

## Zai Pits System: A Catalyst for Restoration in the Dry Lands

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**Abstract:** Historic climatic data have shown that the dry lands are characterised by low and erratic rainfall which is often insufficient for any purpose. Together with some human influences, such as deforestation, over-grazing and intensive cropping, these have seriously affected the ecological equilibrium, resulting in the degradation of natural soil and vegetation resources and a decline in biological productivity in the dry lands of the world. Despite all challenges, some significant improvements were recorded and areas manage to thrive courtesy of the ingenuity of indigenous techniques which are often considered 'harmful' to the environment. It is now widely accepted that indigenous practices such as Zai (ancestral planting pits) provide an effective way of improving the management of degraded lands and reducing soil erosion, vegetation loss and biodiversity as well as grains yield. Zai's importance has been best recorded in Burkina Faso and Niger Republic where people rehabilitated their degraded lands and increased production by many folds. Several studies on Zai system have prompted policy makers to think forth and postulate that if promoted, restoration of degraded soils will be easier and perfect without spending much as seen in countries where the technique is popular such as Mali, Burkina Faso and Niger. Although Zai could easily be replicated by farmers, its large scale application has been hindered by the failure of stake holders to take the initiative and promote it to rest of West Africa. This could be by providing financial /education support to farmers as growing number of them about 70% in most West African States are smallholders and either poor or subsisting. This paper though arguably, saw that writings on Zai are too scanty and its practice is diminishing thereby losing potential of our farmers. It thus contended that for successful restoration of the dry lands in Africa, Zai system must be revived and embraced.

**Keywords:** Zai pits system, restoration, dry lands

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*There is a longstanding and well-documented tradition in the Sahel-zone, specifically in the north of Burkina Faso, of technologies that make farming more productive through improved rainwater management and protection of the soil. Zai is probably the most renowned example of such a technology, which was developed locally based on indigenous knowledge... In Yatenga province, zai are traditionally used to improve poor (bare) soils in drought conditions (Sawadogo, 2011)*

### I. Introduction

Zai is a term that farmers in northern Burkina Faso use to refer to small planting pits that typically measure 20-30 cm in width, are 10-20 cm deep and spaced 60-80 cm apart. In the Tahoua region of Niger, the haussa word "tassa" is used (Motis, D'Aiuto, and Lingbeek, 2013). Zai is an ancestral practice to regenerate degraded and crusted soils by breaking up the surface crust to improve water infiltration. It is a traditional land rehabilitation technology promoted by farmers in Burkina Faso to rehabilitate degraded drylands and to restore soil fertility to the benefit of farmers living in drylands (iwmi.cgiar.org). The technique was adopted to reclaim severely degraded farmland that water could not penetrate. To do that, farmers would dig a grid of planting pits known (also known as Zai) across the rock-hard plots. Zai is an agricultural technique of the Yatenga province of Northern Burkina Faso where gridded pits are made on soils so that it can survive erosion due to run-off (Reij, 1991). This technology is mainly applied in semi-arid areas on sandy/loamy plains, often covered with hard pans, and with slopes below 5% (Critchley et al., 1994).

The application of the Zai technique can increase production by about 500 % if well executed (World Bank, 2005). Sawadogo et al. (2001) explained that pits has been used to diversify plants biomass in Burkina Faso and the practice has help improve soil fertility and crop yield in the area. Zai pits are especially relevant to areas receiving 300- 800 mm annual rainfall (Roose et al. 1993). Higher rainfall amounts could cause water-logging of the pits. Zai practice has the potential to increase cereal yields by a factor 10, and yields increase further with the application of organic amendments. Zai allows collecting 25% of a run-off coming from 5 times its area (Malesu et al., 2006).

Farmer innovations are central to Zai development. For instance, it is their own effort that spread the planting pits rapidly in Burkina Faso, Mali and Niger. Unfortunately the promising result of indigenous techniques has been suffering from political reforms and focus on externally driven projects. In 1984, a farmer named Yacouba Sawadogo began organizing semi-annual market days to promote planting pits. Initially small,

by 2000, Yacouba's market days involved farmers from more than 100 villages in Burkina Faso. In 1992, a farmer named Ousseni Zoromé began a "zai school," training local farmers on a gravel site next to the road. When the crop grew, the effort attracted the attention of the minister of agriculture. By 2001, Zoromé's network consisted of more than 20 schools and 1,000 members, with each group charged with rehabilitating its sown piece of degraded land. Another farmer, Ali Ouedraogo, trained individual farmers in villages around Gourcy and visited regularly to work with them in their fields and exchange ideas (Reij, Tappan, and Smale, 2009).

### **Development of Zai**

Zai is a traditional soil conservation technique that originated in Mali in the Dogon area. It is among the most important techniques implemented in Sahelian countries since the 1980s and has developed land improvement practices on a wide scale, e.g. in Burkina Faso and Niger. Zai planting pit system (also tassa in Tahoua) is an old farming technique rediscovered after the great drought of 1973/74 and later perfected by development partners working with farmers (Abdo, 2014). From that time, the technique has been widely practised in Burkina Faso, Mali and Niger (Sawadogo et al., 2001).

The use of zai pits originates in the western Sahel where infertile, encrusted soils receive low and often highly variable rainfall. On such dry, fragile lands, smallholder farmers face a constant challenge to produce enough food to feed their families and generate much-needed income (Motis, D'Aiuto, and Lingbeek, 2013).

### **How it works**

It consists of dug holes excavated in grids, with a diameter of 15-20 cm and a depth of 10-15 cm or more, filled with manure. They are spaced 70 to 80 cm apart, resulting in around 10 000 pits per ha. Staggered rows of holes are dug perpendicularly to the slope. The excavated earth is formed into a small ridge down slope of the pit for maximum back capture of rainfall and runoff. Manure is added to each pit, though its availability is sometimes a problem. The improved infiltration and increased nutrient availability brings degraded land into cultivation. This organic matter attracts termites, which play a crucial role in improving soil structure. Row crops are then planted in the pits which are able to hold water in excess of 500% of the water holding capacity of the soil.



**Figure 1: Zai Pit System**

**Source:** GIZ (2012)

### **Zai's Impacts the Dry lands**

Restoration of degraded land is increasingly a key issue in a context where food insecurity is one of the main constraints to development. In areas such as the drylands of Africa, testimonies of Zai system as indicated below have stressed the need to promote the technique.

Burkina Faso is the ancestral home of Zai Pits System although some literature pointed to Dogon in Northern Mali. In Burkina Faso's Central Plateau, Zai is used to improve water availability and soil fertility. Farmers have sown crops in planting pits and built stone contour bunds, which are stones piled up in long narrow rows that follow the contours of the land in order to capture rainwater runoff and soil. These practices have helped rehabilitate between 200,000 and 300,000 hectares of land and produce an additional 80,000 tons of food per year (Reij, Tappan, and Smale, 2009).

The Tahoua Rural Development Project (PDRT) in Niger focused on improving community land on plateau, slopes and farmland, using contour stone bunds, zai planting pits, Nardi/Vallerani and hand dug trenches, semi-circular bunds and other techniques on 125 000 ha (Maisharou, 2007).

Variations of Zai pits have been used in several areas of Kenya including the katumani pit in Machakos District, the 'five by nine' pit in the Kirinyaga, Mbeere, Murang'a and Machakos Districts, and the large Tumbukiza pits in the Nyando District of Kenya (Malesu et al. 2007).

Amede et al (2011) showed that zai pits were effective in a highland area of Ethiopia that receives in excess of 1300 mm annual rainfall and where water infiltration into the soil is limited by losses of rainwater to run off, a lack of organic matter, and hardpans. Recognizing the high potential for soil erosion, the pits were enlarged to withstand the strong downhill flow of rainfall runoff. Potatoes and beans were grown over a 3 year period from 2004-2006. Zai pits, in combination with additions of nitrogen, increased potato yields 500%-2000%; bean yield increased by 250% with zai pits.

### **Constraints of the Technique**

Of the few constraints to the use of Zai Pits System, labour poses the great challenge. Barro et al. (2005) stated it takes about 300 hours/ha to dig the zai pits. Kaboré and Reij (2004) said it takes 450 hours/ha to dig the holes, plus another 250 hours/ha to fertilize them. For this reason, the Zai system is more realistic when undertaken by groups of farmers instead of individuals. This means that wealthier farmers benefitted more from the technology.

### **Socio-economic and Environmental Benefits of Zai Pit System**

- One of the greatest ethos of Zai is that it can work with other techniques such as stone contours, Nardi/Vallerani and hand dug trenches to restore degraded soils
- Zai pits are an innovation that addresses effects of land degradation, soil erosion, and soil moisture stress.
- Zai pits also serve to collect and concentrate water at the plant. It thus can reduce the risk of water stress in a region of low and erratic rainfall.
- Zai offers a good potential to both restore degraded lands and maintain their biological status.
- Use of the Zai technique can fix poor grain yields and improve the quality of output produced.
- Planting pits improve soil fertility and agricultural productivity of several crops.

### **Why is Zai not promoted in rest of West Africa?**

Zai pits present a tradition which dates back to centuries in some West African countries. Despite its prominence in Burkina Faso and Niger, it is yet to be promoted in rest of West African countries including neighbouring Nigeria. The non-diffusion of Zai Pits system unfortunately stemmed from many reasons although its benefits are fully known. The system has been locally practiced in few countries of the Sahel and some factors that led to its non-spread across Africa may include;

- Lack of political commitment from African States/AU to whom the reports of these collaborating partners are submitted,
- Introduction of large scale conventional projects after droughts of 1980s which had lasting effects on indigenous techniques of environmental management in Africa,
- Inconsistency in choice of adaptive management to promote which resulted to downplaying such techniques,
- Farmers over dependence on external support which makes them vulnerable should these cease,
- Poverty among farmers which might compel them to neglect labour intensive projects such as Zai and migrate to urban centres to diversify economy,
- Cultural dichotomy which divides the ancestral home of Zai and rest of West African Sahel. This may be behind the prominence of Zai system in Burkina Faso, Mali and parts of Niger.

## **II. Conclusion**

Obviously, the African continent has suffered from various environmental and socio-economic challenges notably climate change, desertification, degradation of natural resources, and poverty. Among the most daunting of these challenges, in particular, declining yield and loss of biological productivity have been characterised as had hitting. Part of the reasons that led to that persistence of these challenge could be neglect of indigenous techniques which forms the fundamentals to environmental resilience in African Sahel. Although Sahelian farmers achieved their success by ingeniously modifying traditional practices such as Zai, the technique as conservation strategy sounds like new hat to many.

Zai is one promising technique which eases the dilemma of choosing an approach to use for the restoration of degraded areas in the dry lands. Zai has breathed new life into African smallholder farming for its propensity of reconnecting farmers to their farms and restoring blighted lands for a better living. In addition to its adaptive capability, the technique is simple and with little effort farmers can attain greater heights of this time by insuring food security and putting more cash in the pockets of many.

### III. Recommendations

The paper recommended that if Zai system is to be promoted, necessary logistics and supports should be provided to local farmers through improve communication, extension services and community adult classes for easy dissemination of the technique.

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