

1 **A farmland biodiversity strategy is needed for China**

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13 **Abstract:**

14 Countrywide citizen science data show the importance of farmland outside protected areas
15 for China's avifauna. We urge the government of China to develop a national strategy for
16 policy and research to protect biodiversity and traditional knowledge of sustainable
17 agriculture to meet the post-2020 goal of the Convention on Biological Diversity.

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19 **Main Text:**

20 Agricultural lands take up to a third of the earth's terrestrial surface. In recent decades, the
21 expansion and intensification of agricultural land, triggered by the continuous increase in
22 human population and dietary changes, has become one of the direct drivers of Anthropocene
23 biodiversity loss¹. The expansion of agricultural production, however, has neither always nor
24 everywhere taken place at the expense of biodiversity. Instead, over the course of centuries of
25 development of agricultural practices, a significant number of wild species have adapted or
26 even become dependent on farmland habitats. The exact characteristics of agricultural
27 development are, therefore, relevant to the fate of global biodiversity, and wildlife-friendly
28 farmlands should be considered as valuable ecosystems. Half of the globe's agricultural lands
29 are distributed in the 17 megadiverse countries, of which China possesses the largest share of
30 the world's agricultural lands at 9.9% of the global total^{2,3}. With its long cultivation history,
31 China has accumulated rich knowledge with regard to sustainable intensive agricultural
32 practices at small scales. The modernization of agriculture in China in recent decades, despite
33 its remarkable success at feeding its large population, has led to the rapid extinction of
34 diverse land-use practices, threatening the coupling of social and ecological systems⁴.
35 Unfortunately, China's National Biodiversity Strategies and Action Plan (NBSAP) for the
36 Convention on Biological Conservation (CBD) fails to recognize traditional agriculture as an

37 asset for biodiversity conservation bearing its unique cultural heritage⁵, nor the drastic change
38 in agricultural practice as one of the causes of domestic biodiversity loss.

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40 **Overlooked biodiversity value of farmlands**

41 Typically, the value of farmland is considered with regard to food production. China's
42 agricultural policies primarily target this production function of farmland. In China's country
43 enforcement reports for CBD, biodiversity in the agricultural sector related to farmland is
44 exclusively interpreted in terms of genetic resource conservation, invasive species and pest
45 control. The term “biodiversity” was not mentioned in the annual budget of the Ministry of
46 Agriculture and Rural Affairs⁶. China's newly developed land-use planning scheme, “Major
47 Function-Oriented Zones”, aimed at optimizing the state’s spatial development pattern in a
48 top-down approach by assigning the territorial space to four types based on development
49 intensity: development-optimized areas, development-prioritized areas, development-
50 restricted areas, and development-prohibited areas⁷. Each area is assigned to one of the four
51 major functions serving for industrial or urban development, food production, or ecosystem
52 services provisioning⁷. Although biodiversity in development-restricted areas may benefit
53 from strictly regulated land-use intensity, this land-use planning policy has led to the
54 segregation of lands for nature conservation and agricultural production. In other words,
55 under the current land-use policy arrangement in China, only lands designated as Nature
56 Reserve are recognized for sustaining biodiversity⁸.

57

58 **High biodiversity in China’s farmlands**

59 Agriculture takes the most fertile lands in China which also provide abundant resources for
60 associated wild species (Fig. 1a). According to remote sensing data, cultivated landscapes
61 covered 1.79 million km² in 2015⁹, i.e., almost twice as much as China’s National Nature

Reserves, stretching over 0.97 million km²¹⁰. Data to assess biodiversity distribution in China's farmlands is overall very limited. However, blooming citizen science approaches on bird species resulted in the most comprehensive nationwide avian database with fine-resolution and up-to-date information on species occurrences collectively compiled by over 7,000 bird watchers¹¹. Although abundance data remain insufficient in the citizen science database, regional study in Europe has reported congruent trends of avian richness and abundance influenced by different farmland management regimes¹². Using these bird data as the best available biodiversity indicator, we simulated potential habitats of 1,111 avian species, including 167 national-protected species and 70 threatened species (see Supplementary Methods). Nearly 25% of the national-protected species and 20% of the threatened species use farmland as habitat (See Supplementary Methods, Supplementary Table 1). Looking at the top 17% (the Aichi Target 11) and 50% (the "Half-Earth" Advocacy¹²) simulated avian-species-rich pixels (1-km grain size), the ratio of cultivated landscapes or National Nature Reserves to the 17% and 50% pixel areas increases from 15.2%/3.6% to 28.7%/3.9%. The importance of the cultivated landscape is more pronounced for threatened birds, with the ratio reaching 37.6%/3.1% and 30.5%/3.6% respectively. Among the 220 birds that use farmland for feeding or nesting, more than half have over 50% simulated potential habitats in cultivated landscapes (see Supplementary Methods, Supplementary Fig. 1). The potential habitats of the 220 species identify six avian-diverse farming regions of China: 1) the Northwest Xinjiang, 2) the Bohai Rim and Parts of the North China Plain, 3) the Sichuan Basin, 4) the Poyang Lake Plain and the Plain of Hunan and Hubei, 5) the Coastal Areas and Plains of the Yellow Sea, and 6) the West Guangdong and East Guangxi Areas (Fig. 1b). Nevertheless, to date there has been a lack of both regulatory and institutional arrangements to support the enormous avian conservation value in these identified species-rich farmland regions.

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88 **CBD post-2020 framework as an opportunity for mainstreaming**

89 China's obligation to conserve biodiversity is bound to its CBD ratification. However, among
90 the eight megadiverse countries that have over 40% agricultural territory, China is the only
91 nation that lacks explicit farmland biodiversity targets in its NBSAP⁵. The only other
92 exception is the United States, which is not a CBD signatory. Heading towards the post-2020
93 biodiversity framework, a broad consensus has been reached for setting conservation targets
94 high in order to reverse the steep species-decline trajectory^{13,14}. The current global protected
95 area system is unlikely to meet such a requirement¹⁵. In this context, the post-2020
96 framework may serve as an opportunity for China to review its biodiversity strategies on
97 farmland. On the one hand, China inherits a myriad of sustainable agricultural systems that
98 facilitate the co-existence of humans and nature¹⁶. The value of this long and rich bio-cultural
99 heritage is a great asset for the future. On the other hand, during the same time period set for
100 achieving the Aichi Targets, China has become the world's largest consumer of chemical
101 fertilizer and pesticide¹⁷. The rapid agricultural intensification with heavy use of pesticides
102 has profoundly undermined ecosystem services sustained by traditional farming¹⁸, putting
103 both biodiversity and food safety at risk. Establishing China's farmland biodiversity strategy
104 requires the recognition of the environmental function of agricultural land at the decision-
105 making level. Farmland has to be valued not only for agricultural production, but also as a
106 shared space within which a great number of species complete their life cycles, especially in
107 areas where farmlands are small and scattered. In this sense, farmland biodiversity is one
108 form of public good produced by agriculture as an environmental externality, which should
109 be integrated into China's ecological compensation schemes.

110

To ensure domestic food security, China has set up a redline of 1.2 million km² of arable land which cannot be transformed into other types of land use. Farmland to be spared for the conservation of birds and other wild fauna and flora is rather limited at present. Thus, new agricultural systems in China should be developed to integrate both traditional wisdom and scientific knowledge of sustainable intensification towards the conservation of focal species in high-priority areas. First, a national baseline of biodiversity distributions in farmlands should be established to set spatial conservation targets, such as within the six avian-diverse farming regions in China. Second, interdisciplinary research projects should be launched to investigate the integration of traditional agricultural knowledge and modern scientific knowledge to foster the successful coupling of sustainable farming with species protection. Third, policy and market incentives should be created to reward wildlife-friendly farming or compensate for farmers' losses in production (i.e., a fund for farmland eco-compensation). Lastly, farmland biodiversity monitoring should be installed to facilitate both action- and performance-based payment. We propose that conserving farmland biodiversity should become part of the jurisdiction of state level administrative responsibility, and research funds should be directed towards finding novel solutions for human-nature coexistence.

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176

177 **Author Contributions**

178 Z. L., L. L., J. H. and M. B. conceptualized and framed the main perspective of the comment.
179 R. H. conducted all species modeling and mapping and wrote the chapter of Supplementary
180 Methods. Z. Z. reviewed the current agricultural policies of China. J. H. provided
181 recommendations regarding agricultural policies. L. L. drafted the manuscript, M. B., Z. L.
182 and J. H. revised the content and language of the manuscript.

183

184 **Competing interests**

185 The authors declare no competing interests.

186

187 **Fig. 1a** The Crested Ibis (*Nipponia nippon*) depends on rice paddy fields. Benefiting from the
188 conservation measures of maintaining traditional land use and restricting agrochemicals, its
189 numbers have increased from less than a dozen to over 2,000 in the past 30 years. Photo:
190 Dingqian Xiang. **Fig. 1b** Six avian-diverse farming regions in China. 1) the Northwest
191 Xinjiang, 2) the Bohai Rim and Parts of the North China Plain, 3) the Sichuan Basin, 4) the
192 Poyang Lake Plain and the Plain of Hunan and Hubei, 5) the Coastal Areas and Plains of the
193 Yellow Sea, and 6) the West Guangdong and East Guangxi Areas. 1) and 2) mainly consist of
194 dry farming lands, 4) and 5) are paddy fields, 3) and 6) have both.

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b

