Conservation Agriculture: A Precision Farming Tool for Smallholders
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Introduction
Globally smallholder farmers constitute the majority of farmers, producing 80 percent of the food in developing countries. Yet, for many, farming is a struggle often with only rudimentary tools and implements available. As a group they can pay little attention to the longer term management of natural resources and can rarely afford inputs such as quality seeds or fertilizer, let alone herbicides for chemical weed management.

The scarcest input to smallholder farming is often energy, particularly the human energy or farm power that is required for land preparation, crop establishment, weeding, harvesting and transport. Many smallholder farmers are women and youth who carry the major burden of arduous hand labour and is a main reason why rural youth in developing regions migrate to urban areas in search of an alternative to rural smallholder agriculture. Conservation Agriculture (CA) presents an opportunity for smallholders to reduce or even eliminate the need for land preparation and heavy digging. Applying precision agriculture (PA) principles to smallholder farming (for example for crop establishment, fertilizer and agrochemical application and irrigation) enables farmers to participate in technology development at their scale of operation. Yet, often the global stakeholders in agricultural technology development, especially private sector input and equipment suppliers are not willing or are unable to reach out to the majority of smallholders in rural areas of much of Africa and Asia.

Examples of Precision Agriculture in CA:
Precision planters. CA embraces the concept of sustainable production intensification by reducing labour and farm power inputs, with more precise seed placement and fertilizer application as well as the judicious use of herbicides for weed management as a complement to agronomic controls such as soil cover and cover crops.

No-till planter s have been developed for all farm power levels (manual, draught animal and tractor). The following are some examples and what is common to all is the use of a method for the precise placement of seeds and the simultaneous application of a precise rate of fertilizer.

The matraca or hand jab-planter comes from Latin America where the traditional tools (for use in tilled soil) have been modified in order to be able to plant through crop residues and crop cover. It has two hoppers, one for seed and one for fertilizer which allows for planting and fertilizing in one pass. Small-scale farmers, especially women, like it because of the labour savings due to the elimination of the arduous hand hoeing for land preparation. The simultaneous and precise placement of fertilizer makes the matraca truly a precision agriculture tool for smallholder farmers.

A new type of hand jab planter (The Yunfan of Chinese design) is now available for smallholder farmers at commercial scale.

Herbicides for weed management. The use of herbicide for weed management in the context of smallholder farmers is a hotly debated topic. However hand weeding is the second most arduous task (after hand digging) and it is mostly done by women and children and so the judicious use of herbicides is becoming more widespread and acknowledged as a modern and drudgery relieving means for weed
management besides other agronomic measures and practices such as applying mulch for soil cover and living cover crops for weed suppression through competition for resources, including sunlight.

Today the hand carried knapsack sprayer is the most common tool for smallholders for applying herbicides. Newer models come with accumulator pumps that eliminate the tiresome hand lever operation. The application of herbicides requires knowledge on the correct calibration and field use of the sprayer. For blanket coverage with a total herbicide it is useful to install a spray boom onto the knapsack sprayer which can also be fitted to a wheeled chassis for even safer and more precise application.

For larger fields and potentially for service providers there are single axle boom sprayers available for draught animals; the work efficiency increases with the wider boom and bigger tank. Farmers’ fields need to have a sufficiently large area with even surface topography.

**Weed mapping and N application.** A new way of making the application of herbicides for weed management as efficient and precise as possible is emerging for larger scale sprayers. It is acknowledged in commercial agriculture that blanket coverage of a fallow with herbicides is expensive and not in line with efficient and precise application of inputs, neither is it in line with sustainable intensification. Therefore, selective spot spraying is now applied with the use of new tools such as the ‘WeedSeeker’. The WeedSeeker technology employs sensors and evenly spaced spray nozzles. The sensors work on the principle of reflecting red and near infrared light (from a light-emitting diode – LED) off a weed beneath. When a green plant is identified (through an on-board analysis of the reflected light) the spray nozzle is activated. Use of the similar GreenSeeker can optimize N application to growing crops.

**Conclusions**

PA is being promoted in order to use fertilizers, water and other expensive inputs more efficiently. Smallholder farmers need to be better integrated into the precision farming discussion. PA has mainly looked at higher input use efficiency and at reducing the environmental footprint of chemical inputs, but PA practices can also enable smallholder farmers to use their limited farm power resources more effectively and efficiently.

Joint efforts of development partners, private sector and local entrepreneurs are required to connect smallholders to technological innovations in agriculture. The major global private sector suppliers of such innovations should be encouraged to make efforts to reach smallholders with targeted equipment lines, geared towards the sustainable and efficient use of natural resources and a gradual production intensification and modernization of smallholder farming.

PA tools should be applied within a system or toolbox of agronomic and management options. An improved tool or implement on its own will not make a difference, it has to fit with the concept of sustainable agricultural intensification.