



Conservation Tillage – Gateway to Food Security and Sustainable Rural Development Crop Residue Management and Cover Crops

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Background

The maintenance of a permanent soil cover of living or dead plant material is the heart of conservation tillage. This requires a total change of cropping systems and often also of livestock husbandry.

Crop residues and weeds should be burned no longer, as a considerable amount of plant nutrients are lost by this practice. Farmers need to be explained that burning crop residues is the same as burning fertiliser.

The soil cover protects the soil like an umbrella from climatic impacts, regulates the water household, provides food for the soil macro fauna, shelter for predators, helps to build up soil organic matter, and serves finally as a carbon sink.

A minimum soil cover of 30% only can reduce surface run-off and erosion by water and wind efficiently.

Functions of soil cover

Physical

- Protection against impact of rain drops – less surface sealing and crusting
- Less run-off
- Increased water infiltration
- Reduced evaporation
- Protection against soil erosion by water and wind
- Prevention of overheating of soil surface
- Reduced diurnal variation of temperature
- Smothering of weeds
- Source of soil organic matter build-up

Biological

- Habitat for predators; prevention of pest out breaks
- Stimulation of soil life (fauna and flora)

Global

- Carbon sequestration
- Preservation of biodiversity (below ground biodiversity; arthropods; small vertebrates; birds)



Cover crops can be planted under the main food crop with a delay of 2-4 weeks (here: Dolichos lablab relay cropped under maize). The cover crop starts growing and takes over only, when the main crop begins to mature. (Photo: W.Mariki)

Types and Sources of Soil Cover

Soil cover can be provided by living or dead plant material, green manures/cover crops, forage crops, crop residues, (dead/dried) weeds, fallow vegetation or mulch produced off-site. Intercropping with fast growing spreading plants like cowpea, sweet potato or pumpkin is another way of producing an effective ground cover, at least during the growing season.

- **Limitations in semi-arid areas:**

While in humid and sub-humid regions the high biomass production due to sufficient rainfall and two growing season provides good preconditions for assuring a year-round ground cover, this becomes a challenge in the dry savannas. The shorter growing season provides fewer opportunities for growing green manures/cover crops, while crop residues serve as forage for livestock. In addition green manures compete with food crops for the limited amount of available water.



Termites may constitute another constraint, as they destroy most of the crop residues during the dry season. However, the excrements protect the soil surface and nutrients are lost only to a certain extent (farmers often destroy termite mounds and use the material as fertiliser).

Another aspect is that farmers fear that termites might attack the seedlings of the following crop.

Measures for producing/assuring a permanent ground cover

Prevention of burning and uncontrolled bush fires

- No burning of crop residues or fallow vegetation
- Control of bushfires by local agreements; bushfire committees; sanctions

Protection of roaming livestock

- Controlled grazing through local agreements; fencing; living fences (hedgerows)

Crop rotations

- Planning rotations that produce sufficient biomass

Growing of green manures and cover crops

- Pure stands
 - In mechanised or large scale farms
 - In humid tropics with two cropping seasons
- Inter- or relay cropping
 - In (semi mechanised) small farms
 - In semi-arid regions (4-6 month growing period)

Crop Residue Management

Best practice is to leave all crop residues in the field, where they serve as soil cover and organic manure. As most crop residues, especially stover from cereals, contain only little nitrogen in relation to carbon (C:N ratio), during their decomposition nitrogen and also phosphorous is absorbed from the soil liquid and thus no longer available during the next growing season.



Crop residues should be left as mulch in the field and protect the soil. The subsequent crop can be planted without any soil preparation directly through the mulch, which suppresses weed growth.

- **Alternative uses:**

Crop residues serve in most situations **several purposes**, and the idea to leave them on the ground as protection or organic manure is new to most smallholder farmers. In semi-arid areas crop residues serve as forage for livestock during the dry season. The land use right of the farmer is limited to the growing season. Later the fields are opened for common grazing. Apart from this, crop residues serve also as construction material or fuel. To change this situation, farmers have to be convinced of the advantage of leaving residues in the field and alternatives have to be shown. A minimum ground cover of 30% should be maintained in any case.



In the semi-arid tropics crop residues serve as forage during the dry season. Farmers should take care however, to leave enough ground cover (> 30%) in view to protect the soil from erosion by wind and water. (Photo: W.Mariki)

Management of Fallow Vegetation

Fallows and especially bush fallows in the humid savannah and forest regions provide a considerable amount of biomass. This biomass is usually slashed and burned, as farmers have no other option to manage these quantities. In addition, farmers appreciate the fertilizing effect of the ashes. What farmers do not realize or matter, is the considerable amount of plant nutrients lost by burning (see above) and the massive CO₂ emissions, contributing to the climate change. An alternative to the slash and burn practice has been developed in the Amazon region of Brazil. The bush vegetation is chopped and mulched by a tractor mounted shredder. A mulch layer is produced, which protects the soil and suppresses weed growth.

The subsequent crop is planted with direct planters, by hand or by animal or tractor powered machines. Herbaceous and grassy fallow vegetation can be dried of by application of glyphosate. The following crop is planted directly through the mulch layer produced by the dead vegetation.



Burning the fallow vegetation destroys all the biomass accumulated during the fallow period. The tractor mounted bush shredder is an alternative. It cuts the bush vegetation into small pieces, thus producing a mulch layer. The subsequent crop is planted directly through the mulch. (Photo: M. Denich)

Cover Crops

A broad range of species may serve as cover crops. In south eastern Africa, where smallholdings dominate, only a few leguminous species have been adopted. These are sun hemp (*Crotalaria juncea*), more a shrub than a cover crop, velvet bean or mucuna (*Mucuna pruriens*) and to some

extent lablab (*Dolichos lablab*), a species providing edible seeds. Generally these green manures/cover crops are relay cropped under maize or sorghum. As farmers are reluctant to plant non-food crops, many extension services and development programmes favour the promotion of cropping systems, that provide a dense ground cover at least during the growing season, i.e. intercropping of legumes (cowpea, beans, soybeans, groundnuts). Grain legumes have, however, the disadvantage that they produce less biomass and are uprooted and exported from the field, when harvested.

Most common cover crops

Mucuna (<i>Mucuna pruriens</i>)	Excellent ground cover, short and long cycle varieties; dies off during the dry season; conditioner edible (white) seeds produced by short cycle variety
Dolichos or lablab (<i>Dolichos lablab</i>)	Excellent ground cover; persists the dry season; produces edible seeds
Canavalia (<i>Canavalia</i>)	Humid/subhumid regions; under permanent crops (plantain) or intercropped with maize; conditioner edible seeds
Hairy Vetch (<i>Vicia villosa</i>)	High altitude forage crop
Calopo (<i>Calopogonium mucinoides</i>)	Humid/subhumid regions
<i>Pueraria phaseloides</i>	Humid/subhumid regions; excellent ground cover; for plantains (oil palm, citrus); provides fodder
<i>Stylosanthes spp.</i>	Forage plant; subhumid – semiarid regions
Sun hemp (<i>Crotalaria juncea</i>)	Upright, bushy growth, no optimal soil cover
Pigeon pea (<i>Cajanus cajan</i>)	Upright shrub, shredded leaves might provide a ground cover
Wild groundnut (<i>Arachis pintoi</i>)	Provides a living mulch in humid/subhumid regions

- Management of cover crops:

Depending on the region and species, cover crops may die off during the dry season and allowing subsequent planting without any special treatment. More persistent or perennial and upright species needs to be desiccated and flattened in order to prepare



the field for planting. This is best done by an animal or tractor drawn roller-cutter which rolls and breaks the plants, which then dry within a few days. Plants may be also desiccated by spraying *glyphosate*, which serves also as (systemic) herbicide.



Prior to planting the new crop, the green manure / cover crop is rolled down and the stems are broken by a "roller-cutter". After drying off, the food crop is planted directly through the mulch cover. The practice does not only save energy and time for soil preparation. It also allows for timely planting and keeps the soil always protected.

- **Choice of the right cover crop:**

The choice of cover crops depends on the climatic zone, the prevalent soils (low pH and water logging is often a limitation), the farming system, the production goals of the farmer and of the available seeds.



Cover crop *Arachis pintoi* (Photo: K. Steiner)

Source of seeds

Provision of seeds constitute still a major constraint for a wide spread use of cover crops and green manures. Seeds of green manures and cover crops are not allowed for international exchange as there are no trade regulations for these species.

- ICRAF centres in the various countries maybe provide seeds of some (agroforestry) species.
- The ACT Secretariat serves as broker for seeds. Requests have to be made in due time, to allow for local production.

Source of information

ACT – African Conservation Tillage Network

Coordinator: Martin Bwalya
c/o IES - University of Zimbabwe
P.O. Box MP 167
Harare/Zimbabwe
Tel: 263-4-334395 / 302603
Fax: 263-4-332853
E-mail: actsecr@afrioonline.co.zw
<http://www.fao.org/act-network>

Contacts and Websites

LEXSYS Database: (developed by IITA) Agroforestry and Forest Ecology Research Group. School of Agriculture and Forest Sciences at the University of Wales, Bangor: lexsys@bangor.ac.uk
<http://ftp.bangor.ac.uk/pub/departments/af/LEXSYS/>

CIRAD, Réseau Agro-Ecologie Francis Forest:
forest@cirad.fr, <http://agroecologie.cirad.fr/>

ICRAF: Agroforestry Database
<http://www.icraf.org/treesd/AFT/AFT.htm>
The database provides information on agroforestry species including some trees on green manures

ECOPORT: FAOs Crop Database. Including a specific category of Green Manures/Covercrops
<http://www.ecoport.org/>

For further information on the use of the database contact: peter.griffie@fao.org

A user guide can be obtained from: kurt.steiner@gtz.de

IDRC Website on Cover Crops:
http://www.idrc.ca/cover_crop/

Cornell University:
http://ppathw3.cals.cornell.edu/mba_project/gmcc/home.html

Literature

BUCKLES, D.; ETEKA, A.; GALIANO, N.; GALIBA, M.; OSINAME, O.; (edt.). 1998: Cover crops in West Africa / Plantes de couverture en Afrique de l'Ouest. Contributing to sustainable Agriculture / Une contribution a l'agriculture durable. IDRC/IITA/SG 2000.

CARSKY, J.D.; ETEKA, A.C.; KEATINGE, J.D.H.; MANYONG, V.M. (Edt.) 2000: Cover crops for integrated Pest Management in Africa. Proceedings of a Regional Workshop, October, 1999, Cotonou, Republic of Benin. IITA, Ibadan, Nigeria.
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