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Full Length Research Paper

Features and treatment of non-point source pollution in the Ningxia Yellow River area

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Non-point source pollution of Ningxia Yellow River Irrigation has become increasingly prominent, making it an important factor affecting the water environment. Research on irrigation non-point source pollution and the progress of pollution control in irrigation has profound significance in terms of protecting the ecological security of irrigation. In the current paper, the Ningxia Yellow River irrigation area was used as the study area. The characteristics of the point source of its pollution are analyzed from literature. Through an analysis of relevant national laws and policies on environmental protection, as well as the policy of prevention and controlling non-point source pollution implemented by the Ningxia government, the non-point source pollution research progress on the Yellow River Irrigation area is summarized. The non-point source pollution in the Ningxia Yellow River Irrigation area is still acute. Crop pollution has been controlled, but the quantity of crop pollution is still serious. The animal manure pollution is growing every year. So, we still need to strengthen the non-point source pollution management.

Key words: NingXia, Yellow River irrigation, Non-point source pollution.

INTRODUCTION

Agriculture has been recognized as the largest contributor to non-point source pollution of surface and ground water (Chau, 2002; Braskerud, 2002; Lee, 1979). Non-point source pollution carries a greater flow of nutrients into a water body from croplands, nurseries, orchards, livestock and poultry farms, sanitary sewage, and landfills that can disrupt the balance of life in the water (Zhao et al., 2006; Edwin et al., 2010; Ding, 2010; Li et al., 2011; Novotny and Olem, 1993). Non-point source pollution shows some special features such as dispersion, randomness, fuzziness and cumulative, compared with industry and other point source pollution (Wu and Chau, 2006; Nigussie and Fekadu, 2003).

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Moreover, the accumulation of farmland soil nitrogen and phosphorus causes massive outflows, leading to water eutrophication that has intensified in recent years (Liu et al., 2003; Wang et al., 2006; Tsai and Yang, 2005; Chau et al., 2002). Yang et al. (2009a) reported that the whole world has 30~50% surface waters to be influenced by non-point source pollution, and 12% of the world's arable land degradation is caused by agricultural non-point source pollution. Gao and Zhang (1999) concluded that agricultural non-point source pollution of rivers and lakes has a total nutrient load of 60 to 80%. In the U.S., Japan, and other developed countries, even if point source pollution has been fully controlled, water quality would still not meet standards, if non-point source pollution control is bad (He and Wang, 1999). Specifically, American non-point source pollution accounts for two-thirds of total pollution, including 75% contributed by the

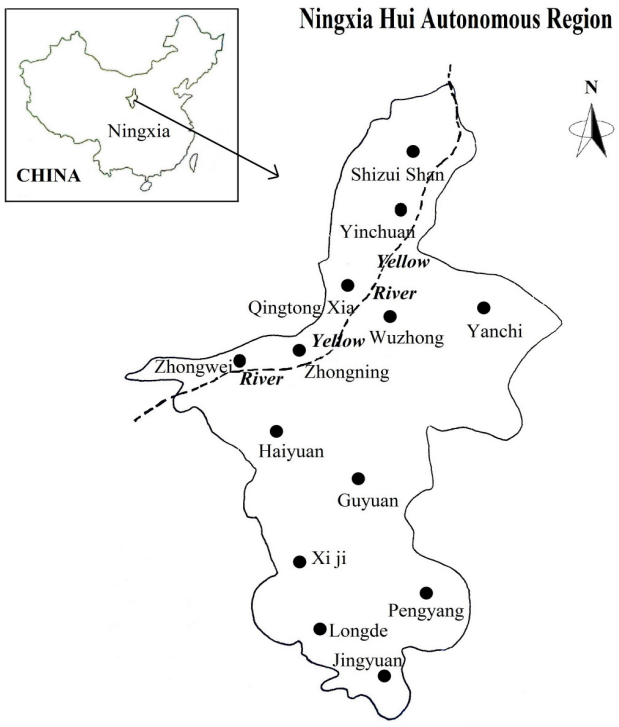

Figure 1. Location of the study area at the Yellow River irrigation area in the northern part of Ningxia along the Yellow River, China.

agricultural sector (Quan and Yan, 2002).

The situation of a country's non-point source pollution in China is very serious. Recent studies demonstrated that the water body nitrogen and phosphorus pollutant may be 66.7% from industrial waste, sanitary sewages, and the agricultural non-point source pollution in China (Zhao et al., 2010). The quantity of soil erosion in China country amounts to 5×10^{10} kg·year^{-1}. The total amount of nutrients N, P, K, and trace elements that are carried off is equivalent to one year's worth of national chemical fertilizer use. A big part of this pollution enters the water body, seriously affecting the rivers and aquatic environment (Zhang et al., 2009). From 1990 to 2008, the fertilizer application rate increased from 2.5×10^{10} to 5.2×10^{10} kg·year^{-1} to improve crop production. Chen et al. (2010) reported that the average fertilizer application rate in 2008 is 430.43 kg·hm^{-2}, far more than the safety limit of 225 kg·hm^{-2} (Jiang et al., 2006). In 2002, animal manure production is 2.7×10^{12} kg·year^{-1}, the quantity of animal manure production is 2.91 times as much as that of industry solid wastes (Wu et al., 2009).

In Ningxia Yellow River Irrigation area, the average fertilizer application rate (500 kg·hm^{-2}) was 2 times higher than the average in China (Yang et al., 2009b). The animal manure production is 1.8×10^{10} kg every year, and was 2.77 times of the industry solid wastes in Ningxia (Sun and Ma 2005). As a result of nitrogen and phosphorus pollution, the Yellow River water quality in Ningxia boundary section is IV, V or bad V water quality for years (Bulletin, 2001–2009). Non-point source pollution has become the modern agriculture restriction and the social sustainable development bottleneck. Therefore, through analysis of the collection of literature and organization of data, we find and figure out the situation of non-point source pollution in Ningxia Yellow River Irrigation.

MATERIALS AND METHODS

Study area

The Yellow River irrigation area in the northern part of Ningxia along the Yellow River (Figure 1) has an annual diversion of approximately 3.4×10^{9} m^3, of which agricultural water use accounts for 93 to 95%. The annual return of 2.5×10^{9} m^3 of water into the Yellow River is controlled by the sector of Qingtongxia. Irrigation is divided into the Qingtongxia, Wei Ning irrigation as well as the irrigation to Yinchuan, Zhongwei (except Haiyuan County), Wuzhong City (except Salt and concentric), and Shizuishan counties (cities, districts). Weining, with a total area of 7.67×10^{4} hm^2 of irrigated land, has an annual lead volume of approximately 8.80×10^{8} m^3. The total area of cultivated land in the Qingtongxia irrigation area is 4.22×10^{5} hm^2, and its annual diversion is approximately 4.92×10^{9} m^3. The Gravity Irrigation District in Ningxia and the Yellow River irrigation area, including two types of Yellow irrigation in the gravity irrigation district, has nearly 200 large and small drains, with a drainage volume of approximately 2.5×10^{9} m^3. The terrain can affect gravity irrigation due to the edge of the gravity irrigation area.

Table 1. Chemical fertilizer employment quantity conditions in the Ningxia Yellow River irrigation area (unit: $\times 10^8$ kg).

Year	2002	2003	2004	2005	2006	2007	2008	2009
Nitrogenous fertilizer	3.76	3.94	4.04	3.91	4.15	4.43	3.38	4.28
Phosphate fertilizer	1.00	1.05	1.07	1.14	1.17	1.18	1.26	1.14

Table 2. Livestock waste excretion in the Ningxia Yellow River irrigation area (unit: $\times 10^8$ kg).

Year	Cattle	Pig	Sheep	Poultry
2002	47.42	10.74	10.20	0.26
2003	46.53	9.64	9.15	0.23
2004	54.27	8.92	8.47	0.21
2005	61.14	9.43	8.96	0.22
2006	67.87	9.90	9.32	0.24
2007	76.01	10.49	9.78	0.26
2008	75.20	8.36	14.53	0.23
2009	69.99	8.92	15.70	0.25

Table 3. Rural household waste in the Ningxia Yellow River irrigation area (unit: $\times 10^5$ kg).

Year	Fecal output	Life wastewater quantity	Solid waste
2000	1.80	0.21	0.27
2001	1.84	0.21	0.28
2002	1.89	0.22	0.29
2003	1.74	0.20	0.30
2004	1.61	0.19	0.29
2005	1.81	0.21	0.31
2006	1.75	0.20	0.32
2007	1.81	0.22	0.32
2008	1.86	0.22	0.33
2009	1.88	0.23	0.33

In order to solve the loss of hills and plateau areas of living and irrigation water, as well as to gradually develop the Nanshan table, Concentric, Solid sea, Hongsipu, Yanhuanding and other Yellow River Irrigation. The Yang Irrigation District has been divided into the Dorothy, Salt Lake, and Hongsipu irrigation districts. The same has been done for the Solid sea-irrigation and Nanshan table irrigation, which is mainly related to the Pingluo east region, Salt Lake County, Hongsipu zone, and Concentric County. In the county, the defender and Haiyuan counties along with Yuanzhou, which have an annual diversion of approximately 1.22×10^9 m^3. The Ningxia Yellow River irrigation is located in a semi-arid area. If it does not follow the Yellow irrigation, natural precipitation cannot form effectively (Liu, 2006). Therefore, the Yellow River water is the main form of irrigation for agriculture. The Ningxia Yellow River irrigation area faces the problem of agricultural non-point source pollution, which is mainly caused by crop production, livestock breeding, and village life trash (Sun et al., 2009).

Non-point source pollution caused by crop production

From 2002 to 2009, the irrigation area farmland employed an average of 7.36×10^8 kg of chemical fertilizer yearly. The average quantity of chemical fertilizer per unit area is 1 746 kg·hm^{-2}. Compared with 2002, the use of nitrogenous fertilizer grew by 14% in 2009, whereas the use of phosphate fertilizer grew by 11% (Table 1).

Non-point source pollution caused by livestock breeding

The Ningxia Yellow River irrigation has faced pollution problems in recent years due to many factors, including the rapid development of the aquaculture industry, especially the large-scale breeding of cows, pigs and poultry, followed by an increasing aquaculture waste problem (Table 2). Untreated emissions of animal urine, manure, and so on, continue to pile up because the rain washes these down into the water.

Non-point pollution caused by rural living garbage

The Ningxia Yellow River irrigation area has maintained a stable rural population for 8 years, from 2000 to 2007. The amount of domestic sewage, fecal excretion, and the little change in volume of solid waste emissions are shown in Table 3.

Table 4. Ningxia 2001-2008 Yellow water diverting quantity and drainage (unit: $\times 10^9$ m^3)

Parameter	2008	2007	2006	2005	2004	2003	2002	2001	2000	1999
Water diversion quantity	67.508	64.132	70.839	71.129	67.305	55.691	73.499	75.189	78.36	87.82
Water discharge	32.112	29.898	35.641	33.548	33.138	25.664	42.316	40.224	43.90	50.07

Agricultural water resource consumption

Irrigation has a long history in Ningxia. Water from the Yellow River is mainly used for agricultural irrigation, which covers 95% of the total amount of water (Shao, 2005). From 2000 to 2008, its water volume rose between 5.57 to 8.78×10^{10} m^3. With 10 annual means, direct water volume was at 7.11×10^{10} m^3. With the Yellow water volume at 2.57 to 5.00×10^{10} m^3, 10 annual mean rows of yellow water volume reached 3.65×10^5 m^3. According to the Ningxia Water Resources Bulletin (Bulletin, 2001–2009), statistics of the Yellow River water and displacement from 1999 to 2008 are shown in Table 4. In 2003, the Ningxia Yellow River irrigation area agriculture fill reduced the use of ammonia nitrogen, of which the total nitrogen annual amount for the Huang Liang water non-point source pollution created was 2.9×10^6 and 3.61×10^7 kg, respectively (Yan et al., 2007). According to the 2007 Ningxia Environment Quality Outline, various drains had poor water quality in 2007 (Wu et al., 2007). More than 200 drains in Ningxia in the acceptance of plenty of chemical fertilizers, pesticides used in farmland discharged into the Yellow River without treatment, except for a few small sewage ditch with testing section.

Policies to control non-point source pollution in the Ningxia Yellow River Irrigation area

Along with the annual aggravation of non-point source pollution, the national and the Ningxia governments have taken the problem of non-point source pollution more seriously. The Ningxia government has proposed a policy with the concrete request to strengthen measures to control non-point source pollution (Table 5).

RESULTS AND DISCUSSION

Recommendations and prevention policies against non-point source pollution in the Ningxia Yellow River irrigation area

Uses of the best management practices (BMPs)

The results showed that animal manure pollution growth rate has been controlled in Ningxia Yellow River irrigation area, but the pollution load is still the biggest percentage. Livestock breeding can bring greater economic benefits, so the livestock breeding is expanding every year. Recently, European and American countries have recommended BMPs to control non-point source pollution (D'Arcy and Frost, 2001), including engineering measures and non-engineering measures. This study uses the engineering measures in livestock breeding, including household biogas projects (Yang, 2010; Gu et al., 2004; Muttil and Chau, 2006), large and medium scale biogas projects, waste fertilizers, water and soil conservation, and so on. Use of these measures for sewage treatment during livestock breeding might effectively protect the security of water quality.

Crop pollution in the Ningxia Yellow River irrigation area has been controlled in recent years.However, the quantity of crop pollution is about 5.0×10^8 kg·$year^{-1}$. It is still big, so there is still need to strengthen management. Thus, use of the non-engineering measures in the planting aspect, such as nutrient management, tillage management (Chichester and Richandson, 1992; Chen and Fu, 2000), plant structure, low pollution planting structure, eco-ditch project (Jiang et al., 2004; Liu, 1997; Muttil and Chau, 2007), multi-reservoir project (Yin, 2002; Dillaha et al., 1989; Cang, 2003), or riparian wetlands project (Zhang et al., 2010; Wang et al., 2008), might limit the source of crop pollution, and reduce the loss of nitrogen and phosphorus radically. Using the non-point source pollution, BMPs could guarantee the sustainable development and maintenance of ecological security in the Ningxia Yellow River irrigation area (Feng et al., 2011).

Therefore, according to the previous researches about BMPs (Tang et al., 2011), we recommended that combining the engineering and non-engineering measures may be an effective approach to control the irrigation of agricultural non-point source pollution in sensitive areas. Additionally, new adaptations of measures to manage irrigated agricultural non-point source pollution are continuously sought and explored in order to actively establish resource-saving and environment-friendly irrigation areas.

Strengthening of new rural construction

The output of Ningxia rural sewage is maintained at about 2.3×10^5 kg every year. The rural household waste is an aspect in agricultural non-point source pollution, but it has the smallest percentage in non-point source pollution. New rural construction is a fresh policy to solve the unbalanced social and economic development between the rural and urban areas (Lan, 2008; Fan et al., 2007). In the construction of new rural sewage, treatment facilities should choose the suitable sanitary sewage processing technology. On the other hand, the overall planning and the rational distribution also should be considered.

Improvement of non-point source pollution control laws

There are many environment laws and regulations in China, including the “Prevention of Solid Waste Pollution

Table 5. A series of polices to control non-point source pollution in the Ningxia Yellow River irrigation area since 1980.

Time	Law and regulations	Law and regulations basic content	Remarks
Before 1980	1973 Several Provisions on Protecting and Improving the Environment	**Article 5:** Strengthen the protection of soil and plants, promote integrated control technologies to prevent agricultural plant diseases, reduce chemistry pesticide pollution	Country
1981–1990	1989 PRC Environmental Protection Law	**Article 20:** "Local people's governments shall strengthen the agricultural environmental protection and control soil pollution, site desertification, salinization, swamp melt, and land subsidence, vegetation sulphide, soil erosion, water depletion, provenance extinction and the occurrence and development of other ecological disorders; the governments shall promote the comprehensive prevention and control of plant diseases and insect pests, as well as ensure the reasonable use of chemical fertilizers, pesticides, and plant growth hormones."	Country
	1984 PRC Water Pollution Prevention Law	**Article 30:** "The application of pesticides shall comply with the regulations and standards of the State for their safe use. Transportation and storage of pesticides and disposal of expired or ineffective pesticides shall be strictly controlled to prevent water pollution."	Country
	1989 PRC Water Pollution Prevention Law implementing regulations	**Article 18:** "The Department of Agriculture of each people's government at the county level or above should regularly monitor sewage for irrigation water, soil and agricultural products. It must take appropriate measures to prevent the contamination of soil, groundwater, and agricultural products."	Country
1991–2000	1996–2000 The Ninth Five-Year Plan	Implementation of measures to strengthen agriculture environmental protection. Prevention and control of the rural enterprise and the use of agricultural chemicals to prevent chemical fertilizer pollution. The prevention and control of water pollution reached an amount of 18.2 billion Yuan in total investment, accounting for 40% of total investments made in this area (Leng, 2009).	Country
	1996 Modify the PRC Water Pollution Prevention Law	**Added as Article 39:** "The Department of Agriculture of each people's government at the county level or above and other relevant department must undertake studies on agriculture production, in which chemical fertilizer and agricultural chemicals are reasonably used. The excessive use of chemical fertilizers and agricultural chemicals must be avoided to prevent water pollution."	Country
2001–2010	2002 People's Republic of China Water law	**Article 30:** "The Administrative Department of Water of each people's government at the county level or above, as well as the basin management institutions and other relevant departments in the development of water resources, must implement the planning and scheduling of water resource use. These agencies must focus on maintaining the reasonable current capacities of rivers, streams, and lakes so that the reservoir and the ground water shall fall within reasonable water levels. These agencies must maintain the water's natural purification capacity." **Article 31:** "Government agencies must be engaged in the development and utilization of water resources, as well as protection against and prevention of water disasters and	Country

Table 5. Contd.

	other similar events. These must be observed in accordance with the authorized plan. The government must be responsible for undertaking various activities to reduce excessive use of rivers, streams, and lakes. waters use function reduces, the ground water ultra to pick, the surface subsidence, the water body pollution, must undertake the."	
2002 People's Republic of China agriculture law	**Article 58:** "The farmer and the agricultural production Operation scheme must maintain the farming, Reasonable use chemical fertilizer, agricultural chemicals, agricultural film, Increases the use organic fertilizer, uses the vanguard technology, protects and enhances the soil fertility, Prevents the agricultural land the pollution, the destruction and the soil fertility decline."	Country
2004 People's Republic of China solid reject pollution of the environment prevention law	**Article 19:** "The State encourages scientific research and production units to research, production and easy to be recycled, disposed or degradable in the environment of film cover and packaging materials. The use agricultural film's unit and individual, must adopt measures and so on recycling use, prevents or the reduction agricultural film to the environment pollution." **Article 20:** "Engaged in livestock and poultry scale cultivation in accordance with relevant state provisions shall be collecting, storing, utilizing or disposal of breeding poultry and animal feces produces in the process, prevent environmental pollution. Forbids in the population concentration area 、surrounding the airport, near the traffic trunk lines and the local people's government defined area outdoor burning straw."	Country
2008 Law of the People's Republic of China on Prevention and Control of Water Pollution	**Article 3:** "Prevention and control of water pollution shall insist on principle of prevents primarily、Prevention &treatment combination、integrated control，Priority conservation of potable water，Strict control industrial pollution, cities life pollution, prevention agriculture non-point source pollution, Actively promote the construction of ecological management，Prevention, control and reduce water pollution and ecological destruction."	Country
2009 Ningxia Hui Autonomous Region Environmental Protection Ordinance	**Article 30:** People's government at various levels must work out the rural environment comprehensive improvement plan, prevent and control the countryside surface source pollution work to include the environmental protection goal responsibility system, and carries out the township (town) and the village. **Article 39:** Government at and above the county level should designate livestock raising in prohibited areas and restricted areas, strengthen pollution prevention and control of livestock and poultry breeding, promote bio-environmental farming, harmless cultivation technologies, and so on, prevent livestock waste, sewage pollution to the environment.	Ningxia
Livestock cultivation policies and regulations	2001《Livestock cultivation prevention and control of pollution policing method》	Country
	2002《Livestock cultivation prevention and control of pollution technology standard》	Country

Table 5. Contd.

		2003《Livestock cultivation pollutant cultivation emission standard》	Country
	2001–2005 Tenth Five-Year Plan	In the rural environment protection aspect, requests to hold the agriculture industry restructure and to speed up small town construction as the turning point in developing agriculture and rural economy, at the same time, carry out the countryside environmental protection popular science public education, take control of agricultural non-point pollution and rural life pollution, improving the environment quality as the important task of environmental protection.	Country
	2006–2010 Eleventh Five Year Plan	Improvement of the rural environment, and promote construction of new socialist countryside, in accordance with the “development of production, affluent life, civilization, clean and tidy village democratic management” requirements of building the new socialist countryside, implement rural well-off environmental action plans, develop rural environment comprehensive renovation, intensify soil pollution prevention, control agricultural non-point source pollution, develop ecological agriculture, optimize agricultural growth.	Country
		The State Council executive meeting of the major projects through the National Science and Technology, “Water Pollution Control and Treatment” (2007-12-26) implementation. Ningxia and Inner Mongolia of the Yellow River irrigated area of irrigation return water pollution control and wetland restoration research and demonstration of key technical issue is China's “Eleventh Five-Year” national major science and technology “water pollution control and governance” in the “comprehensive improvement of river water environment technology and comprehensive demonstration “theme, the” special type of river pollution control and water quality improvement of key technology research and demonstration “projects as an important research topic. Three stages in Ningxia, Inner Mongolia Loop Irrigation District. The first phase of the development from 2009 to 2011, a total investment of 52.34 million Yuan.	
		2005，Organized a region-wide rural agricultural non-point source pollution comprehensive regulation pilot work.	Ningxia
		2006，Through the efforts by the environmental protection department approval region for the first implementation "rural environmental action plans" well-off pilot provinces.	Ningxia
		From 2007, three consecutive years rural comprehensive environment for private environmental 10 pieces. The accumulation investment fund more than 500,000,000 Yuan, the organization has implemented the countryside tap water source area protection, the small and medium-sized enterprise prevention and control of pollution, the sewage trash poultry excrement government and the comprehensive utilization, the soil pollution investigation repair, the new energy use and so on one batch of engineering project.	Ningxia
		Eleventh Five-Year Plan “on agricultural pollution control plan to the scale of the comprehensive utilization of livestock waste emissions during the period from the fifth of	Ningxia

Table 5. Contd.

		5 to 50%, thus reduced the livestock cultivation reject to the surface source pollution influence."	
	2006–2010 Middle and upper reaches of the Yellow River basin water pollution control program	Ningxia has 49 projects, altogether 19170 million yuan，And Yinchuan Yellow River Qian-Tao Non-point source control demonstration projects invested 200 million yuan. [Middle and upper reaches Yellow River basin water pollution control program, 2008].	Country
	Ningxia water-saving irrigation project	Liberation in 60 years by strengthening the legal system construction. Increase infrastructure investment. Adjust water structure. Advance the model district. Promoted saving water technology. Tighten propaganda, and so on. Ningxia water use efficiency and effectiveness gradually increase. Utilization coefficient of irrigation water increased from 0.36 to 0.40; Ten thousand Yuan GDP, Yuan industrial added value, respectively, by 2005 water 1 288 m^3, 151 m^3 down to 851 m^3, 108 m^3 in 2007; The saving water irrigation engineering measure area accumulates has amounted to 2,577,000 mu.	Ningxia
		In 2002, the Ningxia Hui Autonomous Region completes the water conservation capital investment 11.25 hundred million Yuan. The water conservancy infrastructure conditions lead to further improvements [Li, 2010].	Ningxia
		In 2004, "Ningxia water-saving society construction planning programs (2004–2020)"	Ningxia
		In 2007, "Ningxia Hui Autonomous Region Water Conservation Ordinance"	Ningxia
	Special environmental protection in rural areas	In 2010 Ningxia has accumulated investment of rural comprehensive environment special fund 5 million Yuan. Provide 150 garbage trucks. Construct 40 rural refuse transfer station, 30,000 cesspits, 40 place rural sewage treatment facilities, 150 centralized drinking water sources in rural areas are effectively protected. Poultry fecal pollution prevention fund 1,500,000 Yuan. Used in 3 projects the poultry fecal pollution preventions.	Country
	2010 Rural environment comprehensive improvement and well-off environmental protection action	From 2010 to 2012, the central level funds will invest 650,000,000 Yuan. Autonomous regions financial support 3.5 billion Yuan. Total of 1 billion Yuan funds for demonstration work.	Country, ningxia

Law" and the recently made "Water Pollution Prevention Law" that focus on agricultural areas (Zhang, 2010). Other related laws and regulations do not have the pointed strong article. There is a series of laws about agricultural environmental protection in China to constrain the use of chemical fertilizers and agricultural chemicals, but these stipulations are too broad. Moreover, the execution of the law is not strong in practice and must therefore, be strengthened. Rules that govern the production and use of agricultural chemicals and chemical fertilizers, as well as poultry breeds (He, 1998; Leng, 2009; Zhang, 2008) must also be strengthened to ensure the success of the non-point source pollution government propaganda. This can further enhance the people's understanding about the non-point source pollution to help the local government to fundamentally control it.

Increasing of the invested fund

The government should expand the funding invested in the development of new agriculture (Zhang et al., 2008). The existing irrigation canals must be done and project

quality should be improved, along with the effective use of hydraulic engineering. Soil and water loss should be controlled. There should be more overseas studies to strengthen the technology and technical support required to undertake these activities. Advanced saving water technologies should also include drip irrigation, spray irrigation, and infiltrating irrigation. Spate flooding irrigation should be abolished gradually. The emerging hydraulic engineering technology, the sewage treatment project, and the field matching facilities construction investment should also be employed. Finally, the proper use of water resources should be enhanced to protect the water environment effectively.

Conclusion

Agricultural development levels are continuously enhanced throughout the Ningxia Yellow River irrigation area. Agricultural production activities create a contamination concern, which becomes more prominent day by day. In Ningxia Yellow River irrigation area, livestock breeding and crop planting are the biggest percentage in agricultural non-point source pollution. Thus far, a series of policies to protect the water environment, as well as the strengthening of national science and technology to help create effective measures have slowed down the water pollution situation to some degree. Though a series of policies and laws, crop pollution has been controlled, but the quantity of crop pollution is still serious.

The animal manure pollution is growing every year, because livestock breeding can get more economic benefits. So the government should strengthen management of livestock breeding, improve the legal and policy system about planting and livestock breeding. Therefore, the scientific use of water resources, the protection of the Yellow River water resources, the scientific application of fertilizers and improvement of fertilizer efficiency, the improvement of pollution treatment facilities and equipment, implementation of sound environmental regulations and policies, as well as stronger government functions in the irrigation area and the entire Yellow River Basin are necessary requirements to ensure the sustainable development of the area.

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