YOU CAN DO IT!

Innovative homemade equipment
by/for smallholder farmers in
Conservation Agriculture

You can do it with your own available materials

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INTRODUCTION

The adoption and implementation of Conservation Agriculture (CA) at a smallholder farmer level is being constrained by the unavailability of suitable equipment for performing the necessary operations (land preparation, direct seeding and weeding). The difficult socioeconomic conditions suffered by many smallholder farmers still limit their ability to buy the necessary equipment. However, these limitations have been overcome by some innovative farmers who have met the challenge by modifying their existing equipment.

This small guide presents some of their achievements as real life examples of affordable and practical solutions for homemade equipment in CA. The equipment has been invented and developed by smallholder farmers and extension agents of the Ministry of Agriculture and Livestock (MAG) in Paraguay, and has been proven to be valuable in practice. The objective of this small guide is to inspire smallholder farmers, extension agents and researchers to intensify the innovation process for developing appropriate solutions. Examples for each operation in CA have been included and illustrated. These examples can be employed during a transition phase, until the smallholder farmer has experienced the economic benefits of CA, and is then able to purchase more sophisticated equipment.
LAND PREPARATION

The purpose of land preparation is to prepare the soil for sowing the seeds of the subsequent crop. In CA a green manure cover crop (gmcc) precedes the main crop and must be properly managed. During this process, it is crucial that emerging weeds are suppressed, which can be achieved by mechanical and/or chemical methods. Since mechanical management is more desirable from an economic and ecological point of view, some examples for low cost technologies are given here.

The knife roller is the most commonly used tool in Paraguay. Its purpose is to bend over and crush the gmcc or weeds, usually killing the gmcc prior to planting. In this case, it is important that the knife roller only breaks and crushes, but does not chop the cover crop. Appropriate management is needed to avoid re-growth of gmcc or weeds.

Some examples of equipment for land preparation are given here, which can be used in place of the more sophisticated knife roller.
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Vegetation flattener

This tool is probably the simplest way of bending over a gmcc. The vegetation flattener is based on the concept of a wooden rake, which is pushed over the field to bend over the gmcc (see photo 1). It is used with already dead and dry, thin stemmed gmcc, such as black oats (*Avena strigosa*), white lupine (*Lupinus albus*) or italian ryegrass (*Lolium multiflorum*). Due to the gmcc is not being broken or crushed with this tool, it could be necessary to repeat the procedure several times.

Photo 1: Vegetation flattener
The vegetation flattener tyres is made up of three tyres connected to each other with strong screws, and a bar, which is attached on top of the two front tyres (see arrows, photo 2). A chain or rope is attached to the bar, for use with draft animals.

It is recommended to use the vegetation flattener tyres with already dead and dry, thin stemmed gmcc, such as black oats, white lupine or italian ryegrass. The vegetation flattener tyres achieves its best performance, when the front tyres of a tractor are used in its design.

Photo 2: Vegetation flattener tyres
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Vegetation flattener board for animal traction

The vegetation flattener board, or sledge, shown in photo 3, is based on the simple concept of a wooden board cut out of a tree trunk, in this case lapacho (*Tabebuia impetiginosa*). Then two holes are drilled into the board in order to attach chains (see arrows, photo 3).

Photo 3: Vegetation flattener board, animal traction

![Photo 3: Vegetation flattener board, animal traction](image)

Dirk Lange

The farmer stands on top of the board (see photo 4) to provide weight whilst controlling the draft animals. The vegetation flattener board achieves its best performance when used over already dead and dry, thin stemmed gmcc, such as black oats, white lupine or italian ryegrass. It may be necessary to run the implement two or three times over the gmcc to achieve the desired results.
The tree trunk roller consists of a cylindrical tree trunk with strong screws attached to the roller at each end (see arrow), which serve as hitch points. A wire rope or chain is hooked to each screw for pulling by draft animals. The gmcc should be already dead and dry to achieve the best results. In this case, the tree trunk roller can be used for all gmcc.

Photo 5: Tree trunk roller

Porfirio Villalba
The wooden knife roller with metal blades is constructed as a copy of the more sophisticated metal one. Its construction can be carried out together with the local blacksmith, who has the proper tools for the metalwork.

A tree trunk is curved out into a cylindrical shape, metal blades are mounted peripherally (see arrow A, photo 6), and strong screws are fitted into each end in order to serve as hitch points.

Additionally, a frame is constructed and attached to the axle (see arrow B, photo 7), and a chain, for use with draft animals, is hooked up to it (see arrow C, photo 7). The wooden knife roller with metal blades can be used for all gmcc.
Different tools can be used for the planting process, such as a planting stick or jab planter. If draft animals are available (horse or oxen), then a subsoiler or chisel can be used for seedbed preparation prior to direct seeding. In this case, the basic idea is to shatter plough pans and other hard or compacted soil layers, but this should only be done when necessary. After a good rainfall, the subsoiler is passed and the crop is seeded into the slot. This helps to improve the root development and also allows to seed deep rooting crops, which, from this point on, will serve as a "natural subsoiler". Metal subsoilers or chisels should only be used during the first years of CA.

Some examples of homemade equipment for planting and seedbed preparation are given, which can be used in place of more sophisticated equipment.
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Planting stick for cassava

The planting stick for cassava is based on the concept of a wooden stick with a small board fixed to one end (see arrow A, photo 8), similar to a spade. The board is made from a piece of hard-wood shaped into a blade with a tip (see arrow B, photo 8). The planting stick is designed especially for cassava.

During the planting process, the planting stick is pushed into the soil through the mulch cover with the tip first (see arrows C, photo 9). It is then pulled backwards, opening a hole in the ground. The cassava cuttings are placed into the hole, which is then closed with the foot.

Photo 8: Planting stick for cassava

Ken Moriya
Wooden subsoiler for animal traction (1)*

This wooden subsoiler is made from a conventional mouldboard plough. The plough share (see arrow B, photo 10) is replaced by a metal point (see arrow B, photo 10). Additionally, an adjustable disc should be mounted in the front section (see arrow C, photo 11) in order to cut through the soil cover (see photo 12).

Photo 10: Wooden subsoiler for animal traction (1)  Photo 11: Magincador

Rolf Derpsch

Magín Meza

Photo 12

* With this tool CA began on smallholder farms in Paraguay
Wooden subsoiler for animal traction (2)

This wooden subsoiler is a copy of a conventional metal implement. A wooden beam is cut to the required shape, and then a handle and a metal point are attached to the beam (see arrow A, photo 13). Additionally, an adjustable disc should be mounted in the front section (see arrow B, photo 13) in order to cut through the soil cover.
Metal chisel for animal traction

The metal chisel is based on a conventional subsoiler, but where the metal point is replaced by a thinner and longer metal tine. This will shatter plough pans and other or compacted soil layers. The metal point can be constructed together with the local blacksmith, following example in photo 14.

Additionally, an adjustable disc should be mounted in the front section (see arrow A, photo 14) in order to cut the soil cover.

Photo 14: Metal Chisel for animal traction

Dirk Lange
Chisel for animal traction

This chisel is based on a conventional plough, where only the beam and handle are used. A metal tine, constructed together with a local blacksmith, is attached to the beam, following the example in photo 15. Additionally, an adjustable disc should be mounted in the front section (see arrow A, photo 15) in order to cut through the soil cover.

Photo 15: Chisel animal traction

Ken Moriya
This incorporator for small grains is made up of a wooden frame (see arrows A, photo 16) with wooden or metal tines (see arrows B, photo 16). Draft animals pull the implement with ropes or chains, which are attached to the wooden frame.

When small grains, such as black oats, oil radish (Raphanus sativus var Oleiferus) or Italian ryegrass, have been broadcasted over the field, the incorporator for small grains is passed over the same area to ensure soil contact by the seeds, or even to incorporate them into the seedbeds. The tool can only be used in the first years, until the soil cover becomes too dense.
Weeds can be a major problem during the cropping season. They compete with the main crop for nutrients, water, light and space. In CA, a gmcc can be used as a natural "weed manager". Nevertheless, in areas where gmcc do not produce sufficient soil cover, especially in dry areas or during the first few years, it is necessary to have good weed management. Two options are available: mechanical and chemical weeding.

For mechanical weeding under CA, traditional tools are used in Paraguay. One of these is shown here. The problem with chemical weeding is that, very often, the application of commercial herbicides also causes detrimental effects to the main crop. With relatively simple modifications to existing sprayer equipment, the crop can be protected from spray so that herbicides can also be used after the crop has emerged.

Some examples of homemade equipment for weeding are given here, which can be used in place of more sophisticated equipment.
The azada is a common hoe with a modified blade. Instead of being designed to dig holes, the blade is thinner and slightly curved in order to act as a knife (see arrow, photo 18).

This allows the weeds to be cut just above the ground with minimal soil disturbance. Although more time is required to weed mechanically, it is cheaper, provided labour is available, and more environmentally friendly.
Innovative homemade equipment for Conservation Agriculture

Spray shield for Knapsack sprayers (1)

The spray shield for knapsack sprayers is made from a plastic canister. One side is cut off at about 30-40 cm from the top, following the example in photo 19. A hole is then drilled into the top and reinforced with a metal washer (see arrow in photo 19). The spray lance is then fixed to the hole with the spray nozzle in the inside of the spray shield.

When the shield is used, it must be held close to the ground, to avoid herbicide drifts onto the crop. It is recommended that a flat fan nozzle should be used, and must be positioned to also prevent the spray touching the plastic.

Photo 19: Spray shield for Knapsack sprayer (1)

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The spray shield for knapsack sprayers is made out of two plastic/foil bags, the bottom-end of a plastic canister (5 litres) and a wire-frame. First, the open bags are placed over the bottom-end of the plastic canister and wire-frame. Then the two bags are joined together with tape (see arrow A, photo 20) to attain the shape of the spray shield.

The spray nozzle is inserted through a hole in the bottom end of the plastic canister and fixed to it by a washer.

When the shield is used, it must be held close to the ground, in order to avoid spray drift onto the crop. It is recommended that a flat fan nozzle should be used, and must be positioned to also prevent spray touching the plastic.

Rolf Derpsch
Shielded wheelbarrow for Knapsack sprayers for human traction

This shielded wheelbarrow for knapsack sprayers is being used for row crops with a row width of 80-90cm. This implement is based on an old wheelbarrow which is turned upside-down. A mounting frame is then installed above the wheel, which carries the knapsack sprayer (see arrow A, photos 21 and 22).

The spray lance is then fixed to a hole in the bucket of the wheelbarrow (see arrow B, photos 21 and 22).

Photo 21: Shielded wheelbarrow for knapsack sprayer for human traction

Dirk Lange
A plastic curtain is then attached to the bottom edge of the bucket (see arrow C, photo 21) to provide the appropriate angle for application and to avoid herbicide escaping from the spray shield.

In use the sprayer is pushed between crop rows. The sprayer pump is activated by means of a connecting rod linking the pump lever to an eccentric point of the wheel (see arrow D, photo 22).

Photo 22: Shielded wheelbarrow for knapsack sprayer for human traction

Ken Moriya
The applicator is a modified human traction applicator. It has two wooden bars attached on either side of the common applicator (see arrow), which serve to yoke the implement up to draft animals.

Photo 23: Knapsack applicator for animal traction

Ken Moriya
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