IWAS
Brazil
ÁGUA-DF

TECHNISCHE UNIVERSITÄT DRESDEN

Letsmap do Brasil - A land use planning tool for participation

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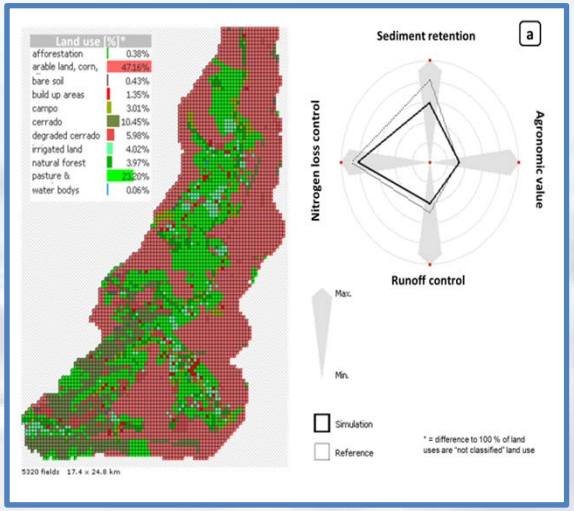

Final Workshop - Project IWAS ÁGUA DF
Integrated Water Resources Management in Distrito Federal – DF
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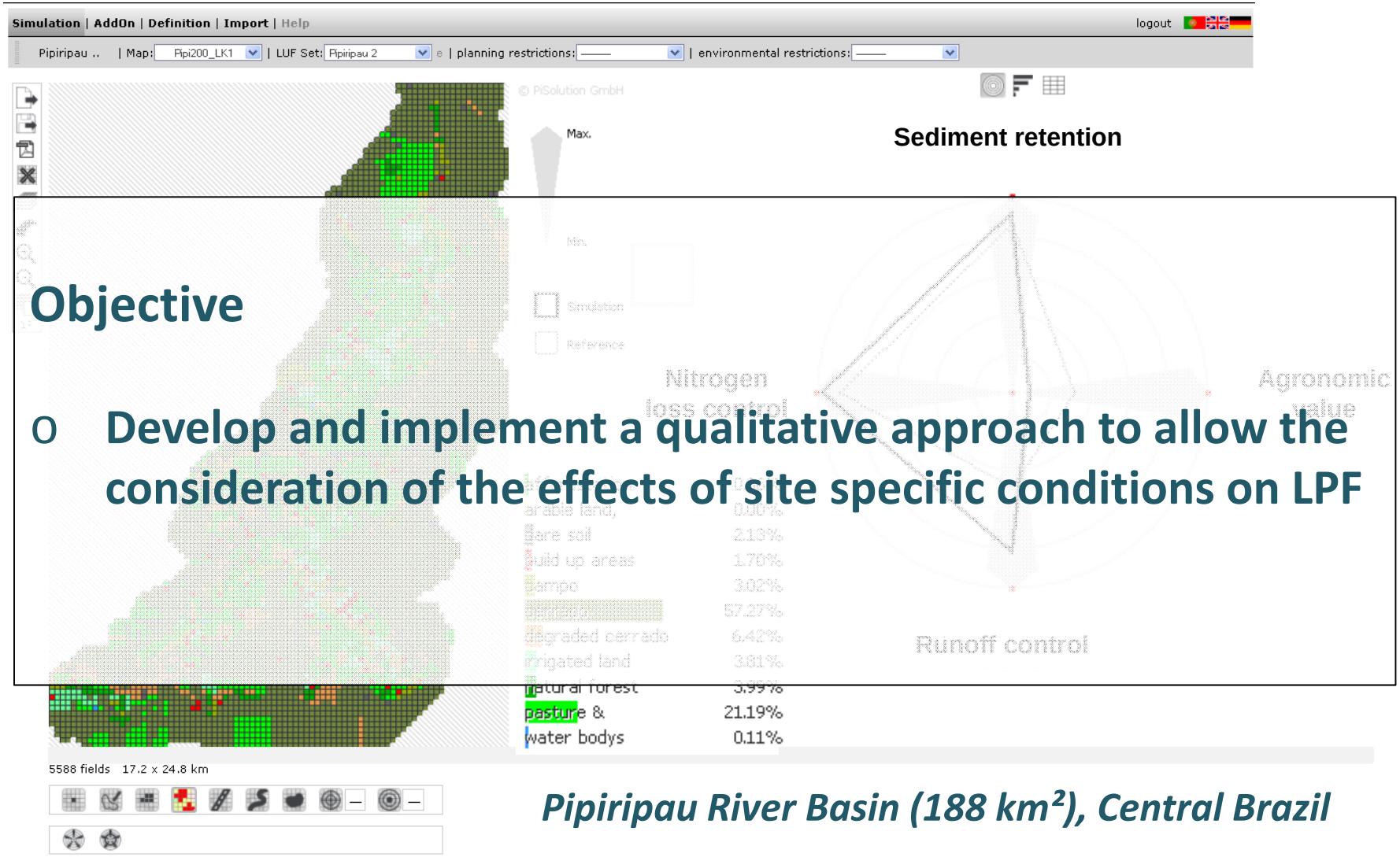
1 Introduction

- Assessing land use (change) impacts and trade-offs at a landscape level

- Support participation in land use planning & sediment management
- Enable stakeholders (also non-experts) to participate
  - Non-complex system
  - Easy to handle and to access

- Web based
- Meso-scale

1 *Lets map do brasil* (GISCAME)

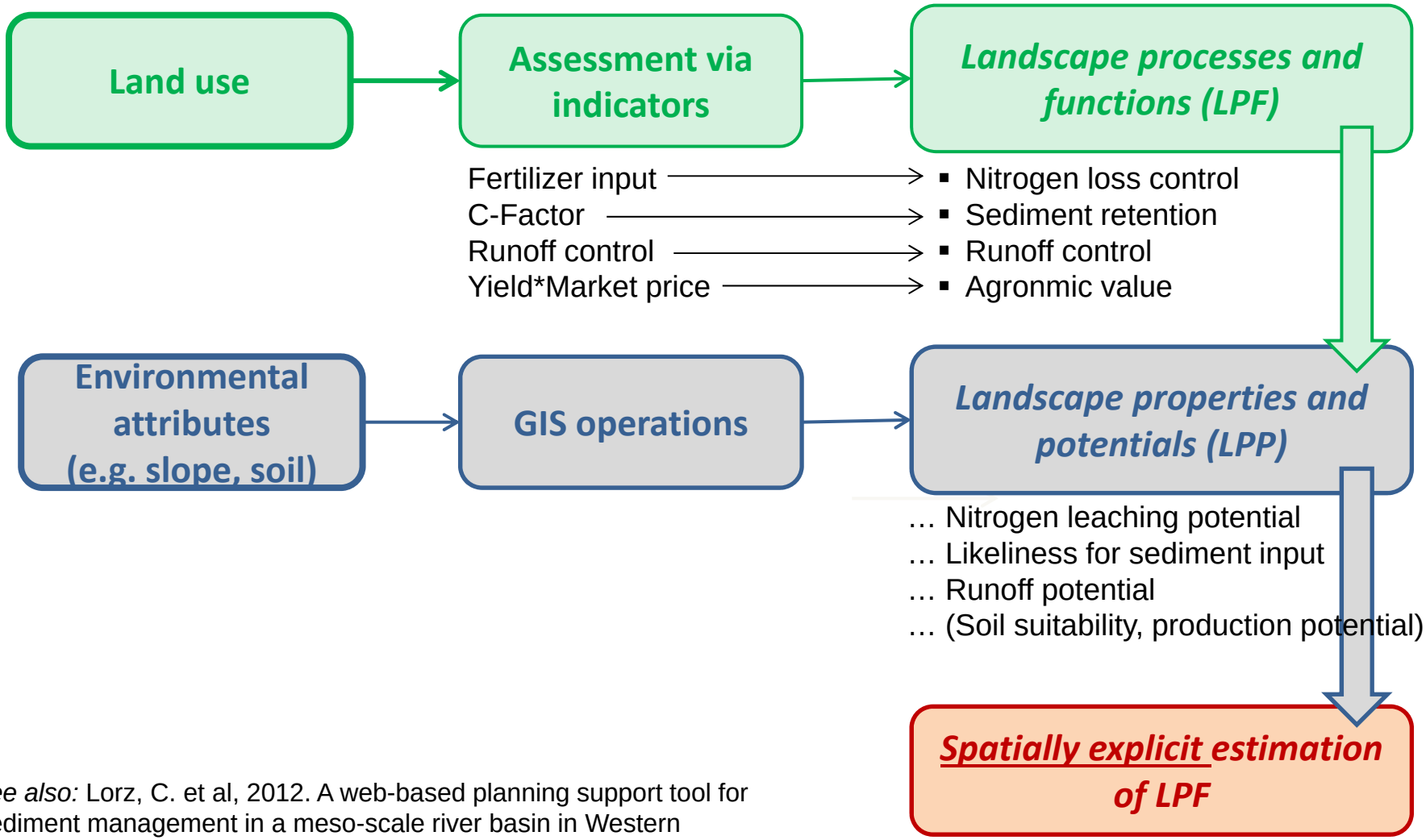


Objective

- Develop and implement a qualitative approach to allow the consideration of the effects of site specific conditions on LPF

Pipiripau River Basin (188 km²), Central Brazil

2 Methodical Approach

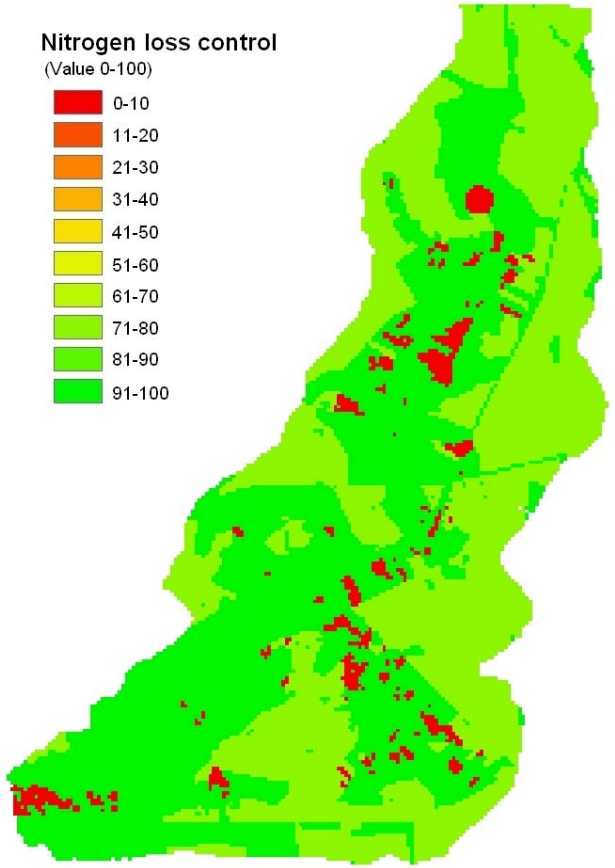


see also: Lorz, C. et al, 2012. A web-based planning support tool for sediment management in a meso-scale river basin in Western Central Brazil, JEMA.

2 Landscape properties and functions (LPF)

Land use → Applied nitrogen fertiliser → Standardisation (0-100 points) → **Nitrogen loss control**

		Sediment retention	Nitrogen loss control	Runoff control	Agronomic value
1	Arable land, gerneral, no tillage	87	80	28	49
2	Arable land, soy, tillage	65	94	11	45
3	Arable land, soy, no tillage	83	94	28	45
4	Arable land, corn, tillage	35	65	11	52
5	Arable land, corn, no tillage	91	65	28	52
6	Arable land, bean	65	90	11	59
7	Arbale land, sorghum	35	92	28	30
8	Arbale land, wheat	75	92	28	60
9	Arable land, cotton	45	22	15	56
10	Coffee	78	0	23	64
11	Fruits	78	52	43	98
12	Vegetables	50	50	15	100
13	Pasture & meadows	84	100	60	24
14	Irrigated land	69	34	27	92
15	Campo (grass savanna)	99	100	100	0
16	Cerrado (tree savanna)	99	100	100	0
17	Natural forest	100	100	100	0
18	Degraded cerrado	90	100	43	0
19	Afforestation	95	100	72	15
20	Bare soil	0	100	0	0
21	Build up areas	88	100	43	0
22	Water bodies	100	100	100	0



Lorz, C. et al, 2012. JEMA

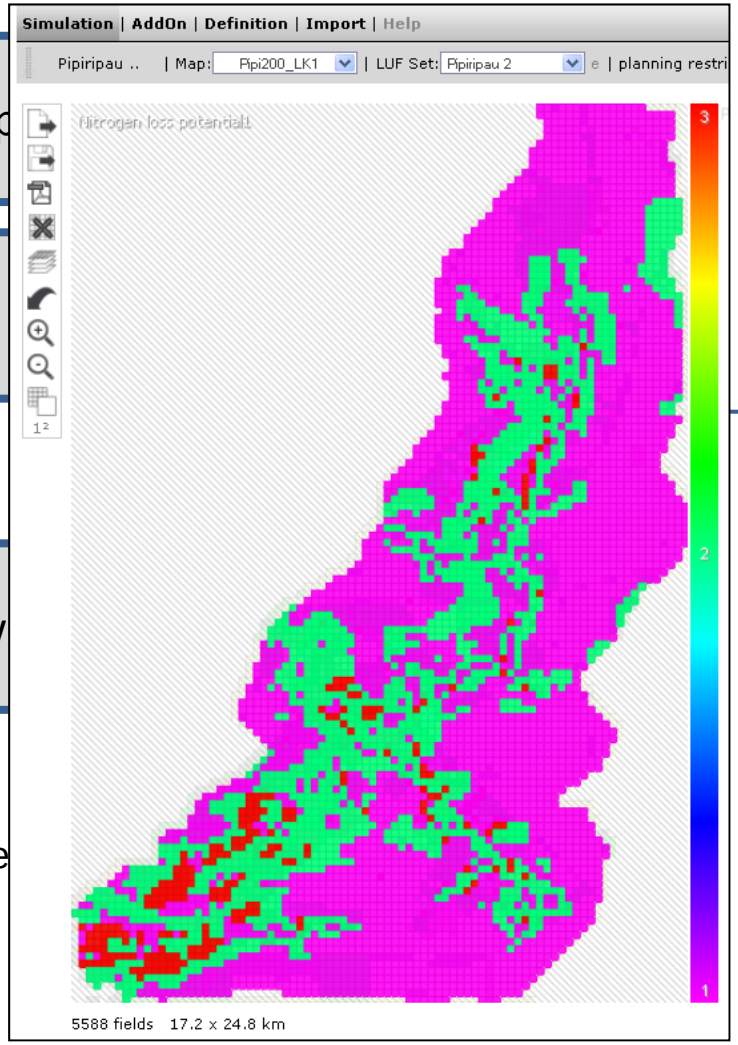
2 Landscape properties and potentials (LPP)

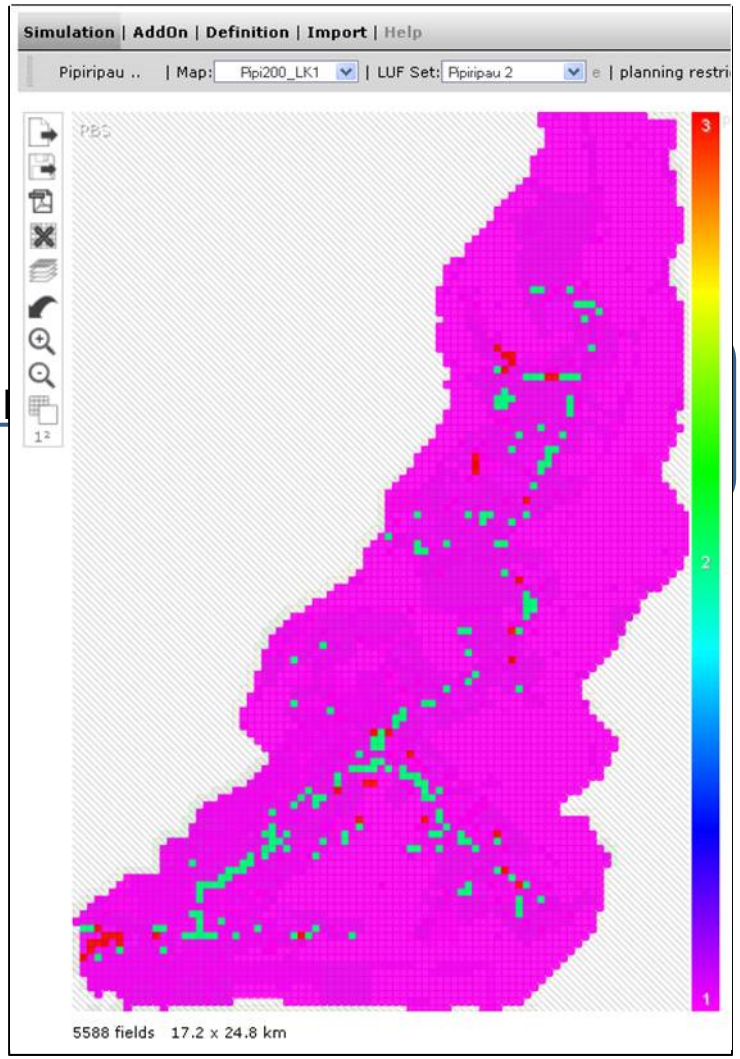
Soil map

DEM

River netw

(after Orlikowski e





1 Low leaching potential

2 Moderate leaching potential

3 High leaching potential

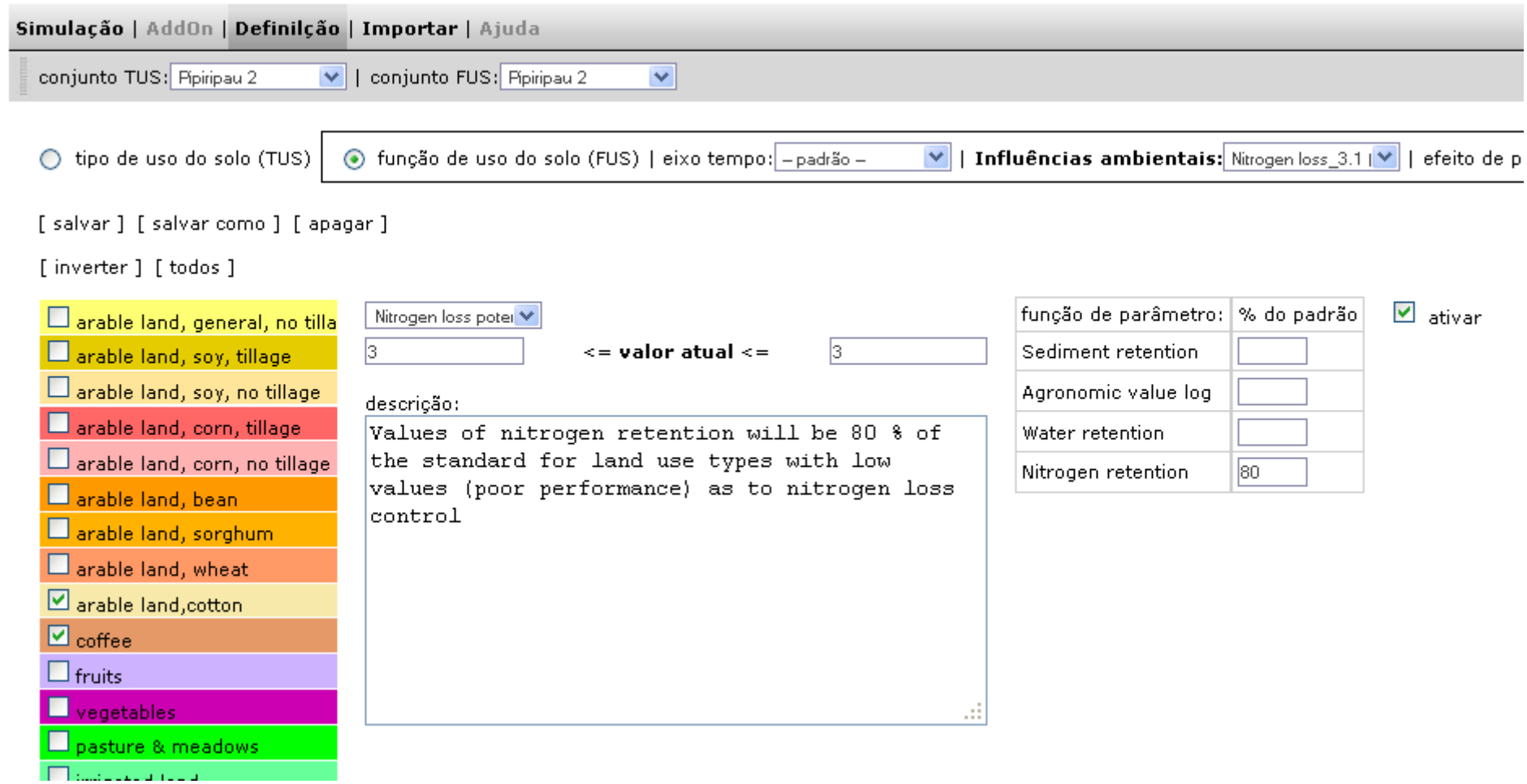
2 Combining LPF and LPP

→ **Reduction of value points (in %) acc. to nitrogen leaching potential**

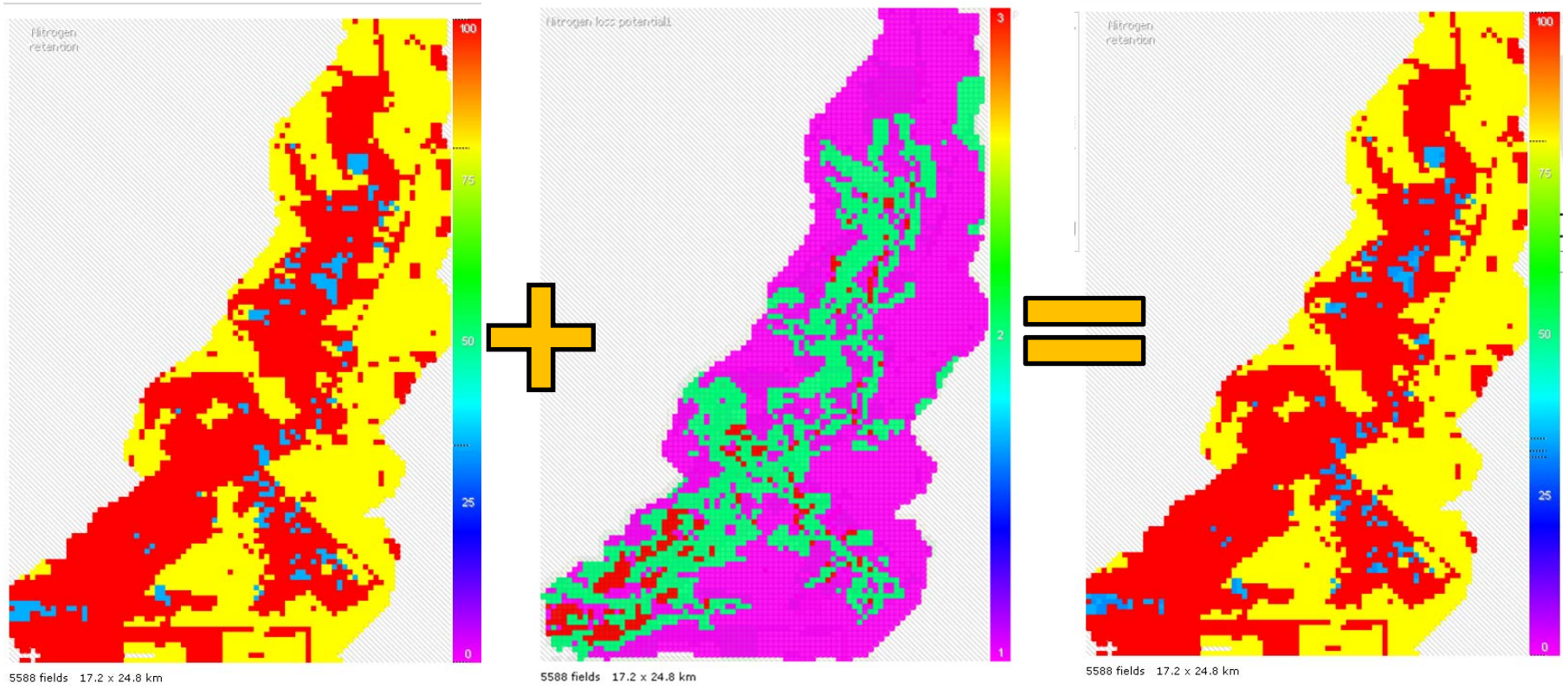
Land use types (and land use classes)	LPF Value classes	LPP (Risk class of nitrogen leaching potential) Low 1	Moderate 2	High 3
Coffee	0-10	0	-10	-20
-	11-20	0	-10	-20
Arable land, cotton;	21-30	0	-10	-20
Irrigated land	31-40	0	-5	-10
-	41-50	0	-5	-10
Vegetables; Fruits	51-60	0	-5	-10
Arable land, corn tillage/no tillage	61-70	0	0	-5
Arable land, general, no tillage	71-80	0	0	-5
Arable land, bean	81-90	0	0	-5
Cerrado; Campo; Arable land, sorghum; tillage/ no tillage; ...	91-100	0	0	0

Reduction in % of initial value

2 Combining LPF and LPP



2 Combining LPF and LPP



Landscape processes and functions (LPF)

Landscape properties and potentials (LPP)

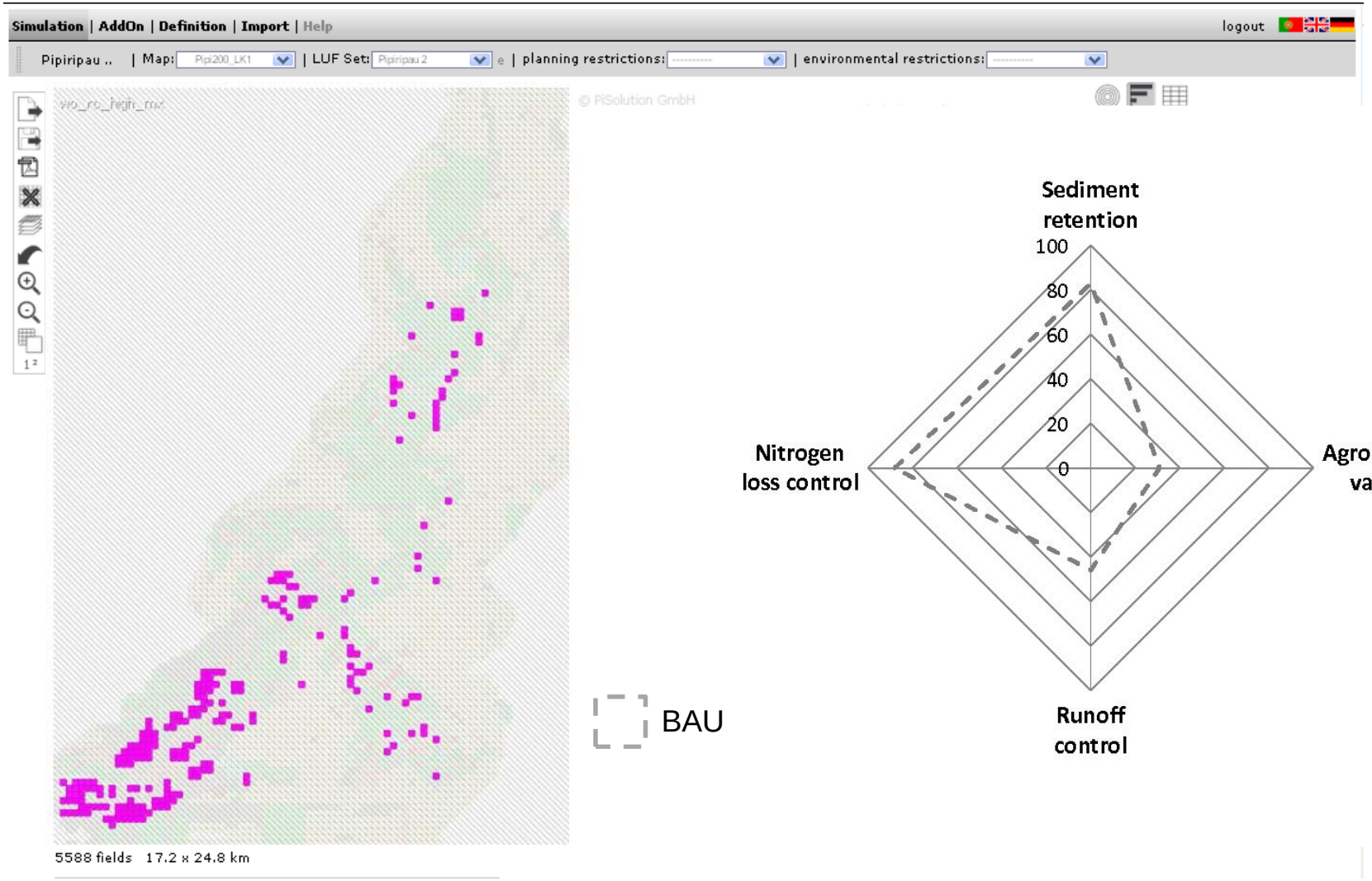
Spatially explicit estimation of LPF

2 Land use change scenarios

- Increased intensification and less intensive land use
- Change land use in the areas that bear the greatest potential for positive (and negative) land use change impacts
- LPP and input layers also used for development of land use change scenarios (~60)

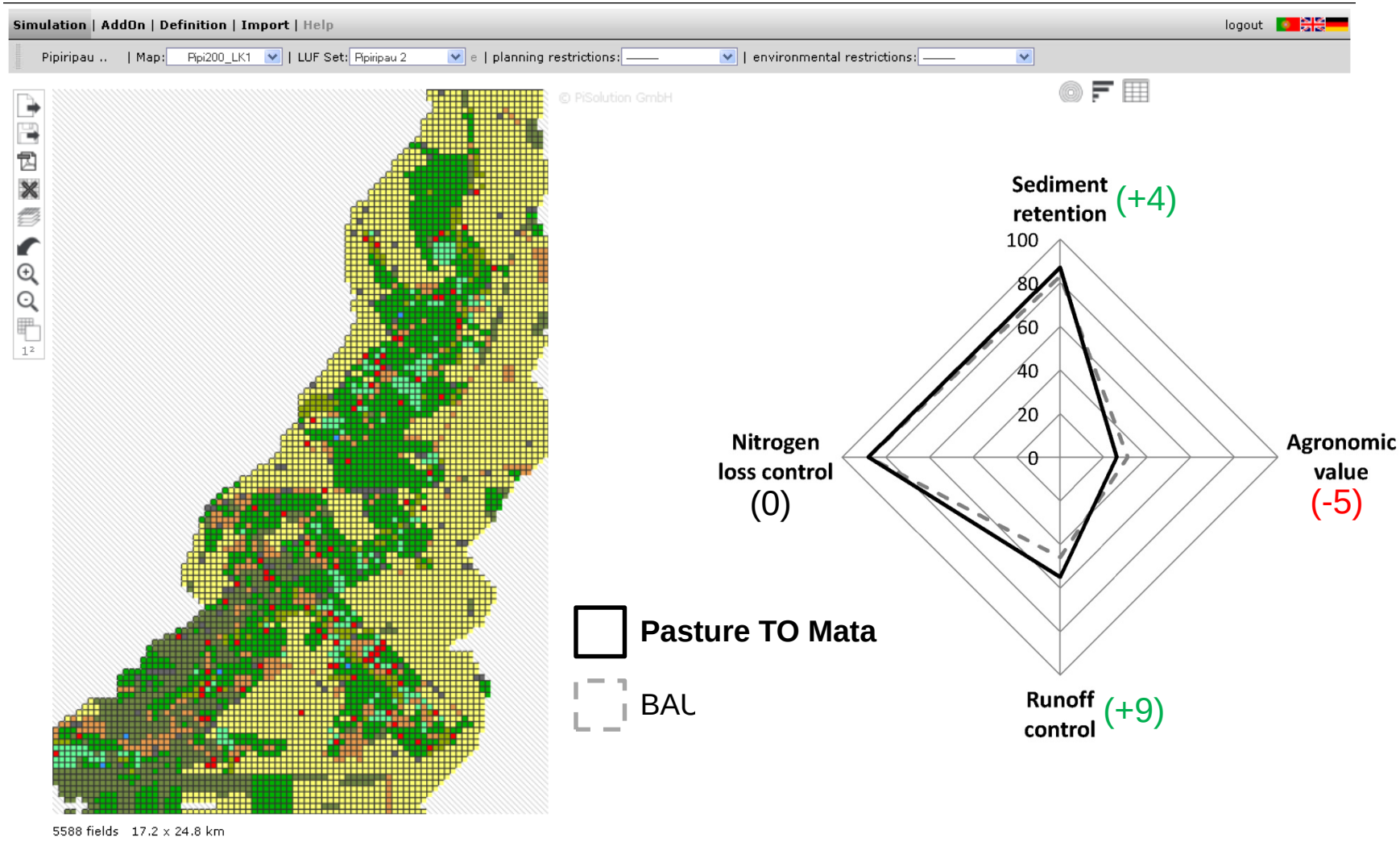
3 Scenario Results

Intensified land use Less intensive land use



3 Scenario Results

Intensified land use Less intensive land use



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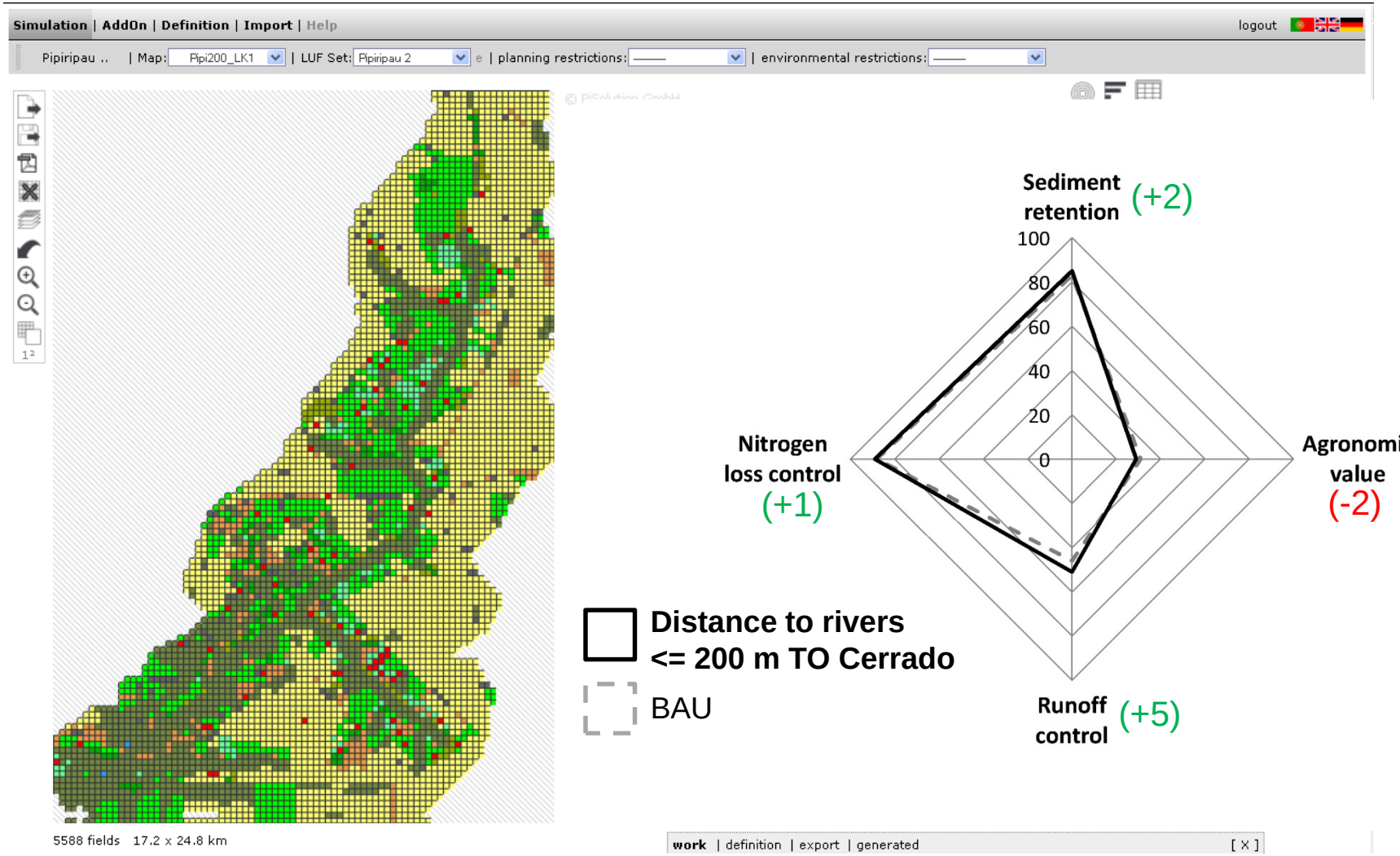

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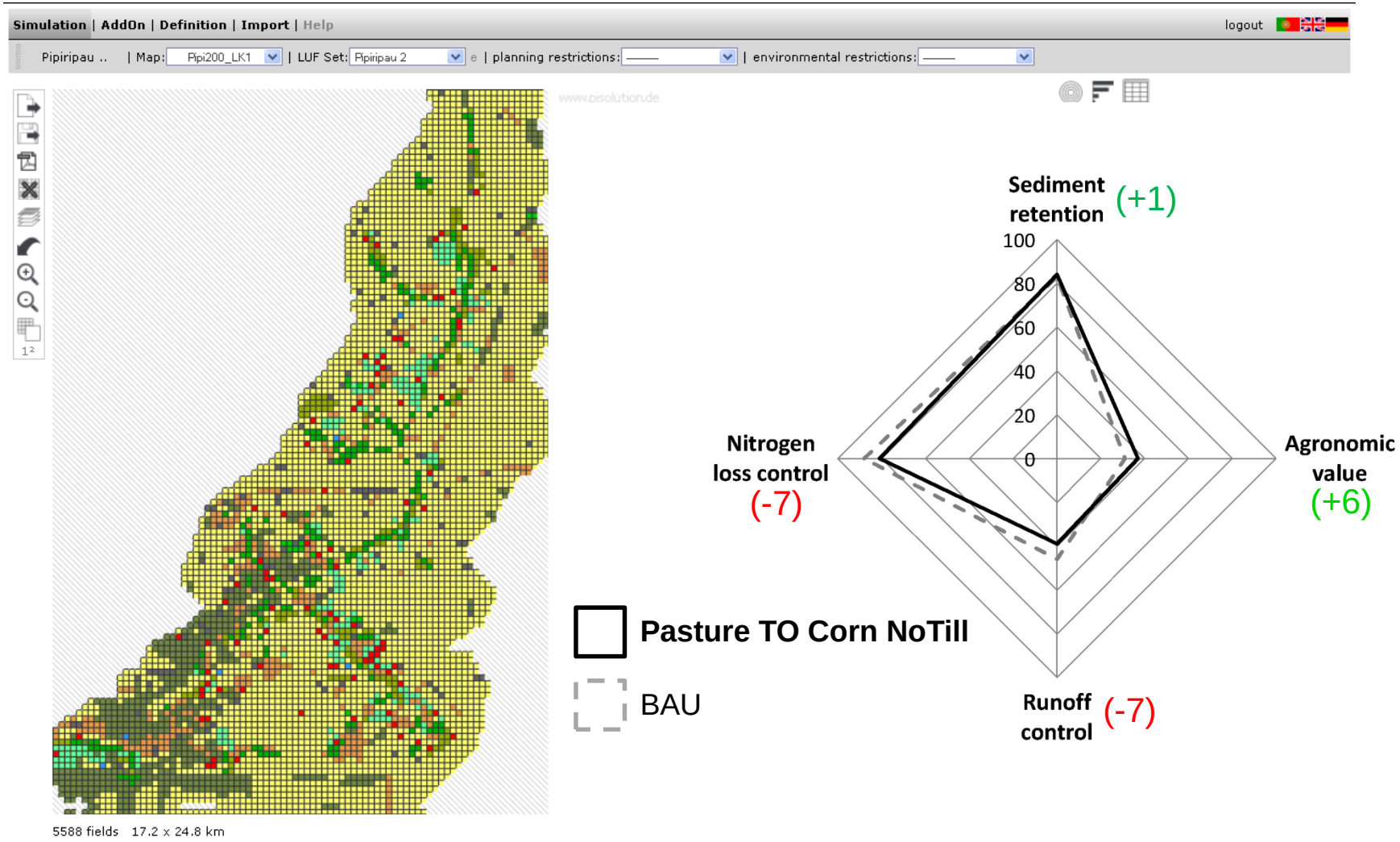
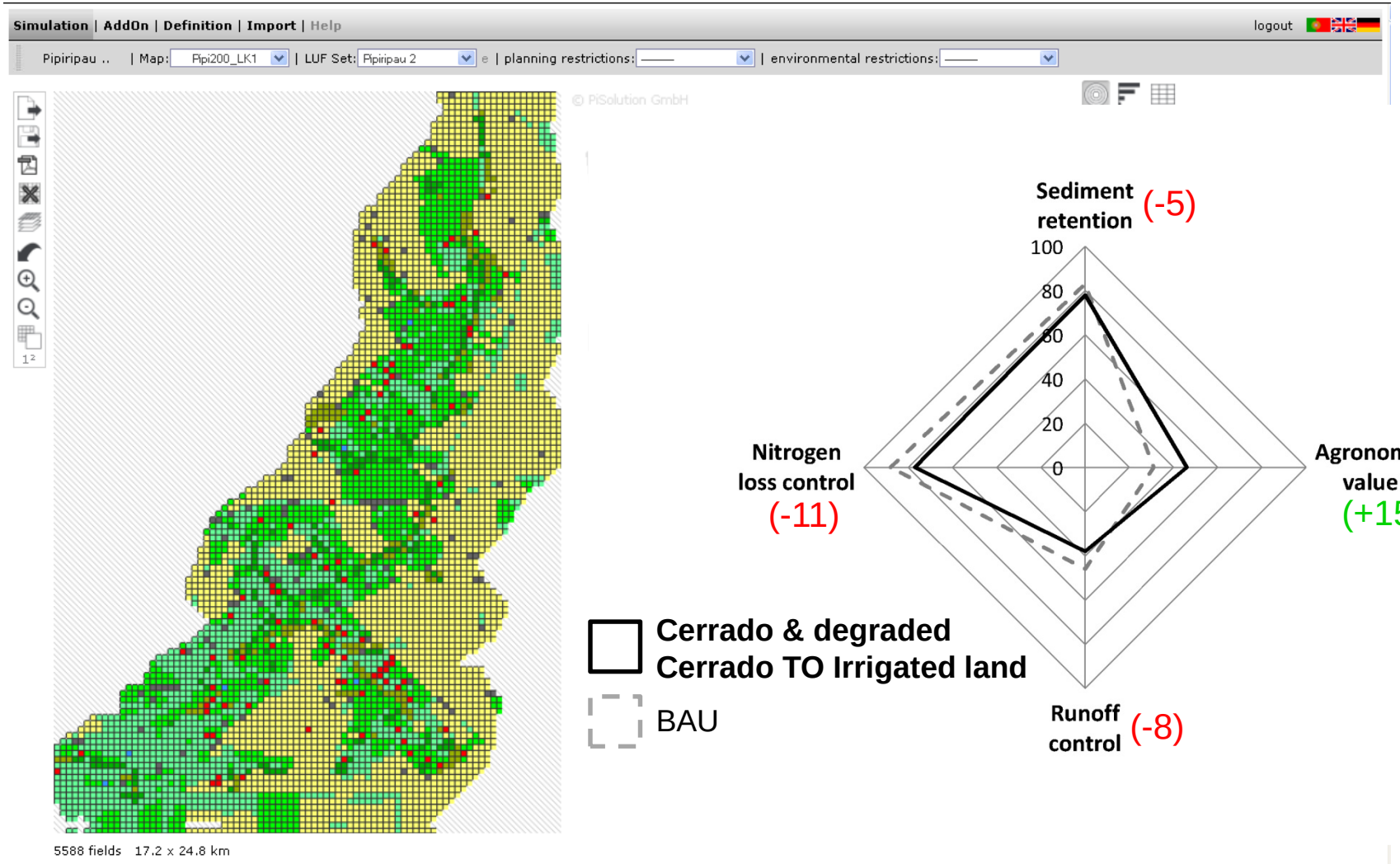
Intensified land use Less intensive land use



3 Scenario Results

Intensified land use Less intensive land use



3 Results: Combined LPF and LPP maps

- Current land use pattern (2006) -> rather high values for sediment and nitrogen loss control (low level of fertilizer input)
- Advocate limitation of further Cerrado/Campo degradation and loss

- Combination of LPF with LPP only leads to minor changes in assessment values (impact still heavily dependent on number of altered cells)

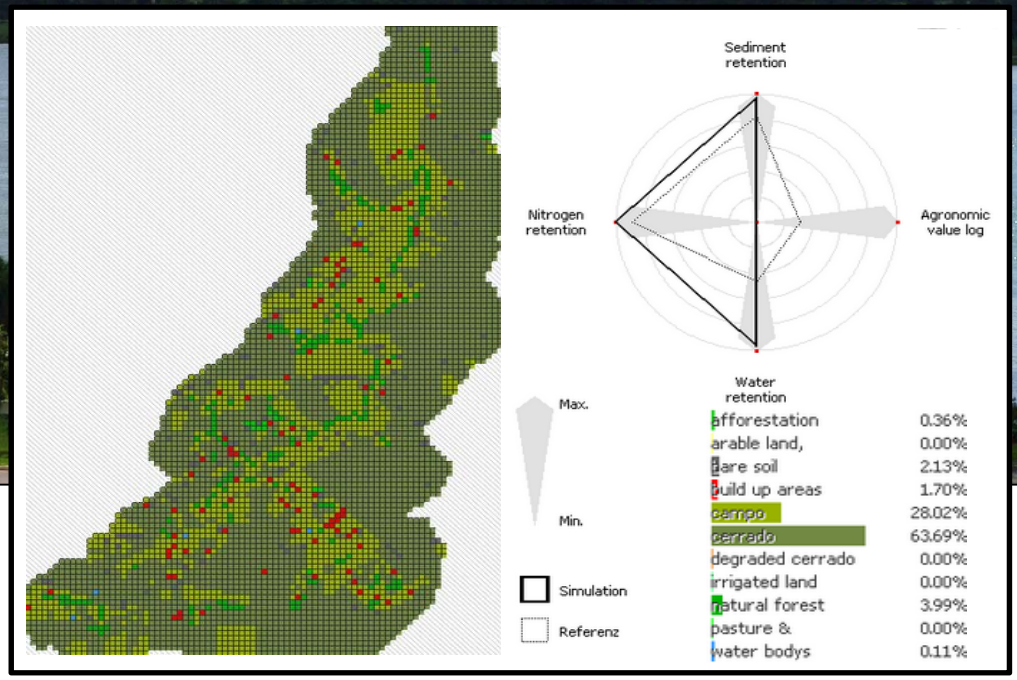
4 Conclusions

- Further development of letsmap do brasil (GISCAME) which is currently applied in several projects in South America, Western Africa and Europe

- Transferability maximized through rather simple methods: (i) Assessment methods (LPF), (ii) GIS methods for data preparation (LPP, scenarios)
- White box rather than black box model
- Suitable when facing limited data availability

- A tool to support participatory processes and training of non-experts
- Scenario simulations simple and real time feedback
- Validation and uncertainty?!

Thank you



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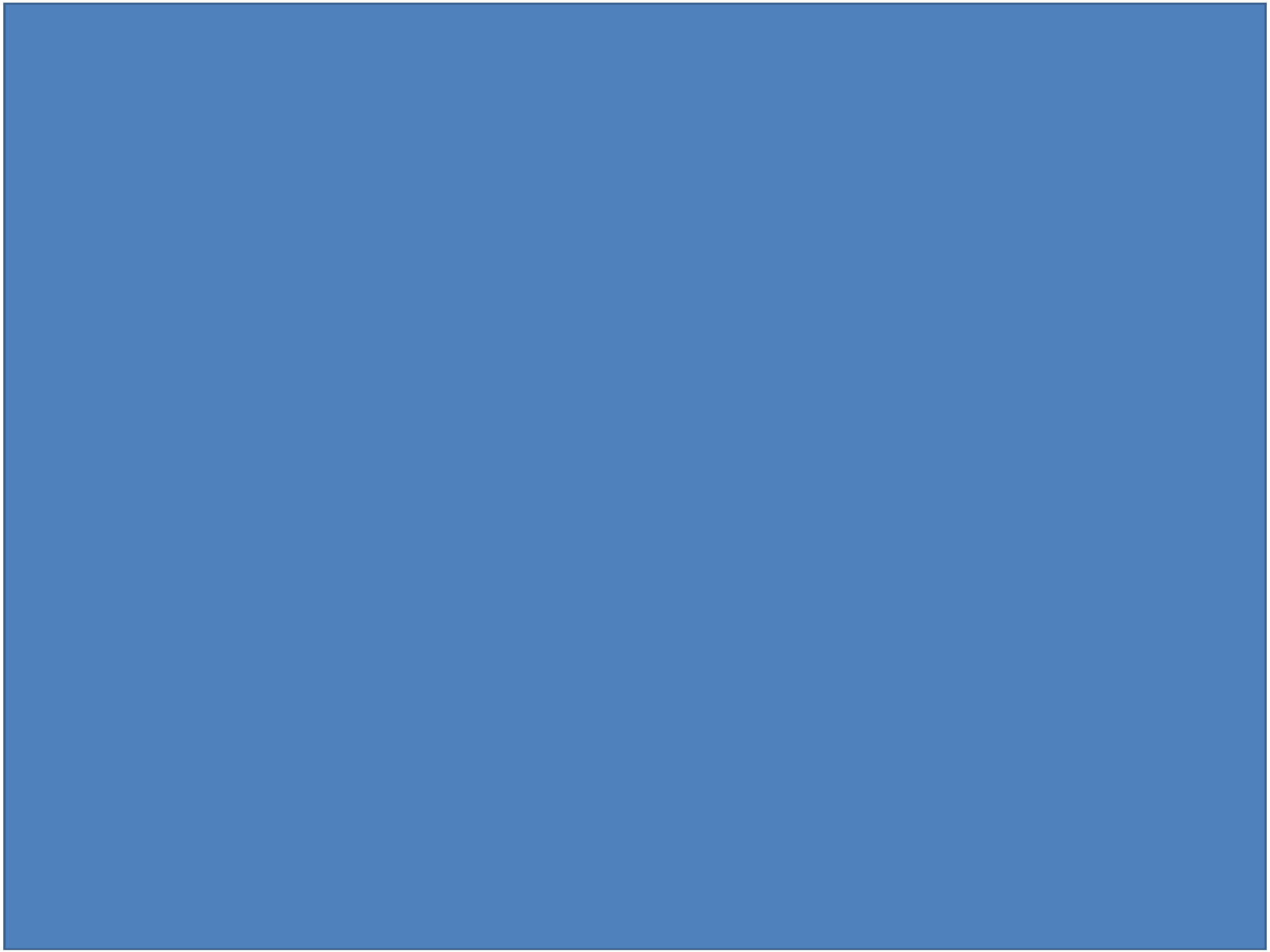
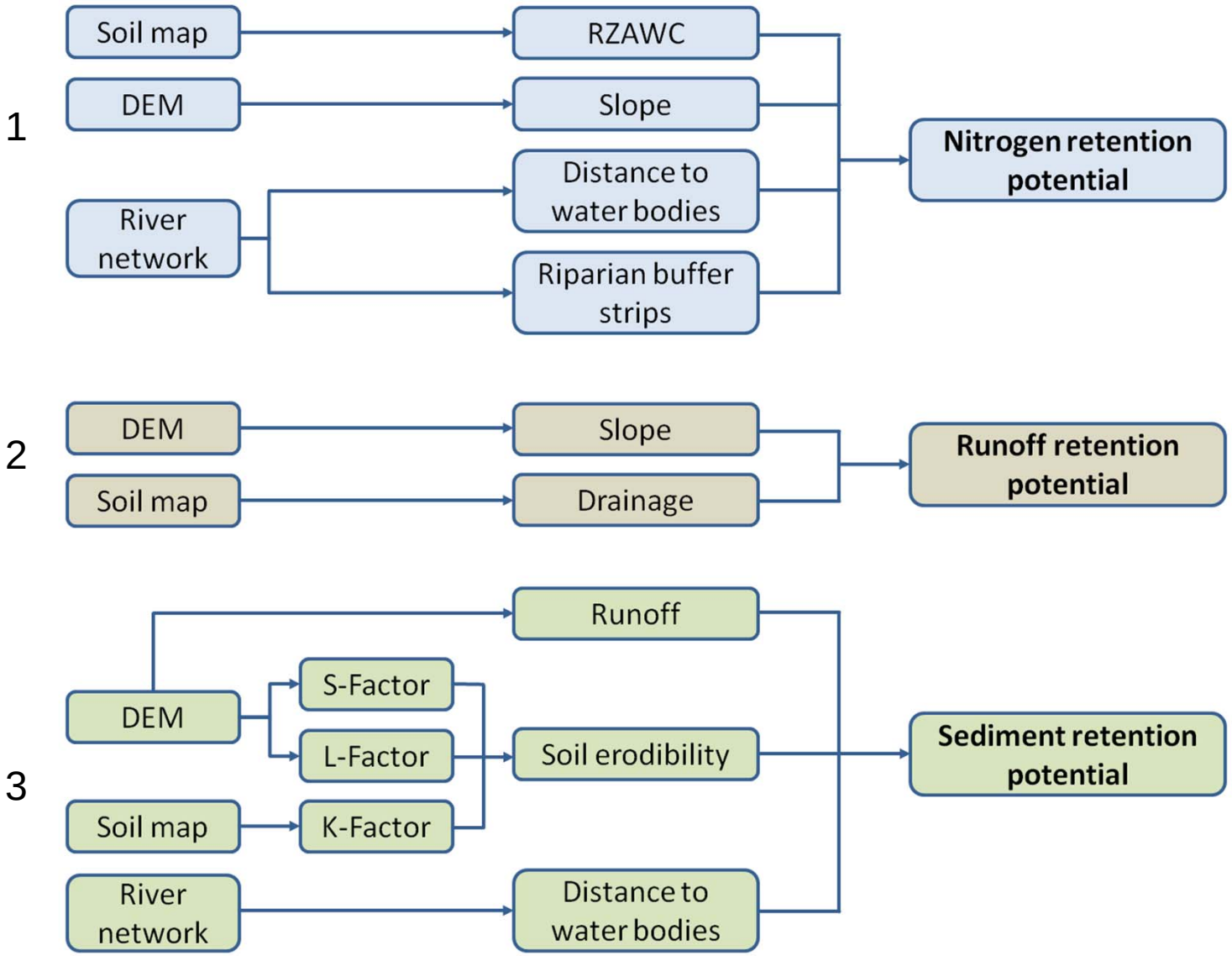




(1) Scheme for calculation of nitrogen retention potential, after Orlikowski et al. (2012)
(2) Scheme for calculation of runoff retention potential, modified after Soil Survey Division Staff (2008)
(3) Scheme for calculation of potential sediment retention from river network, modified after Halbfass and Grunewald (2008)

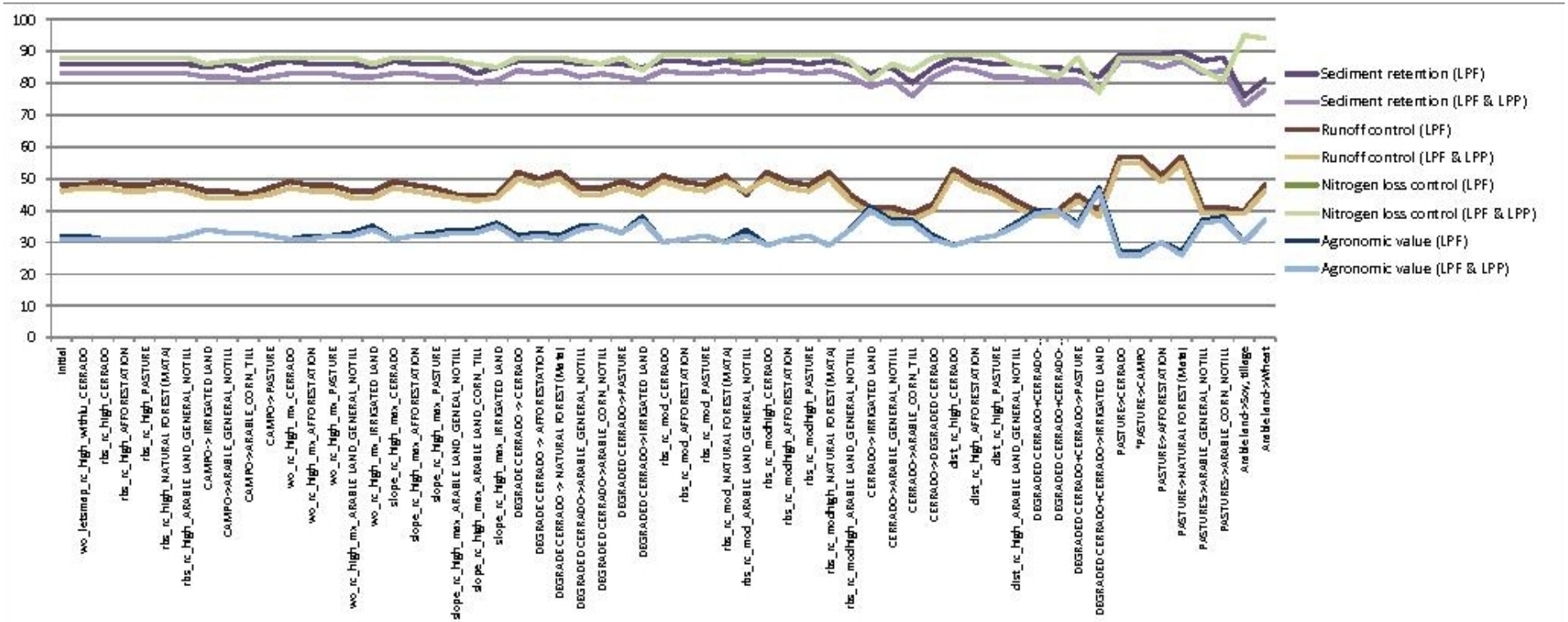
2 Landscape properties and potentials (LPP)

Parameter	Unit	Risk class 1	Risk class 2	Risk class 3
RZAWC [1]	[mm $_{H2O}$/mm$_{soil}$]	>244	142-244	<142
Slope	[			
Distance to surface waters	[m]	<=200	200-800	>800
Riparian Buffer strips	[Distance in m AND land use]	<= 200 AND land use with low nitrogen load	200-800 AND land use with moderate nitrogen load	>800 AND land use with high nitrogen load

[1] Risk class thresholds were defined on the basis of the first and third quartile

25	DEGRADED CERRADO->ARABLE_GENERAL_NOTILL	86	82	47	45	87	87	35	34	*359*
26	DEGRADED CERRADO->ARABLE_CORN_NOTILL	86	83	47	45	86	86	35	35	*359*
27	DEGRADED CERRADO->PASTURE	86	82	49	47	88	88	33	33	*359*
28	DEGRADED CERRADO->IRRIGATED LAND	85	81	47	45	84	84	38	37	*359*
29	rbs_rc_mod_CERRADO	87	84	51	49	89	89	30	30	*461*
30	rbs_rc_mod_AFFORESTATION	87	83	49	47	89	89	31	31	*461*
31	rbs_rc_mod_PASTURE	86	83	48	46	89	89	32	32	*461*
32	rbs_rc_mod_NATURAL FOREST (MATA)	87	84	51	49	89	89	30	30	*461*
33	rbs_rc_mod_ARABLE LAND_GENERAL_NOTILL	86	83	45	46	87	88	34	32	*461*
34	rbs_rc_modhigh_CERRADO	87	84	52	50	89	89	29	29	*558*
35	rbs_rc_modhigh_AFFORESTATION	87	84	49	47	89	89	31	31	*558*
36	rbs_rc_modhigh_PASTURE	86	83	48	46	89	89	32	32	*558*
37	rbs_rc_modhigh_NATURAL FOREST (MATA)	87	84	52	50	89	89	29	29	*558*
38	rbs_rc_modhigh_ARABLE LAND_GENERAL_NOTILL	86	82	45	43	87	87	34	34	*558*
39	CERRADO->IRRIGATED LAND	83	79	41	39	81	81	41	40	*576*
40	CERRADO->ARABLE_GENERAL_NOTILL	85	81	41	39	86	86	37	36	*576*
41	CERRADO->ARABLE_CORN_TILL	80	76	39	37	84	84	37	36	*576*
42	CERRADO->DEGRADED CERRADO	85	82	42	40	88	88	32	31	*576*
43	dist_rc_high_CERRADO	88	85	53	51	89	89	29	29	*770*
44	dist_rc_high_AFFORESTATION	87	84	49	47	89	89	31	31	*770*
45	dist_rc_high_PASTURE	86	82	47	45	89	89	32	32	*770*
46	dist_rc_high_ARABLE LAND_GENERAL_NOTILL	86	82	43	41	86	86	36	35	*770*
47	DEGRADED CERRADO+CERRADO->ARABLE_GENERAL_I	85	81	40	38	85	85	40	39	*935*
48	DEGRADED CERRADO+CERRADO->ARABLE_CORN_NOT	85	81	40	38	82	82	40	40	*935*
49	DEGRADED CERRADO+CERRADO->PASTURE	84	81	45	43	88	88	36	35	*935*
50	DEGRADED CERRADO+CERRADO->IRRIGATED LAND	82	78	40	38	77	77	47	46	*935*
51	PASTURE->CERRADO	89	87	57	55	88	88	27	26	*1184*
52	PASTURE->CAMPO	89	87	57	55	88	88	27	26	*1184*
53	PASTURE->AFFORESTATION	89	85	51	49	88	88	30	30	*1184*
54	PASTURE->NATURAL FOREST (Mata)	90	87	57	55	88	88	27	26	*1184*
55	PASTURES->ARABLE_GENERAL_NOTILL	87	83	41	39	84	84	37	36	*1184*
56	PASTURES->ARABLE_CORN_NOTILL	88	84	41	39	81	81	38	37	*1184*
57	Arable land->Soy, tillage	76	73	40	39	95	95	30	30	*2624*
58	Arable land->Wheat	81	78	48	46	94	94	37	37	*2624*

Szenario (ID)		Sediment retention (LPF)	Sediment retention (LPF & LP	Runoff control (LPF)	Runoff control (LPF & LPP)	Nitrogen loss control (LPF)	Nitrogen loss control (LPF & L	Agronomic value (LPF)	Agronomic value (LPF & LPP)	*Affected fields*
0	**Initial (BAU)**	86	83	48	46	88	88	32	31	*0*
1	wo_letsmap_rc_high_withlu_CERRADO	86	83	48	47	88	88	32	31	*35*
2	rbs_rc_high_CERRADO	86	83	49	47	88	88	31	31	*97*
3	rbs_rc_high_AFFORESTATION	86	83	48	46	88	88	31	31	*97*
4	rbs_rc_high_PASTURE	86	83	48	46	88	88	31	31	*97*
5	rbs_rc_high_NATURAL FOREST (MATA)	86	83	49	47	88	88	31	31	*97*
6	rbs_rc_high_ARABLE LAND_GENERAL_NOTILL	86	83	48	46	88	88	32	32	*97*
7	CAMPO-> IRRIGATED LAND	85	82	46	44	86	86	34	34	*169*
8	CAMPO->ARABLE_GENERAL_NOTILL	86	82	46	44	87	87	33	33	*169*
9	CAMPO->ARABLE_CORN_TILL	84	81	45	44	87	87	33	33	*169*
10	CAMPO->PASTURE	86	82	47	45	88	88	32	32	*169*
11	wo_rc_high_mx_CERRADO	87	83	49	47	88	88	31	31	*236*
12	wo_rc_high_mx_AFFORESTATION	86	83	48	46	88	88	32	31	*236*
13	wo_rc_high_mx_PASTURE	86	83	48	46	88	88	32	32	*236*
14	wo_rc_high_mx_ARABLE LAND_GENERAL_NOTILL	86	82	46	44	88	88	33	32	*236*
15	wo_rc_high_mx_IRRIGATED LAND	85	82	46	44	86	86	35	34	*236*
16	slope_rc_high_max_CERRADO	87	83	49	47	88	88	31	31	*282*
17	slope_rc_high_max_AFFORESTATION	86	83	48	46	88	88	32	32	*282*
18	slope_rc_high_max_PASTURE	86	82	47	45	88	88	33	32	*282*
19	slope_rc_high_max_ARABLE LAND_GENEAL_NOTILL	86	82	45	44	87	87	34	33	*282*
20	slope_rc_high_max_ARABLE LAND_CORN_TILL	83	80	45	43	86	86	34	33	*282*
21	slope_rc_high_max_IRRIGATED LAND	85	81	45	44	85	85	36	35	*282*
22	DEGRADE CERRADO -> CERRADO	87	84	52	50	88	88	32	31	*359*
23	DEGRADE CERRADO -> AFFORESTATION	87	83	50	48	88	88	33	32	*359*
24	DEGRADE CERRADO -> NATURAL FOREST (Mata)	87	84	52	50	88	88	32	31	*359*


100
90
80
70
60
50
40
30
20
10
0
Sediment retention (LPF)
Sediment retention (LPF & LPP)
Runoff control (LPF)
Runoff control (LPF & LPP)
Nitrogen loss control (LPF)
Nitrogen loss control (LPF & LPP)
Agronomic value (LPF)
Agronomic value (LPF & LPP)
Initial
wo_lotsmap_rc_high_withlu_CERRADO
rbs_rc_high_CERRADO
rbs_rc_high_AFFORESTATION
rbs_rc_High_PASTURE
rbs_rc_high_NATURAL FOREST(MATA)
rbs_rc_high_ARABLE LAND_GENERAL_NOTILL
CAMPO-> IRRIGATED LAND
CAMPO->ARABLE_GENERAL_NOTILL
CAMPO->ARABLE_CORN_TILL
CAMPO-> PASTURE
wo_rc_High_ mx_CERRADO
wo_rc_High_mx_AFFORESTATION
wo_rc_High_mx_PASTURE
wo_rc_high_mx_ARABLE LAND_GENERAL_NOTILL
wo_rc_High_mx_IRRIGATED LAND
slope_rc_High_max_CERRADO
slope_rc_High_max_AFFORESTATION
slope_rc_High_max_PASTURE
slope_rc_High_max_ARABLE LAND_GENERAL_NOTILL
slope_rc_High_max_ARABLE LAND_CORN_TILL
slope_rc_High_max_IRRIGATED LAND
DEGRADE CERRADO -> CERRADO
DEGRADE CERRADO -> AFFORESTATION
DEGRADE CERRADO -> NATURAL FOREST(Mata)
DEGRADED CERRADO->ARABLE_GENERAL_NOTILL
DEGRADED CERRADO->ARABLE_CORN_NOTILL
DEGRADED CERRADO->PASTURE
DEGRADED CERRADO->IRRIGATED LAND
rbs_rc_mod_CERRADO
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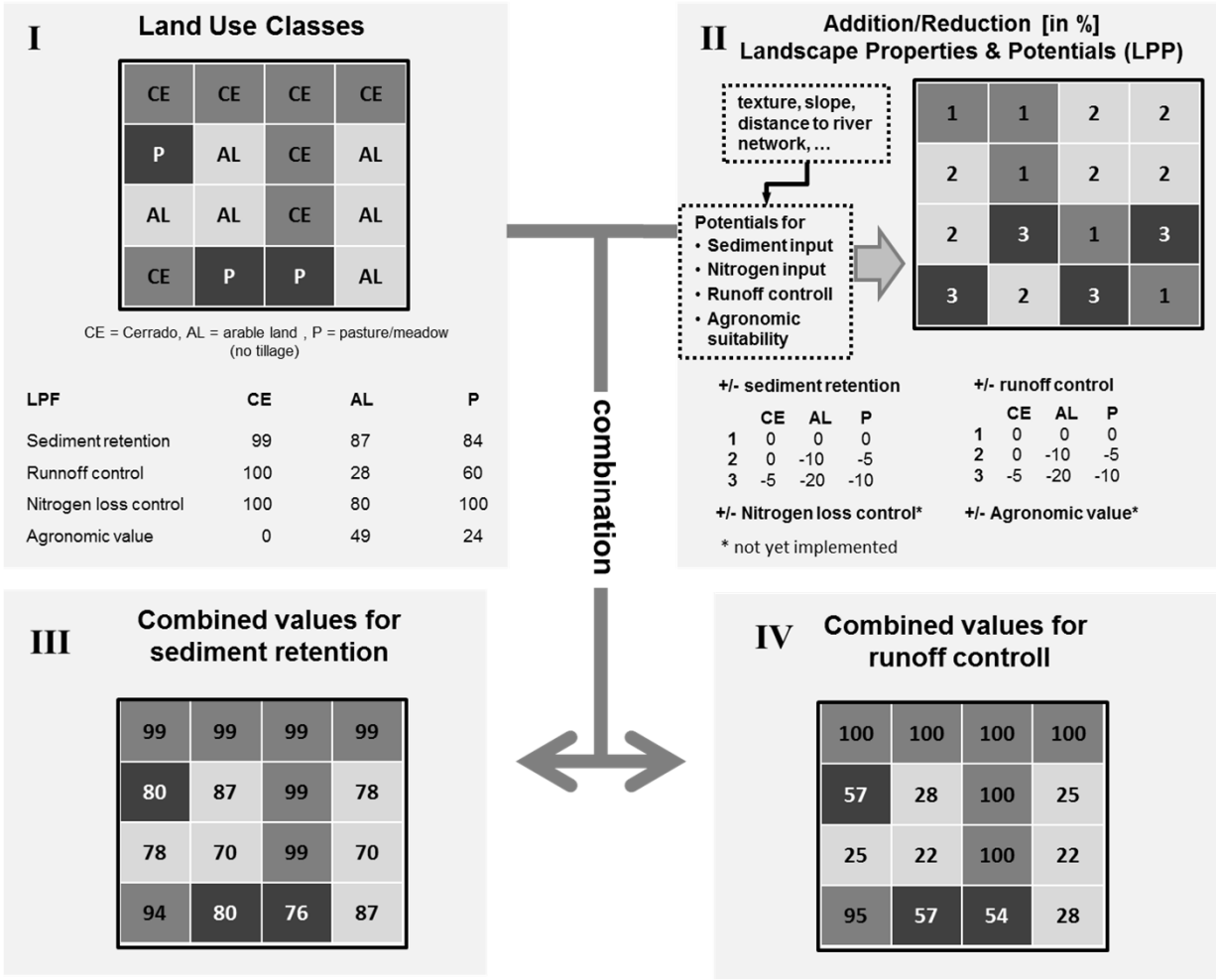
rbs_rc_modhigh_NATURAL FOREST(MATA)
rbs_rc_modhigh_ARABLE LAND_GENERAL_NOTILL
CERRADO->IRRIGATED LAND
CERRADO->ARABLE_GENERAL_NOTILL
CERRADO->ARABLE_CORN_TILL
CERRADO->DEGRADED CERRADO
dist_rc_high_CERRADO
dist_rc_High_AFFORESTATION
dist_rc_high_PASTURE
dist_rc_high_ARABLE LAND_GENERAL_NOTILL
DEGRADED CERRADO+CERRADO-...
DEGRADED CERRADO+CERRADO-...
DEGRADED CERRADO+CERRADO->PASTURE
DEGRADED CERRADO+CERRADO->IRRIGATED LAND
PASTURE->CERRADO
*PASTURE->CAMPO
PASTURE->AFFORESTATION
PASTURE->NATURAL FOREST(Mata)
PASTURES->ARABLE_GENERAL_NOTILL
PASTURES->ARABLE_CORN_NOTILL
AraBeland->Soy, tillage
AraBeland->Wheat


I
Land Use Classes
CE CE CE CE
P AL CE AL
AL AL CE AL
CE P P AL
CE = Cerrado, AL = arable land , P = pasture/meadow (no tillage)
LPF CE AL P
Sediment retention 99 87 84
Runnoff control 100 28 60
Nitrogen loss control 100 80 100
Agronomic value 0 49 24
combination
II
Addition/Reduction [in %]
Landscape Properties & Potentials (LPP)
texture, slope, distance to river network, ...
Potentials for
• Sediment input
• Nitrogen input
• Runoff controll
• Agronomic suitability
1 1 2 2
2 1 2 2
2 3 1 3
3 2 3 1
+/- sediment retention
CE AL P
1 0 0 0
2 0 -10 -5
3 -5 -20 -10
+/- runoff control
CE AL P
1 0 0 0
2 0 -10 -5
3 -5 -20 -10
+/- Nitrogen loss control*
+/- Agronomic value*
* not yet implemented
III
Combined values for sediment retention
99 99 99 99
80 87 99 78
78 70 99 70
94 80 76 87
IV
Combined values for runoff controll
100 100 100 100
57 28 100 25
25 22 100 22
95 57 54 28