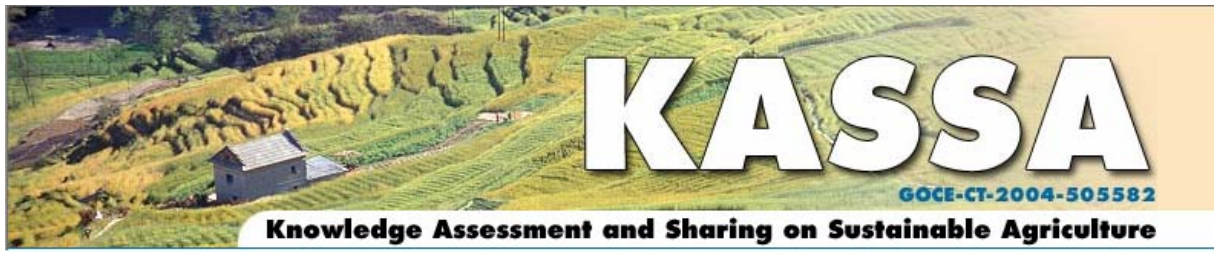

Latin American platform comparative critical analysis. Learning from the KASSA platforms' reports

M.F.S. Ribeiro[1*], J.E. Denardin[2a*], A. Bianchini[3], R. Ferreira[4], C.A. Flores[2b], R.A. H.J. Kliemann[5], Kochhann[2a], I.C. Mendes[2c], G.M. Miranda[1], L. Montoya[2d], N. Nazareno[1], C. Paz[6], R. Peiretti[3], C.N. Pillon[2b], E. Scopel[2e], F. Skora Neto[1]

[1]*Instituto Agronômico do Paraná (IAPAR), Rodovia Celso Garcia Cid, km 375, PO Box 481, 86001-970 Londrina, PR, Brazil*
[2a]*Empresa Brasileira de Pesquisa Agropecuária (EMBRAPA), Rodovia BR 285, km 294, PO Box 4561, 99001-970 Passo Fundo, RS, Brazil*
[2b]*Empresa Brasileira de Pesquisa Agropecuária (EMBRAPA), Rodovia BR 392, km 78, PO Box 403, 96001-970 Pelotas, RS, Brazil*
[2c]*Empresa Brasileira de Pesquisa Agropecuária (EMBRAPA), Rodovia BR 020, km 18, PO Box 08223, 73310-970 Planaltina, DF, Brazil*
[2d]*Empresa Brasileira de Pesquisa Agropecuária (EMBRAPA), Estrada da Ribeira, km 111, PO Box 319, 83411-000 Colombo, PR, Brazil*
[2e]*Empresa Brasileira de Pesquisa Agropecuária / Centre de coopération Internationale en Recherche Agronomique pour le Développement (EMBRAPA/CIRAD), Rodovia BR 020, km 18, PO Box 08223, 73310-970 Planaltina, DF, Brazil / Avenue Agropolis, 34398 Montpellier, France*
[3]*Asociación Argentina de Productores en Siembra Directa (AAPRESID), Paraguay 777, 8th Floor, Of. 4, 2000 Rosario, Argentina*
[4]*Fundação de Apoio ao Ensino, Pesquisa e Extensão (FAEPE), Campus Histórico da UFLA, PO Box 142, 37200-000 Lavras, MG, Brazil*
[5]*Universidade Federal de Goiás (UFG), Campus Samambaia (Campus II), PO Box 131, 74001-970 Goiânia, GO, Brazil*
[6]*Asociación de Produtores de Oleaginosas y Trigo (ANAPO), Av. Ovídio Barbery, Esq. Calle Jaime Mendoza, PO Box 2305, Santa Cruz de la Sierra, Bolivia*
[*] *Platform Coordinator*

Centre de coopération internationale en recherche agronomique pour le développement
Avenue Agropolis, 34398 Montpellier, France

www.cirad.fr

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Partners of the Latin American platform:

29 – IAPAR, Brazil;
30 – FAEPE, Brazil;
31 – UFG, Brazil;
32 – EMBRAPA, Brazil;
33 – ANAPO, Bolivia;
35 – AAPRESID, Argentina.

Scientific advice has been provided by:

Michel Griffon (CIRAD, France);
Ren Wang (IRRI, Philippines);
Jaromir Kubat (VURV, Czech Republic);
Roberto Peiretti (AAPRESID, Argentina).

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This report is the result of a cross-analysis of the platform reports Platform Assessment Report 1.1 - European Platform, Platform Assessment Report 1.2 - Mediterranean Platform, Platform Assessment Report 1.3 - Asian Platform, and Platform Assessment Report 1.4 - Latin American Platform produced by KASSA project. During three days, participants of the Latin American platform met and worked in order to produce this report, which was further edited by the platform coordination and submitted to the approval of the whole group.

For each chapter of the reports, the analysis was done and will be presented according to four main criteria: common points, specific aspects, main contributions and contradictory/not clear aspects.

1 Conservation Agriculture (CA) concept and practices

Common points

- In all platforms, the suppression/minimization of soil tillage is a component of CA concept. Permanent soil cover (cover crops and residues of cash crops) and crop rotations appear as a CA component for all platforms, except for the Mediterranean Platform.

Specific aspects

- While for Latin American, European and Mediterranean platforms, CA is regarded as an "umbrella" that encompasses some elements (suppression/minimization of soil tillage, permanent soil cover, and crop rotation). Specificities of the rice-wheat cropping systems in Asia – where rice is normally transplanted under paddled soil – leads the Asian Platform to adopts RCT (Resource Conserving Technologies) as the ultimate concept; an RCT is CA when soil is maintained covered.

Main contributions

- European is the only platform that differs in concept from what is practiced, thus indicating that farmer's practices may not be exactly the same of the concept, as a results of technical, biophysical, cultural and socio-economic factors that lead farmers to adapt the concept to their specific situation.

Contradictory/not clear aspects

- There is not a precise differentiation between CA and No-Tillage. Sometimes these two terms have the same meaning.
- There is a need of indicators (environmental, technical and socio-economic) for defining the limits of agricultural production systems to be considered as CA. For instance, what would be the maximum allowed frequency of soil tillage once CA is adopted? What would be the maximum allowed rates of water contamination by pesticides?

2 Driving forces

Common points

- Economic aspects (reduction in the costs of machinery and labor, reduction in drudgery) play a major role for changing from conventional soil tillage to CA.
- Availability of adapted machinery as a key factor.
- Other driving forces: erosion reduction, increase in yield and soil fertility and more flexibility for the planting period.

Specific points

- Farmers´ necessity for change (economic in Latin American and Asian platforms; weed control in rice-based systems in Asian and Latin American platforms and a more efficient use of water in Asian and Mediterranean platforms acting as main driving forces from farmers´ perspectives).
- Farmers´ innovativeness and a reactive and proactive attitude as main driving forcers in Asian and Latin American platforms.
- Institutional support (research, public/private partnerships and government policies) as driving forces in Latin American platform.
- The great socio-economic diversity within the Mediterranean Platform makes difficult the analysis of adoption in the whole platform; it would require a separate characterization (North Africa/Europe).

Main contributions

- The wide-scale adoption of CA in Latin American platform makes this region a real example of CA being effectively practiced by small and large-scale farmers. Therefore, information on adoption is based on assessments at farm level
- Mediterranean Platform presents information on farmers´ assessments even not having yet a wide adoption.

Contradictory/not clear aspects

- In Mediterranean Platform, crop yield and soil water availability are mentioned as constraints and driving forces at the same time. This would need to be clarified for each specific condition.
- Adoption issues seem to be more a felling of the participants than based on field evidences (Asian and European platforms).
- Socio-economic and cultural issues are dealt superficially in all platforms.

3 Constraints

Except for the case of Asian Platform (which did not mention any constraint), the main technical/biophysical constraints for the dissemination of CA are the problems with weeds, pests, and diseases (Table 1). Conflicts regarding alternative uses of plant biomass as soil cover, fodder for livestock or shelter (Table 2) and cultural aspects appear as the main non-technical constraints in Latino American, Mediterranean and European platforms.

Table 1. Technical and biophysical constraints for the dissemination of Conservation Agriculture

Constraints	Latin American Platform	Asian Platform	European Platform	Mediterranean Platform
Weeds	X (small-scale farmers)	?	x	X
Pests/diseases	x	?	x	X
Crop residue management		?	x	X
Climatic		?	x	
Soil conditions		?	x	X
Soil type		?		
Yield		?	x	X

Machinery	X (Bolivia)	?		

Table 2. Socio-economic, cultural and institutional constraints for the dissemination of Conservation Agriculture.

Constraints	Latin American Platform	Asian Platform	European Platform	Mediterranean Platform
Investments	X (Small-scale farmers/Bolivia)	?	x	
Higher production costs		?	x	
Cultural	x	?	x	
Subsidies		?	x	
Restriction measures		?	x	
Livestock grazing	X (Small-scale/Bolivia)	?	x	
Absence of proper political support		?		x

4 Scientific and practical results

4.1 Main contributions

4.1.1 Crop yields and stability

- Mediterranean Platform**:** there is limited information of the effect of CA adoption on crop yield and stability. For dryland crops the results are positives and are similar for irrigated areas.
- Latin American Platform: there is plenty of information of the effect of CA adoption on crop yield and stability in both, dryland crops and irrigated areas. These responses are positive mainly when the adoption of CA is continually and for long time, due mainly, to the improvement of the global fertility of the soil.
- European Platform: there is abundant scientific positive information on the use CA but there is a gap in practical field experiences.
- Asian Platform: there is plenty positive scientific information on the use of CA, mainly for rice and wheat. The system provides better timing for seeding these crops.

4.1.2 Soil characteristics

- Mediterranean Platform: results of CA on soil porosity, stability of the structure, and capacity of water storage agree with general data obtained throughout the world and are contradictory in relation to soil resistance to penetration. For hydraulic conductivity of the soil data are not consistent. In relation to soil chemical parameters, adoption of CA improves the availability of N, P, and K of the surface layer and reduces the content of nitrate on the soil profile. There is an increase in C content in the surface layer, lower CO_2 emission to atmosphere, and an increase in soil organic matter in the soil profile. The soil pH decreases slightly with time of CA adoption. The micronutrients contents is not affected.
- Latin American Platform: there is plenty of information on the adoption of CA which improves physical soil properties with frequent problems of increase of soil resistance to

penetration but with increase of water infiltration rate in the soil. Nutrient availability is improved occurring stratification in the soil profile. There is an increase in C content in the surface layer, lower CO_2 emission to atmosphere, and an increase in soil organic matter in the soil profile.

- European Platform: modifications of soil physical characteristics due to the CA adoption are soil and climate-dependent. There are soils that present physical impediment to root penetration, although the soil macro porosity and water infiltration rate are improved. Soil acidity occurs generalized and nutrient leaching occurs in sandy soils. The results indicate reduction in CEC (cation exchange capacity) and no information on C and soil organic matter content increase are presented.
- Asian Platform: there is information on the adoption of CA relative to the increase of soil C and improvement biophysical characteristics in the surface layers.

4.1.3 Weed management

- Mediterranean Platform: the results on the adoption of CA are incipient, promoting changes in the flora and indicate need for research on more precise use of herbicides. The mulching layer promoted by CA and the use of crop rotation systems play an important role in weed management.
- Latin American Platform: adoption of CA promotes plant stubble on soil surface associated to the reduction in soil disturbance alter considerably the biological activity and chemical and physical soil parameters. These reduce the negative effects of herbicides through higher adsorption and degradation in the soil. The infesting flora is reduced in number and in species. The continued use of the same herbicide has induced plant resistance on certain weed species. The adoption of CA tends to promote dependence by herbicides. Nevertheless, in some production systems, the use of herbicides is higher and in some others the use of herbicides is reduced. The integrated weed management under CA showed potential to solve problems relating plant resistance to herbicides and to reduce the problem of high use of herbicides. The use of the so called natural herbicides, as well as mechanical control, have presented restrictions of adoption, mainly due to the specificity and the high demand for hand labor, respectively. In some regions, the use of GMO (genetically modified organisms) is an efficient strategy for weed control.
- European Platform: there is information that adoption of CA increases dependence on herbicides. The absence of crop rotation systems also increase the dependence on herbicides. Adoption of CA alters the infesting flora, predominating species propagated by rhizomes. The higher use of herbicides, not necessary increases the risks of pollution. Adoption of crop rotation systems and soil cover crops have showed efficiency in suppressing weeds, but more research is need.
- Asian Platform: there is information that the CA adoption promotes more efficiency in weed control and reduces the costs of weed control. CA is an strategic measure to control specific weed species. The use of herbicides reduces the requirement for hand labor.

4.1.4 Pest/Diseases management

- Mediterranean Platform: there is information that some pest/disease are favored by the CA adoption, but there are evidences that biological control could be an efficient strategy.
- Latin American Platform: there is information that adoption of CA affects the soil pests. The occurrence of rat constitutes a problem in areas in which the rodent has shelter to survive. Adoption crop rotation systems and soil cover crops are efficient in controlling

airborne insects. In order to control plant diseases crop rotation systems are necessarily required to obtain net profit.

- European Platform: there is information that adoption of CA favors diseases incidence due to the presence of crop residues. The increase in diseases induces higher use of pesticides. The main pest in sand soils is snail. There is evidence of rat occurrence but not generally distributed.
- Asian Platform: there is information that adoption of CA increases root rot incidence. Crop residues left on the soil surface help in the biological control of pests.

4.1.5 Rainwater efficiency

- Mediterranean Platform: the rainfall regime of the region defines the production systems that involves wheat, barley, canola and sunflower under dryland farming. Fruit trees and vegetables are cultivated under irrigation.
- Latin American Platform: there is information that adoption of CA may reduce runoff and increase the water infiltration rate in about 50% of the conventional tillage. The soil water evaporation may be reduced between 10 to 50%. The soil water availability during dry spells is improved under CA, reducing climate risks.
- European Platform: there is information that the hydraulic conductivity and evapotranspiration reduction under CA is an important benefit in dry areas by retention of soil water.
- Asian Platform**:** there is information that the increase of cultivated areas and the industrial and domestic water consumption have reduced water availability for agriculture use. The adoption of CA has potential to reduce water losses by evaporation avoiding salinization. Water consumption by rice under CA may be reduce in 25%.

4.1.6 Soil microbiology

- Mediterranean Platform: there is information that adoption of CA increases enzymatic activity in soil, as well as the population of meso and macrofauna.
- Latin American Platform: there is information that adoption of CA increases *Rhizobium* and *Bradyrhizobium* population in the soil. Due to the absence of soil disturbance, deposition of fertilizer on soil surface and maintenance of crop residues on soil surface occur increases in phosphatase, arisulphatase and β-glucosidase. There is a perception of increased microbial biomass and consequently increase in enzymatic activity (urease and catalase). There is a need of developing analytical procedures for soil quality using microbiological parameters of the soil.
- European Platform: no information is available.
- Asian Platform: no information is available.

4.2 Common and specific aspects

- There are no aspects in disagreement relating scientific results from the adoption of CA and the conventional agriculture. There is limited experience relating practical results obtained from the European and Mediterranean platforms. However, there is a perception that, in a general way, the knowledge level of the adoption of CA focused as system's approach is not the same among all platforms. In this sense, the Latin American and Asian platforms are outstanding.

4.3 Contradictory/unclear aspects

- The European and Asian platforms did not present information relating soil microbiology. The European Platform has no information on rainfall water efficiency. The Asian Platform doesn't show clearly the relation among CA adoption and plant

diseases incidence, presenting some contradiction with other platforms when stating that adoption of CA reduces occurrence of certain plant disease. The Mediterranean Platform presents inconsistency when stating that adoption of CA promotes a more uniform soil porosity in the profile.

5 Impacts

5.1 Socio-economic

5.1.1 Labor and machinery

Common points

- As positive impacts, Asian and Latin American platforms reported the reduction in drudgery, in fuel/lubricants consumption and in intensity of mechanized operations. On the other side, European and Mediterranean platforms reported higher requirements of investments for the transition from conventional tillage to CA.

Main contributions

- Wide-scale adoption by small-scale farmers in Latin American Platform made possible to assess that the transition from conventional tillage to CA resulted in better livelihoods.

Contradictory/not clear aspects

- There is a lack of data on drudgery reduction in European and Mediterranean platforms, as well as on farm investments in Latin American and Asian platforms reports. Specially for small-scale farmers in North African countries, it would be important to clarify those aspects: if farmers do not have capacity to invest for chemical control of weeds, CA can result in more drudgery and labor requirements.

5.1.2 Costs and profitability

Common points

- Asian, Latin American and European platforms report a reduction on labor and fuel costs.

Contradictory/not clear aspects

- According to European platform, reduction of costs and labor depends on soil types and crops cultivated. This would have to be clarified.
- There is relatively few data available for assessing socio-economic aspects due to CA on all platforms.

5.2 Environmental impacts

5.2.1 Carbon stratification and sequestration

Common points

- Both Latin American and European platforms report an increase on soil organic matter under CA.

Contradictory/not clear aspects:

- No data available from Asian Platform.
- Although indicates a soil organic matter increase, there is no quantitative data in the Mediterranean Platform.

5.2.2 Nitrogen and nutrient cycling

Common points

- All platforms report an increase in N contents in the upper soil layers.

Specific points

- Latin American Platform reports higher probability of N leaching under CA in humid regions, while Mediterranean Platform reports lower contents of nitrate leaching.
- European platform reports that CA results in lower loses of N, P, and K
- Higher concentration and stratification of P on the upper soil layers reported only by the Mediterranean Platform.
- Higher efficiency of N fertilizers is reported by Latin American, European and Mediterranean platforms.

Main contributions

- CA system imitates natural ecosystem introducing cover crops acting as nutrient pumps (Latin American Platform).

Contradictory/not clear aspects

- For all platforms (mainly Latin American and Asian platforms), there is a lack of data on the accumulation of macro and micro nutrients on the upper soil layers.
- For all platforms, there is a need of long-term studies on all nutrients under CA systems.
- There is a need for optimization of yield and quantification of N rates for both rice and wheat systems in Asian Platform.
- For all platforms, information is required on the downward movement of nitrates under CA.

5.2.3 Erosion mitigation

Common points

- Latin American and European platforms report erosion reduction through surface plant residues.
- Low soil organic matter accumulation leads to higher soil and water losses
- Inadequate management of sloping areas speeds up soil degradation in Latin American Platform and Asian (Vietnam) Platforms

Specific points

- Latin American Platform reports high erosivity (rainfall index) on the highly weathered tropical soils (Oxisols and Ultisols). However, there is a great variability of soil losses on experimental plots.
- A reduction in sediment losses on CA in the long run is reported by the European Platform.

Main contributions

- Soil and water losses are reduced up to 97% under no-tillage/CA systems in Latin American Platform.

Contradictory/not clear aspects

- There is a lack of data that relates rainfall erosivity and soil types in the Asian, European and Mediterranean platforms.

5.2.3 Pollutants

Common points

- Siltation reduces the availability of drinking and irrigation water and the capacity of the reservoirs as reported by Asian and European platforms.
- In all platforms, there is a lack of data that allow conclusions on the impacts of different agricultural practices (conventional tillage, CA and others) on water quality.

Main contributions

- European platform reports a reduction on nitrates leaching and also greater sediment losses under conventional tillage than under CA, as a result of long-term studies.

Contradictory/not clear aspects

- Data presented by Latin American Platform does not allow to draw conclusions on the impact of CA on water quality, as it is not possible to discriminate the sources of pollution (e.g. which are the agricultural practices being carried out in a watershed and how to discriminate the sources of pollution?).
- There is a need to quantify the contribution of CA systems to the siltation of water sources.

5.2.4 Soil microbiology

Common points

- Latin American and Mediterranean platforms report an increase on the enzymatic activity as a result of CA.

Divergent/specific aspects

- Latin American Platform reports an increase of the microbial biomass and C on the topsoil and an increase of soil organic matter and nematodes.

Contradictory/not clear aspects

- There is a lack of data on soil microbiology in the Asian, European and Mediterranean platforms.
- There is a need for standardization of methodologies for microbial attributes used on soil quality assessment.

6. Main knowledge gaps and research needs

General

- Much emphasis was given to technical aspects, both in terms of knowledge already available and research needs
- Not much emphasis is put on socio-economic/cultural and policy issues, although is known that these are important factors for the dissemination of CA. An example are crop x livestock interactions and also interactions among member of communities for

the use of biomass that occurs in regions of Mediterranean (North Africa) and Latin America (Bolivia) platforms.

- Although there is plenty of evidence on the environmental benefits of CA regarding the decrease of soil losses, there is a lack of data regarding pesticides in water

Asian Platform

- The report of the Asian Platform presents a long list of technical aspects disregarding social dynamic changes and/or specificities of the processes of a systemic approach. Suggestion is made to reevaluate the needs for research and development in order to evaluate the impacts of the continuous adoption of CA.

Mediterranean Platform

- The research proposals are structured in a logical way but are extremely generic. There are some research demands presenting certain degree of details, as the ones relating calibration of soil analysis for CA and OF. There are only a few mentions of the research demands for OF.
- There a is perception of the existence of clear differences in realities, problems and research needs throughout platform, what suggests very specific research agenda for each topic.

European Platform

- The few knowledge gaps and research proposals are scattered along the document; there is no specific chapter on it.