AgNotes

Zai holes 2009

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Land which has yielded little or nothing for decades, in one season with zai can out yield fields considered to be good. Zai have lifted food production in traditionally food deficit areas. Zai holes help to restore exhausted land by optimizing use of organic matter (fertilizer) and water and by reducing weed competition.

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Sule Indo, Niger Republic, demonstrating reduced weed competition and superior growth of crops growing in zai holes.

Zai Holes

What is a zai hole?

Through continuous cropping and removal of organic matter, many soils are very infertile, being particularly low in Phosphorus and Nitrogen. On heavier clay soils water infiltration is low. Few farmers can afford inorganic fertilizers and even manure may be in short supply.

Zai holes are a cultivation system from West Africa traditionally used on heavy clay soils to increase water infiltration. Dry manure or compost is placed in holes (approx. 30cm wide x 30cm deep) which are spaced according to the crop plants requirements (e.g. 1 x 1 meter spacing for millet in West Africa). Termites burrowing up to the organic matter help break it down while producing rich humus. They increase soil aeration and the infiltration of water.
Even on more porous sandy soils, zai holes increase crop yields dramatically.
The concentration of nutrients where the plant has exclusive access to them results in vigorous, healthy crop growth which quickly shades out weeds growing in less fertile soil between zai holes.

Fig. 1. Zai holes.

Fig. 2. Impact on crops.
Two to five fold crop yield increases have been recorded.

Where can zai be used?

Zai perform best in heavy clay soils which do not allow water to infiltrate, but they are effective in any infertile soil. Zai are suited to semi arid climates where maximum concentration of scarce water is needed. This is a labor intensive technique suitable for resource poor farmers who are prepared to work hard to improve their soils and crop yields.
In higher rainfall areas where soils are infertile, zai should be tried in order to benefit from the increase soil fertility. Small scale experimentation is advised as in some heavy soils, water logging may be a problem in high rainfall areas. Experiment with different depth holes, with covering the organic matter with soil so that water cannot sit on the surface, with planting seed to the side of the hole or in the hole, and with different crop species.

How and when do you prepare zai?

Because labour availability, crop needs and soil and weather conditions vary, it is best to conduct small scale experiments – varying the depth of the zai hole, the amount of organic matter or manure and whether seed is planted to the side of the hole or in the hole. THERE IS NO SET METHOD OF MAKING ZAI HOLES. Zai will vary according to farmers specific needs.

Where termites or earthworms are active and organic matter will break down before the next planting season, un rotted leaves and manure may be placed in the hole. Otherwise, it is always best to use well rotted organic matter, compost or dry manure. Where organic matter is in short supply, farmers should simply work with whatever organic matter is available, starting small if necessary and increasing the number of zai holes over time, as more organic matter becomes available. Materials could include manure, ash, sweepings from the home compound, tree leaves or straw.

Fig. 2. Deep zai hole.

Fig. 3. Shallow zai hole.

In windy areas, fertile windblown silt and organic matter will be trapped in the hole, adding to the fertility and water holding capacity of the soil. After the wind has deposited organic matter, compost or dry manure can be put in the hole.

On a small scale, experiment with deeper holes, but you may find that even quite shallow holes, a little larger than normal planting holes filled with compost give big yield increases.

Fig. 4. Placing compost in planting hole.

In very infertile soil, even placement of a small amount of compost in the planting hole at the time of sowing will give an advantage.

Fig. 5. Staggered zai holes.
By staggering zai holes, more water, eroded soil and wind blown material can be trapped.
On sloping land, lines of zai holes should be on the contour.

Impact
People who have tried zai testify to its value and they have benefited significantly. Average crop yields in West Africa under traditional cropping systems range between 200 to 400 Kilos per hectare whereas crops growing in zai holes have yielded between 800 and 2,000 kilos of grain per hectare!

Advantages
In all settings, poor farmers, often living in remote regions find it difficult to purchase inorganic fertilizers. By using locally available organic materials in zai holes, high yields can be attained at low cost.

Photo: Impact of zai hole on crop growth.
Planting crops in zai holes can make the difference between a successful crop and total failure. Vigorously growing millet in the background of this photo was planted in zai holes at the same time as the millet in the foreground, planted in the conventional manner. The millet in the foreground is barely visible.

Caution
While zai holes can give amazing results, as with all new techniques caution should be exercised. Farmers should be encouraged to try zai on a small area initially. Heavy clay soils may get water logged in higher rainfall areas and zai holes may trap water causing the plants to drown. In low rainfall years less water may go into the zai hole than in the surrounding soil, contributing to poor growth. Strong winds can bury the holes all together with sand, making it impossible to know where to plant. If raw organic matter (i.e. organic matter that has not broken down) is used, crop yields can actually decrease as nitrogen become bound up and moisture needed by the crop may be absorbed by the organic matter. Sometimes organic matter contains beetle lavae which eat emerging seedlings.

Digging zai holes is very labour intensive and generally this is not a practice that farmers continue year after year. Zai holes could thus be promoted as an interim activity to rapidly restores infertile soils and return otherwise unusable hardpan clay soils back into production.
In the longer term, it is best to encourage farmers to leave crop residues flat on the ground after grain harvest. This acts as mulch and over time increases soil organic matter and fertility, as well as increasing water infiltration and retention in the soil.

Happy digging!