

# Hand pollination, not agrochemicals, increases cocoa yield and farmer income

October 1 2020

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Cocoa Agroforest in Sulawesi (Indonesia). Credit: M Toledo, University of Göttingen

Cocoa is in great demand on the world market, but there are many ways to increase production. A research team from the University of

Göttingen has investigated the relative importance of the use of pesticides, fertilizers and manual pollination in a well replicated field trial in Indonesian agroforestry systems. The result: an increase in both cocoa yield and farming income was achieved—not by agrochemicals, but by manual pollination. The study was published in the journal *Agriculture, Ecosystems and Environment*.

Cocoa requires cross-[pollination](#) by insects to produce fruit. It is unclear how to encourage natural pollination by tiny midges, flies or wasps. In fact, the true identity of the main pollinators has yet to be discovered. Under [natural conditions](#), more than 90% of flowers are not visited by insects and do not develop fruit. These results clearly show that traditional agricultural intensification with agrochemicals is not always the best way forward.

Working together with colleagues and students of the Indonesian University of Tadulako of Palu, the scientists found that hand pollination increased the yield of [cocoa](#) trees by 161%. After deducting the costs of manual pollination, this meant a 69% increase in income for small-holder farmers. Using more pesticide and fertilizer did not increase yields.



Manuel Toledo-Hernandez, first author and PhD student in Agroecology at the University of Göttingen, pollinating a cocoa flower by hand. Credit: M Toledo, University of Göttingen

"Our results show how agroecological intensification can be successful by promoting [biological processes](#) or using innovative techniques such as manual pollination," explains first author Manuel Toledo-Hernández, Ph.D. student in the Department of Agroecology at the University of Göttingen. The work was supervised by Professor Teja Tschardtke, Head of Agroecology, and Professor Thomas C. Wanger, now at Westlake University in China. They add: "Lower harvests due to insufficient pollination have a major effect on many crops in the tropics

as well as in temperate latitudes. This should be taken into account much more in future efforts to increase production."



Landscape shaped by cocoa cultivation in Sulawesi (Indonesia). Credit: M Toledo, University of Göttingen

**More information:** Manuel Toledo-Hernández et al, Hand pollination, not pesticides or fertilizers, increases cocoa yields and farmer income, *Agriculture, Ecosystems & Environment* (2020). [DOI: 10.1016/j.agee.2020.107160](https://doi.org/10.1016/j.agee.2020.107160)

Provided by University of Göttingen

Citation: Hand pollination, not agrochemicals, increases cocoa yield and farmer income (2020, October 1) retrieved 22 September 2024 from <https://phys.org/news/2020-10-pollination-agrochemicals-cocoa-yield-farmer.html>

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