

On the impact of land cover change: How decreasing wild pollinators' natural habitat affects smallholder crop production in Tanzania

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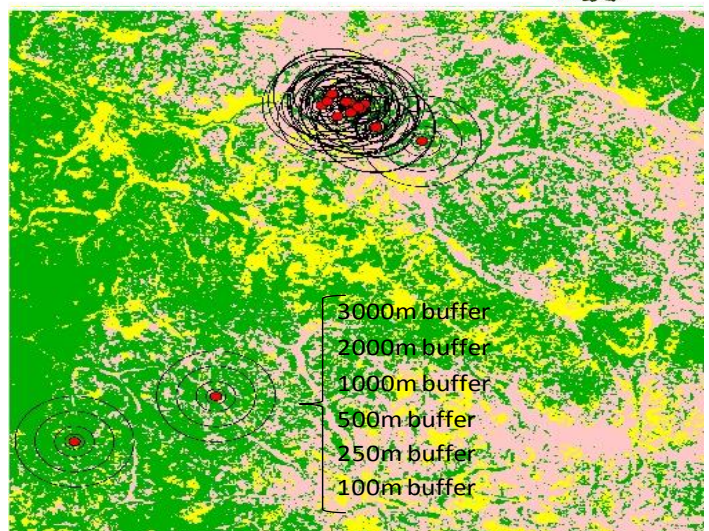
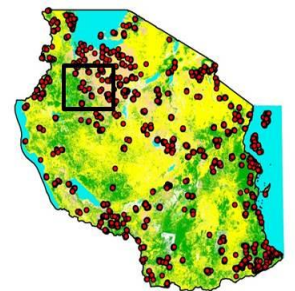
Smallholder farms in Tanzania rely on wild pollinators, but there are drastic changes in land use which result in the reduction of wild pollinators' natural habitat, that is, forests. Our interest is to show how this affects crop revenue of smallholder farm households



About the study

We connect country-wide crop production on individual smallholder farm plots to land cover maps that show changes in forest cover over time. Second, we identify the contribution of forest habitats supporting wild pollinators to crop revenue. Third, to further assist in identifying the contributions of wild pollinators' natural habitats, we use the Food and Agriculture Organization of the United Nations (FAO) pollination management system to divide crops into pollinator-dependent and pollinator-independent.

This is made possible by the fact that smallholder farmers grow a menu of crops which include fruits, tubers, grains, vegetables, nuts and seeds. These crops have varying levels of pollinator dependency. Fourth, because pollinators have limited but varying flight distances, we measure the contribution by capturing the impact of different forest cover distances from the farm plot (100m-3000m buffer zones).



Pollination dependency categories (Food and Agriculture Organisation of the United Nations)

- Essential: in absence of pollinators, crop output is reduced by more than 90% (e.g., watermelon)
- Great: crop production is reduced by 40-90% in the absence of pollinators (e.g., cucumbers)
- Modest: crop production is reduced by 10-40% in the absence of pollinators (e.g., coconut)
- Little: reduction ranges between 0-10% (e.g., tomatoes, peanuts, Bambara beans)
- There is some increase in seed/ breeding/yield due to pollinators (e.g., potatoes, bananas)
- There is no decrease in yield in the absence of pollinators (e.g., rice, maize, chick peas)
- Unknown: because of lack of research, the response is unknown (e.g., ginger, spinach)

Smallholder farms in Tanzania

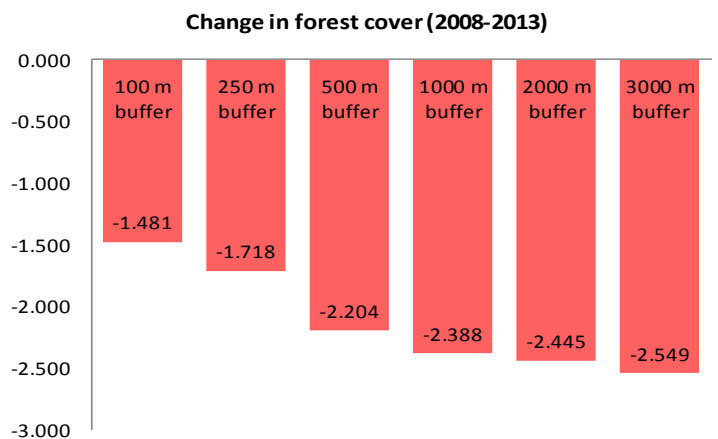
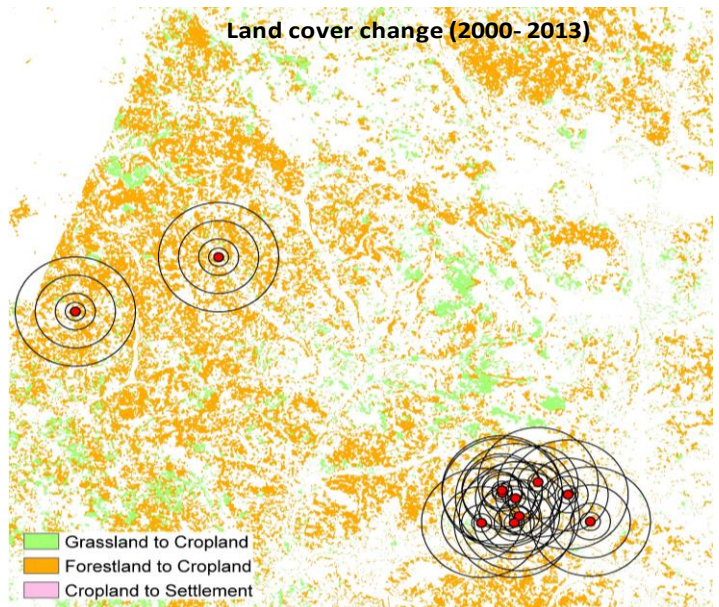
- Agriculture is the backbone of the country, and hence the main ingredient for poverty alleviation.
- There are commercial and smallholder farms; the latter are the majority.
- Smallholder farms are on average approximately two acres in size, use inferior farming methods and lack access to modern technologies.
- On average, Tanzanian households own about two smallholder plot farms.
- There is a high reliance on nature for crop growth, e.g., rainfall, wild pollinators.

Change in the natural habitats of wild pollinators

The upper part of the figure shows how land cover has changed between 2000 and 2013 in Tanzania (from SERVIR maps). While the white color indicates that there has not been any change in land cover, the brown suggests that land cover changed from forests to cropland, and the pink implies that land cover changed from cropland to settlement.

Since the brown color is more pronounced, this suggests that most of the forests in Tanzania have been converted to cropland.

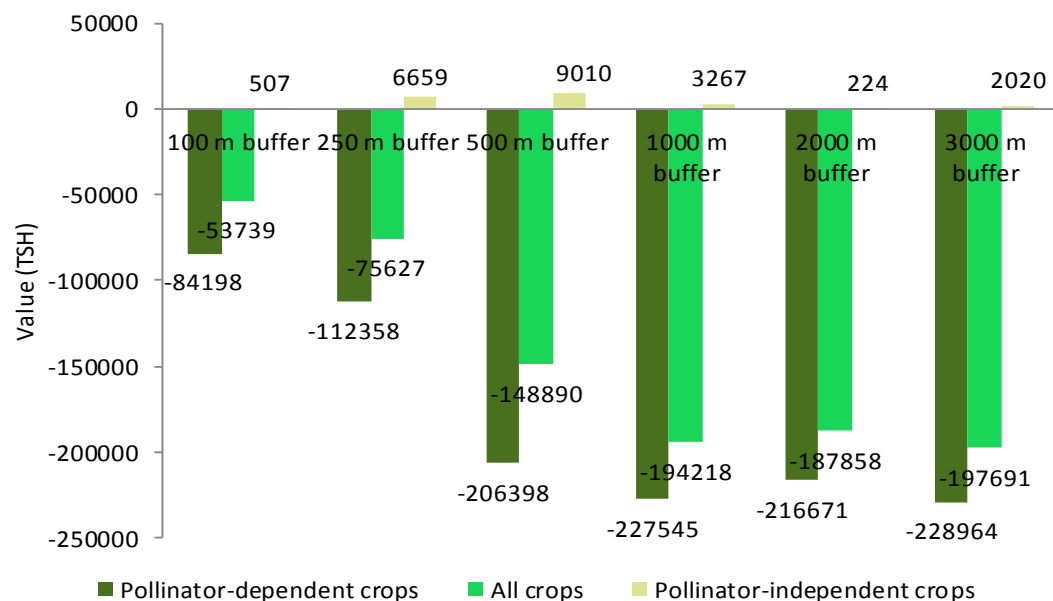
This is in line with our data, which shows that forests – the natural habitat of wild pollinators - have been changing in Tanzania in the different buffer zones in our study period (2008-2013). In general, there has been a decrease in the share of forest in all six buffer zones. This reduction ranges between 1.48-2.5%, depending on the radius of the buffer.



Impact of a reduction in pollinator natural habitat on smallholder crop farms

The dark green bars show the results based on crop revenue from *pollinator-dependent crops* alone, while the light green is based on crop revenue from *all crops*. The advantage of this approach is that the estimation is based on the full effect of pollinator habitat change, while accounting for farmers’ adapting their crop choices. Finally, the green-yellow bar, based on our double-check of the accuracy of our results, is based on *pollinator-independent crops*. Here, we find no effect on crop revenue due to change in pollinator natural habitat, indicating that we have identified the true effect of the loss of habitat on crop revenue. From this we can conclude that a reduction in the natural habitat of wild pollinators is likely to reduce the revenue of smallholder crop farms.

The absolute values for *pollinator-dependent crops* include when we consider both mean and media: TSH-84197.54 (-11% mean), (0% median); TSH-112358.20 (-16% mean), (0% median); TSH-206398.20 (-30% mean), (-2% median); TSH-227545.30 (-33% mean), (-3% median); TSH-216671.20 (-30% mean), (-3% median); TSH-228964.20 (-33% mean), (-5% median) when considering the 100m, 250m, 500m 1000m, 200m and 3000m buffer respectively. The values for *all crops* include: TSH-53739.26 (-7% mean), (0% median); TSH-75627.31 (-11% mean), (0% median); TSH-148889.60 (-21% mean), (-1% median); TSH-194217.90 (-28% mean), (-3% median); TSH-187858.00 (-26% mean), (-3% median); TSH-197691.40 (-29% mean), (-4% median). Lastly, for *pollinator-independent crops*: TSH506.94 (0% mean), (0% median); TSH6659.41 (1% mean), (0% median); TSH9009.55 (1% mean), (0% median); TSH3266.95 (0% mean), (0% median); TSH223.79 (0% mean), (0% median); and TSH2019.60 (0% mean), (0% median). Note that USD1 ≈ TSH2000.



From a policy perspective, our results show that conservation efforts that target the preservation of forest will promote the preservation of natural habitats of wild pollinators, which play a critical role in the crop systems of smallholder farms. This is crucial for Tanzania, and developing countries in general, because most smallholder farms depend on wild pollinators. In addition, there is a need to promote bee farming, not only for honey production, but for increasing crop productivity in sub-Saharan Africa. Currently, bee keeping in Tanzania is mainly practiced on small to medium size farms, mainly for honey and wax production, to earn extra income for the households, and ignores the possibility of earning more revenue from renting out bee hives to increase crop productivity.

Bee hive renting is a strategy which is often used to increase crop productivity in developed countries, and could be crucial to boosting household income amongst smallholder farmers in the developing countries.

RESEARCH BRIEF

Wild pollinators and smallholder farms

ABOUT THIS BRIEF

This brief is based on Naturally available wild pollination services have economic value for nature dependent smallholder crop farms in Tanzania. Scientific reports, 9(1), 3434, by Byela Tibesigwa, Juha Siikamäki, Razack Lokina and Jessica Alvsilver.

FURTHER READING

Byela Tibesigwa, Razack Lokina, Juha Siikamäki and Jessica Alvsilver. The value of wild pollination services to crop productivity: What's gender of the smallholder farmer got to do with it?

<http://www.efdinitiative.org/news/archive/esaford-researcher-awarded-best-poster-during-wcere2018>

Byela Tibesigwa. "Naturally Available Pollinator

Decline Will Decrease Household Food Security and Increase the Gender Gap in Nutrition between Men and Women Who Head Smallholder Farm Households in Sub-Saharan Africa" (EfD Discussion Paper 18-05, 2018)

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Fruits and vegetables sold at the local open market in Tanzania



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