INITIATIVE ON
Agroecology

CGIAR

Biodiversity in an Agroecological Landscape: Harnessing Ecosystem Services for Agriculture

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Biodiversity study -Ecosystem service approach

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How do current farm and landscape management practices impact organisms that render ecosystem services

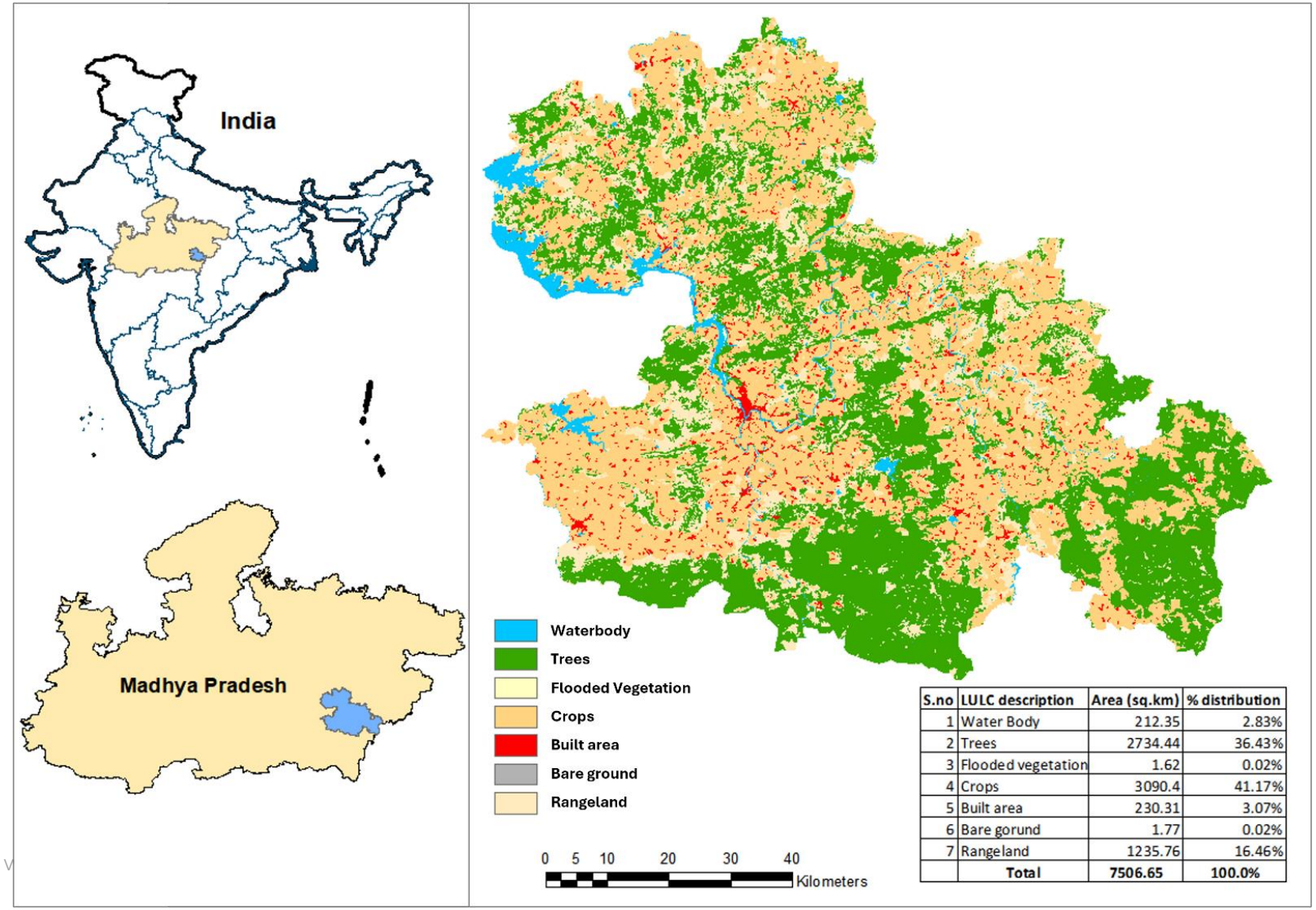
Biological control of pests

- Parasitoids
- Predators

Pollination services

- Plant pollinator interactions
- Leafcutter bees

Study region



S.no	LULC description	Area (sq.km)	% distribution
1	Water Body	212.35	2.83%
2	Trees	2734.44	36.43%
3	Flooded vegetation	1.62	0.02%
4	Crops	3090.4	41.17%
5	Built area	230.31	3.07%
6	Bare gorund	1.77	0.02%
7	Rangeland	1235.76	16.46%
	Total	**7506.65**	**100.0%**

LULC- key features

- Tree cover/ forest 36%
- Rangelands 16.5%
- Croplands 41%

52.5 %

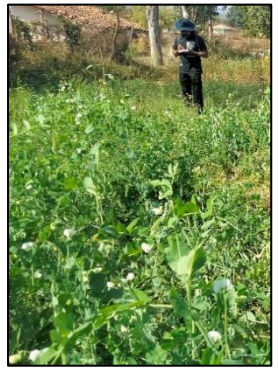


Research questions

1. What are the crucial **landscape** drivers that impact insects in general and parasitoids in particular in homesteads?



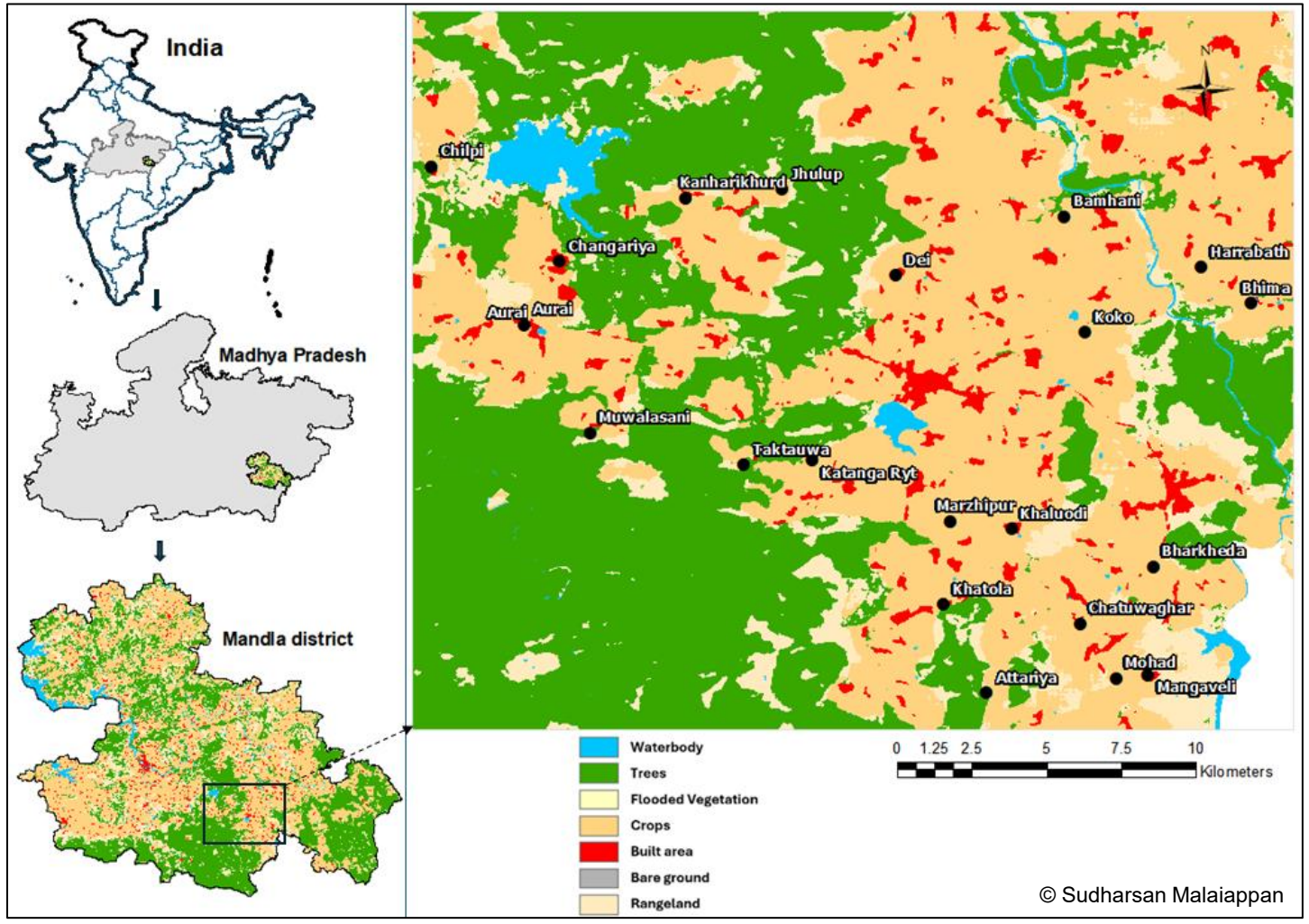
2. Do insect pollinators preferentially visit certain crops in homesteads? (associated to **farm management**)
3. What **landscape** variables are critical for different pollinator functional guilds in homestead gardens?



4. Is caterpillar predation in homesteads associated to **landscape** components?

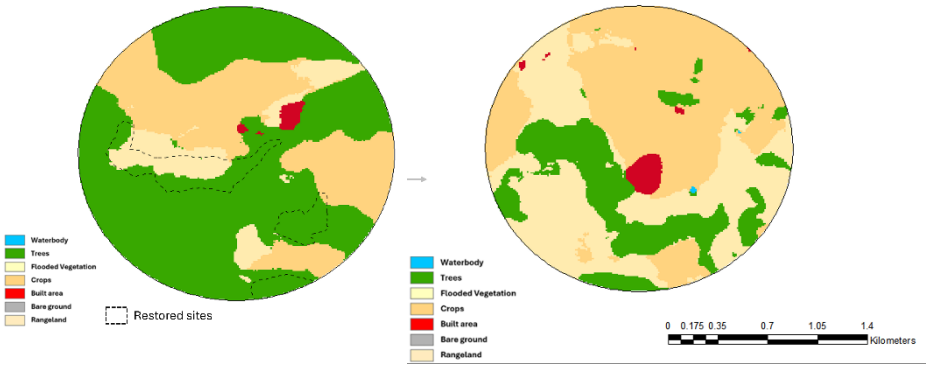


Landscape features of Mandla



Summary of the 21 study locations				
Land use type %	Average %	SD	Min	Max
Forest	15.3	19.6	0.0	61.1
Cropland	69.7	22.3	28.9	97.2
Built-up	5.0	3.8	0.5	15.4
Rangeland	9.5	10.4	0.0	39.8
Water	0.5	0.8	0.0	2.1

Locations were selected such that they largely represented the land use patterns surrounding croplands!



RQ1. What are the crucial landscape drivers that impact insects in general and parasitoids in particular in homesteads?

Parasitoids- Method Malaise traps



Host is moth larve -Chilo partellus
Jowar stem borer



Parasitiod- *Stenobracon sp.*

Their role?

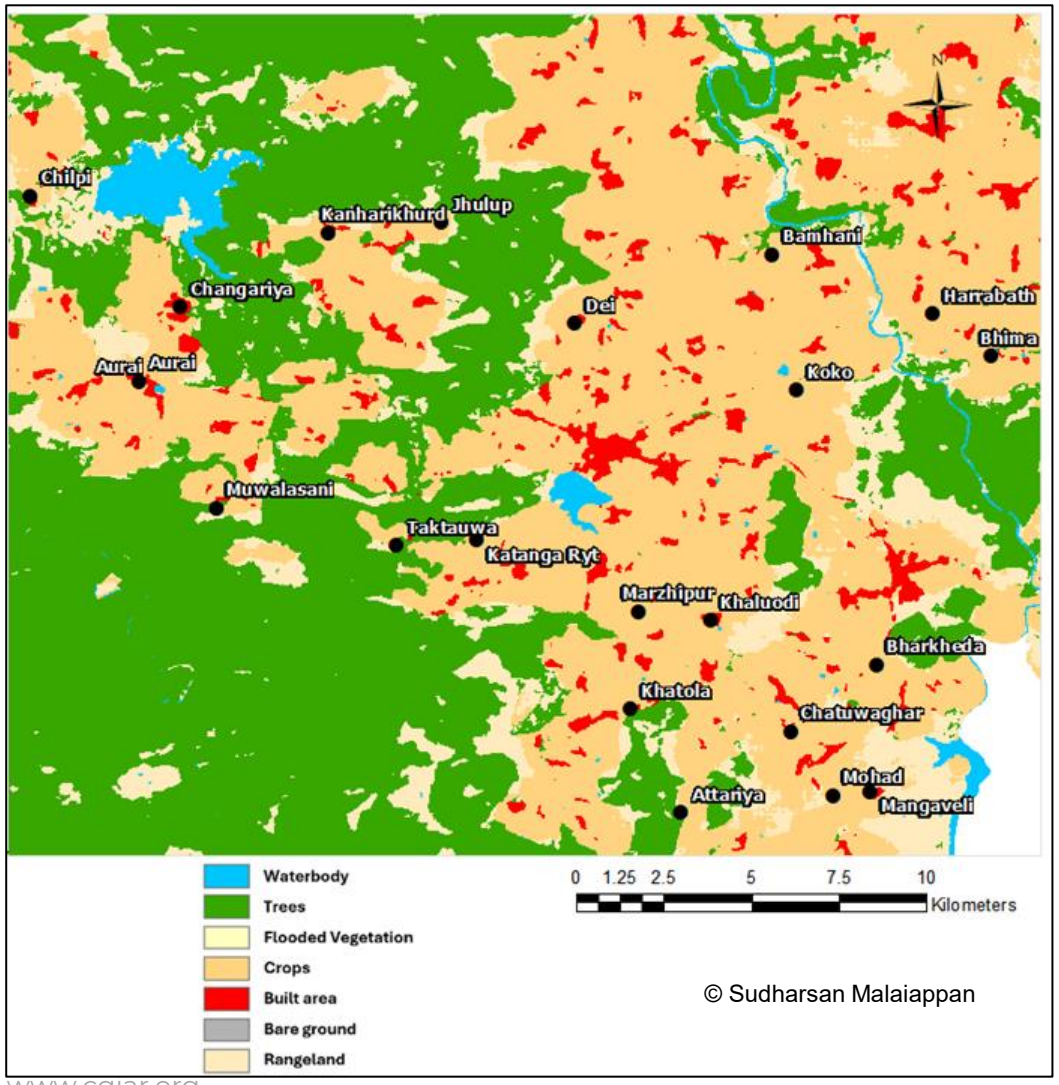
Biological control of pests



21 sites → 42 Malaise traps → 6025 insects → 853 morpho/species



Drivers of insect functional traits - Method Malaise traps





Delta conoideum



Method: Generalised linear models				
Parameter	Overall abundance	Overall richness	Wasp abundance	Wasp richness
Forest cover	-ve	-ve	-ve	-ve
Crop cover	+ve	+ve	+ve	+ve
Built-up area	+ve	NS	NS	NS
Rangeland	-ve	NS	-ve	-ve
Water bodies	NS	+ve	+ve	+ve

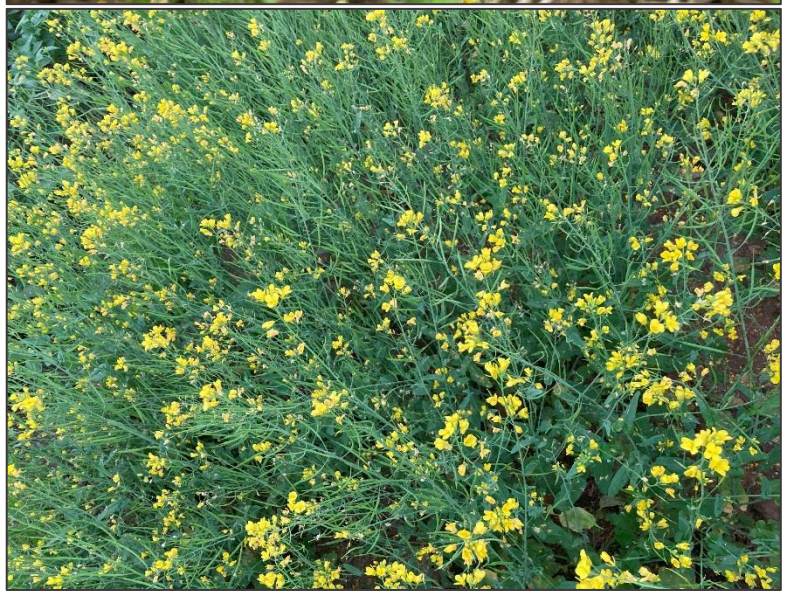
Pollinator dependencies by crops

Crop species	Crop common name	Parts used/ Crop category	Dependence on animal pollination	Mean (D)
Lagenaria vulgaris	Bottle gourd	Fruit/ Vegetables	Essential	1
Luffa aegyptiaca	Sponge gourd	Fruit/ Vegetables	Essential	1
Momordica charantia	Bitter gourd/ Karela	Fruit/ Vegetables	Essential	1
Coriandrum sativum L	Coriander	Fruit/ Spices	Great	0.65
Cucumis sativus	Cucumber	Fruit/ Vegetables	Great	0.65
Brassica campestris L.	Rapeseed	Seeds/ Oil	Great	0.65
Brassica juncea	Indian Mustard	Seeds/ Oil	Modest	0.35
Abelmoschus esculentus	Okra	Fruit/ Vegetables	Modest	0.25
Solanum melongena	Brinjal	Fruit/ Vegetables	Modest	0.25
Capsicum annuum	Chilly	Fruit/ Spices	Little	0.05
Cyamopsis tetragonoloba	Cluster beans/ Guar	Fruit/ Vegetables	Little	0.05
Cajanus cajan	Pigeonpea	Seeds/ Pulse	Little	0.05
Solanum lycopersicum	Tomato	Fruit/ Vegetables	Little	0.05
Vigna unguiculata	Cow pea	Fruit/ Vegetables	Little	0.05

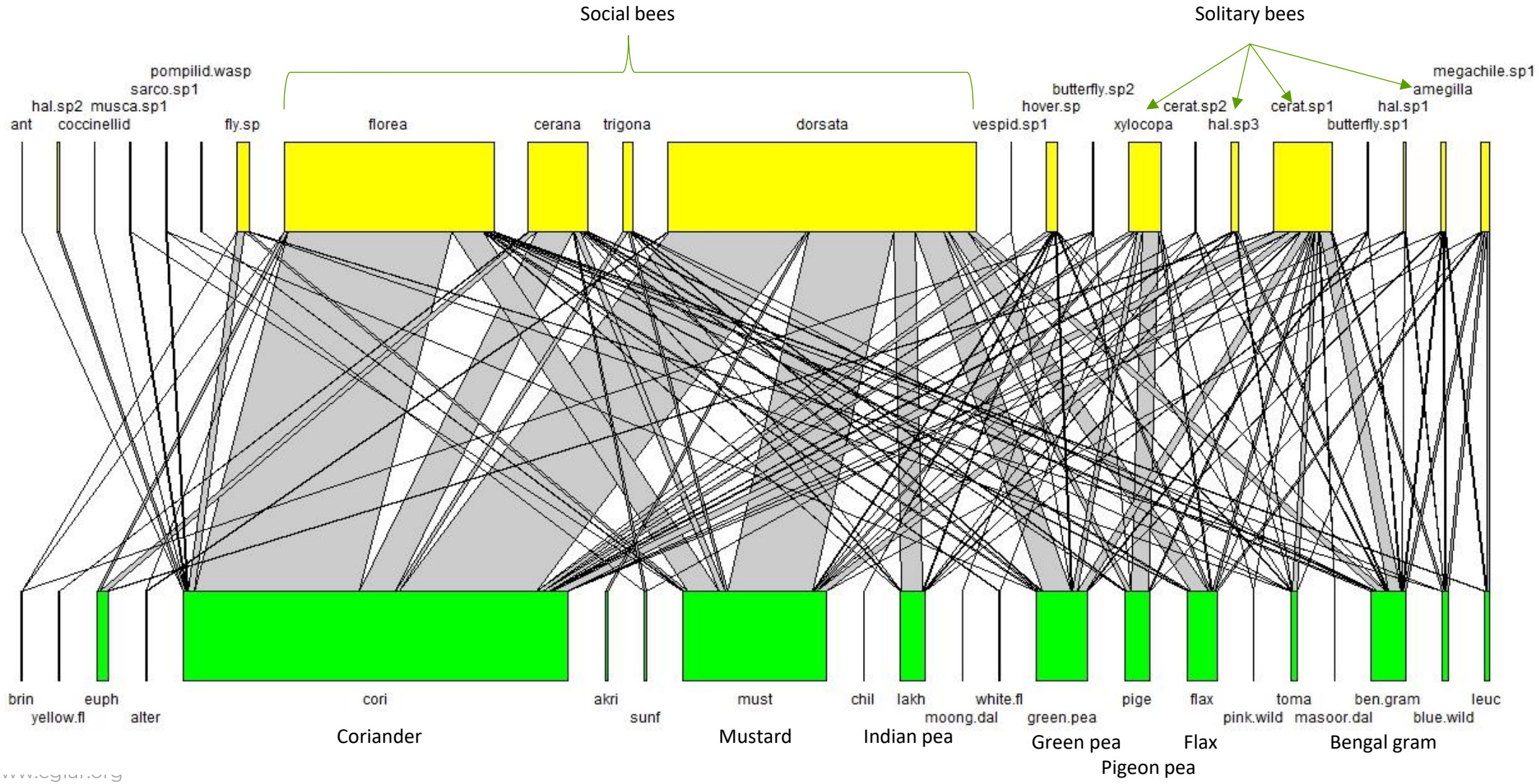
Plant pollinator interactions

- Pollinator visits 13,305 visits (99% on crop plants)
- Plant species 17 crop and 4 non- crops
- Flower visitors 22 species (12 bees, 4 flies, 2 wasps, 2 butterflies, 1 ant, and 1 beetle species)
- Honey bee species most dominant
  - *Apis cerana* (1085)
  - *Apis dorsata* (5599)
  - *Apis florea* (3802)
- Solitary bees- *Ceratina* species most dominant
- Crops most visited
  - Coriander
  - Mustard





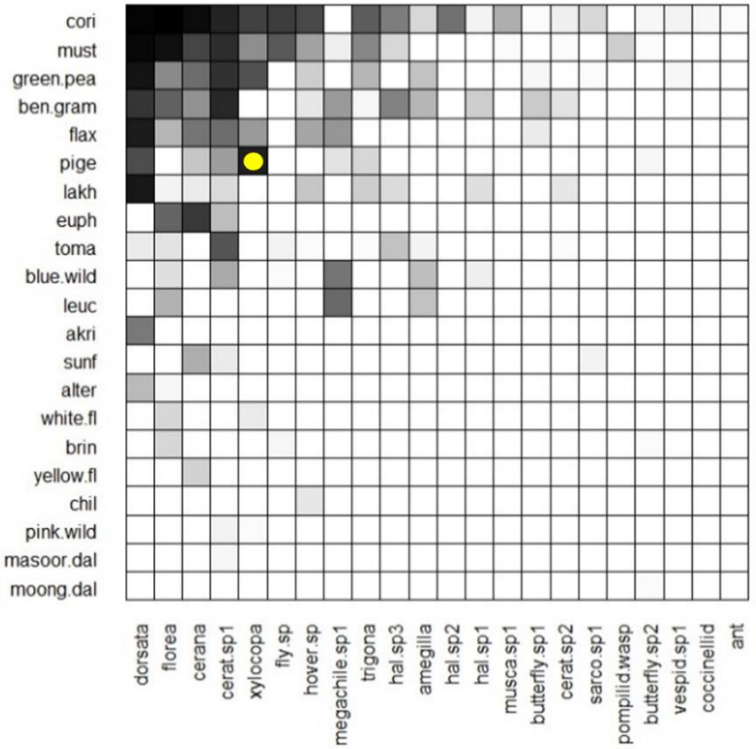
Plant pollinator network

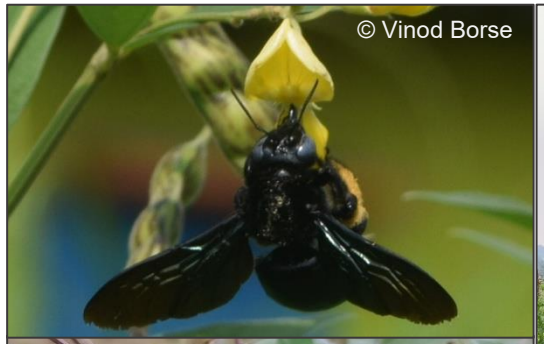


Going into specifics!

Strength of association between pollinators and crop plants

- Xylocopa (carpenter bee) heavily depended on pigeon pea for forage
- Megachile species (leaf cutter bees) heavily depended on pigeon pea for nest building material



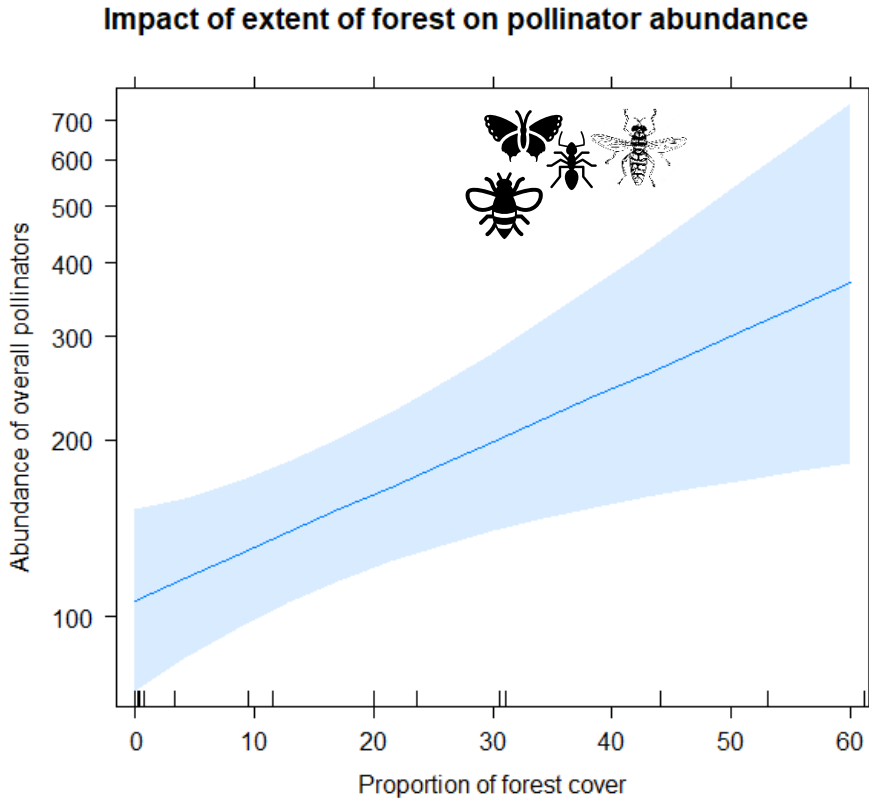


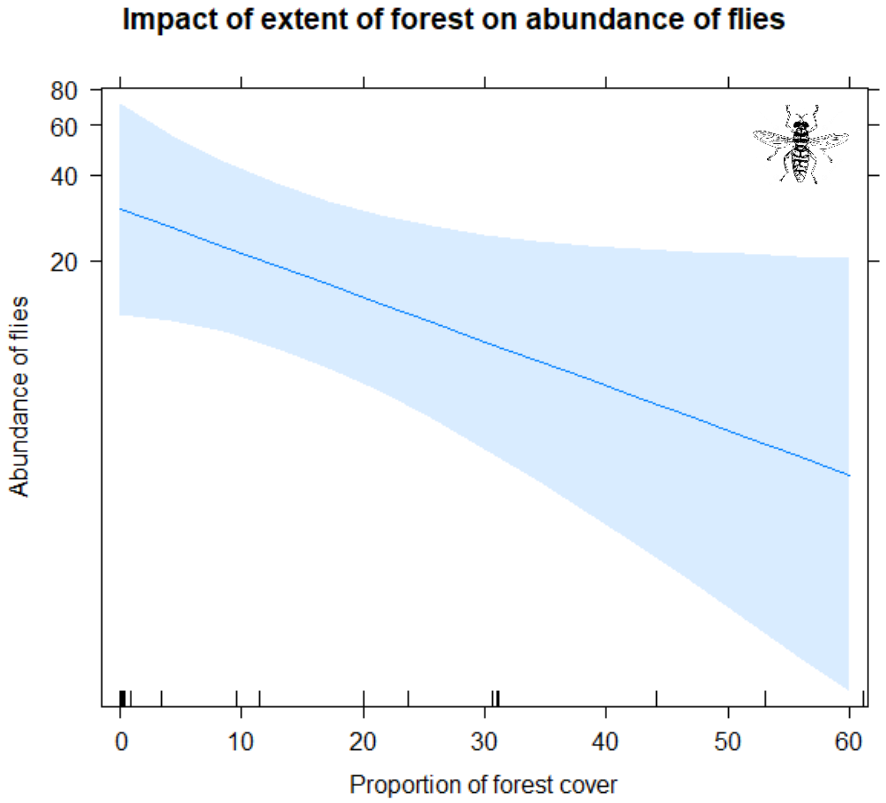




RQ3. What landscape variables are critical for different pollinator guilds and functional groups in homestead gardens?

Response of pollinator guilds and functional groups

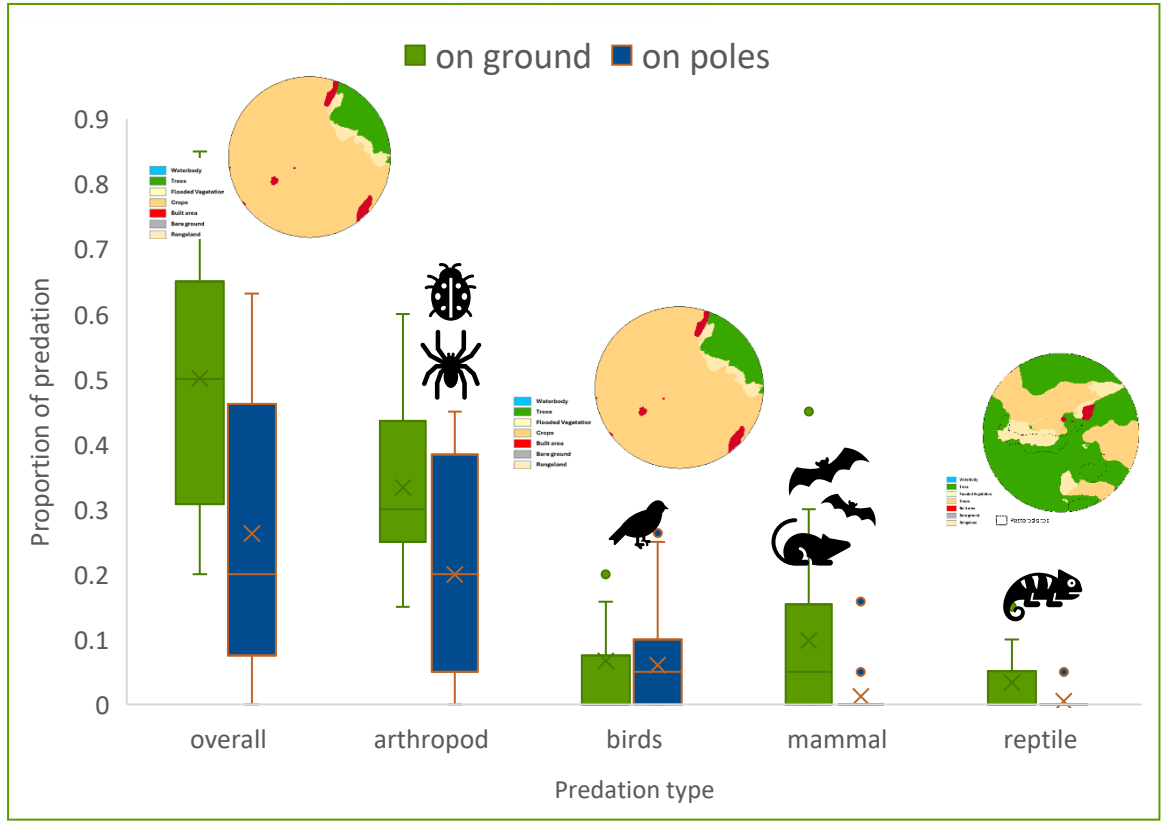




Parameter	Overall pollinators	Honey bees	Solitary bees	Stingless bees	Carpenter bees	Flies
Forest cover	+ve	+ve	+ve	NS	+ve	-ve
Crop cover	-ve	-ve	-ve	NS	-ve	+ve
Built-up area	NS	NS	+ve	NS	NS	+ve
Rangeland	-ve	-ve	NS	+ve	NS	NS
Water bodies	NS	NS	-ve	NS	+ve	NS

Predation study

- Installed 840 caterpillars 38.17% predated
- Main predators- spiders, ants, locusts, beetles, and wasps
- Predation on ground 50% vs on plant 26%



Caterpillars on ground are more often predated than on plants/poles suggesting the ***crucial role of ground-dwelling insect predators***

Arthropods (Insects & spiders)



Birds



Mammals



Reptiles



Conclusions

1. What are the crucial **landscape** drivers that impact insects in general and parasitoids in particular in homesteads?
    - Extent of crop lands seemed to have positive effect on insect diversity in general and parasitoids in particular
2. Do insect pollinators preferentially visit certain crops in homesteads?
    - Coriander, Mustard and Pigeon pea are important crops that provide forage resources for various pollinators. Pigeon pea also provides nest building materials for meghachilds/ leafcutter bees
3. What **landscape** variables are critical for different pollinator functional guilds in homestead gardens?
    - Extent of forest had a significant positive impact on pollinator abundance in general however flies increased with an increase in croplands and not forest
4. Is caterpillar predation in homesteads associated to **landscape** components?
    - Arthropods - most important predators, they prefer locations that were primarily agrarian, while reptilian predators preferred landscapes that were primarily forested

Thank You!

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