Table S1 Calculation formula of farmland ecosystem service value assessment

ES	Value evaluation method	Formula	Introduction of parameters	Parameter value
Providing primary product	Market price method	$V_{F1} = Yr \times Pr \times A$ (S1)	V_{F1}: the value of providing primary product of farmland ecosystem (CNY /a); Yr: the yield of rice in the evaluation area (t/ha); A: the area of farmland ecosystem(ha); Pr: market price of rice in the evaluation area (CNY/t).	
Air purification	Protection cost method	$V_{F2} = (Q_{SO2} \times P_{SO2} + Q_{NOX} \times P_{NOX} + Q_{HF} \times P_{HF} + Q_{Dust} \times P_{Dust}) \times A$ (S2)	V_{F2}: the value of air purification (CNY /a); Q_{SO2}, Q_{NOX}, Q_{HF}, and Q_{Dust}: the average fluxes of SO_2, NOx, HF and dust absorbed by the rice field (kg /ha·a); P_{SO2}, P_{NOX}, P_{HF}, P_{Dust}: the purification cost of SO_2, NOx, HF and dust (CNY/kg).	Q_{SO2}, Q_{NOX}, Q_{HF}, and Q_{Dust} are 44.97, 33.32, 0.57, 917.74kg / ha· a; P_{SO2}, P_{NOX}, P_{HF}, P_{Dust} are 1.44, 0.76, 0.83, and 0.18 CNY/kg.
Control of erosion rates	Opportunity cost method and shadow project method	$V_{F3} = Vn + Vs$ (S3) $Vn = Wsc \times (C_{SOM} \times P_{SOM} + C_N \times P_N + C_P \times P_P + C_K \times P_K)$ (S4) $Vs = 0.24 \times Wsc \times Pe / \rho$ (S5) $Wsc = (M1 — M0) \times A$ (S6)	V_{F3}: the value of control of erosion rates (CNY /a); Vn: the value of reducing soil nutrient loss (CNY /a); Vs: the value of reducing river silting (CNY /a); Wsc: the reduced amount of soil erosion	M1 is 44.51 t/ ha · a; M0 is 8.79-9.13 t/ ha · a; ρ is 1.14 g/cm³ (Jizhai), 1.29g/cm³ (Ziquejie),1.26 g/cm³ (Zhenglong); C_{SOM} is 42.95g/kg (Jizhai), 33.86g/kg (Ziquejie),

			(t/a); M1: erosion modulus of wasteland (t/ha·a); M0: actual erosion modulus (t/ha·a); C_{SOM} ,C_N, C_P, C_K: SOM, N, P, K content per unit of erosion (g/kg); P_{SOM} ,P_N, P_P ,P_K: market price of SOM, N, P, K (CNY /kg); Pe: the cost of earthmoving cleanup and transportation (CNY /m^3); ρ: soil bulk density(g/cm^3).	59.39g/kg (Zhenglong); C_N is 2.04 g/kg (Jizhai), 2.01 g/kg (Ziquejie), 3.05 g/kg (Zhenglong); C_P is 184.77mg/kg (Jizhai), 47.24mg/kg (Ziquejie), 65.07mg/kg (Zhenglong); C_K is 927.53 mg/kg (Jizhai),724.05 mg/kg (Ziquejie),1237.44 mg/kg (Zhenglong).
Groundwater recharge	Shadow project method	$V_{F4} = f \times Tw \times A \times Pr$ (S7)	V_{F4}: the value of groundwater recharge (CNY /a); f: the soil water infiltration rate in rice field (mm/d); Tw: the number of days of standing water period of rice (d); Pr: the unit price of reservoir engineering fee usage (CNY /m^3).	f is 2.5 mm/d; Tw is 300 d.
Flood control	Shadow project method	$V_{F5} = (Hr - Hw) \times A \times 10,000 \times Pr$ (S8)	V_{F5}: the value of flood control (CNY /a); Hr: the average ridge height of rice field (m); Hw: the depth of standing water in paddy field (m); Pr: the unit price of reservoir engineering fee usage (CNY /m^3).	Hr is 0.25 m; Hw is 0.1m.

Increase of fauna diversity and micro-organisms	Ecological value method	$V_{F6} = C_{bv} \times K^{-1}$ (S9) $K = a \times (1 + e^{-t})^{-1}$ (S10)	V_{F6}: the value of increase of fauna diversity and micro-organisms (CNY /a); K: social development stage coefficient; a: correction coefficient, the ratio of the price of conventional and organic rice; e: napierian base; t: subtract 3 from the reciprocal of Engel's coefficient; C_{bv}: the fundamental value of biodiversity conservation (CNY /a).	
Reducing pesticides and herbicides	Substitute cost method	$V_{F7} = (C_C - C_E) \times A$ (S11)	V_{F7}: the value of reducing pesticides and herbicides (CNY /a); C_C: the average pesticide cost for the conventional planting system (CNY /ha·a); C_E: the average pesticide cost for the ecological planting system (CNY /ha·a).	
Maintaining Soil Nutrients	Substitute cost method	$V_{F8} = Bsoc \times A \times Psoc$ (S12) $Bsoc = Isoc - Osoc$ (S13) $Isoc = Mr \times 5 \times Cr + Ms \times 12\% \times Cs$ (S14) $Osoc = E_{CO2} \times 0.27 + E_{CH4} \times 0.75$ (S15)	V_{F8}: the value of maintaining soil nutrients (CNY /a); P_{SOC}: the market price of organic matter (CNY /kg); I_{SOC}: the input amount of soil organic matter (kg / ha·a); O_{SOC}: the output amount of soil organic matter (kg/ ha·a); E_{CO2} and E_{CH4}: CO_2 and CH_4 emissions	E_{CO2} and E_{CH4} is 2,123.63 kg/ha·a and 29.64 kg/ha·a, respectively; Mr and Ms is900,4500 kg/ha·a, respectively; Cr and Cs is 34.60% and 41.40%, respectively.

			from rice fields, respectively (kg/ha·a); 0.27 and 0.75: the conversion coefficients of CO_2 and CH_4, respectively, into pure carbon; Mr and Ms: the biomass of rice root system and straw, respectively(kg/ha·a); Cr and Cs: the carbon content of rice root system and straw, respectively.	
Gas regulation	Carbon tax method and industrial oxygen method	$V_{F9} = V_{CO2} + V_{O2} - V_G$ (S16) $V_{CO2} = Y_N \times \alpha \times Nc \times C_{CT} \times A$ (S17) $V_{O2} = Y_N \times \phi \times C_{IOP} \times A$ (S18) $Y_N = Yr \times (1 - m) / \beta$ (S19) $V_G = E_T \times Nc \times C_{CT}$ (S20) $E_{CH4} = A \times D_G \times g1$ (S21) $E_{N2O} = A \times D_N \times g2$ (S22) $E_{CO2} = A \times D_G \times g3$ (S23) $E_T = (E_{CO2} + E_{CH4} \times GWP_{CH4} + E_{N2O} \times GWP_{N2O}) \times 10^{-3}$ (S24)	V_{F9}: the value of gas regulation (CNY /a); V_{CO2}: the value of CO_2 fixed by rice; Y_N: the net rice yield (t/ha·a); α: the amount of CO_2 fixed for 1 g of rice dry matter; Nc: the carbon content in CO_2; C_{CT}: the Swedish carbon tax rate (CNY /t); V_{O2}: the value of O_2 released by rice; ϕ: the amount of O_2 produced for 1 g of rice dry matter; C_{IOP}: the cost of industrial oxygen production (CNY /t); Yr: the yield of rice in the evaluation area (t/ha·a) m: the moisture content of rice; β: economic coeffificient of rice.	a is 1.63g; Nc is 27.27%; ϕ is 1.19 g; m is 14%; β is 0.5; g1 is 0.334 kg/ha·d; g2 is 0.056 kg/ha·d; g3 is 374.39 kg/ha·d; D_G is 150d; D_N is 65d; GWP_{CH4} and GWP_{N2O} is 28 and 265, respectively; Nc is 27.27%.

			V_G: the negative value of greenhouse gas emissions (CNY /a); E_{CH4}, E_{N2O}, E_{CO2}: the total CH_4 emissions, the total N_2O emissions, the total CO_2 emissions (kg); g1, g2, g3: the average emission flux of CH_4, N_2O, CO_2 in rice field ecosystem (kg/ha·d); D_G: the number of days of growth period of rice (d); D_N: the number of days of non-standing water period of rice (d); GWP_{CH4} and GWP_{N2O}: GWP for CH_4 and N_2O in the past 100-year time horizon, respectively; Nc: the carbon content in CO_2 C_{CT}: the Swedish carbon tax rate (CNY /t).	
Climate regulation	Substitute cost method	$V_{F11} = A \times \mu \times P_C$ (S25) $Q_E = S_E \times D_H$ (S26) $M = Q_E \times 30.57 / 50$ (S27)	V_{F11}: the value of temperature regulation (CNY /a); Q_E: the total cooling effect of the farmland ecosystem (mm); S_E: the average daily water evaporation in the farmland (mm/d); D_H: the hot summer days in the study area (d);	S_E is 6.89 mm/d.

			μ: the heat consumed by evaporation of 50 mm of water from 1 ha rice field, replaced by 30.57 t standard coal combustion heat; P_C: the price of the coal(CNY /t).	
Development of tourism	Travel cost method	$V_{F12}=\sum TR_i$ (S28)	TR_i: the expenses of accommodation, transportation, purchasing local products and entertainment, etc.	
Cultural inheritance	Substitute cost method	$V_{F13}=\sum TC_i$ (S29)	TC_i: the input costs for the protection and inheritance of traditional culture.	

Table S2 Calculation formula of woodland ecosystem service value assessment

ES	Value evaluation method	Formula	Introduction of parameters	Parameter value
Providing primary product	Market price method	$V_{W1} = \sum Y_i \times P_i$ (S30)	V_{W1}: the value of providing primary product of woodland ecosystem (CNY /a); Yi: the yield of product i (t/a); Pi: market price of product i (CNY/t).	
Air purification	Protection cost method	$V_{W2} = (Q_{SO2} \times P_{SO2} + Q_{NOX} \times P_{NOX} + Q_{HF} \times P_{HF} + Q_{Dust} \times P_{Dust}) \times Aw$ (S31)	V_{W2}: the value of air purification (CNY /a); Q_{SO2}, Q_{NOX}, Q_{HF}, and Q_{Dust}: the average fluxes of SO_2, NOx, HF and dust absorbed by the woodland(kg /ha·a);	Q_{SO2}, Q_{NOX}, Q_{HF}, and Q_{Dust} are 117.6, 6, 4.65 , 33000kg /ha·a; P_{SO2}, P_{NOX}, P_{HF}, P_{Dust} are 1.44, 0.76, 0.83, and 0.18 CNY/kg.

			P_{SO2}, P_{NOX}, P_{HF}, P_{Dust} : the purification cost of SO_2, NOx, HF and dust(CNY/kg); Aw: the area of woodland ecosystem(ha).	
Control of erosion rates	Opportunity cost method and shadow project method	$V_{W3} = Vwn + Vws$ (S32) $Vwn = Wwsc \times (C_{SOM} \times P_{SOM} + C_N \times P_N + C_P \times P_P + C_K \times P_K)$ (S33) $Vws = 0.24 \times Wwsc \times Pe / \rho_w$ (S34) $Wwsc = (M1 — Mw) \times Aw$ (S35)	V_{W3}: the value of control of erosion rates (CNY /a); Vwn: the value of reducing soil nutrient loss(CNY /a); Vws: the value of reducing river silting(CNY /a); Wwsc: the reduced amount of soil erosion(t/a); M1:erosion modulus of wasteland(t/ha·a); Mw: erosion modulus of woodland (t/ha·a); C_{SOM} ,C_N, C_P, C_K: SOM, N, P, K content per unit of erosion; P_{SOM} ,P_N, P_P ,P_K: market price of SOM, N, P, K (CNY /kg); Pe: the cost of earthmoving cleanup and transportation (CNY /m^3); ρ_w: soil bulk density of woodland(g/cm^3).	M1 is 44.51 t/ha·a; Mw is 2.09t/ha·a; ρ_w is 0.95 g/cm^3; C_{SOM} is 4.829%; C_N is 0.155%; C_P is 0.047%; C_K is 1.28%.
Groundwater recharge	Shadow project method	$V_{W4} = Q \times Pr$ (S36) $Q = Aw \times J \times R$ (S37) $J = J_0 \times K$ (S38) $R = R_0 – Rg$ (S39)	V_{W4}: the value of groundwater recharge (CNY /a); Q: the increase in water conservation in woodland compared with bare land(mm);	J_0 is 1800mm; K is 0.6; R is 0.39.

			J_0: mean annual precipitation(mm) J: average annual runoff rainfall(mm) K: the proportion of runoff precipitation to total rainfall; R: efficiency coefficient of reducing runoff in woodland compared with bare land; R_0 and Rg: runoff rate of bare land and woodland under runoff producing rainfall; Pr: the unit price of reservoir engineering fee usage (CNY /m^3).	
Increase of fauna diversity and micro-organisms	Shannon-Wiener index evaluation method	$V_{W5} = Sc \times Aw$ (S40)	V_{W5}: the value of increase of fauna diversity and micro-organisms (CNY /a); Sc: conservation species value of per unit (CNY /ha·a).	Sc is 30678.6 CNY /ha·a.
Maintaining Soil Nutrients	Substitute cost method	$V_{W6} = (L_N \times P_N + L_P\times P_P + L_K\times P_K) \times A$ (S41)	V_{W6}: the value of maintaining soil nutrients (CNY /a); L_N, L_P, L_K: the amount of nutrient elements from forest litter returned to forest land (kg /ha·a), P_N, P_P, P_K: the price of N, P, K (CNY /kg).	L_N, L_P, L_K is 128.63, 6.17, 41.4 kg /ha·a, respectively.
Gas regulation	Carbon tax method and industrial oxygen method	$V_{W7} = V_{CO2} + V_{O2}$ (S42) $V_{CO2}' = NPP \times 1.63 \times N_c \times C_{CT} \times Aw$ (S43) $V_{O2}' = NPP \times 1.19 \times C_{IOP} \times Aw$ (S44)	V_{F9}: the value of gas regulation (CNY /a); NPP: net primary productivity of vegetation(t/ha·a);	Nc is 27.27%.

			V_{CO2}': the value of CO_2 fixed by forest; Nc: the carbon content in CO_2; C_{CT}: the Swedish carbon tax rate; V_{O2}': the value of O_2 released by forest; C_{IOP}: the cost of industrial oxygen production.	
Climate regulation	Outcome parameter method	$V_{W8} = Pi \times WT$ (S45) $WT = WT_C \times NPP \times Aw$ (S46)	V_{W8}: the value of temperature regulation (CNY /a); Pi: the value of water vapor per unit volume in regulating climate by transpiration; WT: water vapor transpiration of woodland; WT_C: the transpiration coefficient of woodland.	WT_C is 750.

Table S3 Calculation formula of water ecosystem service value assessment

ES	Value evaluation method	Formula	Introduction of parameters	Parameter value
Surface water for drinking	Market price method	$V_{WA1}= Q_{WA}\times P_{WA}$ (S47)	V_{WA1}: the value of surface water for drinking (CNY /a); Q_{WA}: domestic water consumption (t/a); P_{WA}: the price of domestic water (CNY/t).	

Air purification	Protection cost method	$V_{WA2}=Q_{Dust} \times P_{Dust} \times A_{WA}$ (S48)	V_{WA2}: the value of air purification (CNY /a); Q_{Dust}: the average fluxes of dust absorbed by the water area (kg /ha·a); P_{Dust} : the purification cost of dust(CNY/kg); A_{WA}: the area of water ecosystem(ha).	Q_{Dust} is 498kg /ha·a.
Water purification	Protection cost method	$V_{WA3}= Q_P \times P_P$ (S49)	V_{WA3}: the value of water purification (CNY /a); Q_P: the amount of pollution treatment (kg / a); P_P: the unit cost of pollution treatment (CNY/kg)	
Water resources storage	Shadow project method	$V_{WA4}= A_{WA} \times H_{WA} \times Pr$ (S50)	V_{WA4}: the value of water resources storage (CNY /a); A_{WA}: the area of water ecosystem(ha); H_{WA}: average depth of water (m); Pr: the unit price of reservoir engineering fee usage (CNY /m^3).	
Flood control	Shadow project method	$V_{WA5}=A_{WA} \times \Delta h \times Pr$ (S51)	V_{WA5}: the value of flood control (CNY /a); Δh: the difference between the highest water level and the normal water level (m); Pr: the unit price of reservoir engineering fee usage (CNY /m^3).	

Increase of fauna diversity and micro-organisms	Outcome parameter method	$V_{WA6}=S_{WA}\times A_{WA}$ (S52)	V_{WA6}: the value of increase of fauna diversity and micro-organisms (CNY /a); S_{WA}: conservation species value of per unit water (CNY /ha·a).	
Gas regulation	Carbon tax method and industrial oxygen method	$V_{WA7}=B\times A_{WA}\times (1.63\times N_c\times C_{CT} +1.19\times C_{IOP})$ (S53)	V_{WA7}: the value of gas regulation (CNY /a); B: net primary productivity of phytoplankton(t/ha·a); Nc: the carbon content in CO_2; C_{CT}: the Swedish carbon tax rate; C_{IOP}: the cost of industrial oxygen production.	Nc is 27.27%.
Climate regulation	Substitute cost method	$V_{WA8}= X_1 + X_2$ (S54) $X_1 = Qe \times Pe \times \beta$ (S55) $X_2 = (Qe \times L \times Pe) /3600\alpha$ (S56)	V_{WA8}: the value of temperature regulation (CNY /a); X_1: the value of increasing air humidity; X_2: the value of reducing temperature; Qe: the amount of evaporated from the water (m^3) ; Pe: the price of electricity (CNY/ kW·h) ; β: the electricity consumption of converting 1 m^3 water into steam; L: heat of vaporization of water under standard conditions; α: air conditioning energy consumption ratio	β is 125 kW·h; L is 2260 kJ/kg; α is 3.2.

Table S4 Land use conversion matrix in Zhenglong, Ziquejie and Jizhai villages, 2006–2022.

Land types area, m^2		2006				
		Farmland	Woodland	Water area	Built-up area	Total
Zhenglong, 2022	Farmland	3341144	94180	6020	17204	3458548
	Woodland	209833	4847547	11748	0	5069128
	Water area	6756	7135	72967	520	87378
	Built-up area	105459	18597	3227	315334	442617
	Total	3663192	4967459	93962	333058	9057671
Ziquejie, 2022	Farmland	4630367	40913	6306	22064	4699650
	Woodland	208489	5757575	0	7697	5973761
	Water area	8358	0	28373	0	36731
	Built-up area	198862	55634	19	467472	721987
	Total	5046076	5854122	34698	497233	11432129
Jizhai, 2022	Farmland	1850753	46531	292	10983	1908559
	Woodland	155016	1606072	41	2113	1763242
	Water area	2517	4091	30419	2429	39456
	Built-up area	105930	6170	2298	127234	241632
	Total	2114216	1662864	33050	142759	3952889

Table S5 Land use conversion matrix in Zhenglong, Ziquejie and Jizhai villages, 2006–2014.

Land types area, m^2		2006				
		Farmland	Woodland	Water area	Built-up area	Total
Zhenglong, 2014	Farmland	3440921	44735	3633	25881	3515170
	Woodland	131151	4909663	2991	87	5043892
	Water area	2781	3031	86337	772	92921
	Built-up area	88339	10030	1001	306318	405688
	Total	3663192	4967459	93962	333058	9057671
Ziquejie, 2014	Farmland	4697450	12711	6184	45536	4761881
	Woodland	209918	5806907	0	10556	6027381
	Water area	9278	0	28495	92	37865
	Built-up area	129430	34504	19	441049	605002
	Total	5046076	5854122	34698	497233	11432129
Jizhai, 2014	Farmland	1934871	79090	353	14343	2028657
	Woodland	102683	1572057	41	1922	1676703
	Water area	2517	4084	30422	2419	39442
	Built-up area	74146	7632	2234	124075	208087
	Total	2114217	1662863	33050	142759	3952889

Table S6 Land use conversion matrix in Zhenglong, Ziquejie and Jizhai villages, 2014–2022.

Land types area, m^2		2014				
		Farmland	Woodland	Water area	Built-up area	Total
Zhenglong, 2022	Farmland	3352155	86367	4972	15054	3458548
	Woodland	115224	4935805	11497	6602	5069128
	Water area	7052	6844	73176	306	87378
	Built-up area	40739	14876	3276	383726	442617
	Total	3515170	5043892	92921	405688	9057671
Ziquejie, 2022	Farmland	4624002	69061	1134	5453	4699650
	Woodland	34207	5938897	0	657	5973761
	Water area	0	0	36731	0	36731
	Built-up area	103672	19423	0	598892	721987
	Total	4761881	6027381	37865	605002	11432129
Jizhai, 2022	Farmland	1893203	11807	24	3523	1908557
	Woodland	97032	1661361	3	4847	1763243
	Water area	1	8	39409	37	39455
	Built-up area	38421	3527	6	199680	241634
	Total	2028657	1676703	39442	208087	3952889