



A pit filled with sorghum. Cables and plastic tubing are for measurement of the micro-climate in the pit. Photo: Kees Stigter

Underground storage of sorghum as a banking alternative

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In Jebel Muoya, in the Blue Nile area of **Sudan**, a survey made clear that the socio-economy of *matmuras* - underground storage pits for sorghum - should be understood as a banking alternative. This farmer oriented research supported a project on physical improvement of storage conditions. A bibliography on Sudanese agriculture published in 1994 concluded that traditional storage techniques, and traditional farming in general, had seldom been studied and had never been used as a basis for agricultural improvement. However, since 1985, the Traditional Techniques of Microclimate Improvement Project had done just this at universities in several African countries, including the University of Gezira in the Sudan. In 1992 the project started work on *matmuras*. Forced by increasing climate variability, more frequent failure of rains and hence a need for longer-term storage, farmers introduced innovations for grain storage with regard to the dimensions and linings of the pits. A formal scientific study of these farmer innovations was made to ascertain their suitability for the prevailing cracking clay (black cotton) soils under marginal, semi-arid conditions.

Local production situation

The type of agriculture concerned covers about 350,000 ha of rainfed sorghum, the staple crop of Sudan. Originally, production was organised in smallholdings around the villages, but nowadays sorghum is also produced on farms of up to 400 ha and as far as 30 to 40 km away from villages. Farmers hold land at one or more sites, which fragments crop growth. Although such fragmentation is disadvantageous due to inefficiency of resource use, the diversification of soil type and rainfall distribution that decreases risk is an advantage. Staggered planting times decrease risks further and increase the food supply period. Extension services are virtually unavailable and the production shows all the dangers of monocropping without rotations, resulting in very low productivity.

A banking and safety device

Subsistence farmers have *matmuras* as a safety device for food security. The *matmuras* can hold 2 to 10 tonnes of grain. With the introduction of more commercial and mechanised agriculture, *matmuras* have increased in size. The largest farmers store up to 70 tonnes of sorghum in one *matmura*.

With poorly developed property rights and lack of assets, farmers have no collateral and consequently no access to bank loans. Instead, they depend on the grain stored in *matmuras* to take care of the high cash needs at the beginning of the planting season. Farmers without sufficient capital in the form of stored sorghum rent part of their lands to those with *matmuras* in order to finance their farm operations. This is preferred to the *sheil* practice, an informal form of credit with extremely high interest rates, which requires produce to be sold before the forthcoming harvest or even before planting.

Innovations added

Traditionally, the pits are filled until a dome shape is formed by gravity at the angle of repose (see photo). Then a layer of chaff is spread on top of the sorghum, and a layer of soil of 25 to 50 cm extending about 30 cm from the rims of the pits completes the cap.

Both subsistence and commercial farmers are interested in innovations using shallower but wider pits and adding pit wall linings of chaff. Pits tend to become as shallow as 50 cm instead of up to 1.5 m. These innovations keep the grain drier by diminishing the ingress of moisture in two ways. First, they reduce leakage through cracks. Second, they minimise diffusion of water vapour from the wetter soil into the grain. The innovations increase grain temperatures leading to lower infestation of insects, which adds to cost-effectiveness. This also substantially improves the grain quality at the end of the storage period. As participatory and quantified experiments confirmed, this increases the safe storage period. These improvements are particularly important to subsistence farmers. Farmers with a considerable market surplus are advised to use polythene linings instead of chaff.

The research led to another innovation, particularly important for the smaller pits. The caps were increased to about 50 cm in thickness and extended to about 1 m. around the filled pits. This helped to cover cracks that would otherwise allow seepage of rainwater into the pits. When pits get larger, the filling with a dome of grain is abandoned. In this way, scientific research and farmer innovations jointly improved grain storage for food security as well as cash provision.

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