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RESEARCH ARTICLE

Comparison of indicators for agricultural green development and the Sustainable Development Goals, and mapping the way forward

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Supplementary materials

Table S1 Indicator system and grading criteria of China agricultural green development^[1]

Category	Identifier	Indicator	Grading criteria of indicators				Indicator implication	Data get way
			I	II	III	IV		
Social development	S-D-1	Proportion of agricultural financial investment (%)	>20	15–20	10–15	<10	Percentage of regional agricultural financial input in total financial input of the government in the current year, reflecting the government's support for agricultural development	Statistical Yearbook ^[2] , Rural Statistical Yearbook ^[3]
	S-D-2	Per capita calorie consumption (kcal·d ⁻¹ ·person ⁻¹)	2200–2300	1700–2200 2300–2800	1200–1700 2800–3800	<1200 >3800	The total energy consumption of various foods per capita in the region in the current year	Statistical Yearbook ^[2] , Rural Statistical Yearbook ^[3] , NUFER
	S-D-3	Per capita protein consumption (g·d ⁻¹ ·person ⁻¹)	>23.7	21.3–23.7	19–21.3	<19	Total protein amount of various foods consumed per capita in the region in the current year	Statistical Yearbook ^[2] , Rural Statistical Yearbook ^[3] , NUFER
	S-D-4	Agricultural mechanization level (10 ⁴ kW·ha ⁻¹ ·a ⁻¹)	>5	3–5	1–3	<1	Mechanical power input per unit area of arable land in the current year	Statistical Yearbook ^[2]
	S-D-5	Irrigation lever of farmland (%)	>50	30–50	10–30	<10	Percentage of effective irrigation area in total arable land in the current year	Statistical Yearbook ^[2]
	S-D-6	Education level of agricultural population (%)	>50	30–50	10–30	<10	Percentage of agricultural labor force with high school education or above in the current year	Statistical Yearbook ^[2] , Rural Statistical Yearbook ^[3]
	S-I-1	Urbanization rate (%)	>60	40–60	20–40	<20	Percentage of urban population in total population in the current year	Statistical Yearbook ^[2]
	S-I-2	Per capita cultivated land (ha·person ⁻¹)	>2.5	0.79–2.5	0.2–0.79	<0.2	Per capita arable land area owned by agricultural labor force in the current year	Statistical Yearbook ^[2]
	S-I-3	Proportion of animal protein in protein consumption (%)	30–35	25–30 35–40	20–25 40–45	<20 >40	Percentage of animal protein intake in total protein intake in the current year	Statistical Yearbook ^[2] , Rural statistical yearbook ^[3] , NUFER
	S-O-1	Food self-sufficiency rate (%)	>100	75–100	50–75	<50	Taking nitrogen as an indicator, the percentage of the total amount of nitrogen produced by various foods in the total nitrogen consumption in the current year	Statistical Yearbook ^[2] , Rural Statistical Yearbook ^[3] , NUFER
	S-O-2	Proportion of land transfer (%)	>50	30–50	10–30	<10	Percentage of land transfer area in total arable land area in the current year	Statistical Yearbook ^[2]
	Economic growth	E-D-1	Agricultural output value per unit cultivated land area	>16.3	5.1–16.3	1.3–5.1	<1.3	Ratio of the total agricultural output value to the total area of arable land, garden land and artificial

		(10 ⁴ CNY·ha ⁻¹)					grassland		
Agricultural production	E-I-1	Per capita GDP (10 ⁴ CNY·person ⁻¹)	>9	3–9	0.7–3	<0.7	Ratio of regional GDP to total population in the current year	Statistical Yearbook ^[2]	
	E-I-2	Level of food industrialization (%)	>3	2–3	1–2	<1	Ratio of regional food industrial output value to agricultural output value	Food Industry Yearbook ^[4]	
	E-O-1	Rural Engel coefficient (%)	<30	30–40	40–50	>50	Percentage of food consumer spending in total consumption spending in the current year	Statistical Yearbook ^[2] , Rural Statistical Yearbook ^[3]	
	E-O-2	Rural disposable income (10 ⁴ CNY·person ⁻¹)	>3.8	1.18–3.8	0.3–1.18	<0.3	Per capita disposable income of rural residents in the current year	Statistical Yearbook ^[2]	
	E-O-3	Percentage of agricultural output value in GDP (%)	>35	25–35	15–25	<15	Percentage of regional agricultural output value in GDP in the current year	Statistical Yearbook ^[2]	
	P-D-1	Caloric production per unit cultivated land (10 ⁴ kcal·ha ⁻¹)	>2827	2262–2827	1696–2262	<1696	Ratio of total caloric production of crop and animal products to arable land area in the current year	NUFER	
	P-D-2	Protein production per unit cultivated land (kg·ha ⁻¹)	>1125	750–1125	450–750	<450	Ratio of total protein production of various crops to arable land area in the current year	NUFER	
	P-D-3	Protein production per livestock unit (kg·LU ⁻¹)	>60	40–60	20–40	<20	Ratio of total animal protein production to livestock units in the current year	NUFER	
	P-D-4	Nitrogen use efficiency in crop production (%)	>70	50–70	30–50	<30	Percentage of N uptake of various crops in total N inputs of crop production in the current year	NUFER	
	P-D-5	Nitrogen use efficiency in animal production (%)	>19	15–19	10–15	<10	Percentage of N uptake of various animal products (meat, egg and milk) in total N inputs of animal production in the current year	NUFER	
	P-D-6	Nitrogen use efficiency in food system (%)	>30	25–30	18–25	<18	Percentage of N uptake of various food products in total N inputs of the whole food system in the current year	NUFER	
	P-O-1	Vegetable yield (t·ha ⁻¹)	>52	42–52	31–42	<31	Regional vegetable yield in the current year	Statistical Yearbook ^[2]	
P-O-2	Fruit yield (t·ha ⁻¹)	>28	22–28	17–22	<17	Regional fruit yield in the current year	Statistical Yearbook ^[2]		
R-D-1	Nitrogen use intensity (kg·ha ⁻¹)	<180	180–225	225–315	>315	Ratio of total N inputs of crop production to total sown area in the current year	Statistical Yearbook ^[2]		
R-D-2	Phosphorus use intensity (kg·ha ⁻¹)	<35	35–50	50–65	>65	Ratio of total P inputs of crop production to total sown area in the current year	Statistical Yearbook ^[2]		
R-D-3	Pesticides use intensity (kg·ha ⁻¹)	<3.5	3.5–5.3	5.3–7	>7	Ratio of regional total pesticides inputs to total sown area	Statistical Yearbook ^[2]		
R-D-4	Agricultural film use	<9.78	9.78–12.70	12.70–26.62	>26.62	Ratio of regional total agricultural film use to total	Statistical Yearbook ^[2]		

		intensity ($\text{kg}\cdot\text{ha}^{-1}$)					sown area	
	R-D-5	Irrigation water use intensity ($\text{m}^3\cdot\text{ha}^{-1}$)	<1350	1350–2025	2025–2700	>2700	Ratio of regional total irrigation water consumption to total irrigation in the current year	Statistical Yearbook ^[2]
	R-D-6	Labor input per unit cultivated land ($\text{persons}\cdot\text{ha}^{-1}$)	>5	1.26–5.0	0.4–1.26	< 0.4	Ratio of regional total number of agricultural labor force to the sum of arable land area and garden land area in the current year	Statistical Yearbook ^[2]
Resources inputs	R-I-1	Manure recycling rate (%)	>75	55–75	35–55	<35	Percentage of the regional amount of manure N returned to the field in the total manure N production in the current year	NUFER
	R-I-2	Straw recycling rate (%)	>80	65–80	50–65	<50	Percentage of the regional amount of straw N to filed and feed in the total straw N production in the current year	NUFER
	R-I-3	Footprint of agricultural water ($\text{m}^3\cdot\text{a}^{-1}\cdot\text{person}^{-1}$)	540	590	640	690	Per capita agricultural water footprint in the current year	NUFER
	R-O-1	Energy consumption per unit agricultural output value [$\text{kW}\cdot(10^4\text{ CNY})^{-1}$]	2450	5000	7500	13,370	Ratio between the sum of various agricultural energy consumption (mechanical energy consumption, power consumption) and the gross agricultural product in the current year	Statistical Yearbook ^[2]
	R-O-2	Antibiotic input per livestock unit ($\text{kg}\cdot\text{LU}^{-1}$)	0.02	0.07	0.12	0.17	Ratio of regional animal antibiotic use to the amount of livestock units in the current year	Animal Husbandry Statistical Yearbook ^[5]
	EN-D-1	N surplus in farmland ($\text{kg}\cdot\text{ha}^{-1}$)	<80	80–160	160–240	>240	Ratio of regional total nitrogen surplus of crop system to total area of cultivated land, garden land and artificial grassland in the current year	NUFER
	EN-D-2	N runoff in farmland ($\text{kg}\cdot\text{ha}^{-1}$)	<9	9–13.5	13.5–18	>18	Ratio of regional total nitrogen runoff of crop system to total area of cultivated land, garden land and artificial grassland in the current year	NUFER
	EN-D-3	N leaching in farmland ($\text{kg}\cdot\text{ha}^{-1}$)	<6.4	6.4–12.8	12.8–19.2	>19.2	Ratio of regional total nitrogen leaching of crop system to total area of cultivated land, garden land and artificial grassland in the current year	NUFER
EN-D-4	NH_3 volatilization in agricultural system ($\text{kg}\cdot\text{ha}^{-1}$)	<30	30–60	60–120	>120	Ratio of regional total NH_3 emission of crop system to total area of cultivated land, garden land and artificial grassland in the current year	NUFER	
EN-D-5	Reactive N losses per unit food N ($\text{kg}\cdot\text{kg}^{-1}$)	<3	3–4.5	4.5–6	>6	Ratio of regional total losses of reactive N to total food N production in the current year	NUFER	
EN-D-6	GHG emission intensity per unit cultivated land area	<1785	1785–2680	2680–3570	>3570	Ratio of regional total GHG emission of food system to total area of cultivated land, garden land	NUFER	

		[kg·ha ⁻¹ CO ₂ eq]					and artificial grassland in the current year	
	EN-D-7	Soil organic matter level (%)	>75	50–75	25–50	<25	Ratio of the number of samples above the third level of soil organic matter to the total number of samples	Soil Testing and Formula Fertilization Soil Basic Nutrient Dataset ^[6]
Ecological environment	EN-D-8	Modulus of soil erosion (t·ha ⁻¹)	<1000	1000–2500	2500–5000	>5000	Ratio of regional total amount of soil and water losses to geographical area in the current year	Resource and Environment Science and Data Center ^[7]
	EN-I-1	Surface water quality (%)	>90	70–90	50–70	<50	Regional surface water safe quality in the current year	Bulletin of China's Ecological Environment ^[8]
	EN-I-2	Ground water quality (%)	>90	70–90	50–70	<50	Regional ground water safe quality in the current year	Bulletin of China's Ecological Environment ^[8]
	EN-I-3	Atmosphere quality (%)	>80	50–80	20–50	<20	Regional atmosphere safe quality in the current year	Bulletin of China's Ecological Environment ^[8]
	EN-I-4	Ecological environment quality (%)	>75	55–75	35–55	<35	Regional ecological environment safe quality in the current year	Bulletin of China's Ecological Environment ^[8]
	EN-I-5	Rural sewage treatment rate (%)	>90	70–90	45–70	<45	Percentage of regional total amount of rural sewage treatment in total amount of sewage produced in the current year	Bulletin of China's Ecological Environment ^[8]
	EN-I-6	Rural waste treatment rate (%)	>90	70–90	45–70	<45	Percentage of regional total amount of rural waste treatment in total amount of waste produced in the current year	Bulletin of China's Ecological Environment ^[8]
	EN-O-1	Forest coverage rate (%)	>30	22.5–30	15–22.5	<15	Percentage of regional forest area in geographical area in the current year (as the evaluation indicator of mountainous area)	Statistical Yearbook ^[2]
	EN-O-2	Grass coverage rate (%)	>30	22.5–30	15–22.5	<15	Percentage of regional grassland area in geographical area in the current year (as the evaluation indicator of pastoral area and semi pastoral area)	Statistical Yearbook ^[2]
	EN-O-3	Livestock capacity per unit cultivated land (LUs·ha ⁻¹)	<2	2–4	4–6	>6	Ratio of regional amount of livestock units to total arable land area in the current year	NUFER

Note: The grading standard values of the indicators in the table are based on the principle of “including below but not including above”; the area of natural grassland should also be considered in the calculation of environmental emissions in the five pastoral areas of Inner Mongolia, Gansu, Qinghai, Xizang, and Xinjiang.

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