vacancy of the market main body, when the market system and the market mechanism imperfect such as the agricultural product circulation system, the farm price mechanism, the market information dissemination, the feedback mechanism and so on will definitely restrict the way of the system vicissitude, will affect the system achievements of the system risk, which will initiate by the market flaw.

3.3.3 The Further Expansion of Agricultural Technology Risk

The agricultural technical risk refers to the probability of the real return deviate from the expected return of its utilizing. Whatever the agricultural technology to be used as endogenous variable or exogenous variable, it is without doubt that technology is very critical. Present information and biological technology have greatly expanded the production possible boundary of traditional farming and have obviously reduced the dependence of agriculture on the natural resources. The agricultural competition have transformed gradually from the resources talent superiority into market competition taking the technical superiority as the foundation. According to our investigation, the demand of farmers to the agricultural sciences and technology arranges at the first, with the tendency increasing unceasingly. But what the technical utilization brings is not only income and efficiency, but also risk. At present, the agricultural technology risk also has rising tendency and has the following characteristics.

(i) Agricultural technology has quasi-public goods characteristic and the very strong exterior nature. The place of agricultural production is generally open style. The technological process secrecy of the agricultural production

technology is very bad, and the human imitates the majority of the crop production technologies have the experience characteristic compared with easily. In this case, a new technology's user is impossible to monopolize the achievement of this technical, because other people "travel by vehicle" possibly make to increase the product supplies and the price fall as well as the actual income is smaller than the prospective return.

(ii) Modern agricultural technology mostly carries out the dissemination by way of information transmissions. In the imperfect situation of technology market and the organization promotion of agricultural technology as a result of the information transmission process in technical question, and the information receiver regarding the information responses skill question as well as the signal error which either the information as a result of the information asymmetry or imperfect information, which produces the initiated technological risks or the responsibility risk frequently.

(iii) Agricultural technology risk characteristics exist in man-machine-environment system [43]. What the agricultural technology usually strict request to the operator and the external environment is the technical compatible question. First, the agricultural technology is the shape of transformation knowledge. On the man-machine interface, agricultural technology's user needs to have certain cultural knowledge and the skill can distinguish the crops or the livestock breed character, uses the appropriate technology to carry on the production, the management and the improvement. In agricultural technology promotion, because the farmer cultural level lowers the masters of modern technology with difficulty creates the technical defeat, the economic loss frequently or cuts the new technical proper efficiency. In the person-link and the machine-on the link contact surface, the agricultural environments usually have two kinds: natural environment and social economic environment. If meets the natural condition to change not to be able to satisfy its

technology performance requirement or masters the technology the human cannot adapt the bad environmental condition, then the technical superiority cannot appear, causes the overall income possible and anticipated being far from, has technological risks, which is usually caused by the natural hazards. In the market economy, the technological risks and the market risk intertwine in the same place. Whether a technology can realize its benefit is decided finally by the market supply and demand condition. When the demand had changed, the lag of technical supplies also possibly could not realize the proper benefit, which is one substantial reason of restricting dissemination of agricultural new technology.

3.3.4 Farm Credit Risk Has Become the Agricultural New Risk Variety

Following the market gradual completeness, financial risk becomes a key problem for economic social development. The credit tool becomes more and more importance to the agro business activity. Credit financing generally refers to production lack of fund to allow temporary loan from the others fund surplus or financial institutions. The demand of fund should take the interest as an expense and obtain the right of fund using in certain time, and the due restore principal and interest. With agricultural division of labor and specialized degree enhancement, scale of production expansion, agricultural new project development, new technical use, loan fund scale is in expansion. In money market, including foreign capital introduction even the stables currency and its price also change momentarily. The finance credit risk has been the focal point of the people attention, because it is unable to accately predict the loan and the monetary exchange rate to the future interest rate's change, it is difficult to calculate the production cost. In agricultural project investment process, because of information, but will pour into not completely the future cash flow and the future returns ratio's size will calculate and so on accurately with difficulty.

Therefore, avoid moral hazard, optimal mechanism design is very important. The people will have the information to the future forecast’s accurate degree with them the adequacy are being related, the information will be the decision-making function, in the circumvention finance and the investment of risk question, the information will be necessary and sufficient condition for the decision-making. In the economy exists objectively the unknown information, as well as the information holds the asymmetry, creates the direct risk or the moral hazard frequently. As a result of the impetus agriculture intensified management, must have the flow of massive frequent fund, including in each agricultural fund, the credit question's risk is the universal existence.

3.4 Risk Identification Methods in Agricultural Production Management

To guard against and averse the risk, firstly need to analyze and distinguish the origin of risk and the way of transmission. The so-called risk identification is to judge, classify and appraisal risk nature process for the potential risk, namely identification of potential possible loss. Although the management main body's information is not enough, it is sufficiently to assign a probability value for each alternative plan's result and infers the probability distribution of some event or the action result presents according to the existing information. If cannot determine the probability distribution, then the question turned completely the uncertainty type venture decision, therefore, before to measure the agricultural production operational risk, lacked of information is the difficulty which the risk assessment met frequently. Understanding the possible origin of risk, defying the risk factor, inspection, scope, the risk size and determining the goal of agricultural production management's risk become the first step to research question. Then, we analyze the steps and distinguish the risk according to certain system program.

3.4.1 The Principles of Recognizing Agricultural Production Operational Risk

In the agricultural production management, each decision-making includes the risk factor. However, sometimes the possibility of risk is small, even not considered. Sometimes it is difficult to estimate because of data insufficiency, or because estimating needs to spend much money and time. Therefore, the risk has been neglected even if it is acknowledged. From theoretical analysis of the modern agricultural production economy, if each decision-making needs to be estimated risk, the process of decision-making will become very complex, slow and clumsy and we will not grasp the principal contradiction.

With the establishment of the agricultural insurance system, the risk which is not distinguished or is very small may be decision-making which is used as risk, the personally making used of risk to increase saving additional insurance premium, reducing the insurance market fluctuation, reducing the moral hazard and the fund continually spend. The big risk should be solved by the risk management department or the Insurance Company. Since risk has relations with individuals and enterprise subjective, we must pay great attention to collect more information in the identification process to make the correct judgment. In the agricultural production operating decisions process we first should identify main risk. Besides considering natural hazards, we should also consider the market risk. In the risk identification process the main type of risk and the risk origin we should consider include.

(i) Market risk, like the price, the cost, the income change and the change in the market supply and demand bring the risk. And it is mainly in the domestic and foreign trade circulation of price risk.

(ii) Production risk, like the natural environment, the change in weather and the climatic factor brings the natural hazards and production process decision-making risk. The serious drought, waterlogged and the insect plague occurrence will

enhance the agricultural production cost enormously and may transform through the influence of agricultural product supplies as the market risk.

(iii) Technological risks, for example, technical application and risk in the dissemination of technology. And it is mainly the risks, which are caused by the mechanism of technical information's dissemination and grasping of scientific knowledge.

(iv) Systematic risk, for example the change of management system and each kind of risk is brought by the production operation organization’s transformation. Finally it displays the risk that forms of the organization scale and bring flaw of the management system.

(v) Farm credit risk, for example the change in financial condition risk, interest rate and exchange adjustment risk, agriculture venture capital assignment, use of operation risk and so on. The main performances are the direct investment risk and the moral hazard which the information relation asymmetrically brings in the principal-agent relation.

3.4.2 The Procedures and Methods of Identifying Agricultural Risks

I. The Procedures of Recognizing Agricultural Production and Business Risks

There are different identification processes of agricultural production and business risks. In the application process, we generally distinguish the agricultural production operational risk according to certain procedure; the distinguished content and the evaluating indicators are different, aiming at different types of risk. Risk identification process of typical crops under production may carry on according to the procedures in Figure 3.10.

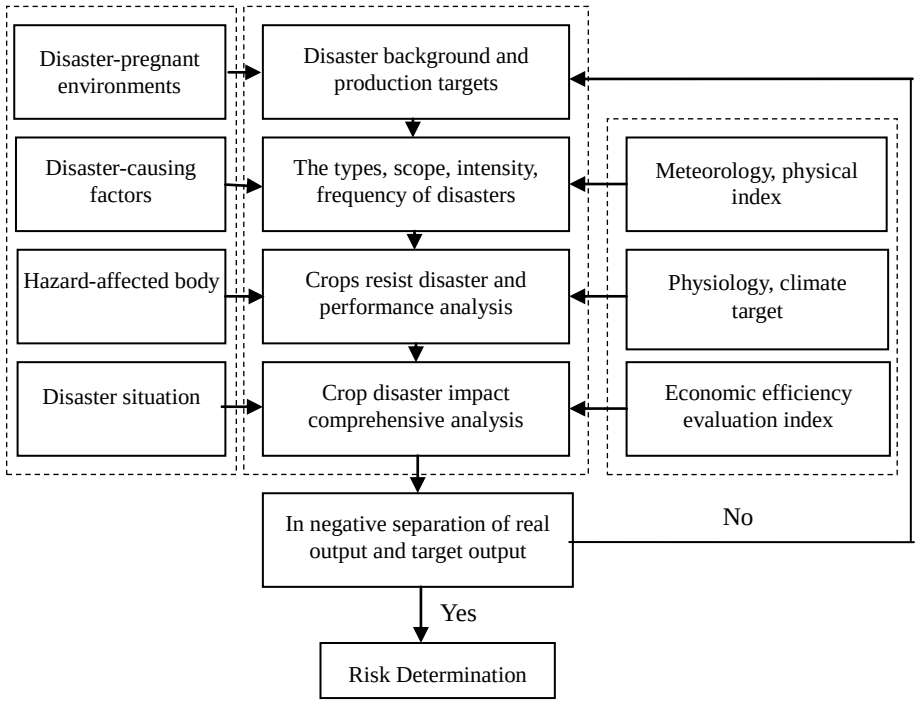

Figure 3.10 *Crops Disaster Risk Recognizer Procedure.*

This procedure embarks from specific environment which pregnant disaster, aiming at the background of crops disaster situation and the production goal, according to each physics, meteorology, climate and plant physiology target, analyzing disaster factor's type, scope, intensity, frequency and as well as character of resisting natural disaster and so on. Compare each kind of economic efficiency target according to the disaster manifestation to make series of judgments of the risk origin and size [17] [44].

Determining the risk is to find or to stimulate probability distribution rule of the risk event. To the specific production project or the production operation process, what we need to reply is that "what is the breeding risk factor? How did they hinder or reduce goal realization of production operation?" What is the

degree of direct or the indirect destructiveness?" we need according to the historical data of risk unit, and compute loss frequency, namely times which loses occurs in assigned time. It is estimated that the loss has the scale or the loss degree, even if when lacking the historical data, we also must give the possible sector of the loss degree (i.e. minimum and maximum loss value). To regular event, we need to compute or stimulate probability type of event occurs, loss expected value and standard deviation in the foundation of recording and describing the occurrence rule.

II. The Methods of Recognizing Agricultural Production and Business Risks

The risk identification has a higher complexity in the agricultural domain. The risk identification needs to consider that the estimation of the risk situation is needed to determine probability of each condition possibly occurrence, these factors possibly are objective or subjective. The probability objective data is the common historical record and the universal experience, therefore to collect the comprehensive material and the information, must certainly establish the account to the large-scale agricultural enterprise, the establishment of financial reporting, according to its book value, the market value, the unique value, the reproduction cost and so on carries on the risk analysis. The objective probability basis's information was formerly already the knowledge which knew, usually used quantity estimate or the statistical analytic method, and for example to draw the probability tree, to carry on the time series analysis, the measurement economic analysis, the price flexibility, the marginal analysis and so on.

The subjective probability estimate is taking the common experience and the knowledge as the foundation, the subjective estimate can receive individual prejudice and the ignorant influence in the consideration question's scope. In order to raise the forecast level, frequently have to use the method of expert advice (for example Delphi method), individual experience judging method, the centralism opinion method and so on. Only then has the agriculture

multi-disciplinary comprehensive scientific knowledge, forms the essential special analysis group, can be the better risk analysis origin and the way of transmission [44] [45].

First, we establish the fundamental model of the agricultural risk system according to system's structure, the environment and the system objective.

Second, use many kinds of probability distribution function description system various links and system objective uncertainty. For example, the possibility appearance of some agricultural production project's pessimistic and the optimistic income value is small, more approaches the possibility which appears in the expectation income value is bigger, we may choose the normal distribution or the triangle distribution to describe it.

Third, we use the analogy procedure that the random sampling calculates many times to carry on the risk analysis, for example, advanced Monte Carlo and Latin Sampling Techniques [46]. Extract the sample stochastically from each factor of certainty, and simulate all kinds of uncertainty combinations. Repeatedly carry on such operation over a thousand times, obtaining over a thousand results in each kind of combination.

Fourth, we process these data results through statistics and discover the rule to change the system structure, for example, arrange the observed value from big to small and count times which each value appears, to form the frequency distribution curve with these numbers of times value, then we can determine the possible of each result appears or the accumulation probability.

Fifth, according to statistics principle, we carry on the quantitative analysis regarding these result data, to determine maximum value, minimum value, quantile, mean value, standard deviation, variance, fiduciary level, information entropy and so on.

Sixth, each uncertainty factor possibly varies to systems operation's influence. Sometimes we must carry on the sensitive analysis to each uncertainty factor, which is also very important step to optimize the production operation goal.

Seventh, directly using ready-made specialized material is the shortcut of risk identification. For example, in the agricultural insurance service which People's Insurance Company develops, about the big plastic sun shelter and the vegetables insurance, the crop production and the poultry insurance and so on, effective insurance table in different productive phases is computed according to the different risk evaluation, may intimate borrowing.

III. Establish Complex System of the Macroscopic Agro Risk Identification and Monitoring

In this research, general for the natural hazards, the technological and the systematic risks we regard them as production risk to inspect. But for the market and the credit risk, we usually take them as unified the operational risk. In the practical work, we should aim at these main agricultural production operational risk to conduct the thorough investigation and material-collection and to establish the risk monitoring indicator system and risk identification systematization process. Embarking from the system idea of distinguishing the agricultural production operational risk, we use the complex system approach to process and to study the agriculture production operation risk has the very vital significance. Qian Xuesen in the late 80s of the 20th century put forward the concept of opening complex giant systems, the theory and methodology [47]. According to this system theory, we may estimate and analysis of the agricultural production operational risk from the angle of complex giant system, with the integration, the synthesis, the structure, the function, the opening, the order, the coordination, the dynamic, the process and the connection, as well as the optimization and so on as viewpoints understanding systems tendency, the change rule of each kind of risk factors. Therefore, with system’s viewpoint and

the method of identification and the analysis of agricultural production operational risk, we establish the agriculture macroscopic risk management system, the study of agricultural production operation strategy, the tactic and realizes the multi-objective methods and the resources, must grasp factor variable in the system's internal essential factor and the environmental essential factor. The available in Figure 3.11 shows the complex great system structures distinguish the agricultural production operational risk [48] [49].

The agriculture is the sub-system of the entire national economic systems. The agricultural production management system has system's openness and the complex characteristic. The agricultural production operational risk may summarize for the influence of agricultural production state of operation each kind of risk factor aggregate. Not only the agricultural development in the nature, the ecology, the market, the society, the culture and so on each aspect has widespread contacting with the other national economics departments. Moreover reform and open policy should be deepened to penetrate it with aspects and so on world politics, economy, society and culture has also established contacting. China's agro ecosystem is a whole world ecosystem sub-system, China's agricultural market is the important component of the world agriculture market, China's rural economy and the social development will become the model of the human society economic development, constructs the comprehensive affluent society and moves toward the world civilization in the front row.

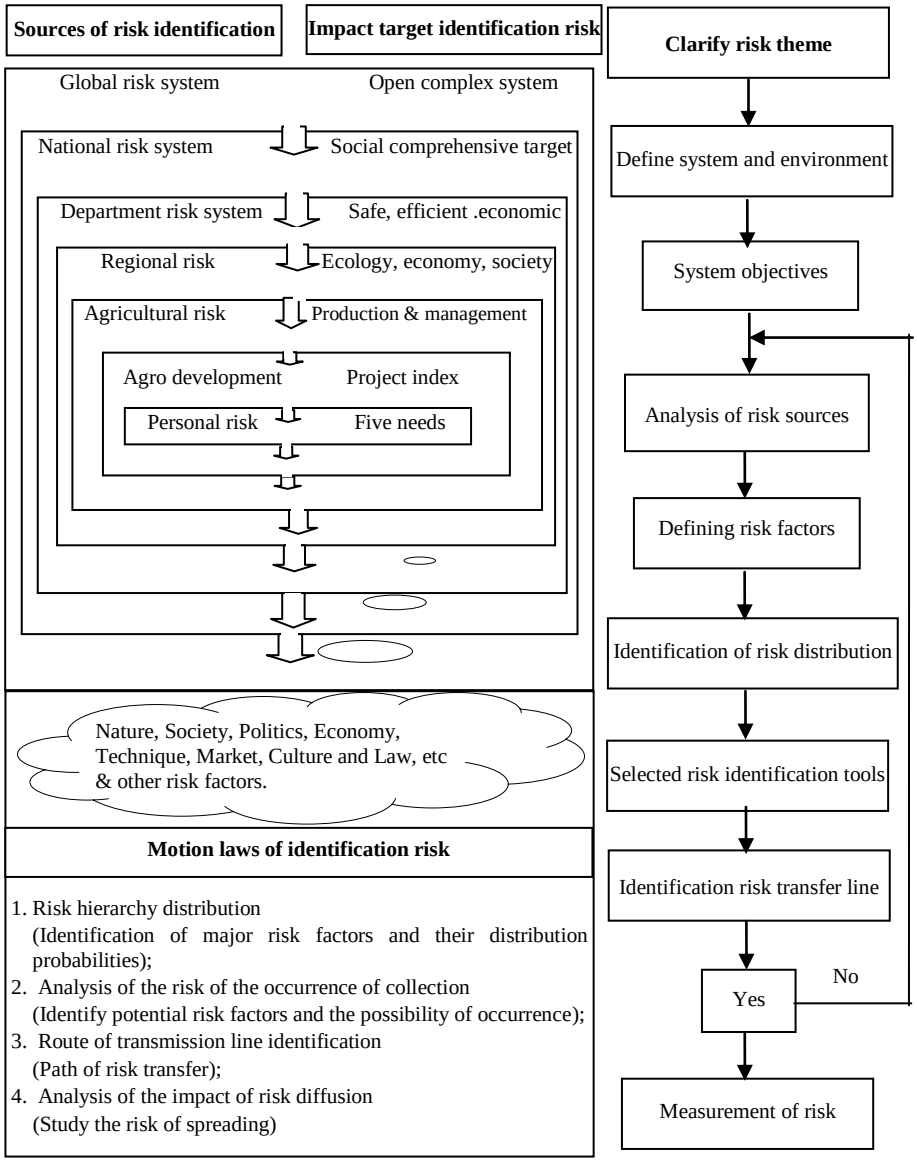

Figure 3.11 *Identifying for Agro Production and Operational Risk as a Complex System.*

Summary

First, this chapter overall has described the agricultural production and business risks system of China and the uncertainty realistic background embarking from the agricultural risk, using the massive fact material, according to the economic and the systems science principle, each kind of main risk which exists to the agricultural production management including the nature, the market, the society and the production technology and so on various aspects of risk factor and the mutual influence has carried on system's elaboration. Through the social economic system analysis, the ecological environment analysis have promulgated different kinds of origin of agricultural production and business risks, the manifestation, the complex characteristics and as well as the relations between various departments of national economy.

Second this chapter evaluates the effects of five kinds of main natural calamities such as drought, flood, wind hail, frost and typhoon etc on the agricultural development of China by using the panel data from 1990-2014, and measured the rates of disaster reduction and affected. And it used basic statistical methods to analyze the development trend and the affected areas variation of various calamities, such as it discussed the natural calamity's long term changes in the diversity and complexity of features.

Third, this chapter introduced the procedures and the general methods of the agricultural production and business risks identification. Regardless of the methods, needs to be familiar with the agricultural production situation, conducts thorough the investigation and the study, understands the agricultural production operating results and the change of each kind of environmental factors, therefore, here simultaneously introduced each kind of risk identification tools.

Finally, this chapter also emphasized on when the risk identification should use the system analysis method, in order to proposed an agriculture mcroscopic

risk management system's tentative plan in China. Now, the agricultural risk identification should have the broader global vision, as mentioned finally in this chapter, we must distinguish the agricultural production operational risk from the angle of Opening Complex Giant System from the opening giant complex system angle, preliminary designed the risk identification system frame.