Plant diversity makes West Africa's shea trees bear more fruit

October 12 2020, by Aoife Delaney

Fruit production of shea is limited by lack of pollination and this limitation is greater at sites with less tree and shrub diversity. Credit: Aoife Delaney

Shea trees are grown widely in semi-arid parts of Africa for their fruit

and seeds. From Senegal in the west to Uganda in the east, they are found in agro-forestry systems called parklands—landscapes where trees are left to grow in cultivated and fallow fields.

These parklands occupy over a million square kilometers in a zone that's home to 112 million people.

The dominance of shea trees in West African parklands reflects their value to society. The fruits ripen at a time when there are few alternative food sources available. It has been estimated that about 10kg of shea butter is consumed per person every year in the region.

In recent decades, shea has become a globalized commodity and international trade in shea can make a significant contribution to the revenue of countries in the shea zone. For example, in Ghana, shea nuts were the fourth best performing agricultural export in 2018, with a value of over US$14 million.

Today, shea parklands face unprecedented changes: population density in many parts of the shea zone has increased and the expectation of financial return from farming has grown. Fallow periods have become shorter as there is more demand for cultivated land. With less time for regeneration, fewer saplings remain when fields are cleared for crops such as sesame, sorghum, soy, millet, hibiscus and cotton.

Simultaneously, the international market for shea butter is increasing, prompting attempts to commercialize shea cultivation in spite of the fact that it has proven extremely difficult and production is still largely dominated by traditional methods.

To support shea nut production in the long term, it is vital to understand the ecological services that support the fruiting of shea, and how these are affected by changes in the landscape.

We undertook a study in Burkina Faso, the world's second largest exporter of shea nuts. The fruit is also a big part of local diets as butter derived from shea nuts is the primary cooking oil for rural-dwellers.

In our research, we investigated the relationship between pollination services and the diversity of trees and shrub species in cultivated fields. We also considered the amount of uncultivated habitat near the fields.

Shea benefits strongly from pollination by insects, primarily bees, to produce fruit. This link between shea trees and bees illustrates how shea is connected with wider environmental conditions, because bees need a range of resources to survive.

What we found

We first chose 10 sites, each one hectare in area, in locations which had different amounts of shrub and fallow land near Kabore Tambi National Park, in Southern Burkina Faso. Five of these sites had low tree and shrub diversity and were heavily dominated by shea trees. The remainder had a higher diversity of woody species.

We studied 10 mature, fruit bearing trees in each site. To assess delivery of pollination services, we estimated the effectiveness of flower visitors as pollinators. We did this by saturating the flowers of three blossoms per tree with pollen by hand while leaving others open for insects to pollinate.

We then compared the number of fruit set on hand-pollinated and naturally pollinated blossoms. The number of fruits yielded by pollen-saturated flowers provided an indication of the fruit yield when maximum pollination was achieved. If the fruit yield of open flowers was much lower, this indicated that fruiting was limited by lack of pollination—"pollination limitation". We also counted the insects

visiting shea flowers on each of our 10 trees at each site.

We found that fruit production of shea was limited by lack of pollination and that this limitation was greater at sites with less tree and shrub diversity. Bees were by far the most common flower visitor. Small stingless bees in the *Hypotrigona* genus were far more abundant than honey bees, indicating that they may play an important role in pollination.

We found honey bees more frequently, and other bees in greater abundance, in sites with a greater diversity of trees and shrubs. These findings show that more pollination occurs in fields with a greater range of trees and shrubs. This might be because a location that has a wide range of different species is likely to contain a variety of plant-based resources used by bees, like nesting sites, pollen, nectar and resin, throughout the year.

Unexpectedly—given the role of local site-level diversity in driving pollination services—natural fruit set was lower at sites close to larger areas of uncultivated land. This may be because shea is a food source for fruit-eating wildlife including birds and mammals that might be more prevalent in larger uncultivated areas.

So, while diversity of trees and shrubs inside fields promotes pollination, semi-natural areas—uncultivated land—may promote natural levels of fruit-eating by wild animals. Uncultivated land includes fallows, which are vital for shea regeneration, providing a source of young trees to replace old trees that no longer produce fruit.

What to do

Since only 42% of shea fruit is estimated to be harvested by people each year—harvesting is generally done by women in small villages—this

leaves a fair share for nature. If shea production is intensified, the importance of plant diversity for pollination should be considered and allowance should be made for the important role of shea fruits in maintaining local wildlife populations.

Shea fruit represents an important ecological, societal and economic resource, and if there were more pollinators in the landscape, more fruit would be produced. Conditions beneficial to both honey bees and other bee species should be fostered to maximize pollination. We recommend that pollination services to shea are supported by maintaining a diverse assemblage of woody species in parklands.

Our findings corroborate existing research, showing that the ecosystem services provided by tree and shrub diversity support the well-being of millions of people in West Africa.

Provided by The Conversation