Supplementary Materials: Land Use Scenario Modeling Based on Local Knowledge for the Provision of Ecosystem Services in Northern Ghana

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This supplementary material supports the main text as follows:

Table S1. Template of the stakeholder survey to select ecosystem services based on the importance related to agricultural land use [1].

Please mark how you think the importance of the suggested ecosystem services related to agricultural land use in the district.

	Very important ← → Less important				
			important		
Food provision	5	4	3	2	1
Fodder provision	5	4	3	2	1
Energy provision (fuel for biomass)	5	4	3	2	1
Construction material provision (roof, fence)	5	4	3	2	1
Marketable products provision	5	4	3	2	1
Water provision	5	4	3	2	1
Soil erosion control	5	4	3	2	1
Global climate regulation (Carbon sequestration)	5	4	3	2	1
Additional opinions: ***If you think that other ecosystem services need to be added to this list, please write down below and assess their importance (e.g., pollination)***					
	5	4	3	2	1
	5	4	3	2	1

Table S2. Template of the stakeholder survey to identify the perceptibility of the differences on the provision of ecosystem services between land use types [1].

Please mark how you think the relative capacity of each land use type to provide suggested ecosystem services (0: no capacity—10:full capacity)

	Food Fodder Energy	Construction Materials	Marketable Products	Water	Erosion Control	Carbon Sequestration	Other
Cereal							
Maize							
Legume							
Rice							
Grassland							
Mixed vegetation							
Forest							

Artificial surfaces	
Water bodies	

Table S3. Template of the stakeholder survey for data generation.

Please fill out the approximate percentage to indicate how land use products (e.g., grains, leaves, stalks, and fruits) are used for each benefit (ecosystem services).

Land Use Types	Food	Fodder	Energy	Construction Materials	Marketable Products	Others ( )	Total
Cereals (millet, sorghum)	%	%	%	%	%	%	100%
Maize	%	%	%	%	%	%	100%
Rice	%	%	%	%	%	%	100%
Legumes (groundnuts, bambara beans)	%	%	%	%	%	%	100%
Grasslands							
Mixed vegetation	%	%	%	%	%	%	100%
Tree/forest	%	%	%	%	%	%	100%
Artificial surfaces	%	%	%	%	%	%	100%
Water bodies	%	%	%	%	%	%	100%

Table S4. Part of a stakeholder survey template for the identification of scenario impacts.

Please mark effects of the each scenario on ecosystem Services considering the potential changes of the services from the current land use types to the future types.

Cereal-Dominated Intercropping: Conversion from Cereal to Cereal-Legume Intercropping				
Ecosystem Servces	**Increase**	**No Change**	**Decrease**	**Extent of Change (%)**
Food				
Fodder				
Energy				
Construction				
Market				
Water				
Erosion control				

Table S5. Application conditions of land use scenarios.

Scenario	Current Land Use Type	Future Land Use Type	Transition Probability (%)	Conditions	
				Neighboring Type	Attribute
1	Cereals	Cereal-dominant intercropping	90	Cereals, legume	Soil type, run-off
2	Maize	Maize-dominant intercropping	80	Maize, legume	Soil type, run-off
3	Legumes	Legume-dominant intercropping	85	Cereals, maize, legume	Soil type

4	Grassland	Grassland afforestation	75	Tree/forest, grassland	Soil type
5	Mixed vegetation	Mixed vegetation afforestation	80	Tree/forest, mixed vegetation	Soil type
6	Cereals	Cereal intercropping with mango	70	Cereals, bare/artificial surfaces	Soil type, run-off
7	Maize	Maize intercropping with mango	70	Maize, bare/artificial surfaces	Soil type, run-off
8	Legumes	Legume intercropping with mango	90	Legumes, bare/artificial surfaces	Soil type
9	Cereals	Cereal intercropping with leucaena	80	Cereals	Soil type, run-off
10	Maize	Maize intercropping with leucaena	70	Maize	Soil type, run-off
11	Legumes	Legume intercropping with leucaena	90	Legumes	Soil type
12	Cereals	Stone or soil bunds on cereals	80	Cereals	Soil type, run-off
13	Maize	Stone or soil bunds on maize	80	Maize	Soil type, run-off
14	Cereals	Windbreak on cereals	70	Cereals, legumes	Soil type, run-off
15	Maize	Windbreak on maize	70	Maize, legumes	Soil type, run-off

Table S6. Impact of land use scenarios on the ecosystem services provision based on a stakeholder survey. Each percentage implies the extent of potential increase or decrease from the supply capacity of the current land use types when a scenario is applied.

District		Land Use Scenarios	Food(%)	Fodder (%)	Energy (%)	Construction Material (%)	Marketable Product (%)	Water (%)	Erosion Control (%)
Bolgatanga	1	Cereal-dominant intercropping	67	64	18	9	56	−22	75
	2	Maize-dominant intercropping	71	63	15	12	63	−22	63
	3	Legume-dominant intercropping	67	38	34	17	53	−23	31
	4	Grassland afforestation	65	1	66	64	53	−25	38
	5	Mixed vegetation afforestation	43	6	59	58	41	−22	33
	6	Cereal intercropping with mango	−12	−5	12	9	21	−32	41
	7	Maize intercropping with mango	−12	−5	12	9	21	−32	41
	8	Legume intercropping with mango	43	22	36	24	45	−30	41
	9	Cereal intercropping with leucaena	23	64	35	19	27	−29	57
	10	Maize intercropping with leucaena	23	64	35	19	27	−29	57

	11	Legume intercropping with leucaena	17	67	36	22	30	−25	59
	12	Soil or stone bunds on cereal	63	55	47	27	74	−25	66
	13	Soil or stone bunds on maize	63	55	47	27	74	−25	66
	14	Windbreak on cereal	54	51	49	47	46	−21	60
	15	Windbreak on maize	54	51	49	47	46	−21	60
Bongo	1	Cereal-dominant intercropping	60	45	14	−6	54	2	47
	2	Maize-dominant intercropping	62	41	−2	5	53	4	41
	3	Legume-dominant intercropping	43	17	19	12	54	−27	32
	4	Grassland afforestation	40	3	52	52	51	−32	46
	5	Mixed vegetation afforestation	37	33	48	48	40	−28	42
	6	Cereal intercropping with mango	26	17	15	11	44	−32	26
	7	Maize intercropping with mango	26	17	15	11	44	−32	26
	8	Legume intercropping with mango	45	25	23	20	45	−21	36
	9	Cereal intercropping with leucaena	20	51	33	14	22	−25	41
	10	Maize intercropping with leucaena	20	51	33	14	22	−25	41
	11	Legume intercropping with leucaena	32	55	35	22	38	−31	39
	12	Soil or stone bunds on cereal	58	50	35	28	48	−22	67
	13	Soil or stone bunds on maize	58	50	35	28	48	−22	67
	14	Windbreak on cereal	40	40	39	40	30	−22	45
	15	Windbreak on maize	40	40	39	40	30	−22	45

References

1. Koo, H.; Fürst, C. Using local knowledge on ecosystem services for land use impact assessment in Sub-Saharan Africa. *Ecol. Indic.* **2017**, under review.