FiBL
EXCELLENCE FOR SUSTAINABILITY

Research Institute of Organic Agriculture
Forschungsinstitut für biologischen Landbau
Institut de recherche de l'agriculture biologique






Reduced tillage and green manures for sustainable organic cropping systems

Paul Mäder (paul.maeder@fibl.org)

CORE organic II

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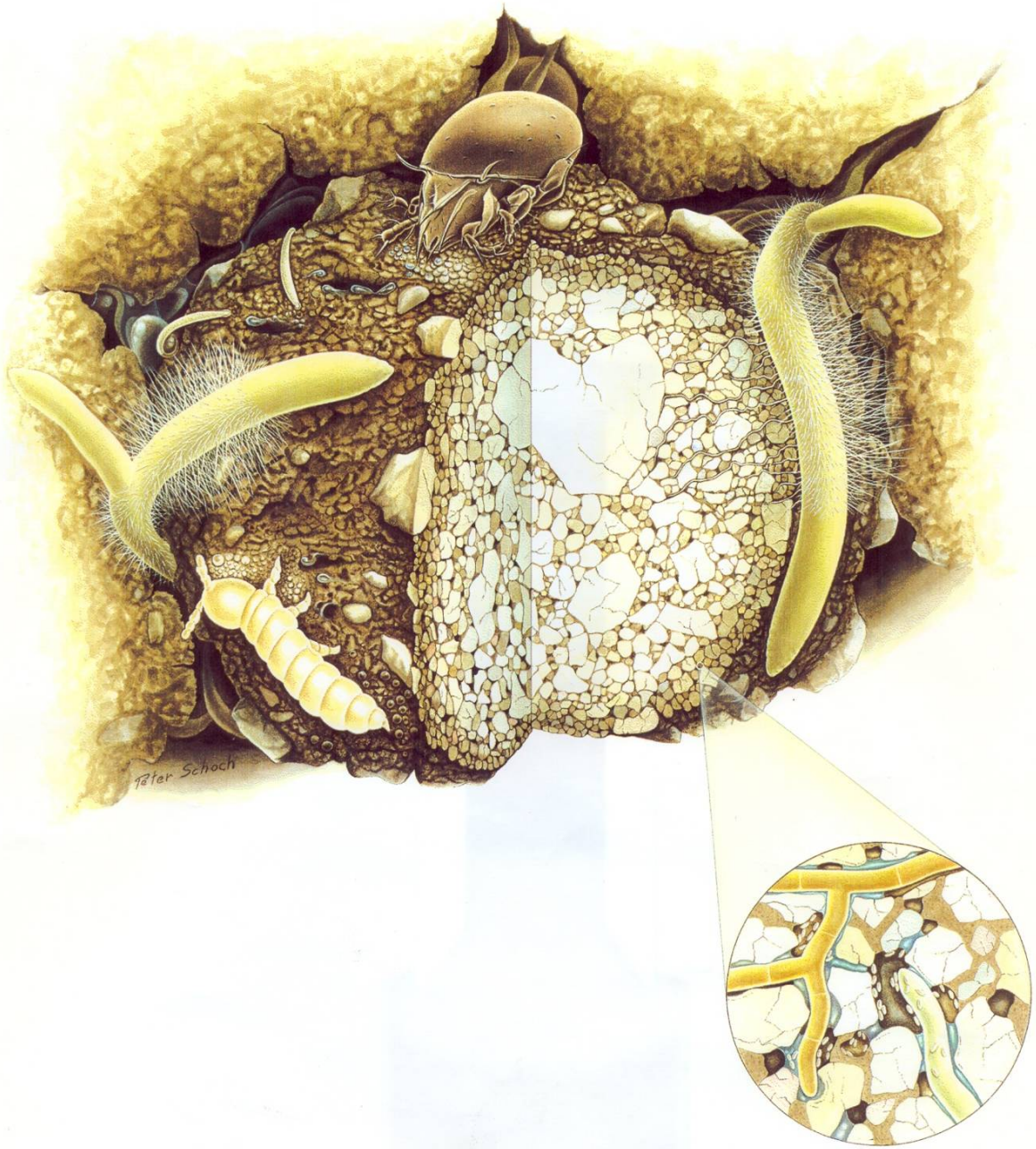

Background

- **Organic farming shows many benefits with respect to soil fertility and biodiversity**
- **No-tillage is a wide spread cropping system (US, South America, Australia)**
- **Green manure offers manifold ecological services such as nitrogen fixation and increased biodiversity**
- **Vision: Development of reduced tillage systems without the use of herbicides and mineral fertilisers**

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Research Approach

- to explore knowledge on reduced tillage under organic farming conditions from published literature, running field trials and to gather farmer's knowledge

- to conduct case studies on soil fertility, weed control and biodiversity, green manure and nutrient management

- to model data obtained and to prototype sustainable organic cropping systems

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Geographical distribution of partners and trials

Short term

Mid term

Long term

Farm survey

Switzerland, France, Germany, Netherlands, Belgium, Luxemburg, United Kingdom, Estonia, Italy, Spain, Austria

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TILMAN-ORG Kick-off Meeting 14./15. Nov. 2011

Photo: Alföldi, FiBL

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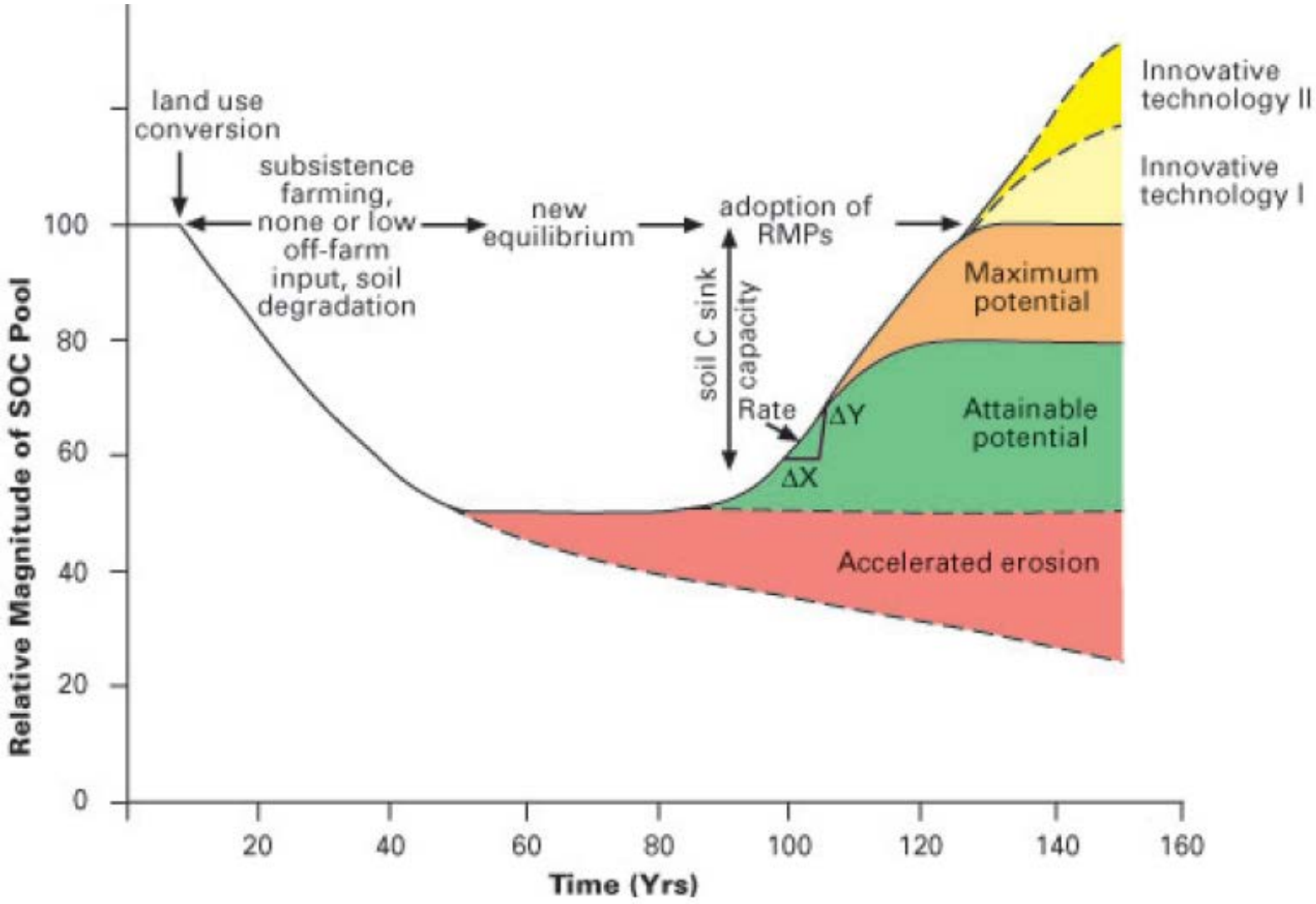
Soil organic carbon (SOC) dynamics



Lal, 2004

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Reduced tillage

Shallow ploughing
e.g. stubble cleaner

Non inverting tillage
e.g. chisel

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Direct sawing of soybean in rye

Photo: ISARA, Lyon

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Soil organic carbon in no-tillage vs conv tillage

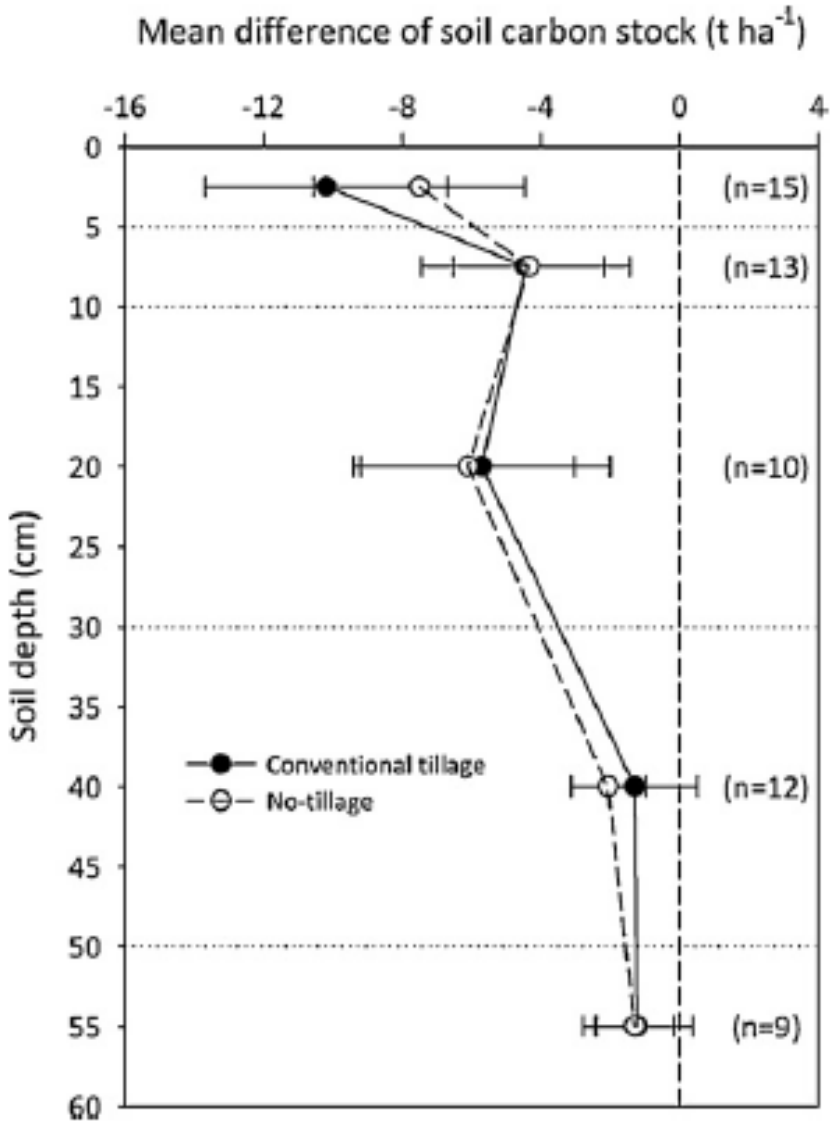

Fig. 1. Mean difference (MD) of soil carbon contents at different soil depth in cropland soils under conventional tillage (solid circles) and no-tillage (open circles) as compared with in adjacent natural soils. Horizontal bars show the 95% confidence interval; numbers of observations are the same for the tillage treatments and given in parenthesis

Luo et al., 2010

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On-farm production of nitrogen

Potential of **140 Million tons N**, which can be fixed by leguminous understory crops, intercrops, and overwintering cover crops in arable systems **(Badgley et al., 2007).**

Reference: 100 Million tons N with use of fuel

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TILMAN-ORG Project goals

“The TILMAN-ORG project’s overall goals are to design improved organic cropping systems with:

- **enhanced productivity and nutrient use efficiency,**
- **more efficient weed management and increased biodiversity, but**
- **lower carbon footprints (in particular increased carbon sequestration and lower GHG emissions from soils).”**

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TILMAN-ORG Project objectives I

- **to summarise existing knowledge and farmers' experiences on reduced tillage and green manures in organic systems in a wide range of soils and climates across Europe (WP1 and 2),**
- **to stimulate bio-geochemical processes governed by soil microorganisms and soil carbon build-up via reduced tillage and strategic integration of green manures into organic rotations (WP3),**
- **to improve weed control by integrating management techniques such as green manures, mechanical weeding and crop diversification, while evaluating impacts on weed diversity and their functional role in agro-ecosystems (WP4)**

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TILMAN-ORG Project objectives II

- **to increase the efficiency of nutrient use by green manures (including N_2-fixing legumes), thereby reducing off-farm inputs (WP5),**
- **to calibrate the farmers' decision support tool NDICEA to assess the effects of reduced tillage options and green manuring on N cycling and C pools (WP5), and**
- **to design viable organic cropping systems applying reduced tillage and green manures at the farm level for major European regions (WP6).**

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Project structure

WP 0 WP0: Coordination and Dissemination
Co: Paul Mäder (FiBL); DCo: Christophe David (ISARA); Dissemination M: Helga Willer (FiBL)

WP 1 Management of mid-term and long-term experiments on reduced tillage and green manure across Europe M: Paul Mäder (FiBL); DM: Julia Cooper (UNEW)

WP 2 Effects of reduced tillage and green manures on crop performance, weed management and soil quality M: Julia Cooper (UNEW); DM: Joséfine Peigné (ISARA)

WP 3 Impact of reduced tillage and green manure on soil quality and greenhouse gas emissions
M: Michael Schloter (HMGU)
DM: Andreas Gattinger (FiBL)

WP 4 Improved weed management and functional weed biodiversity under conservation methods
M: Paolo Barberi (SSSA)
DM: Xavier Sans (UB)

WP 5 Improved nutrient management in reduced tillage systems by use of green manures and appropriate off-farm inputs
M: Geert-Jan van der Burgt (LBI); DM: Thorsten Haase (WIZ)

WP 6 Prototyping of sustainable conservation agriculture systems by use of knowledge based assessment M: Josefine Peigné (ISARA); DM: Wijnand Sukkel (DLO-PRO/PRI)

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Visions and outcomes I

- **TILMAN-ORG will contribute to stopping degradation of European agricultural.**
- **TILMAN-ORG will provide new strategies for increasing yields while maintaining soil quality.**
- **TILMAN-ORG will restore soil fertility, promote biodiversity and enhance nutrient cycling.**
- **TILMAN-ORG will result in more resilient cropping systems with higher yields and yield stability in the context of more variable and extreme weather patterns as predicted by the IPCC.**
- **TILMAN-ORG will enhance the C sequestration and storage potential of arable soils.**

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Visions and outcomes II

- **TILMAN-ORG will contribute to better estimates of how reduced tillage systems under organic farming management can mitigate climate change. Trials will generate data on both soil C sequestration and GHG emissions (CO_2, N_2O and CH_4) from soils.**
- **TILMAN-ORG will deliver scientifically validated decision-support tools, and guidelines on most suitable agronomic practices and approaches, techniques and technologies adapted to different crop production systems/rotations and pedo-climatic conditions found in Europe.**
- **TILMAN-ORG will also contribute to the economy of the European community.**

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Frick Tillage Trial

TILMAN-ORG partners

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Thank you!

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This compilation has been achieved within the framework of the 1st call on Research within CORE Organic II

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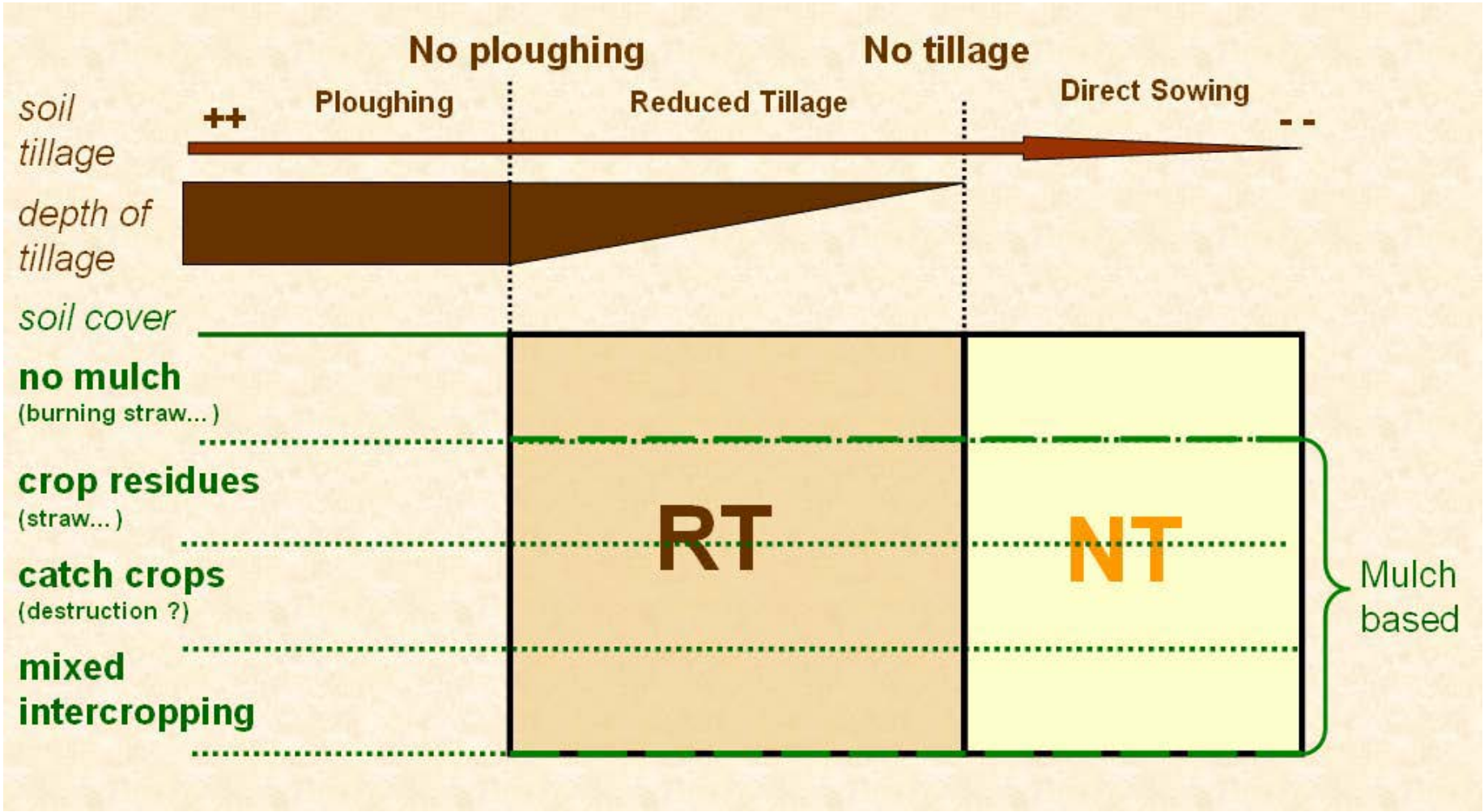
Diversity of CA systems



Source. Kassa Project