Sustainable Intensification and Biodiversity

ISFM Outperforms Conventional Agriculture for Underground Arthropod Diversity in Northern Ghana.

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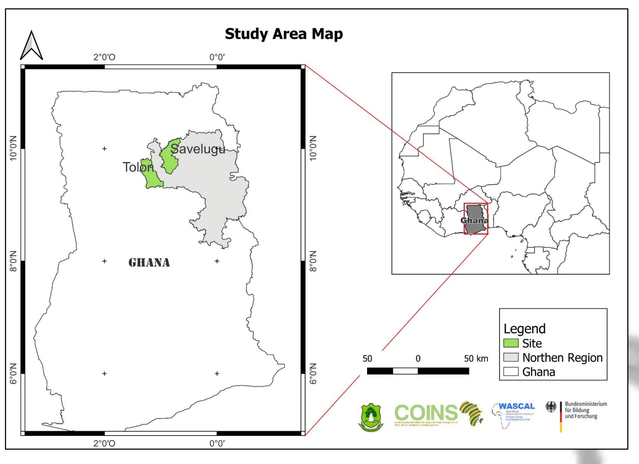
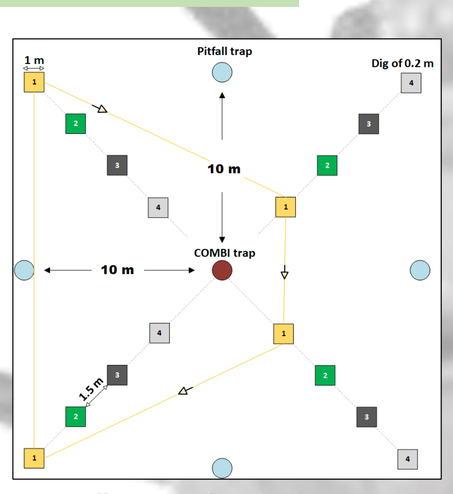
1- Background

Integrated Soil Fertility Management (ISFM) is increasingly promoted as a sustainable intensification practice in West Africa. However, its impacts on biodiversity remain poorly understood. This study examines the response of arthropods to land use (LU) across an intensity gradient that includes pristine areas, ISFM, and conventional farms in northern Ghana.

2- Methods



Study area



Collection plot design

Design: 3 plots × 3 LUs (pristine proxy, conventional, ISFM farms)

Sampling:1 Combi trap, 4 pitfall traps, 4 soil excavations (1m²)

Timeline: End of fallow, 03 times collection of 72 h each.

Species were sorted in morphospecies and counted per LU (Hackman et al., 2017).

Analysis: Hill diversity (Hill 1973) ${}^{q}D$ profiles and species accumulation (Coleman et al., 1982) curves.

$$ {}^{q}D = \left(\sum_{i=1}^{S} P_i^q \right)^{\frac{1}{1-q}} $$

Where S is the species richness, P_i is the relative abundance of the i^{th} species and q is the order or sensitivity parameter.

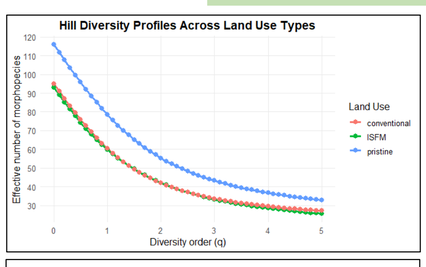
Combi trap installation

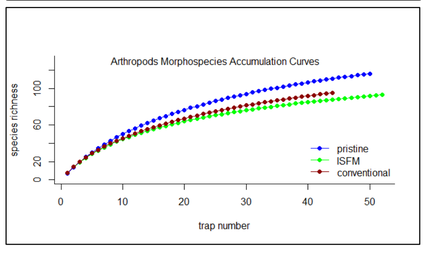
Soil excavation

Pitfall trap

Pinned arthropods for sorting and counting

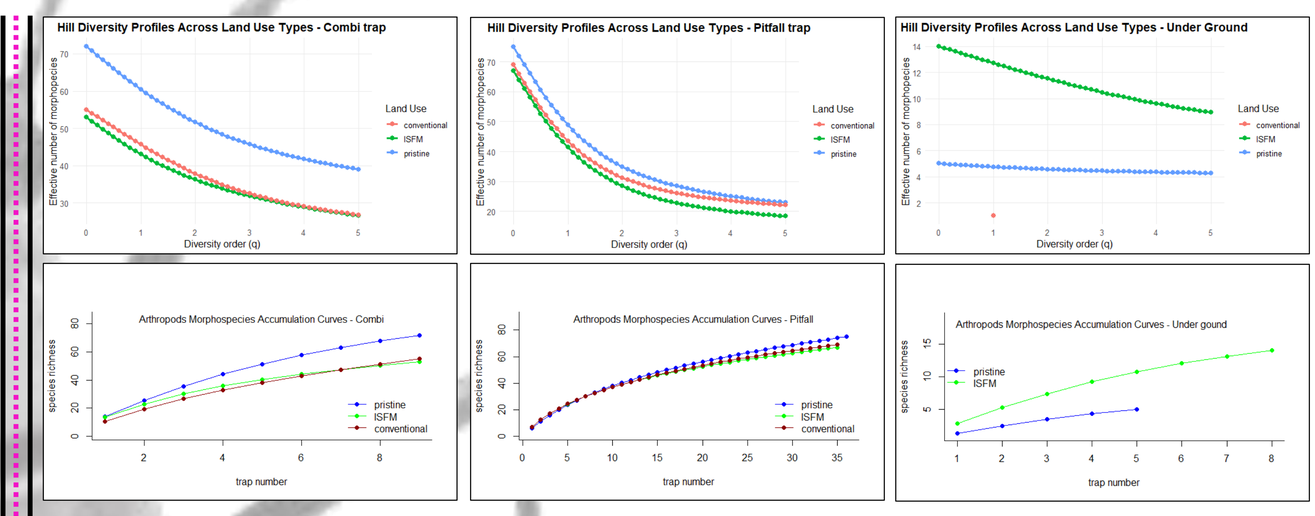
3- Results





Overall biodiversity

- Pristine (>115) > conventional (95) ≈ ISFM (93)
- More intensive sampling could result in higher diversity
- 5,097 individuals,152 morphospecies collected.



Above- and on-ground (Combi & Pitfall) arthropod diversity: Pristine > conventional ≈ ISFM

Below-ground fauna diversity: ISFM >> pristine > conventional

4-Discussion

Contrasting patterns above vs below ground

- ISFM only improved soil habitat through organic matter inputs and reduced chemical intensity.
- Above ground arthropod diversity heavily depends on better land coverage in most of conventional (weeds).

Further cross-cutting analysis required

- Higher above-ground biodiversity is not necessarily advantageous for cropping: could include crop enemies; deeper analysis required to understand agriculture-arthropod relationship.

ISFM improvement policy

- Increase in ground coverage of plants may improve above-ground biodiversity conservation potential of ISFM.

Surprising finding

- ISFM supports 3x higher pedofauna diversity than pristine areas.
- Conventional agriculture severely impacts soil communities.

5- Conclusion

- Preliminary results indicate potential for ISFM as a biodiversity-friendly intensification strategy, particularly for soil ecosystem services.
- Improving plant coverage of ISFM farms may enhance biodiversity.

6- Reference

- Hackman, K. O., Gong, P., & Venevsky, S. (2017). A rapid assessment of landscape biodiversity using diversity profiles of arthropod morphospecies. Landscape Ecology, 32(1), 209–223. https://doi.org/10.1007/s10980-016-0440-4
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- Hill, M. O. (1973). Diversity and Evenness : A Unifying Notation and Its Consequences. Ecology, 54(2), 427–432.