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The Degree of Farmers' Cognition on Non-point Source Pollution: Based on the Statistical Analysis of 453 Farmers

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Abstract With the rapid development of modern agriculture, agricultural non-point source pollution becomes increasingly serious in China, improving farmers' environmental protection consciousness plays a very important role in the reduction of agricultural non-point source pollution. Therefore, this investigation and study chooses rural areas of five counties from Chongqing city and Zhejiang province as our samples, our investigation and statistical analysis includes the following four aspects: farmers' cognition on non-point source pollution concept, farmers' cognition to rural environment satisfaction, farmers' cognition on non-point source pollution in agricultural production and farmers' cognition on the consequences of agricultural non-point source pollution and the effects on ecological environment. The analysis and conclusions of farmers' consciousness cognition on agricultural non-point source pollution, provides the supports in theory and practice for optimizing the behavior of farmers, promoting the management of agricultural non-point source pollution and implementing new rural construction goal.

Key words Agricultural non-point source pollution, Environmental protection consciousness, Cognition degree, Farmers

1 Introduction

The rapid development of modern agriculture, improving agricultural intensification and promoting economic development, also brings more severe damage to ecological environment than traditional agriculture, especially, the excessive use of fertilizers and pesticide in agricultural production, the discharge of wastes from large livestock farms cause very serious negative effects on surrounding ecological environment. On February 6, 2010, "the bulletin on the first national pollution census" announced by Ministry of Environmental Protection and three other ministries shows: In 2007, the emissions of chemical oxygen demand (COD) from agricultural non-point source pollution are 13 240 900 tons, which is accounting for 43.7% in total COD emissions, and agricultural non-point source pollution is the main source of total nitrogen and total phosphorus emissions, respectively accounting for 57.2% and 67.4% (Rao Jing, 2011)^[1]. The destruction of agriculture ecological environment is changing from "point source pollution" to "non-point source pollution", agricultural non-point source pollution has become the largest non-point source pollution of environmental problems in our country. For agricultural non-point source pollution, many experts agree that: the main reason of serious environmental pollution is that environmental protection consciousness is not enough (Whittington D, 1998; Zhu Zhaoliang, 2004; Hu Xinliang et al, 2011; Yan Chang et al, 2013)^[2-5]. Therefore, changing farmers' traditional concept and improving environmental protection consciousness have a substantial effect to the reduction of agricultural non-point source pollution. As

farmers' environmental protection consciousness playing a very important role in the prevention and control of agricultural non-point source pollution, therefore, in this paper, through questionnaire, we want to know the following content: farmers' cognition on non-point source pollution concept, farmers' living satisfaction to rural environment, farmers' cognition on the consequences of agricultural non-point source pollution and the effects on ecological environment, *etc.* The analysis and conclusions of this article provide the support in theory and practice for optimizing the behavior of farmers, promoting the management of agricultural non-point source pollution and implementing new rural construction goal.

2 Data sources

Considering of cost and recycle, this study adopts field survey method, survey sites include a few villages of Beibei, Hechuan, Fengdu, and Shizhu in Chongqing city and Wenzhou in Zhejiang province.

This research adopts random sampling method in sample selection, to ensure the fairness of samples, we extract one person every five people who are willing to accept interviews, but interviewee should have independent economic ability and his or her age is over 18.

When survey, firstly, we ask whether farmers know the concept of agricultural non-point source pollution, then show them some pictures related in agricultural non-point source pollution, lead farmers to become interested in understanding the influence that agricultural non-point source pollution on ecological environment, ask farmers talk about their evaluation to local water, soil, living environment and so on.

At the same time, the questionnaire also involves in farmers' views and attitudes to environmental conditions, environmental pollution and environmental problems and other issues. This in-

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vestigation withdraws a total of 453 valid questionnaire, among them Beibei, Hechuan, Fengdu, Shizhu in Chongqing city respectively are 120, 98, 65, 57, and Wenzhou in Zhejiang province is 113.

3 Analysis of farmers' cognitive degree on non-point source pollution

3.1 Analysis of farmers' cognitive degree on non-point source pollution concept According to the survey on farmers' cognition on the concept of agricultural non-point source pollution, Farmers who know the concept of agricultural non-point source pollution are 214 people, accounting for 47.24%, which shows that there is nearly half of people know the concept of agricultural non-point source pollution in countryside, this level is not low, and after our investigation, our propaganda on the knowledge of agricultural non-point source pollution helps farmers to strengthen the understanding of agricultural non-point source pollution.

When asked whether farmers perceive local agricultural non-point source pollution is serious or not, on the whole, there are 83% of farmers consider agricultural non-point source pollution is not serious or not clear the concept.

3.2 Analysis of farmers' cognition on the satisfaction degree of rural environmental quality In the interview, we select six aspects to questionnaire, such as farmers living environment, water quality, air quality, farmland quality, wetlands quality, wildlife condition. In view of the overall farmers' cognitive to environment deterioration, we ask farmers which terms they think become bad fastest in rural environment in nearly five years of the above six aspects, survey results show that: in recent five years, farmland quality becomes worst in rural environment, which may mainly related in soil quality decline caused by excessive use of fertilizer and pesticide.

This is consistent with many scholars' research, excessive amounts of pesticides and fertilizers can not improve crop yields, but have side effects, such as reducing soil quality, destroying un-

derground water and so on (Vladimir Novotny, 1999; Wei Xin et al, 2012)^[6-7].

The rural environment satisfaction survey is shown in Table 1. We can see that, farmers who satisfy rural living environment are 193 people, accounting for 42.60% of total farmers; farmers who satisfy rural drinking water quality are 235 people, accounting for 51.88%.

In terms of rural air quality, they generally are satisfied with air quality in rural areas, it is accounted for 86.98%, which is basically contrary to the local economic development level, it reflects areas far from the main city may have better air quality, and through comparing the records of interview dialogue and questionnaire, we find that migrant farmers have a better satisfaction evaluation to local air quality than farmers who are not immigrant, which also indirectly reflect air quality issue in big cities.

Farmers who do not satisfy soil quality are 281 people, accounting for 62.03%, which is the largest proportion in all items, in the interview, we find that most farmers reflect farmland soil degraded too fast, soil compaction phenomenon is very common, in order to increase production, they have to use lot of chemical fertilizers, otherwise it is hard to get good harvest. This phenomenon shows that: the use of chemical fertilizers has led to the rapid changes of land condition, in pursuit of yield, farmers have to use a lot of chemical fertilizer, but the reducing of soil fertility caused by excess use of chemical fertilizers affect the ability of agricultural production, then farmers have to use more fertilizer, so that farmers become in such a vicious cycle.

In the survey of farmers' attitude on wetland quality, the proportion of farmers who are satisfied with wetland quality is accounted for less than 50%, through our interviews and field view, in countryside, many ponds have garbage, the smell make farmers around can't stand; when referring to the conditions of rural wildlife and woodland, many farmers feel wild animals are fewer and fewer, as building roads, felling trees unlawfully, woodland area became smaller and smaller in rural areas.

Table 1 The questionnaire on farmers' environment satisfaction

Satisfaction degree	Living environment		Drinking water quality		Air quality	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Satisfactory	193	42.60%	235	51.88%	394	86.98%
General	136	30.02%	83	18.32%	43	9.49%
Not satisfied	124	27.37%	135	29.80%	16	3.53%

Satisfaction degree	Farmland quality		Wetland quality		Wild animals and plants conditions	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Satisfactory	108	23.84%	213	47.02%	257	56.73%
General	64	14.13%	59	13.02%	72	15.89%
Not satisfied	281	62.03%	181	39.96%	124	27.37%

3.3 Farmers' cognition on non-point source pollution in production In order to understand whether farmers use fertilizers and pesticides is excessive in the process of agricultural production, whether farmers know fertilizers and pesticides can lead to the consequences of agricultural non-point source pollution, we have made corresponding survey (see Table 2).

Through the survey, we find that more than sixty percent of

farmers know their excessive use of fertilizers, but they can't estimate how much volume they exceed the standard quantity, only 9.05% of farmers don't know they use fertilizers and pesticides too much. Most people know the common sense that excessive use of chemical fertilizer has a harmful effect, but there is still 21.41% of people don't know excess use of fertilizer will lead to damage. In terms of pesticides, 13.02% of people don't know their use of

pesticide is too much.

In general, farmers have already realized the excessive use of fertilizers and pesticides in the process of production, but farmers think it is a very common phenomenon, thus it can be seen agricultural non-point source pollution is a very prominent problem in the countryside.

Although farmers recognize the harm of excessive use of fertilizers and pesticides, but it is still stay in thought level, not form a constraint force to their behavior, one important reason is that farmers need fertilizers and pesticides in agricultural production and increasing household income.

Many farmers think, use of chemical fertilizers and pesticides can get benefit in a short period of time, can guarantee normal growth of crops, it also can make the farmers be at ease to work outside, many farmers focus on migrant workers, they treat as agriculture as a sideline.

Therefore, in order to solve the problem of agricultural non-

point source pollution, an important measure is increasing agricultural comparative benefits and farmers' agricultural income.

In addition, in the interview, we also learn that in terms of the use of pesticides, farmers can control the amount of pesticides in crops for their own consumption, while they don't focus on amount of pesticide in crops for sell, therefore, when purchase agricultural products, government needs to strengthen the detection of agricultural products, in order to prevent food safety problems brought by pesticide residues (Cheng Xiaoming, 2013)^[8].

3.4 Farmers' cognition on agricultural non-point source pollution consequences and the effects on ecological environment

In order to understand the farmers' cognition on agricultural non-point source pollution consequences, we design three questions; whether agricultural non-point source pollution continues to deteriorate, whether it affects farmer family life now, whether it affects farmer family life of 20 years later, whether it affects life of farmers' future generations.

Table 2 Investigation of farmers' cognition on non-point source pollution in agricultural production

Satisfaction degree	Whether knowing the use of fertilizer is excessive in agricultural production		Whether knowing it is harm to use excessive fertilizer		Whether knowing the use of pesticide is excessive in agricultural production		Whether knowing it is harm to use excessive pesticide	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Know	285	62.91%	325	71.74%	349	77.04%	353	77.92%
Dimness	127	28.04%	31	6.84%	45	9.93%	64	14.13%
Don't know	41	9.05%	97	21.41%	59	13.02%	36	7.95%

Table 3 Investigation of farmers' cognition on agricultural non-point source pollution consequences

Satisfaction degree	Whether affecting farmer family life now		Whether affecting farmer family life of 20 years later		Whether affecting life of farmers' future generations	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Yes	104	22.96%	145	32.01%	204	45.03%
Dimness	109	24.06%	210	46.36%	173	38.19%
No	240	52.98%	98	21.63%	76	16.78%

The survey results of Table 3 show that: for the present situation of agricultural non-point source pollution, 52.98% of farmers think agricultural non-point source pollution does not affect their family life, but for the developing trend of agricultural non-point source pollution, most of the farmers can't be sure or not clear whether agricultural non-point source pollution will affect their future life, it suggests that farmers have not enough understanding the seriousness of the agricultural non-point source pollution, they can't confirm the influence degree if pollution continues to worsen.

For themselves and future generations, farmers consider a lot, but for understanding that fertilizers and pesticides cause environmental pollution, they are almost in unconscious on the whole. In this survey, nearly 38.75% of people believe that fertilizer will cause soil harden, but will not cause pollution to environment; 61.25% of people believe that fertilizer will only increase crop yield and no negative impact, will not cause environmental pollution. 32.5% of the farmers think pesticide affects environment, the reason is that people who have strange disease increase in recent years, while rarely before; 67.5% of people think pesticides will not cause environmental pollution, the reason is that if

pesticides cause environmental pollution, the government won't let them used.

More than 50% of people think that rural environmental pollution from life waste is gradually increasing, when let them choose what pollution threat them, most of the farmers choose that pollution threat their life and health, but for such items as eutrophication of water bodies, heavy metal deposition soil and threaten drinking water safety, they choose very few.

When asked about in use of chemical fertilizers and pesticides, in addition to considering their own costs and benefits, whether farmers consider the impact on surrounding environment and other stakeholders, 43% of them choose considering appropriately, farmers from underdeveloped regions consider much less the surrounding environment in agricultural production.

For pesticide residues, more than half of farmers have a basic cognitive, it thanks to China's accession into WTO, The government advocates the production, popularity and certification work of green agricultural products, and clear which pesticides cannot be used in agricultural production, so as to ensure the edible safety of agricultural products.

But in the survey of pesticide residue problem, only 44% of farmers think that is a serious problem, more than half of farmers do not have a clear understanding for the harm of pesticide residues. 70% of farmers think protecting rural ecological environment has a promoting effect on agricultural production activities, this fully shows that more and more farmers gradually realize the importance of environmental protection work to themselves and future generations' development.

4 Conclusions

This investigation and study choose rural areas of five counties from Chongqing city and Zhejiang province as our samples, our investigation and statistical analysis includes the following four aspects: farmers' cognition on non-point source pollution concept, farmers' cognition to rural environment satisfaction, farmers' cognition on non-point source pollution in agricultural production and farmers' cognition on the consequences of agricultural non-point source pollution and the effects on ecological environment.

Overall, the cognition of farmers in China's western region about agricultural non-point source pollution is still at a lower level, it is related in their cultural level of education; relative to the west, the statistical results of samples from Wenzhou region show that the southeast region of farmers in economic development level is higher, in a higher level economic development area, with high cultural quality, and more opportunity to contact with modern urban culture, farmers of southeast have higher ideological aware-

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capacity is strong, the ability of enduring external disturbance is high, and urban development and construction activities have little influence and the ecological constraint is low. Therefore, it is suitable to conduct large scale urban construction and industrial development, and develop this zone into economic center of Dianchi Lake basin. In future, it is recommended to speed up urban development, boost infrastructure construction, make industrial distribution more reasonable, promote development of industrial clusters, increase efficiency and intensification of land resource, and drive the process of urbanization.

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ness in the aspect of environmental protection consciousness. The analysis and conclusions of the consciousness cognition on agricultural non-point source pollution, provide the support in theory and practice for optimizing farmers' behavior, promoting the management of agricultural non-point source pollution and implementing new rural construction goal.

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