phosphorus fractionation in soil and sediments along a continuum from agricultural fields to lake sediments

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SOILS: WHERE FOOD BEGINS

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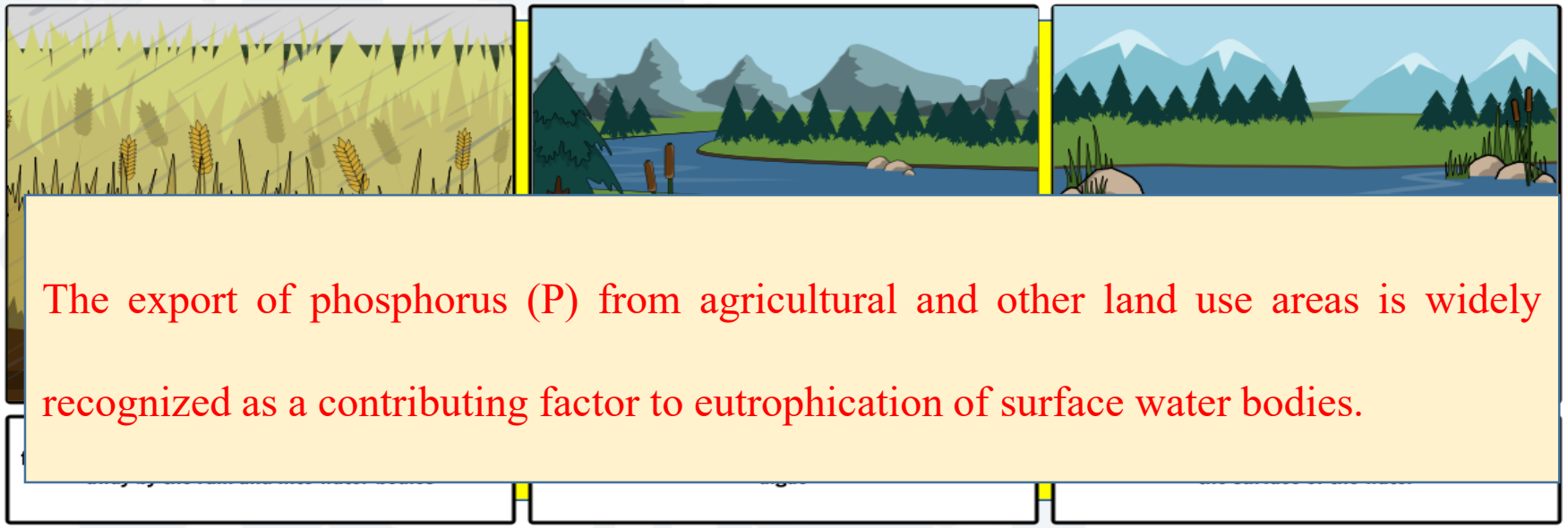
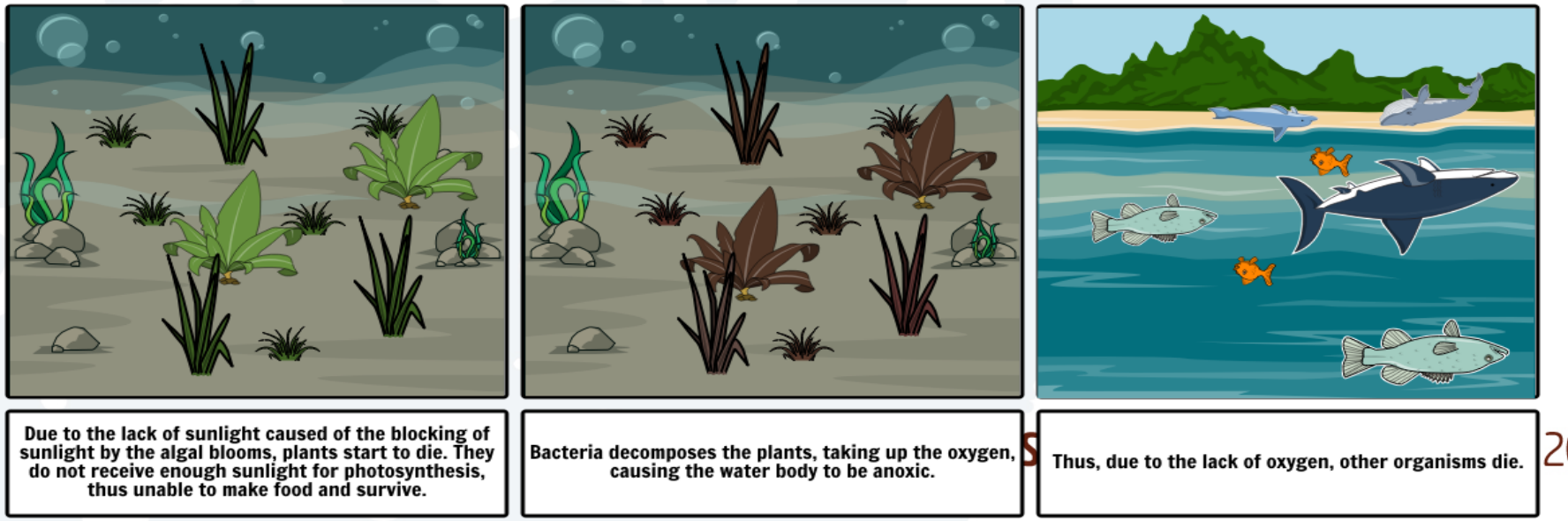


The export of phosphorus (P) from agricultural and other land use areas is widely recognized as a contributing factor to eutrophication of surface water bodies.



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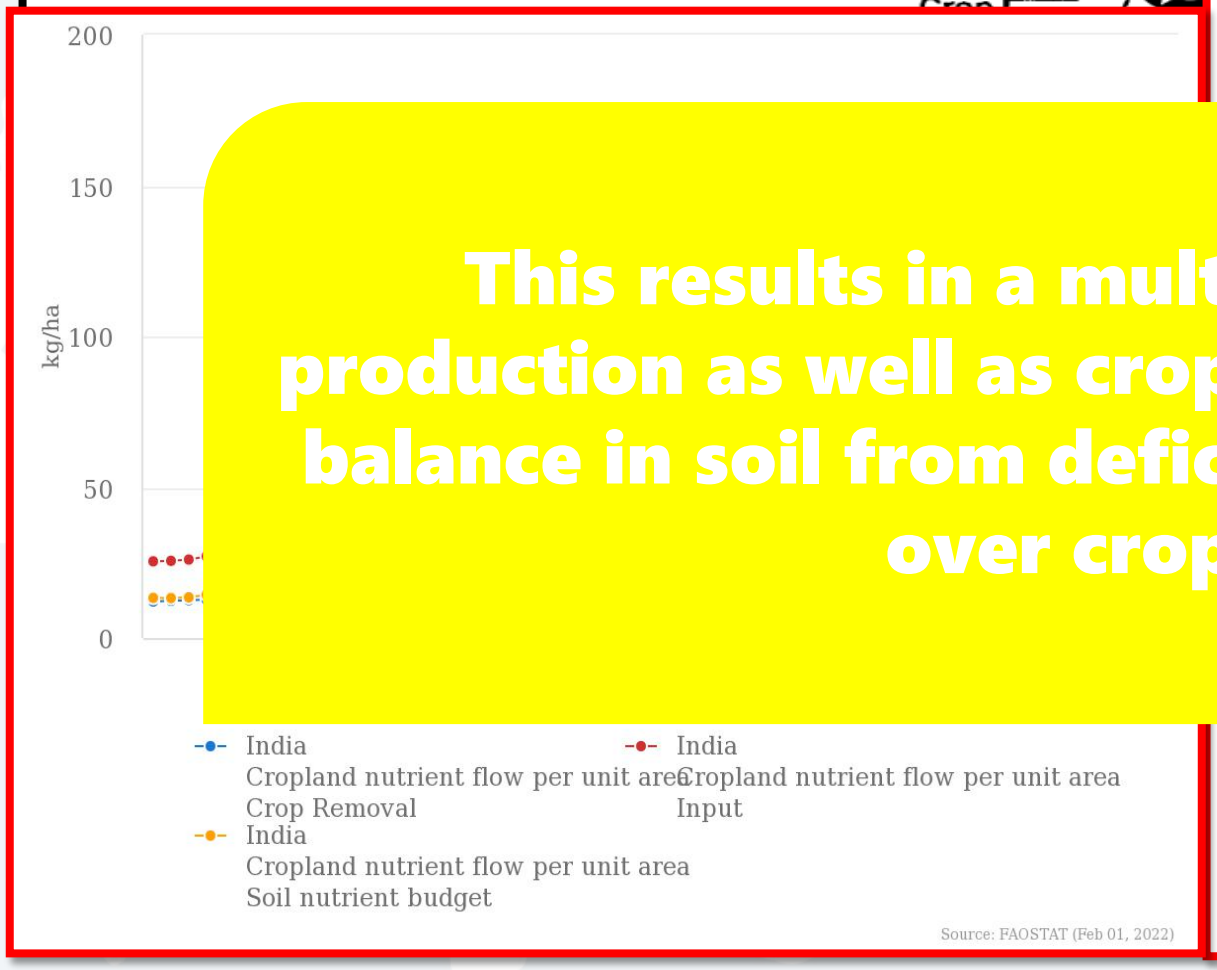
Phosphorus Cycle

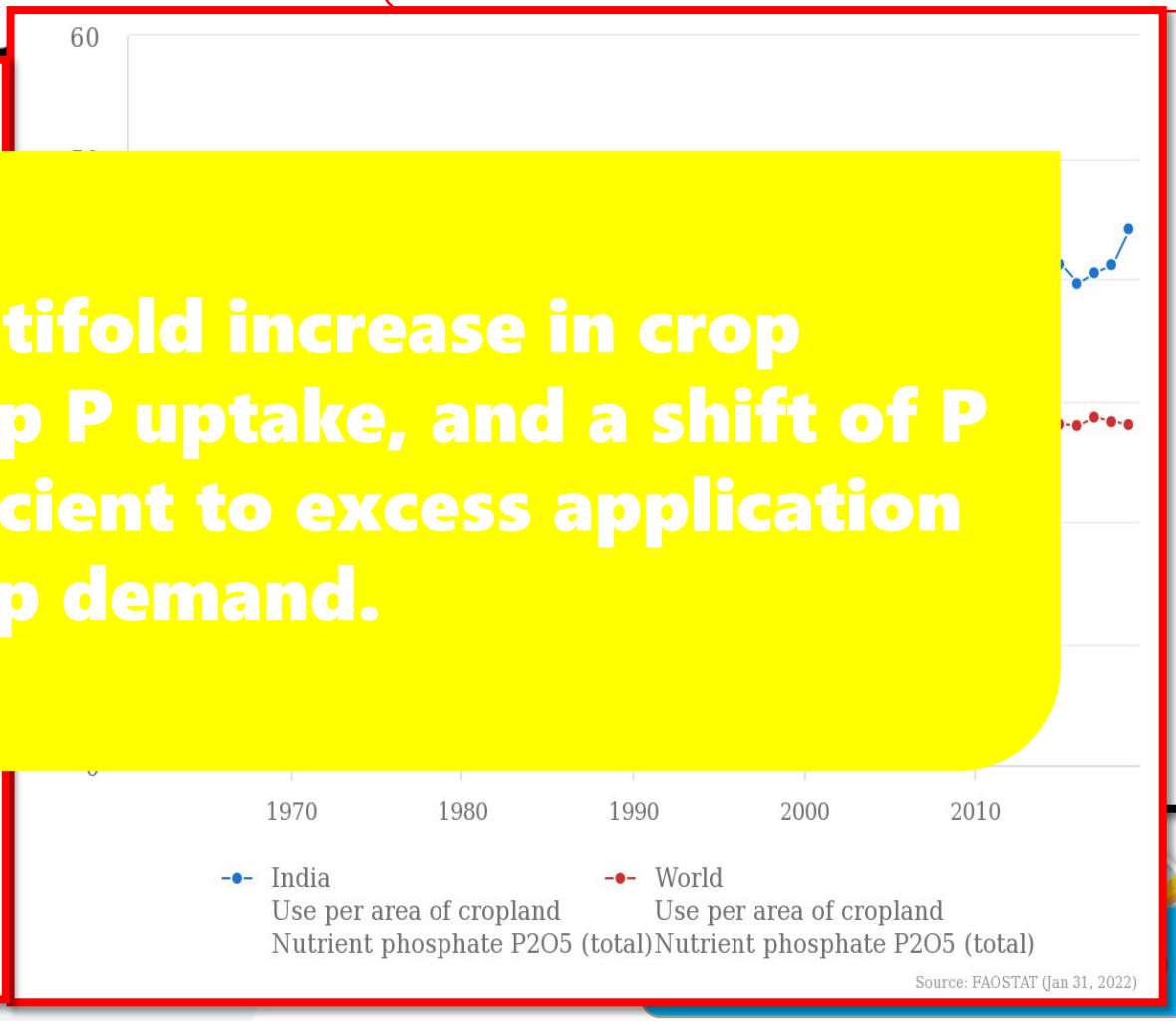
Fertilizers
$H_2PO_4^-$, HPO_4^{-2}

Agricultural, Municipal, and Industrial By-Products
Biological and Organic P

Soil nutrient budget of India

P use per area of cropland

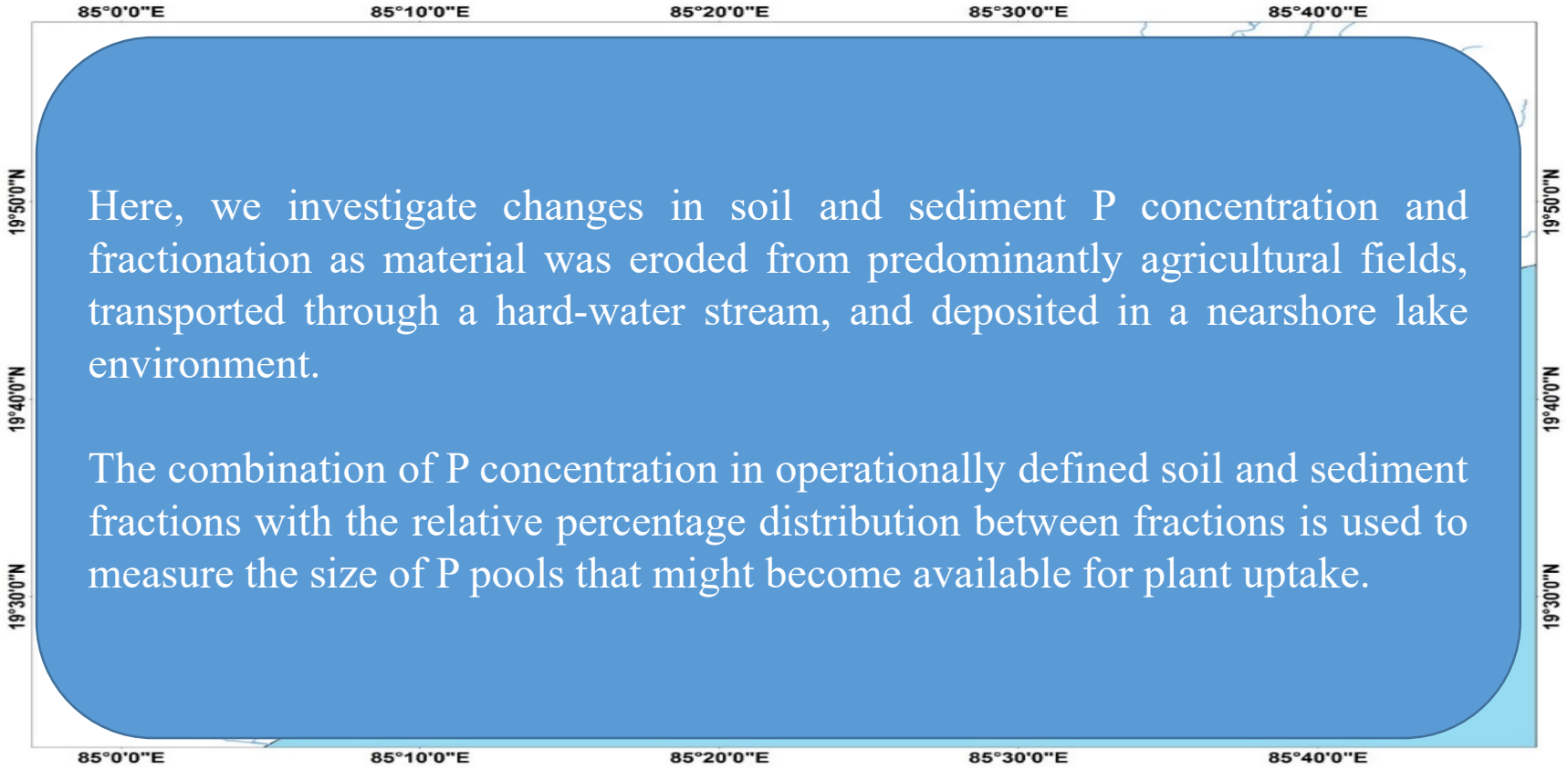




This results in a multifold increase in crop production as well as crop P uptake, and a shift of P balance in soil from deficient to excess application over crop demand.

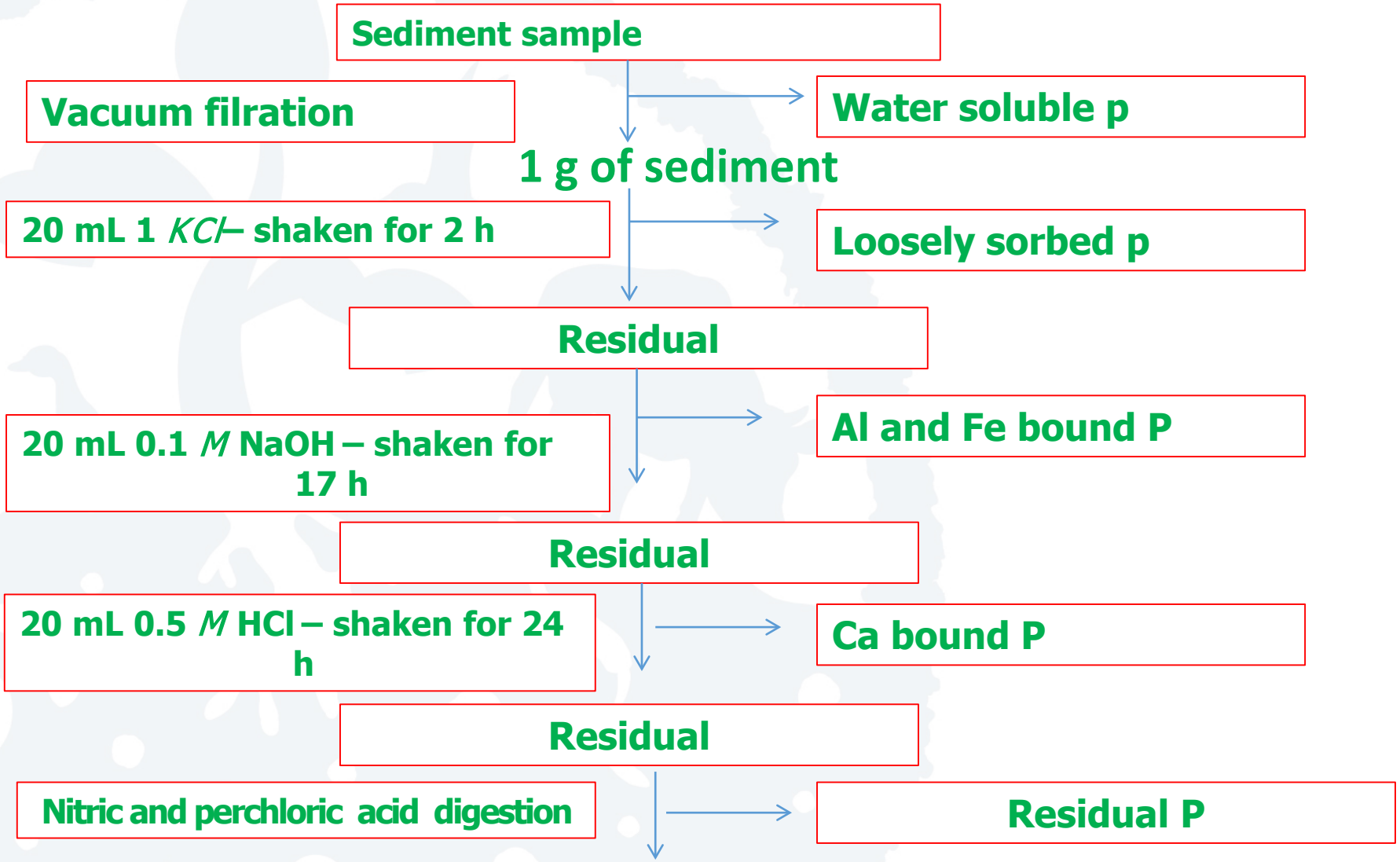
Study area

- Ramsar site by the Ramsar Convention of Wetlands in 1981.



Fractionation scheme of P in sediment

(Moore and Reddy (1994))



The Physico-chemical properties and Total P content in the lake sediment.

Parameter	Minimum	Maximum	Mean	Std. Deviation
T-P (mg kg^{-1})	99.5	971.9	568.0	288.2
pH	6.20	9.35	7.88	0.61
EC (dSm^{-1})	0.35	28.50	5.46	5.21
OC (%)	0.23	2.11	0.97	0.54
$CaCO_3$ (%)	0.00	4.20	1.04	1.02
Sand (%)	3.43	91.30	52.65	25.22
Mud (%)	8.70	96.57	47.35	25.22

While the TP concentration is of concern, P fractionation may also play a more important role in determining the impact of P on the system.

Descriptive statistics for various P fractions (mg kg^{-1}) in field soil and stream sediment.

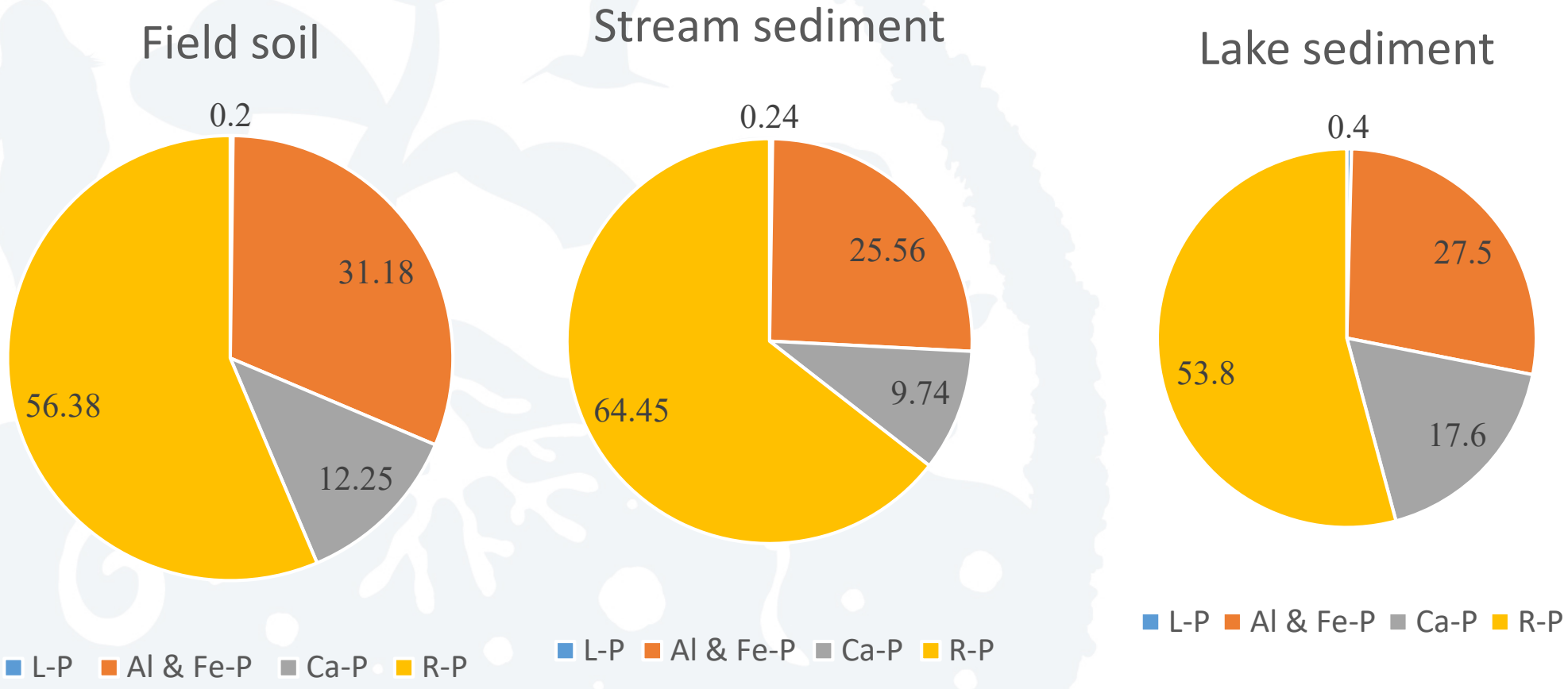
		L-P	Al & Fe-P	Ca-P	R-P	Total P
Field soil	Min	0.85	9.85	0.92	17.33	30.49
	Max	7.77	408.97	670.45	428.84	1028.58
	Mean	0.87	109.32	61.65	235.66	395.12
	Std	1.94	107.72	135.70	128.83	255.08
Stream sediment	Min	0.54	40.29	12.71	135.32	192.12
	Max	1.20	316.14	134.52	434.60	838.69
	Mean	0.84	128.52	48.12	279.79	457.27
	Std	0.20	93.43	37.05	101.97	219.17

Some fractions are available for biotic uptake while others sequester P in relatively immobile phases.

Table 2. Average phosphorus fraction (mg P kg^{-1}) of aluminum & iron bound phosphorus (Al & Fe -P), residual P (R-P), calcium bound phosphorus (Ca-P), for field soils, streams, and lake sediments of Chilika Lake.

Land use	L-P	Al & Fe-P	Ca-P	R-P	Total-P
Field soil	0.87	109.32	59.08	225.84	395.12
Stream sediment	0.84	128.52	48.12	279.79	457.27
Lake sediment	1.63	105.13	64.36	210.23	633.02

Relative percentage of P fraction



Research findings

- The land use type clearly influenced forms and distribution of P in the catchment area.
- Higher labile P suggest that the agricultural site was vulnerable to P loss from the field to water bodies through erosion and leaching .
- Increase in TP in the lake sediment area suggest external loading of nutrient due to deposition sediment in the lake as material is transported from field dominated by agriculture to lake sediment.
- The lake receives its major portion of riverine inflow from the north and northwest part by the rivers Daya, Bhargavi, and Luna carrying anthropogenic inputs which might be the reason behind the highest total P observed in the lake.

- Impact of P on water bodies/ lake is depend on the various mechanism that controls the P fractionation during transport of sediment from filed to lake.

- Shallow water lake is most vulnerable to internal P loading owing to their frequent mixing of the overlaying water with bottom and sediment which release P and triggers primary production.

- Different management practice and land use types have a influence on P fractionation pattern, with less P input in the agricultural field could help to reduce macrophyte growth in the lake.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