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Article

The protection planning of small and micro habitats in urban fringe areas: Enlightenment from the management of high natural value farmland in the EU to the maintenance of bio-diversity in urban areas in China

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Abstract: The habitat unit in urban fringe is an important link to support regional biodiversity; due to the influence of ur-ban system and agricultural system, most of them are semi natural, appeared with diverse types, small patches, scattered layout, and generally relying on low intensity farming activities. Export-oriented expansion of urban construction land and intensive agricultural production are prone to reduce the scale and quality of semi natural habitats in urban fringe areas; and the existing measures cannot effectively protect them. High natural value farmland management is an effec-tive measure of the EU to protect semi-natural habitats related to agriculture and maintain regional biodiversity. Through combing the main points of high natural value farmland such as type definition, evaluation, identification, maintenance management, etc., this paper proposes the suggestions for optimization of small and micro semi-natural habitat protection in China: (1) strengthening the recognition of the value of small and microhabitats and related land use; (2) identifying small and micro-habitats that are conducive to the maintenance of biodiversity, and incorporating them in the overall protection of regional network; (3) combining the rigidity and flexibility of land use control, with the consideration of complex function demands; (4) Converging with the existing statutory planning to enhance the protection efficiency of small and micro habitats.

Keywords: urban fringe area; small and micro-habitat; high natural value farmland; space management; the European Union

Maintaining a high level of biodiversity is of great significance for the stability of regional ecosystems and the provision of public welfare in urban and rural areas. For example, vegetation richness is related to the degree of soil and water conservation along the river [1], and the diversity of local crops is related to the food supply health of urban and rural residents. The exploitation and utilization of natural resources by human society has caused a large number of habitats to be eroded and destroyed, which seriously threatens the biodiversity of the region and even the whole world. Due to the combined action of the urban-rural system, the habitat units in the marginal area are generally small in scale, scattered and rich in types, mainly semi-natural habitats, and are mostly associated with traditional farming activities (low-intensity/non-intensive agricultural production). Small plots of farmland or fallow land for low-intensity tillage or grazing, shrub land distributed on the edge of farmland, and forest panel units combined with farmhouses, etc. This kind of land can provide suitable habitat for some wild species, effectively connect urban green space with peripheral ecological matrix, and improve the habitat proportion in the region. However, due to the characteristics of complex functions and complex ownership, it is difficult to receive due attention and effective protection from existing control subjects. From the perspective of the maintenance of regional biodiversity and the overall protection of habitat units, this

paper will clarify the potential functions, maintenance basis and management dilemma of semi-natural habitats in marginal areas. Combined with the analysis of the protection practice of high natural value farmland in the European Union, the paper explores the efficient management and control ways to realize the protection and utilization of semi-natural small and micro habitats in the marginal areas.

1. Layout characteristics, potential functions and conservation dilemmas of habitat units in marginal areas

1.1. Composition, characteristics and service potential of habitat units in marginal areas

The habitat network with spatial continuity and heterogeneity across urban and rural areas is the basis for maintaining regional biodiversity. However, urban construction and development are prone to cause many impacts on it, such as landscape pattern change, habitat encroachment, invasion of alien species [2], loss of native species [3], and soil and water pollution [4]. At the same time, the combined effects of large-scale cultivation of single crops and land leveling in intensive agricultural production practices aggravated the reduction of biodiversity in both urban and rural areas.

Due to human activities, high strength interference fringe area habitat unit, with a few valleys, ridges, wetland gap [5,6], construction and other remaining natural habitats [7], how to adapt to the soil and water pollution, greenhouse climate environment background and on human activities, especially agricultural production activities) half exists in the form of natural habitats. Woodland and arable land are the dominant landscape elements in semi-natural habitats in marginal areas [8], which are characterized by small patches, scattered and mixed layout. The author analyzed the current land use data in Meishan urban fringe area, and found that the total scale of forest land in the area accounted for about 86%, but the patches were mostly less than 10 hm^2, and the patches were mainly smaller than 1 hm^2. The cumulative size of small farms and gardens also accounted for 20% of the total productive land (**Figure 1**). It should be noted that intensive agricultural landscape, artificial construction landscape and related land use do not have strong supporting effects on biodiversity, so they are not considered in this paper.

By the edge of the city - countryside dual function system habitat area habitat unit than other area, showing the interference of stronger adaptability and higher species richness, can effectively increase the area of habitat land accounted, rich habitat types, strengthening the large habitat, to some extent compensate for urban and rural development and construction of the negative impact of the regional biodiversity. (1) The intensity of land development in the marginal area is in the middle, and the level of biodiversity supported by it is higher than that of urban area, rural hinterland and natural ecological area [9]. For example, the study of Li Junsheng et al. Found that the species richness along the environmental gradient from the outer countryside to the inner city showed an unbalanced unimodal curve distribution, and the suburban area had the highest level of biodiversity [10]. (2) the level of biodiversity is also closely related to the integrity of landscape ecological pattern and the number of

dispersal routes of species [3,11]. The habitat unit in the marginal area can help the construction of ecological corridor system, repair the connection between fragmented habitat patches, thus improving the level of regional biodiversity and promoting the effective play of ecosystem services [8].

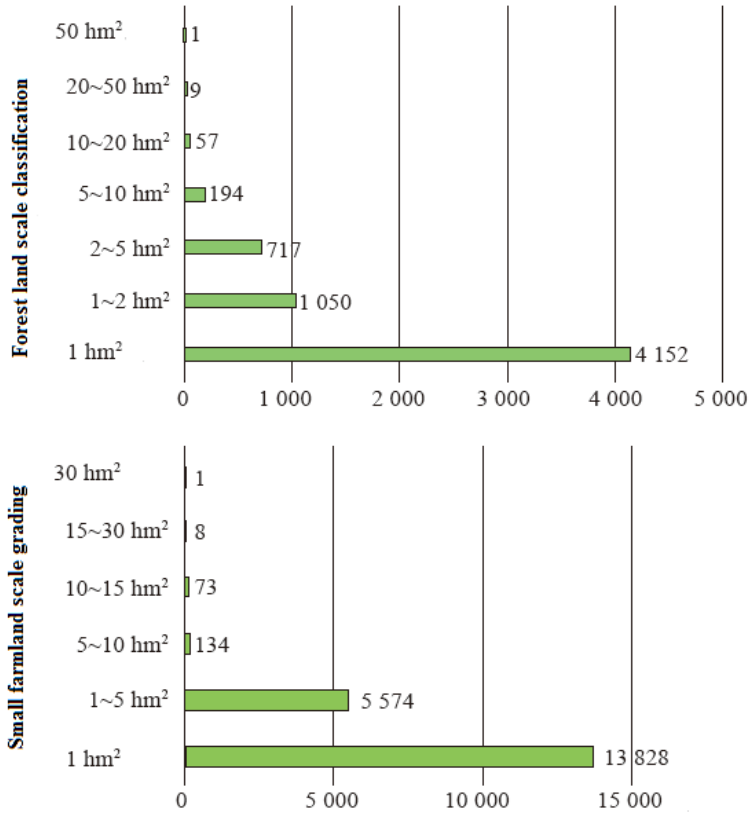

Figure 1. The frequency of woodland and farmland patches of different sizes in the urban planning area.

Data Source: Based on the conceptual master plan of "166" control area of Meishan Central City, the author modified the drawing.

1.2. Habitat units in marginal areas maintain the link with agricultural production

The maintenance of semi-natural habitats in marginal areas is closely related to agricultural production activities and related space, and the effects of different agricultural production modes on habitat units are different. According to the effect, the effects of agricultural production on habitat maintenance in marginal areas can be summarized into three categories. The first is land patch encroachment: in order to obtain continuous flat land for mechanical farming, intensive agricultural production encroachment on small forestland, consolidation of small farmland, and large area of single crop cultivation, resulting in a significant reduction of habitat scale and habitat type in marginal areas. Secondly, the destruction of habitat quality: land leveling and other behaviors in intensive agricultural production destroy the topographic and geomorphic characteristics of habitat. At the same time, a large number of fertilizers and pesticides are used to pollute the regional ecological environment, which exacerbates water pollution and soil erosion from non-point sources. Third, semi-natural habitat maintenance: protect and maintain semi-natural habitat in accordance

with traditional agricultural production mode and related production, living and ecological space organization, and improve the level of regional biodiversity.

Intensive agricultural production mode can ensure sufficient food output when land and manpower are limited. It is of great significance to carry out the basic national policy of ensuring food security in China. However, as a marginal area adjacent to the urban area, agricultural and forestry land plays a compound function of ecological barrier, biodiversity maintenance, environment regulation and outdoor recreation places for urban and rural society in addition to the function of food production, so it should be taken into account in planning and control.

1.3. Existing control points and the lack of habitat protection in marginal areas

The existing measures of biodiversity protection in China attach more importance to the protection of large plaque and the overall maintenance of network system, and attach more importance to the control of passive marking and less importance to the guidance of active management, making the organic whole habitat network in a state of fragmentation and control [12]. Since the late 1970s, our country has increasingly raised attention on natural resources and biodiversity protection, and various laws and regulations have been promulgated in succession [13], Including the environmental protection law (revised in 2014), “forest law” (revised in 2019), the grassland (revised in 2013), “the wild animal protection law” (revised in 2018), “the seed law (revised in 2015), the water and soil protection act (revised in 2010), the nature reserve ordinance,” wild plants protection regulation” And so on. However, the protection and control objects of the promulgated laws and regulations mainly focus on the representative natural ecosystems, rare and endangered species or important ecological function areas. The control measures adopted are more similar to “rescue protection”, mainly establishing nature reserves and national parks [14], etc. Although attention is paid to the control of protected area scale, the construction and maintenance of habitat network are ignored [15]. Therefore, a large number of land and space closely related to biodiversity protection (such as migration/dispersal corridors and ecological stepping stones) have not been properly protected, especially in the marginal habitats that have been eroded by urban and rural construction and intensive agricultural production, and the protection efficiency of control measures is low.

In order to improve the isolation and limitations of the existing laws and regulations mentioned above in land use protection, The State Council issued the Guiding Opinions on the Establishment of a Protected Nature Area System with national parks as the main body in 2019, stressing that habitat elements management should be combined with systematic protection, and scientific utilization should be combined with efficient protection. However, it has not paid enough attention to the habitat protection of marginal areas, especially the semi-natural habitat protection related to agricultural production.

1.4. Overall network conservation trend and habitat conservation dilemma in marginal areas

The control measures for systematic and network protection of habitat units have been recognized by scholars and managers at home and abroad. As Germany planning administrative department of the biodiversity conservation should be multiple approach is put forward, should not only focus on control the target species protection oriented recognition by the habitat and migratory corridor, still need to pass on the protection of the natural and semi-natural habitats, repair and series of measures to strengthen urban habitat and broken in the relationship between peripheral important large habitat, Then a multifunctional habitat network is formed, and relevant land is dynamically managed in combination with environmental impact assessment [16]. In addition, along with the social from all walks of life to natural systems to support the sustainable development of human cognition, red line, such as urban growth boundary delimitation in ecological protection work, but also to the protection of the biodiversity and its occurrence system combined with land and space management, to achieve the human society development and natural ecological protection compatible reciprocity. For example, in the delineation of the ecological security pattern of Wuhan metropolitan area, it is proposed to define the forbidden and restricted areas of urban and rural development based on the protection of four major elements: biodiversity, water environment, geological soil and agricultural production [17]. When building the spatial pattern of future urban development, Taizhou also fully considered the impact of biodiversity protection, flood, cultural heritage and recreation landscape security pattern reservation and control [18].

At present, there are four main reasons for the lack or low efficiency of habitat unit protection in urban fringe areas. (1) The identification criteria for existing protection measures are difficult to match: the existing measures for agricultural and forestry land control, such as the Regulations on Nature Reserves and the Regulations on Basic Farmland Protection Areas, mostly adopt the identification criteria for large scale, high contiguity or typical (such as providing habitat for specific species) of the land itself. The habitat units in the marginal area are small in scale and scattered in layout, and the maintenance of regional biodiversity is mainly reflected in supporting ecological processes and strengthening the connection between large habitats. Therefore, they cannot provide suitable habitats for endangered or rare species, so it is difficult to match the existing measures of land use identification criteria and realize effective management. (2) The semi-natural nature and layout characteristics of land use increase the difficulty of management and control: the land patches involved in marginal habitats are generally small in scale, scattered in layout, and numerous associated elements, so it is difficult to effectively identify and draw protection in the planning and control of land use (**Figure 2**). Moreover, there is multi-department management, and the control measures of each department have a single factor protection orientation and are independent, which can not maintain the habitat composite function output well. (3) Lack of supporting technology: Limited by the accuracy of satellite remote sensing data, small patches of habitat are difficult to identify. (4) Complex land tenure: the demands of multiple stakeholders have not been fully considered, and the protection resistance is high. Based on the above analysis, it

can be concluded that the identification of land patches, efficient management and maintenance, and combination of protection and utilization are the key points of habitat unit protection in marginal areas, which will be discussed in the following sections in conjunction with the protection of high natural farmland in the European Union.

Figure 2. It is difficult for land use planning to effectively identify small pieces of secondary woodland.
Data Source: Compiled by the author based on satellite images and the overall land use plan of Guansheng town (2006–2020).

2. Biodiversity maintenance and high natural value farmland conservation practices in the European Union

2.1. Measures related to biodiversity conservation in the EU

In the European Union, the process of agricultural mechanization started early and the level of intensification was high, which was considered to be the main cause of biodiversity loss [19]. The protection of ecosystems and biodiversity in the European Union began with the Birds Directive in 1979, which initially focused on the protection of wild bird species. With the signing of the Convention on Biological Diversity (CBD) in 1992, the maintenance of ecosystem health and the protection of biodiversity have officially risen to the international strategic perspective. Subsequently, the EU strengthened the protection and management of biodiversity in the region, and promulgated a number of regulations and policies (**Table 1**), which mainly involved the construction of regional habitat network, the protection of important habitats and the maintenance of habitat quality.

Table 1. Main regulations and measures for biodiversity and ecosystem protection in the EU.

Year	Name of regulation/measure	Control objectives	Main Control Points
1979	Birds Directive (Directive 2009/147/EC, 2009)	To provide comprehensive protection for wild birds	To protect important bird habitats and establish a network of special protected areas (spas); To avoid or minimize anthropogenic impacts on bird homing, breeding and rearing of young birds; Sustainable management of hunting practices
1991	Nitrate Directive	Preventing and controlling agricultural pollution	Control the use of nitrate-related products in agricultural production
1991	Nitrogen Directive (DIR.91/676)	Preventing and controlling agricultural pollution	Limiting the use of nitrogen fertilizer to reduce nitrogen emission in agricultural activities; Prevent "nitrogen-sensitive areas" from being polluted and protect water quality
1991	Organic Act (Reg.2092/91)	Reduce the negative impact of agricultural production environment	We will encourage organic agricultural production without chemical fertilizers and pesticides, and reduce emissions of nitrogen, phosphorus and other polluting elements in agricultural production
1992	Habitats Directive (dir.92/43/EEC)	Protect important species and their associated habitat units	To establish and protect core areas (scis/sacs) that are important for the maintenance of species communities, and to supervise and manage them; Ensure the rational use of animal and plant resources, so that the overall good condition
1992	Agricultural Environment Ordinance 2078/92	Reverse the decline of wild species and environmental damage caused by intensive agricultural production	Comprehensive state subsidies are provided to encourage farmers to engage in environmentally friendly activities on their land, such as encouraging intensive farming to shift to extensive farming and allowing land to lie fallow
1997	Nature 2000 (Natura 2000)	Systematic conservation of species and habitat resources, coordination of human activities and nature conservation	The core habitat protection network is established by combining the protected areas defined by the bird directive and habitat directive. Strictly control nature reserves; Private land should be protected and guided for sustainable use, such as environmentally friendly agricultural methods
2000	Water Framework Directive	Water resources and water ecosystem protection	Integrated watershed management; Improving water ecosystem and factors; Promoting sustainable use of water resources; Reduce pollution by harmful substances; Groundwater pollution prevention and control; Hydrological regulation to reduce the impact of floods and droughts
2006	Biodiversity Action Plan (BAP: Biodiversity Action Plan)	Biodiversity and ecosystem conservation	Protecting important habitats and species; Protecting rural biodiversity; Protecting the biodiversity of the Marine environment; Integrate biodiversity conservation concerns and implement impact assessments in land use and development; Reducing the impact of invasive alien species; Supporting biodiversity for adaptation to climate change
2011	The EU Biodiversity Strategy towards 2020	Stem the loss of biodiversity and ecosystem services in the EU and protect local biodiversity	To ensure the construction and long-term operation of the network of protected areas identified in Natura 2000 (hereinafter referred to as the Natura 2000 network) to protect target species and their habitats; Through the construction of green infrastructure, the ecosystem can be maintained and restored, and the composite value of resources can be mined. Promote the sustainable development of agriculture and forestry, promote environmentally friendly farming, protect the diversity of agricultural heritage and increase the diversity of forest species; Promoting sustainable fisheries development; Fight against invasive alien species; Helping to sustain global biodiversity
2013	Green Infrastructure Strategy	Ensure the protection, repair, construction and functional enhancement of green infrastructure	Protect natural and semi-natural areas, build green infrastructure network, guide land development and space management; Through natural solutions to achieve environmental, social and economic benefits compatible; As an alternative or supplement to the grey infrastructure
2014	Regulations on the Management of Invasive Alien Species 1143/2014	Preventing and controlling the negative impacts of invasive alien species on native species and habitats	Preventing the intentional or accidental introduction of invasive alien species; Establishing surveillance systems to detect the presence of invasive species early and eradicate them quickly; Regional collaboration to prevent the further spread and impact of invasive species
2020	Eu Biodiversity Strategy towards 2030	To protect regional biodiversity and explore its compound service value for	Construct a continuous network of protected areas; Protect terrestrial and Marine ecosystems and restore damaged areas (return nature to agricultural land, restore soil ecosystems, improve the quantity and quality of forestland,

human society and natural ecology	energy efficient use and regeneration, strengthen urban and peri-urban green Spaces); To deepen the legal framework for nature protection

Source: Author collated.

In the EU's biodiversity protection practice, the control measures related to agricultural production take up a large proportion. Agricultural land in the European Union accounts for as much as 40%. Therefore, faced with the increasingly saturated food supply market, the prominent disadvantages of mechanized agriculture, and the intensified industrial competition worldwide, the European Union and its member states have to consider the future development trend of agriculture from the economic, social, political, environmental and other aspects. Among them, the idea of preserving high natural value farmland to maintain regional biodiversity dates back to the 1990s and has since been incorporated into environmental protection and agricultural policies. For example, Agenda 2000, adopted in 1998, emphasizes the improvement of the environment for agricultural production and the protection of ecologically vulnerable areas; The 2008 Common Agricultural Policy (CAP: The reform of The Common Agricultural Policy explicitly stipulates The protection of agriculture-related biodiversity and habitat units [19], and The European Agricultural Fund for Rural Development (EAFRD) from 2014 to 2020: In the European Agricultural Fund for Rural Development, "restoration, protection and strengthening of ecosystems related to agriculture and forestry" are listed as priority funding projects [20]. The funding contents include high natural value farmland and rural landscape protection, pesticide use management, water and soil environmental quality improvement, etc. [21].

2.2. Definition of high natural value farmland and its land use composition

There were differences in the types and degrees of impacts of different agricultural production modes on regional ecosystems (**Table 2**). Studies have shown that the implementation of low-intensity production and the protection of the highly heterogeneous woodland-farmland chimeric landscape can maintain a high level of biodiversity [22]. High Natural Value Farmland (hnvf: Conservation of High Nature Value farming is one of the most representative agrorelated biodiversity maintenance measures in the European Union. It is mainly targeted at low intensity farming systems. Among them, agricultural production activities play a supporting role in maintaining the level of regional biodiversity. The high natural value of farmland in the protected area is mainly reflected in the protection of diverse plant species and communities, appropriate disturbance to maintain vegetation community succession, protection of ecological elements and support of natural processes, and provision of diverse habitats for wild species [23]. More than 50% of the habitats of rare species in Europe are found in high natural value farmland areas [24]. The classification of high natural value cropland by Ellin Anderson et al. (1) Agricultural land mainly covered by semi-natural vegetation (hnvf 1) according to land type and tillage intensity is widely adopted in domestic and foreign studies. (2) Land containing natural or semi-natural ecological elements, mainly using low-intensity agricultural production mode (hnvf 2); (3) Land that uses more intensive production than the first two types of land but can support the survival of rare/endangered species or important native species (hnvf

3) [23].

Table 2. The corresponding relationship between different agricultural patterns and ecosystem quality level in land use.

Type of farm/agriculture	Related production system	Quality of ecosystem
No production system	Native vegetation (no productive agricultural activities)	100%
Extensive grassland management	Medium to high density livestock production (e.g. Cattle/sheep, etc.) On natural grassland	40%
Extensive organic farming	Agriculture with low intensity external material or energy inputs, using sustainable agricultural production management	35%
Extensive agriculture	Traditional agriculture; Extensive agriculture; Agriculture with low intensity external material or energy inputs	25%
Intensive organic farming	Organic farming that relies on rain irrigation	20%
Intensive grassland management	A grassland production system that depends on tillage, reseeding and fertilization	20%
Intensive organic farming	Organic farming in developed countries (where conventional farming requires long-term soil and water management and inputs)	15%
Intensive production system	Intensive agriculture; Agriculture requiring a high intensity of external material or energy inputs	10%
High intensity intensive production system	Agriculture that depends on drainage and irrigation systems; Agriculture where land is obtained through other soil leveling practices; Regional specialized production system; Specialized production systems on a farm or landscape scale	5%

Source: Translated and collated according to references [25].

High natural value cropland is an important component of Natura 2000, a landscape ecological network across Europe. It includes semi-natural grasslands, steep slopes, shrub lands, permanent crops (orchards, olive groves, etc.), dryland crops that have been fallow for ecological restoration. As well as highland grasslands, hay meadows and small plots of farmland located in mountainous areas and related to pastures [26]. This kind of land can fully adapt to the local climate and geographical environment, and has the characteristics of low chemical input, mechanization level, farming/feeding scale, and yield of agricultural and sidproduct, but relies on high density labor force for maintenance [27]. Related measures include land sharing/wildlife-friendly farming, land sparing and wilderness, and ecological intensive production Intensification), organic farming [28], etc.

Table 3. Introduction of high natural value farmland identification methods based on different perspectives.

Perspective	Methods the main points	Specific measures	The data source	Expected results form	Suitable type
Land cover perspective	Areas with a high proportion of semi-natural vegetation, close to areas of natural vegetation (such as natural woodlands) or the presence of multiple agricultural land types were selected	(1) The relevant agencies should make unified environmental zoning and report the scope and indicators to the member States; (2) According to the environmental zoning and their own conditions, the experts of each country shall refine the indicators (the most rigorous and comprehensive) for the evaluation of the natural value of land use and delineation of the possible hnvf; (3) Data verification	Colin land cover classification, mainly targeted at 19 types of land closely related to agriculture, such as non-irrigated farmland, permanent irrigated farmland, rice fields, vineyards, berry plantations, etc	The minimum range of potential hnvf distribution map (accuracy 10 km×10 km, some known hnvf may be missed); Maximum potential hnvf distribution map (10 km×10 km, possibly including some non-HNVF sites)	Category I and Category II high natural value farmland

		and revision, including comparison with known data, comparison with results of other countries in the same environmental zone, representative national key verification, etc			
Agricultural Systems Perspective	Low intensity agricultural areas were determined according to production characteristics (fertilizer consumption, stocking density, fallow area), and their proportion in cultivated land was calculated	(1) determine the six kind of low intensity but high natural value of agricultural land, cultivated land, including low intensity at the low intensity of olive groves and other permanent planting system, outside the farm, permanent grassland grazing system (the main source of feed grass), arable land, livestock grazing system (the main source of feed for arable land) and other low intensity planting or livestock systems; (2) To develop common EU standards; (3) Develop regional identification standards for Western Europe, Scandinavia and Southern Europe respectively	Environmental zoning data for different regions and land production characteristics from the Agricultural Statistics Data network	Drawings and tables showing the distribution of different hnvf types; According to the hnvf environmental representation, the proposed land use identification index system and environmental management suggestions are summarized. Pressure index of agricultural production on hnvf	Category I and Category II high natural value farmland
Species information Perspective	To identify areas and sites associated with the breeding and habitat of agricultural pollinated and conservation bird species (specs)	(1) According to the 10 potential hnvf in different regions, such as Mediterranean shrub, mountain steppe, high marsh, sand dune and salt marsh, dryland steppe, wetland steppe and agricultural complex, the representative species of pollinating birds and the protective bird species related to farmland habitat were determined. (2) According to the bird occurrence data and habitat requirements (literature research), formulate corresponding land use identification indicators	Species distribution data and habitat requirements from departments and institutions related to biodiversity conservation (mainly bird conservation) in different European regions, such as the European Bird Census Committee data	Representative bird presence and distribution data; Distribution of agricultural land related to species conservation; Proportion of habitats of related species in high natural value farmland (European level, 50 km × 50 km)	High natural value farmland of all types

Data source: The author compiled and drew according to references [23].

2.3. Identification strategy of small farmland with high natural value

Although the overall scale of high natural value farmland in the European Union is about 40% of the total area of existing nature reserves [19], its land patches are generally small and scattered, making it difficult to define and protect them. To this end, the environmental protection departments of the European Union, the member states and scholars of related research directions have explored the scope identification and quality assessment of high natural value farmland from the whole and national levels of the European Union respectively.

The exploration on the identification of high natural value farmland in the EU as a whole began in the 1990s, mainly based on land use types, agricultural system patterns, species diversity information and other contents, among which the evaluation system proposed by Anderson et al. Is the most representative. In 1994, Beaufoy, in his book The Nature of Farming, proposed that land use type could better reflect tillage intensity and could be used as an indicator to identify farmland with high natural value. In 2004, Anderson report submitted to the European environment agency, such as different types for the eu area is high, the geographical distribution of natural value of farmland may set up a relatively perfect system of evaluation and recognition (**Table**

3), and USES the existing bird species (reflect farmland environment quality indexes of species) statistical data to validate: (1) Land Cover analysis method, that is, to analyze the classes of CORINE Land Cover, extract the Land use characteristics and indicators that can be used for the evaluation of semi-natural vegetation Cover, and identify the Land use based on them, which is applicable to hnvf 1 and hnvf 2; (2) Analysis of agricultural systems, namely agricultural Statistical Data Network (FADN: Farm Accountancy Data Network (hnvf 1 and hnvf 2) to extract indicators reflecting the potential role of agricultural production systems in maintaining or enhancing the high natural value of land and identify land based on these indicators; (3) Species information analysis method, that is, representative species are selected, indicators related to their occurrence frequency are extracted and land use is identified, such as passerines and shrub birds in traditional agricultural landscapes [29]. The above three methods have their own emphasis, but generally should not be used alone for land use identification, but should complement each other. For example, the species information analysis method can verify the land use identified by the former two methods, and clarify the importance of land use for habitat protection and species maintenance [23]. Because farmland with high natural value is preserved in the wave of mechanized production, it is mostly related to geographical location, geographical conditions (such as topography and landform), regional culture and other restrictions [23], Paracchini et al., therefore, deepened the above method and increased the consideration of environmental gradient changes [30].

Based on the evaluation criteria of the European Union, the member states refine the indicators with the goal of improving adaptability and landing ability, mainly focusing on the characteristics and use of land patches, environmental factors, and species distribution. Lang, etc (Lomba et al.) In the study of Portugal in northwest area, analyzing the characteristic of the landscape elements, dominance, evenness, number of patches, shape index and edge density, etc.), intensive degree and crop diversity, etc., to evaluate high value associated with agricultural land, and through the cluster identification clear land boundary [27]; At the same time, more methods, tools and data were introduced in the evaluation process through cooperation with local governments, regulatory departments, farmers' associations and various public welfare organizations [26]. Brunbjerg et al. Analyzed topographic and geomorphological characteristics, potential occurrence frequency of species, current land use intensity, and distribution of rare and endangered species, evaluated and identified high natural value farmland in Denmark, and classified it into 13 levels from high to low, with the level above 5 designated as protected areas by the government [31]. Martin et al. (Matin et al.) Identified and validated potential high natural value farmland in Ireland by weighted evaluation of semi-natural habitat coverage, stocking density, hedge/shrub coverage, river system density and soil diversity within the land [32].

2.4. Effective protection and control of farmland with high natural value

The conflicts between agricultural activities and regional biodiversity and habitat protection are mainly reflected in three aspects, namely, agricultural intensive production, the abandonment of farmland with high natural value (often with low

productivity), and the change of farm operation scale (such as agricultural intensive production, mono-crop cultivation, etc.) [33]. Land, waste or fretting over farming and so on all of the typical half natural habitats could maintain biodiversity and other functions of play, so targeted controls aspires to habitat protection and appropriate quality maintenance, land use, through the land management, protection of motivation, participation, promote the measures, such as the contradictions between the protection and coordination of land use (**Table 4**), And strengthen landing management.

As for land use management, the main measure taken by the EU is to incorporate the protection requirements of high natural value farmland into the evaluation indicators of agricultural and environmental strategies. On the one hand, this can increase the scientificity of policy formulation and implementation, and on the other hand, it can improve the effectiveness of land use protection. Among them, indicators such as "low-intensity land use to protect farmland with high natural value" and "high proportion of semi-natural habitats" are included in the control contents of the Common Agricultural Policy, and are used as evaluation indicators of agricultural agri-environment schemes; In the revised version of the Common Agricultural Policy in 2014, maintaining crop diversity, protecting permanent grassland and establishing ecological core areas (EFA: Ecological Focus Area) three "greening measures", involving the protection and maintenance of many kinds of farmland with high natural value [34]. The EU also requires all member states to incorporate the evaluation indicators of high natural value farmland into the common monitoring and evaluation framework (CMEF: Common monitoring and evaluation framework), combined with the European evaluation network for rural development, evaluates the impact of the implementation of rural development plans on the scale, quality and biodiversity level of farmland with high natural value, and takes the evaluation results as an essential part of the plan evaluation report [26]. In addition, farmland with high natural value is also included in the European biodiversity index system (SEBI: Streaming Europe biodiversity indicators) has become a key indicator to define and evaluate the ecosystem and its service efficiency [32].

Table 4. Coordination strategies to address major conflicts between agricultural production and biodiversity conservation.

Coordination strategy		Conflict types												
		Intensive production			High natural value farmland abandoned							Change in scale of operation		
		Fertilizer	Insecticides, endocrine and antibiotic substances	Utilization of genetically modified organisms	Pasture transition	Afforestation	Urbanization	Succession	The management of nature is inadequate	Loss of native species	Loss of cultural sites	The trend of single planting	Small-scale landscape features	The diffusion process
Management for	Policy and management framework	√	√	√	√	√	√	√			√	√	√	
	Laws and regulations	√	√	√							√	√		
	Land purchase	√			√	√					√		√	
Incentive measure	Grant/compensation	√			√	√		√		√	√		√	√
	Marketing: health products; Educate consumers; environmental mark	√	√	√	√			√		√	√	√	√	√
	Produce tradable environmental products				√			√		√		√		√
	Sign formally	√	√		√			√	√	√	√		√	√
	Audit (self-audit and external)	√	√		√							√	√	
Participation oriented	Training (extension workers and farmers)	√	√						√		√		√	√
	Expand information sources	√	√	√					√	√			√	√
	Identifying and utilizing social connections		√	√						√	√	√	√	
	Adjustment/communication			√					√			√	√	
	Identify goals and vested interests	√	√	√	√						√	√	√	√
	Enhance the role of science and technology in conflict resolution.	√	√	√				√	√					√

Source: The author translated according to reference [33].

In terms of incentives, the EU mainly protects farmland with high natural value through a large amount of financial subsidies, although it costs a lot but the effect is not good. Maintaining necessary agricultural production activities in farmland with high natural value is of great significance for habitat protection. Halada et al. (1) compared the habitat directive list and found that 63 habitat types were dependent on or benefited from agricultural activities [35]. However, the existing control measures in the EU pay more attention to the protection and preservation of land itself, but ignore the maintenance of habitat quality and the guidance of related agricultural activities. For example, the guiding measures of the Common Agricultural Policy for agroecological environmental protection and biodiversity maintenance are mainly divided into two categories. One is direct financial subsidies, which account for about 75% of the total agricultural expenditure of the EU, and 30% of which will be used as special support for "greening measures" after 2014. The other is to formulate rural development strategies. Agri-environment plan is the focus of this part of policy and the main direction of funds. It emphasizes the implementation and promotion of specific environmental measures (including the protection of farmland with high natural value), and subsidizes the economic losses caused by farmers' failure to carry out agricultural production [28,36]. However, whether the production mode in the unsubdivided land is intensive or low density, and whether the agricultural activities are related to habitat maintenance, result in a large number of high natural value farmland that requires appropriate intervention of agricultural activities. High agricultural subsidies, which impose a huge economic burden on the EU, do not seem to have had the desired effect. For example, Feehan et al., after investigating the implementation effects of agri-environmental protection programs in Ireland, found that the most species-rich and the least species-rich areas were found in farms that had not signed agreements with the government, and the average species richness of farms that had not signed agreements was higher than that of farms that had signed agreements [37]. In addition, the over-generalized scope of subsidies leads to farmers who really play an important role in maintaining farmland with high natural value turning to intensive agricultural production or directly abandoning farmland because they do not receive due subsidies [26].

In terms of participation and promotion, it emphasizes the mining and compatibility of the compound functions of land use, that is, by strengthening the connection between human society and natural resources, it excavates the mutual promoting relationship between various ecosystem services [38], and implements resource protection strategies supported by communities [39]. Such measures usually require communication, training and promotion in the early stage. Reduced economic benefits and increased opportunity costs are the main reasons for the encroachment or destruction of farmland with high natural value [40], while benefiting from the environment is the most direct motivation for people to voluntarily maintain sustainable land use [39]. Although the productivity of farmland with high natural value is generally not high, the mining of ecological and social value-added benefits can better make up for the shortage of economic benefits in large-scale production and promote public participation. Such as: Etshekape et al., by analyzing the socio-cultural elements that influence farmers and gardeners to adopt environmentally friendly agricultural and forestry production patterns in the urban fringe of Kinshasa, it was

found that fruit production (73.9%) and shade shelter (86.4%) were the main reasons for promoting public acceptance of environmentally friendly farming [41]. But such tactics are less involved in EU regulation.

3. Implications for biodiversity maintenance and spatial control in urban areas in China

Agricultural and forestry land accounts for more than 50% of land size in most urban planning areas in China, and is an important carrier supporting small and micro habitats and regional biodiversity in marginal areas. However, due to the influence of topographic changes and urban construction, agricultural and forestry land in the marginal area is generally small in scale and scattered in layout, which makes it difficult to be effectively controlled by existing measures, and the problem of encroachment and destruction is obvious. The eu in the face of the spread of the construction land expansion, agricultural intensive production disadvantage highlighted and regional biodiversity has fallen dramatically development dilemma, proposed to have high natural value of farmland ecosystem services potential/agricultural system protection as one of the main coping strategies, and after nearly 30 years to explore optimization, fringe area in China is instructive and habitat protection and space control unit.

3.1. Planning and control strengthen the cognition of high natural value land in marginal areas

Half natural plants/vegetation as the main form of urban fringe area small-scale agriculture, forestry and land can support kinds of habitat unit and protect native species resources, and through power corridor and ecological stepping stone system construction, strengthen the link between a large ecological plaque within the region, but both the planning control in China did not pay enough attention to its. For example, the construction of natural reserve system, which emphasizes biodiversity maintenance and ecological security, focuses more on the protection of large patches such as national parks, nature reserves and natural parks. In the territorial space management and dual evaluation system, the size of land patch, the service potential of the patch itself, and the adaptation degree to modern agricultural production are still taken as the main evaluation indicators. According to the EU's habitat protection practice, a variety of land use hybrid layout production mode and low strength and high natural value of farmland is monomer are generally small scale, their ecological value is outstanding, but plays an important role in maintaining the local biodiversity, are not only good for increasing survival depends on the farmland landscape animals and other specific species conservation, It also has landscape style maintenance, multiple agricultural and sideline products supply, outdoor recreation and other composite functions. Therefore, for urban fringe areas with few nature reserves or large habitat patches, and where the public has complex functional demands for habitat units, land use control should emphasize the protection and value cognition of semi-natural small and micro habitats and site conditions, such as low-intensity farming farmland, pastoral grassland, secondary woodland and shrub woodland [42]. The habitat unit is included in the overall spatial control and planning of the region.

3.2. Land use identification and zoning control based on the overall network construction and environmental resource characteristics

Farmland and woodland with high natural value can not only maintain small and micro habitats and species diversity in urban fringe areas, but also protect the necessary spatial patterns carrying natural ecological processes such as species dispersal or migration. Therefore, the identification and control of land with high natural value should not only be limited to the marginal area itself, but also should put forward corresponding evaluation indicators and control points according to the systematic function of land use and the characteristics of environmental elements, and serve as a supplement to the existing standards.

In order to evaluate and identify small and micro-habitats in marginal areas and corresponding farmland and woodland with high natural value, we should first construct landscape ecological networks that maintain regional biodiversity and essential natural processes. It is emphasized that the land use control for biodiversity protection can be mainly summarized into two categories: one is centered on the protection of specific species (rare, endangered or representative), that is, determining the habitat conditions, impact factors and their weights suitable for the habitat and reproduction of the target species, and evaluating and protecting the land use based on it [43]. The other type is centered on the overall protection of habitat network, that is, the identification of land that is important for the maintenance of habitat network space and the systematic protection. The first type of method is common and easy to implement, but it is prone to over-subjectivity in the selection of target species, or does not consider the connection between habitats [43], so it is more common in the demarcation and control of nature reserves, and is not suitable for marginal areas with small and dispersed habitat patches. The second method from the regional level, emphasize the construction of landscape ecology network [44] in order to strengthen the relationship between habitat, thus protecting indigenous species and their occurrence habitat, at the same time maintain land evaluation and identify key points control characteristics fringe area small microenvironment and high value of biodiversity conservation and urban area to maintain the relationship between the source: The authors map the natural ecological processes to ensure the essential material energy supply of habitats, which is suitable for small and micro habitats and land use protection in marginal areas. For example, in order to better play the role of high natural value farmland in biodiversity maintenance, the European Union proposed to integrate high natural value farmland into the Natura 2000 network for overall management and control. Therefore, the identification of small and micro-habitats and their corresponding high-value land in marginal areas should be based on the overall framework of regional landscape, and through the analysis of land use types, agricultural farming patterns, and species distribution characteristics, the land use and space that play a supporting role in the maintenance of landscape pattern should be determined, and the dominant function characteristics of land use should be defined. In addition, zoning management (such as protection, repair and transformation) should be carried out in the construction of corridors and patches at all levels.

On this basis, combined with the analysis of land patch characteristics and natural environment elements, it can further define the range of small and micro-habitats and

their corresponding high-value land in the marginal area, which is convenient for land conservation and zoning management. According to the protection practice of high natural value farmland in the European Union, the remaining small and micro habitats in areas dominated by urban or agricultural landscapes are mostly distributed in :(1) agricultural or urban fringe areas with obvious natural constraints (such as poor soil and steep slope) [27]; (2) Areas that adopt or rely on low-intensity farming/grazing. For example, Larkin et al. (1) found that linear green areas such as shrub woodland and hedge on the edge of farmland or along drainage channels were the most common habitat units, accounting for 43% of the habitat area in the study area [34]. Therefore, can be fit and landform characteristics, and the distribution of the hydrological factors close degree, land use intensity [45], habitat heterogeneity (such as a natural habitat) [46], plaque morphology (e.g., evenness, patch density, the ongoing ratio), as a fringe area of high value land and small micro habitat identification evaluation index, And verified by field survey data.

3.3. Management of small and micro-habitats and high-value land in marginal areas combines rigid control with elastic guidance

Fringe area small micro habitat for urban area biodiversity support, more dependent on land development and utilization of natural process followed in [26] and a moderate amount of manual intervention, management and maintenance level directly affects the quality of habitat, so there is no need to stop completely high natural agricultural production activities in the value of farmland, forest land, only need to control its farming intensity [26]. For example, Wright et al., through research, proposed that the layout of mixed agricultural land that maintains low-intensity production is better than idle farmland in protecting biodiversity [47]. Therefore, it is critical to protect high natural value farmland and forest land and guide their users or owners to take the initiative in environmentally friendly farming activities that contribute to the maintenance of biodiversity.

Due to the complexity of urban fringe area land ownership, the function demands of composite, and long-term dynamic process, thus protect the fringe area of small micro habitat needs not only from the material space to control land use scale, layout, etc, also need to consider behind habitat as a condition of support of society, economy and environment, take control and elastic rigidity land use to guide the management way of combining Avoid encroachment of land use, function alienation, abandoned tillage and other problems. Rigid land use control is mainly reflected in the protection and management of farmland and woodland with high natural value. In order to avoid encroachment of land use caused by urban and rural construction and agricultural intensive farming, control can be carried out in the way of “fixed structure, fixed scale, fixed location and fixed function”. Flexible use of lead is mainly for the edge area of land use dynamic character, diversity, compound, namely by interests, policies to encourage, guide the community recognized low intensity high natural value and active participation of farming activities, such as diversification of crops, reduce chemical use, etc. Due to the multi-element composition and complex structure characteristics of the social-ecological system in the marginal area, resilient measures should be considered to cope with the rapid change of land use and function [48], and

regional cooperation should be adopted [49].

Direct financial subsidies to farmers to protect farmland with high natural value and maintain traditional agricultural practices have achieved significant results in the short term, but the social and ecological system decoupling limits the effectiveness and time. Therefore, long-term habitat protection should be achieved by enhancing public awareness and active participation. In order to promote the stakeholders (the public, the public sector, civil society groups, etc.) To better participate in the preparation, decision-making and resource allocation of rural development plans, the EU has implemented the Linking Rural Economy and Development Action Plan (LEADER: Liaison Entre Actions de Developpement de l 'Economie Rurale and community-led local development programmes (CLLD: Community-led Local Development). By 2018, the EU had managed to attract 61% of the rural population to participate in the decision-making process of rural development plans.

3.4. Protection measures for small and micro-habitats and high-value land in marginal areas shall be implemented in accordance with statutory planning and control

The small and micro habitats and corresponding farmland and woodland with high natural value in the urban fringe area are easily reduced to the management "vacuum area" due to the multi-department management and control. Therefore, the connection with other existing statutory planning and control should be strengthened to realize the landing protection. In the practice of high natural value farmland protection in the European Union, in order to strengthen management effectiveness, the management departments have incorporated land protection into a number of agricultural and environmental policies, and made it a prerequisite for planning review. In China's land resource planning and management system, the protection of small micro-habitats in marginal areas and their corresponding high-value land use is mainly related to the content of land space planning and green space system planning, so land use control should be strengthened to connect with the two. (1) The connection with the national spatial planning system is mainly reflected in the overall national spatial planning and detailed planning at the city (county) level. Among them, the connection between the protection of small and micro habitats in the marginal area and the control content at the general plan level can further clarify the ecological spatial pattern that supports regional biodiversity and ecological security, refine the division of agricultural production space and the demarcation of urban growth boundary, optimize the spatial layout of urban and rural areas, and lay the foundation for regional management. Detailed planning level cohesion can be born fringe area of small micro habitat and corresponding high value land "determinate structure, size, position, or function" management, improve urban growth boundary control force and the scientific nature, also can maintain small microenvironment of farming activities as necessary for the relevant land development condition, to promote implementation. (2) The connection with the green space system is mainly reflected in the improvement of the existing planning system and the refinement of control measures. First of all, the fringe area small microenvironment and the corresponding high value land use control can strengthen the management of green space within a planned urban area, both can

join peripheral landscape ecology network, but also for these areas within the green space organization put forward detailed control requirements, strengthen control varies widely with the center of xiamen city the linkage between urban green space system planning content, At the same time, it can make up for the lack of protection and management of green space in the marginal area. Secondly, high-value land and habitat units that are important for the maintenance of regional biodiversity are identified in the general marginal green space zoning, so as to more accurately manage land use and improve management and energy efficiency.

4. conclusions

The identification and protection of semi-natural small and micro-habitats in the marginal area can make up for the negative impact of the homogenization, simplification and over-artificialization of green space in the urban construction area on regional biodiversity, and is of key significance for the protection of ecological space in the marginal area and the improvement of the efficiency of construction land management and control. This paper reviewed the identification and maintenance of high natural value farmland in the European Union, and put forward the key points of the management and control of semi-natural small and micro habitats in the marginal area mainly composed of agricultural and forestry land :(1) strengthen the management departments' recognition of the value of small and micro habitats and land in the marginal area; (2) Identify the possible small and micro habitats and land use by analyzing the topography, hydrological elements, farming patterns, and land use heterogeneity, and integrate them into the regional landscape ecological network for overall management and control; (3) Rebuild the connection between social and cultural systems and natural ecosystems, guide the public to take the initiative to participate in the effective protection of land use through the appropriate use of small and micro habitats; (4) Strengthen the connection with national space planning and green space system planning, and increase the implementation of control.

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