

The zai hole biochar cycle

The zai hole biochar cycle is a synergistic and holistic cycle which can continually reduce CO₂ emissions, as well as increase CO₂ fixation and long term carbon sequestration, in an ongoing and upward spiral of social, climatic and ecological benefits.

Zai holes have been proven to greatly increase crop growth on small hold farms in Africa, and tree growth in reforestation projects and on-farm windbreaks and woodlots, particularly in infertile soils in drier climates. Increased plant growth on farms and in reforestation projects means increased CO₂ fixation. Increased plant growth results in increased long term sequestration of carbon as humus in soils. Increased on farm fuel production also reduces deforestation of natural forests that occurs because of the high demand for fuel wood. Retained forests continue to fix CO₂, and produce water vapour through evapo-transpiration, as well as bacterial cloud condensation nuclei, both of which have ameliorating and cooling effects on the climate.

Adding biochar to zai holes can further enhance plant growth and CO₂ fixation, and the biochar in the soil in the zai holes sequesters carbon for potentially tens of thousands of years.

Crop wastes, which could include wood from relay planted rotational plants (for example, *Sesbania sesban*, *Crotalaria grahamiana* and *Tephrosia vogelii* in Western Kenya) and fuel wood from plants grown in zai holes in woodlots and windbreaks, can be used in fuel efficient stoves. These stoves reduce CO₂ emissions compared to typical three stone wood fires, and also reduce particulate (black carbon) pollution. This last benefit reduces health problems and even deaths from smoke and particulate inhalation, and negative climate impacts. Fuel efficient stoves also require less wood and so they reduce deforestation. In some cases, environmental weeds could also provide additional fuel for stoves and produce biochar, with numerous positive ecological consequences. Even ash from stoves can be helpful as a fertilizer in zai holes, providing potassium, calcium and other nutrients to increase plant growth.

Fuel efficient stoves produce biochar, so that biochar can then be incorporated into existing and new zai holes, resulting in ongoing and increasing CO₂ fixation and long term carbon sequestration. The increasing incorporation of biochar into existing zai holes and the ongoing creation of new zai holes then provide more and more fuel for the stoves, which produce more biochar for zai holes, and so on.

This Zai hole biochar cycle has potential application in many parts of the world, and is intended to be practical, achievable and inclusive for people with limited resources available to them, so that all may benefit.

Additional notes: adding animal and sterilized human manure to zai holes can also increase tree or crop growth and carbon fixation, providing and recycling otherwise wasted nutrients, and ultimately storing carbon as humus. The humus in turn increases plant growth and carbon fixation and storage. Diluted livestock and human urine can also be recycled as a free fertilizer to increase plant growth in zai holes. Biochar fed to livestock can reduce methane emissions. The biochar is then defecated and incorporated into soils by dung beetles and earth worms, providing long term carbon sequestration.

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