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Farmers' attitudes towards the introduction of agri-environmental measures in agricultural infrastructure projects in China: Evidence from Beijing and Changsha

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ABSTRACT

Agricultural infrastructure construction is an important component of agricultural policies in China that aim to increase production and ensure food security. One objective of agricultural infrastructure is to promote modern intensive agriculture, which has already caused agri-environmental problems including environmental pollution, landscape degradation, and biodiversity loss. In European countries, agri-environmental measures are widely implemented with farmers' participation, and it is anticipated that these measures will be introduce into agricultural policies, such as agricultural infrastructure projects, in China. As one of the direct stakeholders, farmers and their attitudes towards agricultural infrastructure projects and their perceptions of agri-environmental issues need to be understood before the policy is implemented. This research aimed to determine farmers' attitudes towards agricultural infrastructure projects and the possible incorporation of agri-environmental measures in these projects using a questionnaire survey in Beijing and Changsha. The results showed that farmers were generally unsatisfied with the top-down implementation process of agricultural infrastructure projects because they were seldom involved and felt their needs were not considered by the authorities. Most farmers would accept at least one simple agri-environmental measure, and subsidies could significantly increase the acceptance level. Economic risk and farm business type were crucial factors influencing farmers' acceptance of measures. We suggested that if governments hope to implement agri-environmental measures as part of agricultural infrastructure projects, improving the public participation process should be a priority, and a combination of top-down and bottom-up approaches should be considered with respect to farmers' knowledge, opinions and farm business types to design suitable measures for local conditions.

1. Introduction

1.1. Agricultural policies and infrastructure development in China

The huge population of China challenges its agricultural sector. Increasing agricultural production and ensuring food security remain the priorities of China's agricultural policies. Three stages can be identified in the history of China's rural land use and agricultural policies (Table 1). Among the listed policies, the national Integrated Agricultural Development and rural land consolidation projects directly target agricultural infrastructure construction, while the "building a new countryside" policy and the "beautiful villages" campaign are included as part of the goals. China's agricultural production has benefited from these policies, increasing by 36.9%, and farmers' net income has tripled in the last decade.[1]

The aspects of agricultural infrastructure construction, which include irrigation and water conservancy, construction of road and shelterbelts, agricultural machinery services, and agricultural production circulation system and technology services, vary among different policies and programmes. Using land consolidation as an example, four types of infrastructures are described in the *Regulation for China Land Consolidation Planning and Design (TD/T1012-2000)*: (1) field road construction and pavement; (2) irrigation and drainage ditch digging, pavement and motor-pump

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[1] Calculated based on data from the China Statistical Yearbook 2003–2012. http://www.stats.gov.cn/tjsj/ndsj/ (in Chinese, accessed 12.07.15).

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Table 1
Stages of agricultural policy in China.

Time period	Rural policy	Agricultural infrastructure
1952	Land reform redistributed rural lands from landlords to the poor, and 96% of the farmer families were organized into rural cooperatives (Long et al., 2010).	
Start-up stage: 1952–1978	Rural cooperatives	Construction of agricultural infrastructures started under the planned economic system to improve production conditions.
1978	The reform and open-up policy launched by Deng Xiaoping.	
Restricted stage: 1978~2003	Household contract responsibility system[a]; Integrated Agricultural Development	Farmers' enthusiasm for agricultural production was motivated; agricultural infrastructures continued to develop but were limited.[b]
2003	China's GDP per capita exceeded 1000 US dollars (Long et al., 2010). Policies changed after China entered the WTO in late 2001.	
Developing stage: 2003–now	Rural land consolidation[c] projects; Building a new countryside; "Beautiful villages" campaign[d]; Specialized agricultural infrastructure projects	Agricultural infrastructure construction received considerable attention and became a significant component of many agricultural policies.

[a] The household contract responsibility system is a rural land use policy that separates the ownership and use right of rural lands. The rural collective organizations are the land owners, investors, constructors and maintainers of agricultural infrastructures. They contract lands to farmer households for agricultural use. This ownership and use right separation policy remains the basic principle of China's current rural land use policy (Shi, 1997).

[b] Agricultural infrastructures remaining from the cooperative period suffered considerable damage due to lack of maintenance, chaotic ownership and over use (Shi, 1997; Ren et al., 2009).

[c] Land consolidation in China is not the same as in Europe, which simultaneously focuses on the adjustment of land tenure, the alleviation of land fragmentation, the improvement of rural development and the environment (FAO, 2003; Pašakarnis and Maliene, 2010). In China, land consolidation is defined as a series of construction projects, which are implemented on unused or improperly used land, or land used with low efficiency, supported by specialized funds. It considers the overall planning of land use with four major goals, including an improvement in the quality and an increase in the quantity of farmland, agricultural infrastructure construction and environmental protection (Yun et al., 2008). However, the definitions of land consolidation in both China and Europe do have some common ground and are changing from simple to comprehensive over time.

[d] The "Beautiful villages" campaign[2] is a rural development policy launched by Ministry of Agriculture of China in the early 2013, aiming to establish distinctive development models of villages that are ecologically liveable, culturally harmonious and have high-efficient production, to promote the coordination of agricultural production structure, rural life, resources and environment, and to accelerate agricultural and rural ecological civilization construction process.

well digging; (3) village infrastructure construction; and (4) tree shelterbelt planting. These tangible infrastructures are the agricultural infrastructures referred to in this paper. Since the first national land consolidation project launched in 2001, 1.6 million hm^2 of land across China was consolidated until 2005 (Fan, 2006), and 2.78 million hm^2 of cultivated land was supplemented until 2008 (Yan et al., 2012). In the government's latest *National Land Consolidation Plan (2011–2015)*, 26.7 million hm^2 of high standard primary farmland was planned, and it was anticipated that a total of 53.4 million hm^2 would be completed by 2020 (MLRC, 2013). These remarkable achievements of land consolidation imply that a huge number of agricultural infrastructure projects have been and will be implemented.

The above-mentioned rural policies are nationwide polices that were implemented in a top-down manner, starting from central government and progressing to the province, city, county and village levels. In the example of land consolidation, the Ministry of Land and Resource established the national land consolidation plan, and then the province, city and county level planning was established according to the superior plan.[3] After the plan was approved by the government, projects were implemented by a specialized company usually chosen by competitive bidding.

1.2. Agri-environmental issues in China

Although the agricultural policies have changed over time, their main goal has remained the same. The promotion of modern intensive agriculture has been highly important in China's rural policies since the second stage. However, this accomplishment has come at a price. Environmental problems brought about by agricultural intensification have already been recognized worldwide and are also happening in China. The most obvious consequence is the loss of traditional Chinese agriculture featured by the maximization of resource efficiency, the utilization of organic manure and high crop heterogeneity (Yang, 2006; Liu et al., 2013). High inputs, monoculture and infrastructure constructions of intensive agriculture have also contributed to the loss of crop diversity (Xu and Wilkes, 2004; Fu et al., 2005; Liu et al., 2013) and wildlife diversity, such as insects (Liu et al., 2010) and birds (Wood et al., 2010). The inappropriate and excessive use of chemical fertilizers has caused severe pollution of the soil, air, surface and ground water (Zhu and Chen, 2002; Ju et al., 2006, 2009; Cui et al., 2010) and subsequent landscape degradation and biodiversity loss. These agri-environmental problems reduce the sustainability of agriculture and urgently need to be solved at the policy and practice levels. However, agricultural intensification remains an objective of China's agricultural policies. Although the government requires that rural development must include ecological conservation and improvement as a precondition, putting this principle into practice is not that easy. Arguments pertaining to the inflexible standards of agricultural infrastructure, such as the *Regulation for China Land Consolidation Planning and Design (TD/T1012-2000)*, which seldom consider the regional disparity in climate, terrain and natural resources, and the weak ecological design and implementation of related projects, have emerged in recent years (Yun and Yu, 2011; Yu et al., 2012; Long, 2014). The former was denounced for causing homogeneity of the rural landscape at various sites that lost their regional characteristics and sense of location (Yun and Yu, 2011), while the latter may cause agri-environmental problems (e.g., Xiao et al., 2013).

In addition, as the most direct stakeholders in the agricultural infrastructure project area, farmers are seldom involved in the project planning, design or implementation process (see Sections 3.3 and 4.2) though public participation is a basic principle in

[2] Ministry of Agriculture of People's Republic of China, 2013.03.22 http://www.moa.gov.cn/zwllm/tzgg/tz/201302/t20130222_3223999.htm (in Chinese, accessed 12.07.15).

[3] China Land Consolidation and Rehabilitation Centre, 2013.11.29. http://www.lcrc.org.cn/publish/portal0/tab114/info32340.htm (in Chinese, accessed 12.07.15).

rural programmes such as land consolidation. Moreover, according to the authors' experience based on interviews with farmers in Beijing, it was obvious that farmers were not satisfied with the condition of local agricultural infrastructures even though they were newly built. This indicated that the plan of these infrastructures did not consider farmers' needs. A better understanding of farmers' attitudes towards agricultural infrastructure projects is needed.

1.3. Research needs and objectives of this paper

Agri-environmental problems are not unique and have attracted the government's attention in China. In Europe, the agri-environmental schemes (AES) under the Common Agricultural Policy were widely implemented in the EU member states and have been proven to be effective as a solution for agri-environmental problems, especially biodiversity recovery to a certain extent (O'Brien et al., 2006; Davey et al., 2010; Perkins et al., 2011). The EU agri-environmental schemes encourage farmers to voluntarily carry out environmentally friendly farming practices and conservation measures by providing subsidies for certain measures or outcomes, for instance, the Environmental Stewardship in England (Natural England, 2013) and the "payment-by-results" compensation method in Germany (Matzdorf and Lorenz, 2010). The EU's rural policies attach great importance to farmers' participation, such as the Leader Approach under the EU rural development policy (2007–2013), which encourages bottom-up elaboration and implementation at the local scale (European Communities, 2006, 2008). Agri-environmental policies have also attracted researchers' attention in recent years. Many authors have discussed this issue from ecological (Kleijn et al., 2006; Whittingham, 2007; Concepción et al., 2008), social and psychological (Beedell and Rehman, 1999; Willock et al., 1999; Wilson and Hart, 2000; Siebert et al., 2006; Guillem and Barnes, 2013) and economic (Falconer, 2000; Mettepenningen et al., 2011) perspectives. With respect to the social and psychological aspects, there are numerous studies on farmers' attitudes, perceptions and behaviour towards AES (Herzon and Mikk, 2007; Fjellstad et al., 2009; Giannoccaro and Berbel, 2013; Guillem and Barnes, 2013), the factors affecting farmers' willingness to participate (Sattler and Nagel, 2010; Schroeder et al., 2013) and the design of agri-environmental measures (Schroeder et al., 2013).

In China, efforts have been made to ease the environmental problems in rural areas through certain large-scale ecological restoration programmes such as the National Forest Conservation Programme and the Grain for Green Project (Li, 2004; Xu et al., 2006; Cao et al., 2009). Unlike the AES in Europe, not all of these projects were based on a voluntary principle and could not be included in the scope of agricultural policies (Sun et al., 2006). Agri-environmental measures that include wide-spread involvement by farmers, such as the AES in Europe, are scarce in China. Relevant studies only focused on national policy strategies or theoretical explorations (e.g., Wan et al., 2005; Long et al., 2010; Yun and Yu, 2011; Long, 2014) rather than farm- or household-level research (e.g., Wu and Yang, 2013). In certain large cities such as Beijing, scientists and governments hope to introduce agri-environmental measures by providing subsidies for agricultural policies such as agricultural infrastructure projects (Liu et al., 2012c; Yu et al., 2012). One example is the subsidies for winter cover crops in Beijing, which aim to prevent the soil from direct exposure to the air.[4] In the academic field, some research has been conducted on incorporating ecological designs into agricultural infrastructure projects (e.g., Zhao et al., 2007; Liu et al., 2012b). However, gaps remain in farmers' perceptions of agricultural infrastructure and agri-environmental issues. In this paper, we assumed that agri-environmental measures could be designed and included in agricultural infrastructure projects, and implemented and managed by farmers. Our research attempts to explore farmers' attitudes towards the existing agricultural infrastructure projects and the possibility of the introducing agri-environmental measures in these projects. The objectives of this paper are to determine (1) farmers' perceptions of the agri-environment in rural areas and their experience of environmental change; (2) farmers' attitudes towards the results and implementation process of agricultural infrastructure projects; (3) farmers' willingness to practice agri-environmental measures and the factors affecting their choices; and (4) the implications for policy design.

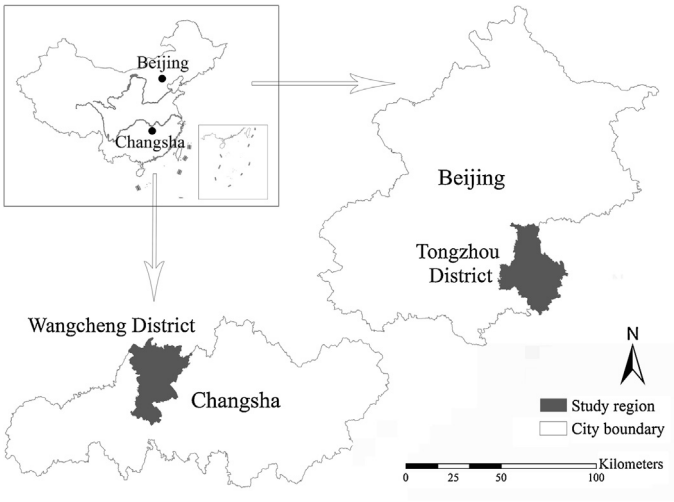

Fig. 1. Location of study regions.

2. Methods

2.1. Study regions

Data were collected in five villages in Tongzhou District, Beijing, and three villages in Wangcheng District, Changsha, which is the capital of Hunan Province (Fig. 1). Beijing is representative of developed metropolitan regions in North China and Changsha is representative of cities with a medium economic level in South China. Some social and agricultural facts pertaining to these two districts are shown in Table 2. Though cultivated lands were mainly used for grain production in the two regions, the differences in farming style resulted in different agri-environmental problems, and hence require different agri-environmental measures. According to the literature and local farmers, environmental pollution (water pollution, air pollution and solid waste discharge[5]) is severe in Tongzhou, as is lack of management, while in Wangcheng, the main environmental problems are water pollution from agricultural non-point pollution (Yao, 2011; Chen, 2013), heavy metal pollution of the soil (Liu et al., 2012a), insufficient drainage systems and lack of green space. Agricultural infrastructure projects were implemented in both study regions over the past 3–5 years, including the construction of field roads and drainage ditches in

[4] Committee of Rural Issues of Beijing, 2009.04.07 http://zfxxgk.beijing.gov.cn/fgdyna/pghome/fgdyna.prinfodetail.prStatuteDetailInfo.do?GM_T_CATALOG_INFO/CATA_INFO_ID=188552 (in Chinese, accessed 12.07.15).

[5] Ministry of Environmental Protection of China 2015.06.02 http://www.mep.gov.cn/zhxx/hjyw/201506/t20150602_302735.htm (in Chinese, accessed 12.07.15).

Table 2
Social and agricultural facts of Tongzhou, Beijing, and Wangcheng, Changsha (2012).

	Tongzhou, Beijing	Wangcheng, Changsha
Proportion of rural population (%)	36.8	96.1
Proportion of cultivated land area (%)	38.7	32.5
Cultivated land area per capita (m^2)	737.58	594.85
Annual income per capita of rural residents (10^4 yuan)	1.59	1.65
Main crops	Wheat, maize	Paddy rice
Other types of main agricultural land use	Artificial woodlands, nursery gardens	Fish and lotus ponds

Data sources: Changsha Statistical Yearbook, 2013. http://www.cstj.gov.cn/tjnj/2013/; Beijing Statistical Yearbook, 2013. http://www.bjstats.gov.cn/nj/main/2013-tjnj/index.htm; Tongzhou Statistical information website: http://stats.bjtzh.gov.cn/n5244966/n7979873/c9086995/content.html (all in Chinese, accessed 12.07.15).

both regions, irrigation canals in Changsha, and farmland tree shelterbelts in Beijing.

2.2. Data collection

Data were collected through face-to-face interviews using a semi-standard questionnaire (see Appendix B). The questionnaire was divided into four sections: (1) farmers' personal and family characteristics; (2) farmers' perceptions of the environment in rural areas and their experience with environmental change; (3) farmers' awareness of agricultural infrastructure projects and their attitudes towards the results and implementation process of these projects; and (4) farmers' willingness to participate in agricultural infrastructure projects, their acceptance of agri-environmental measures with and without subsidies, and the initial factors that affected their choices. In sections 2–4, respondents were asked to select a score from a five-class scale to express their agreement with each statement. In section 4, respondents were required to answer yes or no to the agri-environmental measures to express their acceptance/disagreement. Three simple measures that could be implemented in both farming systems were provided and stated as follows: (1) plant grass/herbs or shrubs as a buffer strip along the field margin (buffer strip measure); (2) set apart some land with low or no chemical fertilizer and pesticide use (low input measure); and (3) plant grass/herbs as mulch in orchards (orchard mulching measure). The purposes of these measures were to increase the heterogeneity of the intensive agricultural landscape, preserve biodiversity and protect the soil.

A pre-survey was conducted in August 2013 in Beijing, and the final survey was conducted in September 2013 in Changsha and October 2013 in Beijing. Interviewees were randomly selected by interviewers and any comments made by the interviewees related to our topic were recorded.

2.3. Statistical analysis

Although the total number of respondents was not high enough to be considered representative of the two cities, we can still use these data to learn about farmers' perception of agricultural infrastructure construction and agri-environmental measures and to analyze the results for policy design using appropriate methodology. Statistical analysis was performed using the software IBM® SPSS 20. A non-parametric test was the main analytical method used because it is best suited to small samples and five-scale social data. However, the overestimation of the non-parametric test should be considered. First, average scores, standard deviations and frequency distributions were calculated for each question. Second, two-tailed chi-square tests were performed to test the differences between the Beijing and Changsha farmers with respect to their characteristics and choices for various questions. *T*-tests were used when the variables were continuous and followed an approximate normal distribution, such as age and household size. Third, correlation analysis was performed to assess the potential relationships between farmers' characteristics and their choices. Pearson's correlation tests were used between two interval scale parameters, and Kendall Tau correlation tests were used between two ordinal or nominal scale parameters. Finally, a cluster analysis was performed to identify possible groups of farmers according to their acceptance of agri-environmental measures. Hierarchical cluster analysis with within-group average linkage and Euclidean distance was used. The differences in the other questions and parameters between the groups of farmers were summarized and tested using chi-square tests.

3. Results

3.1. Profile of respondents

A total of 284 farmers, 133 in Beijing and 151 in Changsha, were interviewed. The basic characteristics of the respondents are summarized in Appendix A. The average age of the respondents was 52.4. The ratio of male to female respondents was approximately 1:1. Most of the respondents had only received a nine-year compulsory education (42.5%) or less (43.6%). Two-thirds of the respondents were full time farmers and the proportion was significantly higher in Changsha ($\chi^2 = 4.467$, $p = 0.025$). Household size was significantly larger in Changsha than in Beijing ($t = 5.449$, $p = 0.000$). In Changsha, most of the respondents' farmland was cultivated for self-sufficient production, while in Beijing, most of the respondents used their farmland for profitable production ($\chi^2 = 70.547$, $p = 0.000$); 95% of them rented out their land to individuals or companies rather than farming it themselves. As a result, 80.5% of the respondents in Beijing received non-agricultural income, which was significantly higher compared with Changsha ($\chi^2 = 6.721$, $p = 0.010$). The annual household income was significantly higher in Changsha ($\chi^2 = 69.193$, $p = 0.000$), while agricultural subsidies were higher in Beijing ($\chi^2 = 132.261$, $p = 0.000$), but the number of respondents without agricultural subsidies was higher in Beijing.

3.2. Farmers' perceptions of agri-environmental issues

We divided the agri-environmental perceptions into four aspects as shown in Table 3. Respondents generally agreed that the environment was important for both the economy and agriculture, and farmers should be responsible for the farmland environment. There was a significant difference between the Beijing and Changsha respondents with respect to their responses to the 3 statements for the first aspect, but there were no obvious trends in their preference for the environment. The respondents' opinions on environmental change were vague; the mean score ranged between 3 and 4 and the standard deviation exceeded 1. Generally speaking, the respondents thought that wildlife was decreasing and water pollution was severe, whereas the village was becoming cleaner and greener. The respondents in Beijing and Changsha shared the same opinions, except for the improvement of green space, which was better in Beijing ($\chi^2 = 12.833$, $p = 0.013$). With respect to their knowledge about the agri-environment, especially biodiversity, the

Table 3
Farmers' responses to the agri-environmental statements.

Statements	Scores	Total	Changsha	Beijing
1. Attitude towards the environment in rural areas				
1.1 Only the environment is well protected, the economy can develop better.**	Mean	4.64	4.50	4.80
	Std Dev	0.76	0.87	0.58
1.2 A healthy environment is good for agricultural production.**	Mean	4.51	4.54	4.48
	Std Dev	0.92	0.77	1.06
1.3 Farmers should be responsible for the environmental condition of their own farmlands.*	Mean	4.70	4.70	4.71
	Std Dev	0.60	0.54	0.66
2. Experience with environmental change				
2.1 Wildlife on farmlands is decreasing.	Mean	3.76	3.93	3.57
	Std Dev	1.53	1.47	1.57
2.2 Water quality in the village is improving.	Mean	3.05	3.21	2.88
	Std Dev	1.42	1.37	1.47
2.3 The hygienic condition of the village is improving.	Mean	4.42	4.50	4.34
	Std Dev	0.92	0.76	1.07
2.4 The green space in the village is improving.**	Mean	4.02	3.86	4.20
	Std Dev	1.16	1.18	1.12
3. Knowledge about agri-environment – biodiversity				
3.1 I like to see beneficial wild birds and insects on my farm.**	Mean	3.92	3.93	3.91
	Std Dev	1.25	1.20	1.31
3.2 Wild flowers and grass along the field margin can attract pest predators.**	Mean	3.36	3.22	3.51
	Std Dev	1.42	1.32	1.51
3.3 Inappropriate use of pesticides and chemical fertilizer is one reason for the decrease in wildlife.**	Mean	3.44	3.05	3.89
	Std Dev	1.38	1.35	1.27
4. Willingness to participate in rural environmental protection				
4.1 I would like to learn more about rural environmental protection.*	Mean	3.75	3.76	3.74
	Std Dev	1.32	1.26	1.39
4.2 I would like to participate in rural environmental protection work.**	Mean	3.94	3.99	3.87
	Std Dev	1.32	1.23	1.42

1 = strongly disagree, 2 = disagree, 3 = do not know or difficulty in deciding, 4 = agree, 5 = strongly agree. χ^2 tests for the difference between Beijing and Changsha.
* $p < 0.05$.
** $p < 0.01$.

respondents' opinions were unclear. For example, 32% (scored 1–3) of the respondents did not like to see birds on their farm even though they were beneficial; 51.4% of the respondents did not think the field margin could be used to control pests, and 47.2% thought that chemical fertilizers and pesticides would not harm wildlife. The respondents in Beijing showed greater appreciative for biodiversity (for 3.2, $\chi^2 = 15.593$, $p = 0.004$; for 3.3, $\chi^2 = 57.670$, $p = 0.000$). When asked about their willingness to participate in rural environmental protection work, the respondents were indecisive. The respondents in Changsha were more positive than those in Beijing (for 4.1, $\chi^2 = 10.521$, $p = 0.033$; for 4.2, $\chi^2 = 20.421$, $p = 0.000$), but they both seemed to prefer taking actions than increasing their knowledge.

Correlation analysis showed that the respondents' perceptions of the agri-environment were more related to their family than their personal characteristics. In the four aspects of agri-environment perception, the attitude towards the environment in rural areas was significantly positively correlated with farm business type (for 1.1, $r = 0.253$ $p = 0.000$; for 1.2, $r = 0.140$ $p = 0.012$; for 1.3, $r = 0.224$ $p = 0.000$) and main source of income (for 1.1, $r = 0.176$ $p = 0.002$; for 1.2, $r = 0.202$ $p = 0.000$; for 1.3, $r = 0.198$ $p = 0.001$). This implied that the respondents with profitable farmlands or those that relied on non-agricultural income expressed more positive opinions about the environment. The correlations between the other aspects and respondents' characteristics were not significant or had no pattern.

3.3. Farmers' attitudes towards rural agricultural infrastructure projects

Most respondents (79.5%) knew about the agricultural infrastructure projects in their villages. In Changsha, 41.5% and 44.1% of the respondents thought these projects were implemented by local residents or outside people, respectively, and the remainder (14.4%) thought they resulted from the cooperation of both sides. In Beijing, however, 89.4% of the respondents thought the projects were implemented by outside people, and only 4.3% and 6.4% thought they resulted from local residents or cooperation, respectively.

The respondents were generally satisfied with the outcomes of these projects (Table 4), including the improvement of the environment, the agricultural production condition, and their standard of living. However, when asked about the outcomes directly, they were not as positive as for certain aspects. When talking about public participation, half of the respondents (50.0% scored 1–3) claimed that the local authorities did not inform the residents in the villages of these projects. Half of the respondents (50.4% scored 1–3) thought the current implementation method was not appropriate, especially in Beijing where the ratio was 61.7% and was significantly higher than that in Changsha (41.0%, $\chi^2 = 10.881$, $p = 0.028$). The respondents shared the same idea that "all the projects in rural areas should have farmers' participation" (78.9% scored 4–5, mean 4.20 in total with no significant difference between regions). However, in reality, the respondents' participation rate in these projects was very low, especially in Beijing ($\chi^2 = 14.474$, $p = 0.006$; Fig. 2). Nevertheless, the respondents hoped to take part in the agricultural infrastructure projects in the future, and the willingness was stronger in Changsha ($\chi^2 = 9.419$, $p = 0.051$). Approximately 60% (scored 4–5) of the respondents thought that the organizers of these projects had considered their needs during the project planning and implementation, whereas 91.1% thought their needs and opinions should be considered seriously (Fig. 3).

The correlation analysis showed that the younger the respondents ($r = -0.161$, $p = 0.007$) and the higher their level of education ($r = 0.123$, $p = 0.017$), the greater their willingness to participate in rural agricultural infrastructure projects. Meanwhile, the more they wanted to learn ($r = 0.335$, $p = 0.000$) and take part in rural environmental protection ($r = 0.392$, $p = 0.000$), the more they wanted

Table 4
Farmers' responses to the assessment of the project results statements.

Statements	Scores	Total	Changsha	Beijing
These projects improved the environment in the village and fields**	Mean	4.52	4.39	4.69
	Std Dev	0.77	0.81	0.70
These projects improved the conditions for agricultural production.**	Mean	4.39	4.47	4.29
	Std Dev	0.90	0.71	1.08
These projects improved farmers' living standards.*	Mean	4.24	4.31	4.16
	Std Dev	1.03	0.94	1.13
I am satisfied with the outcomes of these projects.*	Mean	3.71	3.53	3.92
	Std Dev	1.28	1.32	1.22

1 = strongly disagree, 2 = disagree, 3 = do not know or difficulty in deciding, 4 = agree, 5 = strongly agree. χ^2 tests for the difference between Beijing and Changsha.
* $p < 0.05$.
** $p < 0.01$.

to participate in agricultural infrastructure projects. The respondents who thought that outside people carried out the projects gave a lower score to the appropriateness of the project implementation ($r = -0.212$, $p = 0.000$), and fewer agreed to the consideration of farmers' needs ($r = -131$, $p = 0.044$) and their participation ($r = -0.182$, $p = 0.004$).

3.4. Farmers' willingness to practice agri-environmental measures

3.4.1. Willingness and affected factors

The respondents were asked to choose if they would practice three agri-environmental measures on their own lands with or without subsidies. Almost all of the respondents (98.7%) would like to practice at least one measure. Half (53.4%) of the respondents chose only one measure, and 30.5% chose two, while the remainder (14.8%) chose all three measures. Generally, the respondents tended to accept the buffer strip and low input measures, but not the orchard mulching measure, either with or without subsidies (Fig. 4). Considering the situation of no subsidies, the buffer strip measure was more acceptable in Beijing ($\chi^2 = 23.296$, $p = 0.000$), and the low input measure was more welcomed in Changsha ($\chi^2 = 7.708$, $p = 0.008$). The orchard mulching measure was regarded as most unacceptable by most respondents, but the level of acceptance was significantly higher in Beijing ($\chi^2 = 16.224$, $p = 0.008$). The provision of subsidies resulted in respondents showing significantly greater interest in the low input ($n = 188$, McNemar test $p = 0.000$) and orchard mulching measures ($n = 188$, McNemar test $p = 0.000$). The number of respondents that accepted to practice each of the 3 measures all increased significantly in Changsha ($n = 95$, McNemar test $p = 0.022$, 0.000, 0.000). In Beijing, however, the level of acceptance of the buffer strip measure decreased (not significant), and the level of acceptance for the low input and orchard mulching measures increased significantly ($n = 93$, McNemar test $p = 0.000$, 0.012).

Economic risk was listed by 62.3% of the respondents as the primary factor when they decided to accept a measure (Fig. 5). This was in accordance with the results that more respondents accepted the measures under the provision of subsidies. In Beijing, 20.2% of the respondents listed the effectiveness of the measure as the most important factor, compared with time (15.4%) in Changsha. Moreover, space, labour, management and policy were also considered as factors of primary importance by some respondents.

Evaluating the relationships between the number of acceptable measures and the respondents' characteristics revealed a significant correlation with farm business type ($r = 0.171$, $p = 0.006$). This indicated that farmers who rented out their land or had profitable production tended to accept more agri-environmental measures, while farmers who only farmed for self-sufficient production tended to accept one measure or less. The farmers' opinions on biodiversity were positively correlated with the number of acceptable measures (for statement 3.2, $r = 0.245$, $p = 0.000$; for statement 3.3, $r = 0.150$, $p = 0.025$), indicating that the more a farmer appreciated biodiversity, the more agri-environmental measures he or she could accept. In addition, the more a farmer was concerned about economic risk, the lower their acceptance of the measures ($r = -0.276$, $p = 0.000$). No significant correlations were found between the number of accepted measures and farmers'

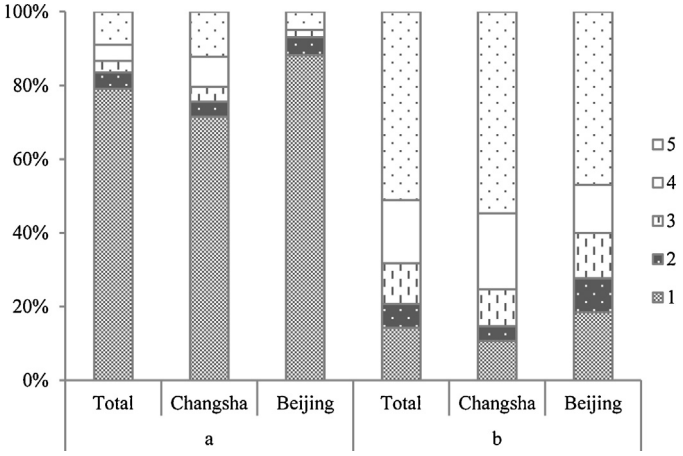

Fig. 2. Farmers' participation in rural agricultural infrastructure projects and their willingness to participate. ((a) I have participated in some of these projects. (b) I would like to participate in the projects in the future. 1 = strongly disagree, 2 = disagree, 3 = do not know or difficulty in deciding, 4 = agree, 5 = strongly agree).

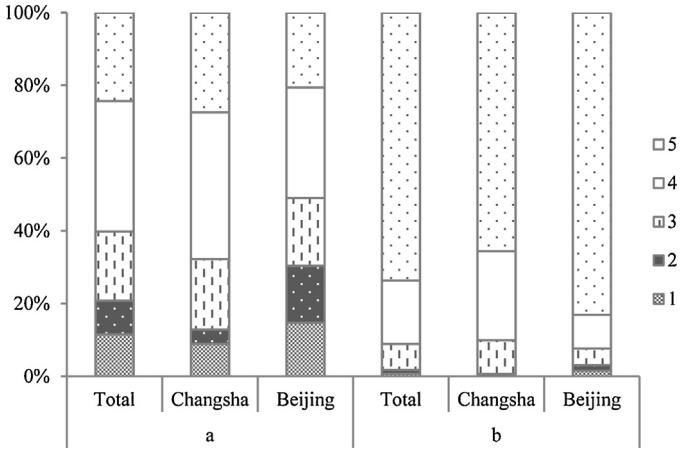

Fig. 3. Farmers' assessments of the authorities' consideration of their needs in agricultural infrastructure projects. ((a) The organizers of these projects have considered the needs of farmers. b. Local authority should take farmers' needs into consideration when projects are planned. 1 = strongly disagree, 2 = disagree, 3 = do not know or difficulty in deciding, 4 = agree, 5 = strongly agree).

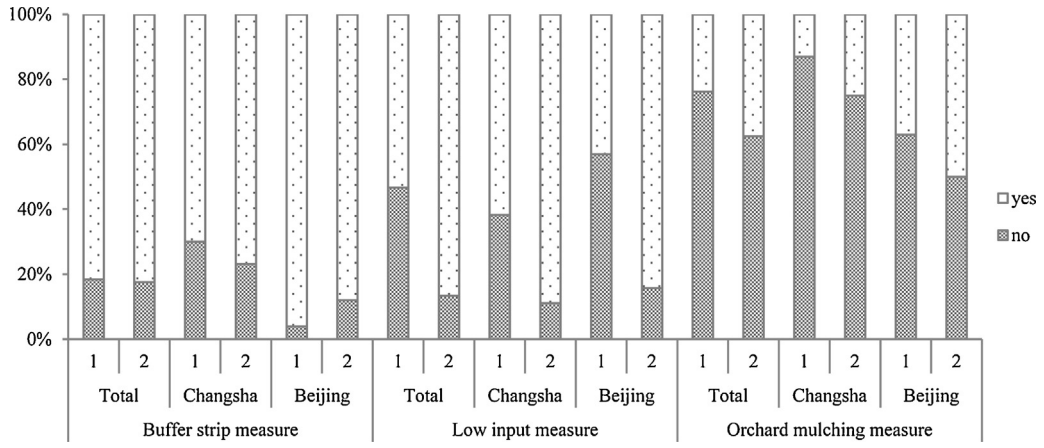

Fig. 4. Farmers' acceptance of the provided agri-environmental measures with or without subsidies (1 = no subsidies, $n = 223$ in total; 2 = under subsidies, $n = 216$ in total).

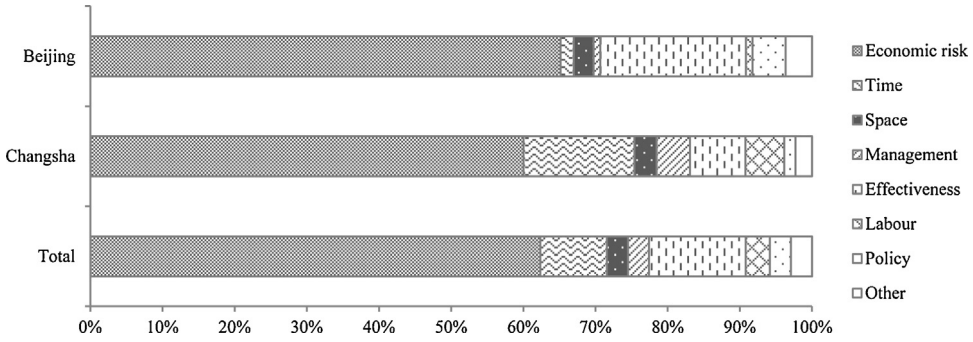

Fig. 5. Farmers' listed factors that they considered initially when choosing agri-environmental measures.

altitudes towards agricultural infrastructure or their willingness to participate in both agricultural infrastructure projects and rural environmental protection.

3.4.2. Clusters of farmers

The respondents were grouped into three clusters according to their choices of measures without subsidies. The first cluster of farmers contained 86 respondents with 80.2% from Changsha and 19.8% from Beijing. The second cluster contained 104 respondents with 45.2% from Changsha and 54.8% from Beijing. The last cluster contained only 33 respondents, with 21.2% from Changsha and 78.8% from Beijing. The characteristics of the respondents and their perceptions of the agri-environment for the different clusters are shown in Table 5. The first cluster of respondents tended to choose 2 measures (the buffer strip and low input measures), and most of them owned self-sufficient farmland. The ratio of non-agricultural income was the smallest in the first cluster, but the family income was the highest. The second cluster of farmers tended to choose only the buffer strip measure. One-third of them owned farmland for profitable production and the rest only farmed for themselves. They relied on non-agricultural income, and their family income was the lowest. The third cluster of farmers accepted all of the measures simultaneously. Half of them (51.5%) rented out their land. Their family income was medium, and they had the highest ratio of non-agricultural income. With respect to the agri-environmental perceptions, cluster 3 showed the greatest interest in the agri-environment, as this cluster had the highest approval level of the environmental benefit for economics and agriculture (statement 1.1, 1.2) and the highest opinion of biodiversity (statement 3.2, 3.3). The willingness of the farmers to learn agri-environmental knowledge and participate in protection work (statement 4.1, 4.2) was also the highest. The agri-environmental perceptions of clusters 1 and 2 fluctuated between the different statements and no clear preference for the agri-environment was evident.

4. Discussion

4.1. How did farmers value the agri-environment?

Our study showed that farmers generally approved of the positive effects of the environment on the economy and agriculture, and they felt responsible for the environment. However, farmers' opinions about environmental change varied, as well as their perceptions towards the agri-environment, especially biodiversity. In our study, we translated biodiversity into beneficial birds and insects to help farmers understand the topic. Generally, farmers liked to see birds and insects in their own fields, as identified in Guillem and Barnes (2013). However, several farmers expressed that all birds and insects were pests. This may indicate a situation in China similar to that found in the research of Herzon and Mikk (2007). These authors found that farmers might have a poor opinion of biodiversity and usually did not accept weeds and pests as part of the concept. Positive opinions of the agri-environment led to positive willingness to participate in environmental protection work in our study. However, in this part of the questionnaire, no detailed work was mentioned; therefore, understanding of environmental protection work may differ between farmers and scientists. Quite a few farmers expressed a negative or indifferent attitude towards environmental protection. Farmers might be aware of the environmental problems but they do not associate these problems with their farming activities (Ahnström et al., 2008). Consequently, it is understandable that farmers in Changsha did not agree with the statement that the inappropriate use of chemicals in agriculture

Table 5
Cluster of farmers, their characteristics and perceptions of the agri-environment.

	Cluster	1	2	3
Buffer strip measure** (%)	Yes	62.79	91.35	100.00
Low input measure** (%)	Yes	100.00	0.00	100.00
Orchard mulching measure** (%)	Yes	3.49	16.35	100.00
Farm business type** (%)	None	4.65	5.77	6.06
	Non-profitable production	74.42	59.62	33.33
	Profitable production	20.93	34.62	60.61
Main source of income** (%)	Agricultural	41.86	27.88	24.24
	Non-agricultural	58.14	72.12	75.76
Annual household income**	Mean	4.61	3.34	4.03
	Std dev	2.73	2.13	2.33
1.1 Only the environment is well protected, the economy can develop better.*	Mean	4.49	4.70	4.85
	Std dev	0.82	0.68	0.51
1.2 A healthy environment is good for agricultural production.**	Mean	4.48	4.43	4.67
	Std dev	0.84	1.03	0.89
3.2 Wild flowers and grass along the field margin can attract pest predators.**	Mean	3.52	3.18	3.94
	Std dev	1.18	1.54	1.30
3.3 Inappropriate use of pesticides and chemical fertilizer is one reason for the decrease in wildlife.*	Mean	3.41	3.32	3.67
	Std dev	1.24	1.52	1.43
4.1 I would like to learn more about rural environmental protection.**	Mean	3.85	3.78	4.28
	Std dev	1.15	1.32	1.05
4.2 I would like to participate in the rural environmental protection work.*	Mean	4.07	4.09	4.16
	Std dev	1.10	1.31	1.35

χ^2 tests for the difference between clusters.
* $p < 0.05$.
** $= p < 0.01$.
This table only listed the terms that were significantly different from each other between the clusters. For annual household income, 1 = below 10000, 10 = above 100,000; the interval is 10,000 yuan.

was responsible for biodiversity losses. Cary and Wilkinson (1997) identified perceived profitability as the most important factor that influenced farmers' use of conservation practices. This may explain why farmers in our study were more willing to take action than to improve their knowledge of environmental protection because there is no economic benefit for "improving knowledge" compared with "taking action".

4.2. What were farmers' attitudes towards the agricultural infrastructure projects?

Our study revealed that the top-down implementation of the agricultural infrastructure projects was not welcomed by the farmers because they did not feel as though they were truly involved in the process. First, most local authorities did not inform their residents about the projects. Only half of the respondents were informed, while the other half knew about these projects through other means or by seeing their implementation. The farmers claimed that the local authorities held a meeting to which only village representatives and party members were invited, or that they were informed through a village broadcast. A similar situation was reported by Fjellstad et al. (2009) for Norwegian Protected Landscapes, and farmers thought that this type of public participation made no sense. Schenk et al. (2007) noted that the method and timing of the information transfer could influence farmers' acceptance of rural planning or policies. The non person-to-person method of information transfer, such as through newspapers or broadcasts, would make people feel that they were not personally addressed, possibly resulting in low concern, and being informed late would cause criticism or rejection (Schenk et al., 2007). Second, farmers felt that their needs or opinions were not considered by the authorities. Similar situations were found in other cases. In a review conducted by Siebert et al. (2006), there was a case in Finland where farmers felt that their own views were not considered in the establishment of a EU Nature 2000 protection network. Ignorant opinions were also prevalent in the establishment of Protected Landscapes in Norway, which caused farmers' dissatisfaction with the government (Fjellstad et al., 2009). Third, local people's participation rate in the projects was low and they thought that the current implementation method was not appropriate. Generally, farmers were not satisfied with the fact that agricultural infrastructure projects were implemented by people from outside their villages, but there were different views. Some farmers thought that the authorities did not want village residents to reap benefits from the projects and therefore contracted the projects to outside people or someone related to them. These farmers often complained about the corruption of local authorities during the interview. Other farmers said that people from outside might be more professional than the local residents, resulting in the projects being carried out efficiently. One possible reason for the contradictory opinions was the information barrier caused by the inappropriate notification of the agricultural infrastructure projects and the lack of communication between the authorities and farmers. The farmers in Beijing were less willing to participate than the farmers in Changsha and they expressed more dissatisfaction with the local authority. This may be because most of them thought the projects were implemented by outsiders rather than direct stakeholders such as themselves. Our study and many other studies such as those mentioned above indicate that sufficient and proper communication between farmers and authorities might help ease the resentment and misunderstanding of the farmers. As Tyler (2000) noted, people accept a decision more easily if they are treated with dignity and respect, and if they can participate in the decision making process. Consequently, agricultural policies and programmes must consider improving public participation in the whole process and resulting suggestions incorporated rather than be a mere formality.

Although the farmers were not satisfied with the implementation process of the agricultural infrastructure projects, they were generally satisfied with the outcomes. The farmers' perceptions of the agri-environment also influenced their willingness to participate in agricultural infrastructure projects, implying that education of the agri-environment could be used as a tool to improve farmers' understanding of agricultural infrastructure projects and the associated agri-environmental measures.

4.3. Did farmers accept the agri-environmental measures?

In our study, most farmers were willing to incorporate at least one agri-environmental measure. Approximately 62.3% of the farmers considered economic risk as a primary concern, while the remainder considered environmental effectiveness, time and other factors. Economic risk meant that the measures might cause a reduction in crop production and therefore a reduced income. Many researchers have identified the economic factor as being of great importance to farmers when choosing agri-environmental measures, but this is not always the most significant factor (Siebert et al., 2006; Schenk et al., 2007; Guillem and Barnes, 2013; Van Herzele et al., 2013). Sattler and Nagel (2010) showed that the economic factor was not the most important when referring to benefits or subsidies, whereas cost neutrality and cost reduction were among the most important reasons. In a German case, farmers said it would be sufficient for them to participate in the set-aside measures if the compensation would cover the loss of arable land use (Siebert et al., 2010). The farmers in our study were more willing to take measures when provided subsidies, but many of them expressed that they would reconsider their decisions according to the level of the subsidies. As reported in Schenk et al. (2007) and Cao et al. (2009), it could be inferred that if the agri-environmental measures described in our research were actually implemented, there would be a high possibility that these farmers would terminate these measures and return to their former farming style when the subsidy stopped, especially those who considered subsidies as their only reason. However, the subsidies were not welcomed by all of the farmers, especially those in Beijing. Similar to Ahnström et al. (2008), if farmers' attitudes towards conservation measures were negative, financial compensations only had minimal and short-term impacts on their actions. Long-term impacts should rely on changes in farmers' perceptions (Van Herzele et al., 2013). On the whole, the subsidies were not efficient for increasing the acceptance of the agri-environmental measures, for all types of measures as well as all types of farmers.

In our research, 37.7% of the farmers did not list the economic component as the most important factor. Though the proportion was much lower than the value reported by Van Herzele et al. (2013), i.e., 61.7%, the listed factors were comparable. Edwards-Jones (2006) summarized six groups of factors (besides economic factors) that affected farmers' decision making, i.e., the demographic characteristics of the farmers, psychological factors, household factors, the structure of the farm business, the wider social milieu and the characteristics of the measures to be tested. In our research, four groups of factors could be recognized; the demographic characteristics and wider social milieu were not recognized. First, regarding the characteristics of the measures, the compatibility with local conditions and farming practice was an important factor because it would be much easier for farmers to practice and there would be lower cost and less labour and time (Herzon and Mikk, 2007; Sattler and Nagel, 2010; Guillem and Barnes, 2013). In our research, this was listed by farmers but expressed as separate factors that included time, space, labour and management. Several farmers in Changsha claimed that they had already applied the low input measures to their fields. The low level of acceptance of the orchard mulching measure was likely because the interviewed farmers did not own orchards or as some farmers said, they had not heard of or observed anyone applying a similar measure before. The environmental effectiveness was also listed by a number of farmers in our study, which was also chosen by many farmers in the case of Van Herzele et al. (2013). This signified that the compatibility of the measures not only referred to the management convenience but also the actual results of the different types of measures. Second, the psychological factor here is the farmers' perceptions of the agri-environment, which may significantly affect their decision-making process (Guillem and Barnes, 2013). The correlation and cluster analysis revealed that farmers with a more positive opinion of the agri-environment were more willing to accept more than one agri-environmental measure. However, several studies have noted that farmers' willingness might not be in accordance with their perceptions (Herzon and Mikk, 2007; Guillem and Barnes, 2013), and willingness as well as perceptions did not equate to action (Cary and Wilkinson, 1997; Herzon and Mikk, 2007). This could be the result of the mixture of factors affecting the farmers' decision-making process (Edwards-Jones, 2006). Farmers' agri-environmental perceptions or beliefs might originate from education or previous experiences of agri-environmental programmes, which were proven to have positive effects on their willingness to participate in new agri-environmental measures (Beedell and Rehman, 1999; Herzon and Mikk, 2007; Schroeder et al., 2013; Siebert et al., 2010). Therefore, education or pilot experiments on agri-environmental measures could be approaches to increase farmers' participation. Third, the household and farm business characteristics were also found to affect farmers' choices in our study. The farmer's family income (source) and farm business type significantly influenced their choices and agri-environmental perceptions. Farmers who owned profitable agricultural lands had a more positive opinion of the agri-environment and were more willing to accept agri-environmental measures. However, this differed from the European studies, not because these farmers owned larger farms and were more concerned about costs (Sattler and Nagel, 2010; Schroeder et al., 2013), but because most of the farmers in our study, especially those in Beijing, gained profits by renting their land out. Consequently, the farmers were not directly influenced by the cost and losses associated with the land. Other factors such as social recognition were also identified as important to a certain extent (Siebert et al., 2006; Herzon and Mikk, 2007; Sattler and Nagel, 2010), but were not listed by the farmers in our research.

4.4. Policy implications

Two aspects of policy implications could be extracted from this study. The first is the implementation method of the agricultural infrastructure projects. The results of the farmers' attitudes revealed a worrisome fact that the farmers were not satisfied with the current top-down implementation of these projects. However, under China's national policy environment, the top-down approach dominated by governments is always of high priority in the planning and implementation process of rural policies. Some researchers argued that top-down implementation may cause refusal by farmers, while a cooperative process would be more accepted by farmers, and a combination of bottom-up and top-down approaches was ideal (Siebert et al., 2006; Schenk et al., 2007). Under these circumstances, we suggest that farmers' participation in agricultural infrastructure projects or relevant policies should be strengthened at a local level. The overall planning process at the provincial and city levels should remain as top-down, whereas more emphasis should be placed on the role of farmers at a local level to improve the suitability of plans for local development. Farmers should be involved in the whole process of agricultural infrastructure projects, especially the implementation stage, and farmers' opinions and needs should be considered with real respect. The implementation process should be open and transparent, especially with respect to the financial aspect, to win maximum trust from farmers.

The second aspect is the policy of the agri-environmental measures. With respect to achieving higher agricultural production and ensuring food security, the advancement of modern intensive agriculture will not change in a short time period. In this context, agri-environmental measures could act as guarantee measures for agricultural sustainability, but may only be secondarily positioned,

especially in the main grain producing area. Considering the factors that affect the farmers' acceptance, agri-environmental measures must be accompanied by proper subsidies and be suitable for the farm business type. Education and pilot experiments could increase the acceptance and participation of farmers. Similar to the study conducted by Hou et al. (2015) in the Loess Plateau, policy should be more targeted and should direct farmers to adopt more agri-environmental measures through the provision of subsidies as incentives. Though farmers' agri-environmental perception, their willingness to practice agri-environmental measures and their attitudes towards rural agricultural infrastructure projects may be affected more by their personal opinions and farm business types rather than the regional background, disparities among regions should not be ignored. As part of the agricultural infrastructure projects, the design of agri-environmental measures should be tailored to the local climate and landscape and should be customized to the local lifestyle and farming practices. For example, in Beijing, the slope of field roads and ditches could be used as buffer strips because most of the ditches do not contain water for most of the year. By contrast, the ditches in Changsha are almost continuously filled with water and have an impermeable pavement, which is not suitable for vegetation; consequently, the buffer strip could be located along wider field roads or around the abundant water ponds. Agri-environmental measures are not limited to those presented in our research; measures such as maintaining and managing diversified woodlots and water ponds in fields, enhancing semi-natural habitats and reducing the amount of unnecessary impermeable pavement of field roads and ditches could also be included. As the number of investigated farmers was not high enough to be representative of the two regions, a more thorough, sophisticated and targeted survey should be conducted before agri-environmental policies are devised and put into practice. However, it should be mentioned that the effectiveness of agri-environmental schemes in Europe was doubted by certain researchers (Kleijn et al., 2001; Kleijn and Sutherland, 2003; Stockan et al., 2014). Therefore, from an ecological perspective, agri-environmental measures should have clear objectives, such as the target species to be protected, and should be tailored to meet the specific habitat and distribution needs. Agri-environmental measures also should be designed at a landscape scale to enhance the connectivity of patches and corridors (Marshall et al., 2006; Concepción et al., 2008), and ensure proper complexity of the landscape structure (Tscharntke et al., 2005; Concepción et al., 2008).

5. Conclusions

This paper discussed farmers' perceptions of agricultural infrastructure projects and the possible introduction of agri-environmental measures in these projects, as well as their willingness to adopt relevant measures. The results showed that the farmers were unsatisfied with the current top-down implementation of agricultural infrastructure projects and hoped to participate in these projects. There is a high possibility of introducing agri-environmental measures in agricultural infrastructure projects in China, which we assumed because farmers' acceptance of agri-environmental measures was generally high provided there were subsidies. Economic risk was the primary factor that influenced the farmers' acceptance of an agri-environmental measure. Farm business type and source of income influenced the number of agri-environmental measures accepted by farmers, as well as their attitudes towards the agri-environment. To integrate agri-environmental measures into infrastructure projects and conform to China's policy environment, we suggest a combination of top-down and bottom-up approaches for the implementation of agricultural infrastructure projects, during which farmers' opinions should be taken seriously. However, before the actual policy is devised or implemented, a more detailed and targeted survey should be conducted. In addition, the policy should be tailored to the specific region.

Acknowledgements

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Appendix A. Basic characteristics of the respondents

			Total (n = 284)	Changsha (n = 151)	Beijing (n = 133)
Personal characteristics	Age** (mean)		52.4	49.6	55.7
	Sex (%)	Male	47.2	59.0	48.0
		Female	52.8	41.0	52.0
	Education (%)	Lower than primary school	10.4	9.5	11.3
		Primary school	33.2	35.4	30.8
		Middle school	42.5	38.8	46.6
		High school	12.9	15.0	10.5
		Higher than high school	1.1	1.4	0.8
	Occupation* (%)	Full-time farmer	65.4	71.3	58.6
		Part-time farmer	34.6	28.7	41.4
Family characteristics	Household size** (mean)		4.5	5.1	3.9
	Farm business type** (%)	None	6.7	6.0	7.5
		Self-sufficient production	57.0	79.5	31.6
		Profitable production	36.3	14.6	60.9
	Agricultural subsidies per mu** (%)	0	18.8	11.0	32.0
		<=200	62.4	88.2	18.7
		>200	18.8	0.8	49.3
	Annual household income** (%)	<10,000	10.8	3.8	17.8
		[10,000, 30,000)	42.8	32.3	53.5
		[30,000, 50,000)	26.3	40.0	12.4
		[50,000, 100,000)	14.7	15.4	14.0
		>=100,000	5.4	8.5	2.3
	Main source of income** (%)	Agricultural	27.2	34.0	19.5
		Non-agricultural	72.8	66.0	80.5

χ^2 or t tests were used to determine the difference between Beijing and Changsha.

* $p < 0.05$.

** $p < 0.01$.

Agricultural subsidies refer to the direct food subsidy in China, which aims to encourage farmers to plant crops, thus ensuring agricultural production and preventing farmland abandonment. "Mu" is a commonly used unit of area in China; 1 mu = 666.67 m^2.

Appendix B. The questionnaire

1. Attitudes towards the environment in rural areas (score 1–5, 1 = strongly disagree, 2 = disagree, 3 = do not know or difficulty in deciding, 4 = agree, 5 = strongly agree; the same below)
1.1 Only the environment is well protected, the economy can develop better.
1.2 A healthy environment is good for agricultural production.
1.3 Farmers should be responsible for the environmental condition of their own farmlands.

2. Experience with environmental change (score 1–5)
2.1 Wildlife on farmlands is decreasing.
2.2 Water quality of the village is improving.
2.3 The hygienic condition of the village is improving.
2.4 The green space in the village is improving.

3. Knowledge about agricultural agri-environment – biodiversity (score 1–5)
3.1 I like to see beneficial wild birds and insects on my farm.
3.2 Wild flowers and grass along the field margin can attract pest predators.
3.3 Inappropriate use of pesticides and chemical fertilizer is one reason for the decrease in wildlife.

4. Willingness to participate in rural environmental protection (score 1–5)
4.1 I would like to learn more about rural environmental protection.
4.2 I would like to participate in the rural environmental protection work.

5. Awareness of local agricultural infrastructure projects
5.1 I know that agricultural infrastructure projects have been implemented in the village. (Yes/No)
5.2 I know about these projects because the village committee/government informed me. (Yes/No)
5.3 Who implemented these projects? (Possible answers: local people, specialized companies or individuals from outside the village, cooperations. . .)

6. Assessment of the results of the agricultural infrastructure projects (score 1–5)
6.1 These projects improved the environment of the village and farmland.
6.2 These projects improved the agricultural production condition.
6.3 These projects improved the living standard of the local people.
6.4 I am satisfied with the results of these projects.

7. Attitudes towards the implementation of the projects (score 1–5)
7.1 I have participated in the implementation of (one or some of) these projects.
7.2 The implementation method was appropriate.
7.3 The organizers of these projects have considered the needs of the farmers.
7.4 Local authorities should take farmers' needs into consideration when projects are planned.
7.5 All of the projects in rural areas should include participation by farmers.
7.6 I would like to participate in the projects in the future.

8. Acceptance of agri-environmental measures
8.1 Would you accept to practice the following agri-environmental measures in your own field? (Yes/No)
1) plant grass/herbs or shrubs as buffer strip along field margins to control pests;
2) set apart some land with low or no chemical fertilizers and pesticides;
3) plant grass/herbs as mulch in orchards.
8.2 If the government provides subsidies for the implementation of the above measures, would you accept them? (Yes/No for each measure)
8.3 Is the economic risk the primary factor that you considered when choosing the above measures? (Yes/No) If not, what was the primary factor?

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