

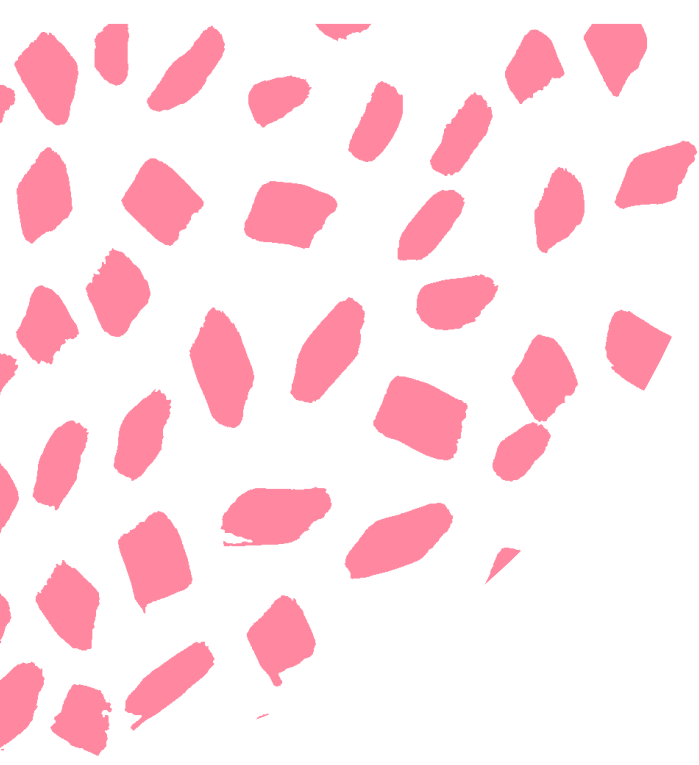


INnovative Conservation Agriculture Approaches: Food Security and Climate Action Through Soil and Water Conservation (INCAA)

Addendum to the Final Report: Progress of the overall INCAA project and contributions of the CDR-BOKU team

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March 2018



a cooperation of



1 Structure of the INCAA project

The INCAA project was structured in 5 Work Packages with specific deliverables.

Work Package	Deliverables	CDR-BOKU contriution
WP1: management and coordination (ZALF)	D1.1 - D1.6: progress reports (every 6 months)	0.2 person months
WP2: Analysis of the CA value chain (UE/ICAAM)	D2.1: Report on existing CA practices in the region D2.2: Report on CA benefits along the value chain D2.3: Report on constraints for the use of CA practices D2.4: Report on proposals of actions to overcome identified constraints	
WP3: Analyse the institutional influence on CA adoption (ZALF)	D3.1 Report on the inventory of methods to assess institutional and individual drivers and constraints of CA innovation D3.2 An adapted and expanded version of the QAToCA tool to cover all aspects and sectors (stakeholders) in the CA innovation system D3.3 Report/publication on the application of the tool in assessing institutional influence on innovation and region specific supporting and hindering factors D3.4 Report/publication on an expanded QAToCA tool to accommodate agricultural	1.2 person months
WP4: Capacity strengthening, knowledge transfer, networking (KARI)	D4.1: Folder with dissemination material for upscaling CA at all levels D4.2: Final Workshop in 2017 with invited participants from research, policy making and champion farmers on CA project outcomes D4.3: Preparation of a policy brief on CA upscaling	0.2 person months
WP5: Develop a set of approaches to strengthen institutional learning for innovation of CA (CDR-BOKU)	D5.1 Report on communicative action for innovation in natural resource management, proposing an institutional learning process. D5.2 Production of min. three instructional videos on initiating, guiding and closing institutional learning processes. D5.3 Publication on the designed institutional learning process for innovation.	3 person months

2 Progress summary

Due to the no-cost extension of the project, ZALF will close the project and provide the final overall report by June 2018. The CDR-BOKU has continuously participated in coordination activities and worked closely with the coordinator to make sure the contributions were aligned to the overall project objectives and ongoing activities. CDR-BOKU will support ZALF in finalizing the final report.

WP1: management and coordination

WP2 was implemented by the University of Evora and mainly as a PhD study. The CDR-BOKU did not have an active role in this WP.

WP2: Analysis of the CA value chain (UE/ICAAM)

To complete the defined deliverables, a qualitative approach was chosen and 53 interviews were conducted in Kenya and 51 interviews were conducted in Burkina Faso.

The currently prepared reports highlight the following findings (see the INCAA Final workshop report, attached):

Burkina Faso	Kenya
<ul style="list-style-type: none"> • Different cultures enable a diverse set of challenges and opportunities. CA principles are a challenge in different extent to different ethnic groups; • Farmers assess soil quality from an appreciation of colour, texture, capacity to hold water but mostly crop performance. Several methods are used to improve soil fertility; • Cotton farming is mostly a challenge but can also provide opportunities. • The need maintain/improve soil fertility is of everyone's best interest since it has the potential to maintain/decrease investment needed; • Many farmers seem to be searching for alternative solutions to cotton. The answer is usually investing in livestock. • More efforts should be put into developing and evaluating strategies that are able to guarantee biomass for the soil and livestock. 	<ul style="list-style-type: none"> • CA principles are individually conjugated with others in a mix-strategies approach. • Farmers discern soil condition from an appreciation of colour, texture, reaction to sun and rain, crop performance. People use several methods to improve soil fertility. • Problem of drought is portrayed as a long-standing threat to local livelihoods with disputable trends. Lack of irrigation systems is the main constraint to crop production. • Both CA and non-CA farmers added a feature to their understanding of CA that is not clearly announced in CA literature — herbicides' use. • CA may be recognised to provide slightly better yields than non-CA but it is not resistant to severe drought and remains behind what is promised in promotion campaigns. • There are environmental and health issues to be addressed regarding the introduction of pre-emergence herbicides in Laikipia through CA promotion. • Alternatives to managing weeds should be carefully researched. • More attention should be given to strategies that guarantee soil cover. Otherwise CA is of little adequacy to Laikipia.

We expect that the final reports will be turned into a publication and/or will be available as published thesis.

Deliverable 3.1 is attached to this report. The CDR-BOKU collaborated with ZALF in the revision of the QAToCA tool and integrated it into the learning process designed for WP5.

To illustrate the revised QAToCA 2.0, snapshots of the Excel-Tool are attached to this report. The reports on the application of the expanded ITCOA tool were realized as part of the publication of D5.3 and a publication currently developed: “Developing pathways for improving farmers livelihood using a Transformative Learning Approach –Conservation Agriculture in Kenya” led by ZALF. Lorenz Probst and Sara Kaweesa are co-authors of this study.

WP3: Analyse the institutional influence on CA adoption (ZALF)

The African Conservation Tillage Network (ACT) took over the lead of this work package from KARI for funding and organizational reasons.

The final workshop was organized by ACT (see attached report), and CDR-BOKU contributed to its facilitation. ACT has compiled a comprehensive directory of instructional materials on CA (attached). The Policy Brief is yet to be completed. The learning process designed by CDR-BOKU is expected to be an integral part of the recommendations.

WP4: Capacity strengthening, knowledge transfer, networking (KARI)

The WP5 was the main contribution of the CDR-BOKU to the overall INCAA project. All activities and outputs were completed and are described in detail in the main narrative report to the Commission for Development Research.

WP5: Develop a set of approaches to strengthen institutional learning for innovation of CA (CDR-BOKU)

Appendices:

1. INCAA Final Project Workshop Report
2. Deliverable 3.1 Report on the inventory of methods to assess institutional and individual drivers and constraints of CA innovation
3. Snapshots of QAToCA 2.0
4. Directory of instructional material on CA

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INnovative Conservation Agriculture Approaches: Food Security and Climate Action through Soil and Water Conservation

INCAA

Final workshop Report



July, 12th – 13th 2017

Venue: *African Institute for Capacity Development (AICAD),*

Jomo Kenyatta University of Agriculture and Technology (JKUAT), Juja, Nairobi - Kenya

Report prepared by
African Conservation Tillage Network

Project Partners

1. Leibniz Centre for agricultural landscape research (ZALF) e.V., Institute for Socioeconomics, Müncheberg, Germany
2. KALRO-Kabete (Soil and Water Management and Conservation Agriculture), Nairobi, Kenya
3. Université Polytechnique de Bobo Dioulasso - Institut du Développement Rural (UPB - IDR), Bobo Dioulasso, Burkina Faso
4. African Conservation Tillage Network (ACT) East Africa, Kenya
5. African Conservation Tillage Network (ACT) West Africa, Burkina Faso
6. Universidade de Évora, Instituto de Ciências Agrárias e Ambientais Mediterrânicas (UE/ICAAM), Évora, Portugal
7. BOKU-University of Natural Resources and Life Sciences, Vienna, Austria

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Acronyms

ACT	African Conservation Tillage Network (ACT)
AICAD	African Institute for Capacity Development
CA	Conservation Agriculture
BOKU	University of Natural Resources and Life Sciences, Vienna, Austria
UPB – IDR	Université Polytechnique de Bobo Dioulasso - Institut du Développement Rural, Bobo Dioulasso, Burkina Faso
INCAA	INnovative Conservation Agriculture Approaches: Food Security and Climate Action through Soil and Water Conservation
JKUAT	Jomo Kenyatta University of Agriculture and Technology
QAToCA	Qualitative participatory expert Assessment
SSA	Sub-Saharan Africa
TLA	Transformative Learning Approaches
UE/ICAAM	Universidade de Évora, Instituto de Ciências Agrárias e Ambientais Mediterrânicas (UE/ICAAM), Évora, Portugal
ZALF	Leibniz Centre for Agricultural Landscape Research

1.0 Introduction

The INCAA project is designed as an action research process aimed at targeting the challenging (and often missing) interfaces of science-driven technology and local realities in innovation systems. The overall objective of INCAA is to mentor and analyse a learning process that supports the innovation of CA in Sub-Saharan Africa. Building on experiences of former projects, INCAA (1) mapped benefits and adaptations of CA in innovation systems around the partner projects; (2) fostered joined learning of stakeholders to test and validate CA tools; and (3) developed learning strategies for an innovation process towards CA including institutional and individual dimensions. The case study sites of the project are Laikipia County, Kenya and Koumbia Commune, Burkina Faso.

Within the framework of the INCCA project, an end of project workshop was held in Nairobi, Kenya at the African Institute for Capacity Development (AICAD) Conference Centre, Jomo Kenyatta University of Agriculture and Technology (JKUAT) from 12th to 13th July 2017. The aim of this workshop was to present and discuss the findings of the 3-year project (1.9.2014 - 31.08.2017), which has been funded under the ERAFRICA programme (<http://www.erafrica.eu>) as project number: ERAFRICA_IC-018.

The workshop was held for two days with the plenary sessions for the first day and a field visit to CA farmers in Machakos County for the second day.

2.0 Welcome Address

The workshop was to be opened by the JKUAT Management who were however absent owing to an on-going lecturers' strike. The task was therefore taken by the ACT Executive Secretary,



Figure 1: Eng. Saidi giving the welcome address

Engineer Saidi Mkomwa. He thanked the participants for attending the workshop and more importantly for participating in the implementation of the project activities in Kenya and Burkina Faso. He welcomed them to the workshop and urged them to fully participate in the discussions. He thanked the team leader of the project for effective coordination of the team and appreciated their choice of having ACT co-host the event. He hoped that the findings of the research would help in unearthing the bottlenecks to Conservation Agriculture (CA) adoption in

Africa and give practical recommendations that can propel the African Governments to embrace and mainstream CA in their extension and academic systems.

3.0 Plenary Session 1 – Project Introduction

The first presentation was made by the project team leader Dr Johannes Schuler who gave the background of the project. He stated that the challenge for smallholder farmers in Sub-Saharan Africa was to feed a growing population while preserving the natural resource base of the agricultural system. He cited the potential in CA being promoted as a strategy that can improve yields, soils and effective water use.

He said the INCAA project was an action research process to follow the impact of the CA2Africa <http://ca2africa.cirad.fr/> and Agroecology based Aggradation Conservation Agriculture (ABACO) <http://abaco.act-africa.org/> projects to identify the successes and barriers to CA adoption as well as the opportunities that can be exploited to upscale and increase the adoption of CA.



Figure 2: Johannes Schuler making his presentation

He summarised the six work packages that were addressed by the project partners namely:

WP1: Management and coordination by ZALF

WP2: Analysis of the CA value chain by UE/ICAAM

WP3: Analyse the institutional influence on CA adoption by ZALF

WP4: Capacity strengthening, knowledge transfer, networking by ACT and KALRO

WP5: Develop a set of approaches to strengthen institutional learning for innovation of CA by CDR-BOKU

WP6: Implementation of participatory knowledge exchange and transfer mechanisms into higher education by ZALF and JKUAT.

He also highlighted the main events that have been held in the project period as:

- Kick-off meeting in Nairobi and Laikipia - April 2015
- Field study in Laikipia - April/May 2015
- Transformative Learning Workshop in Burkina Faso in May 2016
- Field study in Burkina Faso - April/May 2016
- Transformative Learning Workshop in Laikipia in March 2017
- Final Workshop on project outcomes in Kenya (July 2017)

He finally highlighted the day's programme.

4.0 Plenary Session 2 – Promotion of CA in Africa

The ACT Executive Secretary, Engineer Saidi Mkomwa, presented an overview of CA promotion in Africa and upscaling in Africa. He gave a brief of ACT's origin and organizational set up and highlighted its 6 strategic targets namely strengthening adoption and scaling up of CA, improving Sustainable land management (SLM) and climate change resilience, enhancing Capacity building and partnerships, improving Communication, information and knowledge management, strengthening entrepreneurship and business development and network management and support functions.

He touched on the three principles of CA, which ACT advocates for in addition to other good agronomic practices and highlighted some of the tools and equipment that come in handy for small-scale CA farmers. He also highlighted some of the success stories and projects that have enabled farmers to reduce cost of production and achieve high yields in both crops and livestock.

He also highlighted some of the key institutional achievements as; Institutional and organizational growth and presence in Africa region, Governance systems, Policies, Board of Directors, ICAAP-Africa; Increase in numbers and diversity of ACT membership; Partnerships built with North, South and national governments in 33 African countries; Increased awareness of stakeholders on CA in CC adaptation and mitigation in Africa; Imparted learning skills on CA to more than 1000 research and extension officers, worked with several national governments to develop CA training materials; Influencing policy development and realization at national, regional and global levels through events e.g. III WCCA in 2005; 1ACCA (birth of Malabo Declaration, CSA Vision 25 x 25) and Positive changes in CA in Africa namely CA adoption in over 20 countries in Africa, cropland under CA increased to 2.68 million ha – an increase of 447% since 2008/09 (though sadly this is only about 2.5% of the cropped land in Africa).

He finally cited the policy, organisational and technical challenges hindering CA upscaling in Africa. The coping strategies being applied by ACT include engaging regional Institutions for operationalization of the Malabo declaration CSA vision 25x25 (regional level), strengthening CA centres of excellence (National level) and supporting formation and nurturing of entrepreneurial mechanised CA service providers associations (grassroots level).

5.0 Plenary Session 3: Experiences from Laikipia

The Laikipia East Sub County Agriculture Officer, Mrs. Margaret Evanson, presented the experience of the County on CA. She noted that farmers in Kenya's arid and semi-arid lands (ASALs) areas have higher than average land holdings, but get low and highly fluctuating yields due to inappropriate agricultural practices. She reported that the County has embraced CA and is

fully promoting it alongside the conventional practice after several stakeholders namely FAO, ACT, KENDAT, among others sensitized and trained the staff and farmers in the Counties within the last ten years. Currently, they are collaborating with FAO to promote GAP and CA to increase farm productivity and profitability. The target is to reach 10,000 farmers out of which so far 4,000 are practicing some aspects of CA. They are also linking the farmers to markets through engaging the aggregators and service companies. She mentioned the key stakeholders and implementing partners in the current project as Farmer co-operatives, National Government, County Governments, Private Companies/Aggregators/Buyers, Agro dealers, Local entrepreneurs and Farmers. The major challenges cited were input acquisition, fixed mindset of farmers, crop-livestock competition, human-wildlife conflict and natural disasters like drought, floods, hailstones and frost.

6.0 Plenary Session 4: Field Survey Methodologies

Paulo Rodrigues described the methodology used for the surveys in Kenya and Burkina whose goal was:

- i. To collect an inventory of regional used CA practice;
- ii. Analyse and assess the real and potential benefits of CA to livelihoods of smallholder farmers (the whole value chain) and shortlist regionally adapted CA practices for Kenya;
- iii. Identify the constraints for the use of CA practices, and
- iv. Propose actions along the value chain to overcome the constraints identified.

The methodology aimed to link a set of farming techniques considered as CA to different sources of knowledge and knowledge creation, adoption and reproduction by small-scale farmers in Laikipia region, Kenya and Koumbia Commune, Burkina Faso. It used a combination of approaches from human ecology, anthropology and agriculture. The main considerations were local peoples' understanding on soil fertility, erosion, sustainability, and innovations; the historical records and social memory of farming changes and adoption/abandonment of techniques; the paths and means for experimentation, i.e. travelling/migration, contact with NGOs/state departments, creativity, labour, capital; the arenas of knowledge sharing, e.g. kinship, friendship, gender and age, local-state-NGO, media; and the agricultural, social and economic circumstances and changes leading to the adoption/rejection of conservation agriculture. Semi-structured interviews were conducted taking into account the ethical concerns of the respondents. Fifty three (53) interviews were conducted to 64 people in Kenya while 51 interviews were conducted to 51 people in Burkina Faso.

7.0 Plenary Session 5: Field Survey Burkina Faso

Paulo Rodrigues also presented the Burkina Faso field survey results in this session. In Burkina Faso, the survey was done in Koumbia Commune, situated in Tuy Province and Hauts-Bassin Administrative Region. He noted that historically two major drivers of change in the area are cotton

and land pressure. The former due to the “complex” system developed around its production where pretty much all cotton is bought by a cotton company which in turn has great influence on the farming practices in the region. The latter originated from demographic trends plus the mobility of people in the region. The combined factors have culminated in a shift to continuous land use and consequently soil impoverishment. This soil impoverishment problem is recognized by most local farmers. The survey also revealed that farmers use an array of techniques to manage soil fertility putting a lot of value in manure and organic fertilisers. CA was introduced in the area as a strategy to improve soil fertility in 2011/2012. CA is still under scrutiny by farmers often seen as something for the future. Direct seeding is used outside the CA plots as a strategy to cope with unreliable rainfall patterns but it is sometimes regarded as something for those without resources (social status issue). Most farmers relate CA to the soil coverage principle since in their perception it is the most noticeable feature. At the same time, the availability of biomass and the competition of usage as fodder for animals, exacerbated by free grazing, are seen as the biggest challenges for CA adoption. Some concerns were also expressed in terms of unwanted fauna being more common in CA plots.

The survey concluded that:

- Different cultures enable a diverse set of challenges and opportunities. CA principles are a challenge in different extent to different ethnic groups;
- Farmers assess soil quality from an appreciation of colour, texture, capacity to hold water but mostly crop performance. Several methods are used to improve soil fertility;
- Cotton farming is mostly a challenge but can also provide opportunities. The need to maintain/improve soil fertility is of everyone's best interest since it has the potential to maintain/decrease investment needed;
- Many farmers seem to be searching for alternative solutions to cotton. The answer is usually investing in livestock;
- More efforts should be put into developing and evaluating strategies that are able to guarantee biomass for the soil and livestock.

8.0 Plenary Session 6: Field Survey Kenya

Prof Gottlieb Basch made his presentation during this session. He stated that the survey in Kenya was done by Ms Joana Sousa and its objective was to analyse CA in regard to local livelihoods, knowledge and resilience in Laikipia East Sub County in Umande and Ethi locations. He narrated the changes in land use and land ownership throughout the 20th century and stated that even today, the small scale farmers are still portrayed as unproductive and backward and their farming methods considered as the source of soil depletion. According to the survey CA appeared to be one of the strategies to increase soil fertility, decrease soil erosion and increase yields. The main staples of the region were maize, beans and potatoes. There were no centralized villages and the fenced homesteads were scattered in the landscape. He gave the various terminologies used by the locals to describe the soils characteristics and the strategies farmers are applying to rehabilitate the soil, which was observed to be ‘tired’.

Though farmers agree that CA can help them improve fertility, most of them remain skeptical and the few who practice it do not apply all the principles. Most farmers also relate CA with herbicides and minimum tillage and fear the negative effects of chemicals to health. The competition for crop residue with livestock makes achievement of residue retention in the farm a nightmare.

The survey concluded that;

- CA principles are individually conjugated with others in a mix-strategies approach.
- Farmers discern soil condition from an appreciation of colour, texture, reaction to sun and rain, crop performance. People use several methods to improve soil fertility.
- Problem of drought is portrayed as a long-standing threat to local livelihoods with disputable trends. Lack of irrigation systems is the main constraint to crop production.
- Both CA and non-CA farmers added a feature to their understanding of CA that is not clearly announced in CA literature — herbicides' use.
- CA may be recognised to provide slightly better yields than non-CA but it is not resistant to severe drought and remains behind what is promised in promotion campaigns.
- There are environmental and health issues to be addressed regarding the introduction of pre-emergence herbicides in Laikipia through CA promotion.
- Alternatives to managing weeds should be carefully researched.
- More attention should be given to strategies that guarantee soil cover. Otherwise CA is of little adequacy to Laikipia.

9.0 Plenary Session 7: Transformative learning approaches

The Transformative Learning Approaches (TLA) was presented by Dr Tim Ndah. He noted that despite the substantial support of donors and development agencies, CA has not moved from the invention to the innovation stage in Sub-Saharan Africa. He reported that in Sub-Saharan Africa, CA has been taken up significantly mostly in South Africa, Zambia, Zimbabwe and Mozambique and some parts of Kenya and Tanzania. There is a challenge of specifying the quantity and quality of adoption due to inadequate information and lack of a precise tool for targeting CA interventions. Hence there is a need for a precise tool for diagnosing the adoption potential of CA in SSA. To achieve this the tool/proposed methodology needs to integrate the joint learning approach processes.

To achieve this need the INCAA team embarked on designing a new assessment approach – the **Transformative Learning approach** around CA under the INCAA project. This builds on improved content and structure of QAToCA, complemented by selected action research methods. The outline and content of the transformative learning approach include;

- ✓ A theoretical consideration behind multi-stakeholder joint learning processes, innovation systems, and communicative action (linear technology transfer, innovation systems thinking, multi-stakeholder processes and theory of communicative action).

- ✓ A translation of these considerations into a learning process that reflects current insights from learning theory and practice (Agro-ecosystem health (AESH) exploration, historical timeline, stakeholder mapping, participatory non edited video clips, transformative multi-stakeholder learning workshop, conclusion)
- ✓ A realisation of the approach to better target learning and understanding around CA adoption.

He noted that the transformative learning process operationalises the principles of these concepts keeping in mind their limitations and strengths in supporting a learning process under CA.

10.0 Plenary Session 7: Lessons learnt from comparing the two case studies

Dr Johannes Schuler presented the Lessons Learnt from comparing the two case studies. The approach used was the SWOT analysis based on the results of all work packages (results of field studies and the transformative learning approaches). Table 1 and 2 below summarizes the results of the SWOT analysis.

Table 1: SWOT analysis - Burkina Faso

Strengths	Weaknesses
<ul style="list-style-type: none"> • Soil improvement / fertility • Erosion control • Less costs • Extending the growing season • Weed control 	<ul style="list-style-type: none"> • Competition for biomass • Diversity of farmers' needs / farmer structure • CA often a black box • Traditional practices are still common, e.g. burning of residues • Mulch attracts snakes, termites, insects
Opportunities	Threats
<ul style="list-style-type: none"> • Promote CA under cotton • Engaging the Fula community: no loans accepted, no cotton, more CA • Possibility to revisit communal grazing practice • Strengthening of by-laws & land titles • More sorghum growing • Fencing • Need to diversify livelihood creates more room for CA 	<ul style="list-style-type: none"> • Free grazing • Dominance of cotton: strict rules • Critical mass not yet achieved, e.g. services, knowledge, adoption • Changing demographic patterns triggered by the main road

Recommendations for change promotion in Burkina Faso were given as:

- Grow forages to reduce competition for biomass
- Overcome CA black box with trainings, dissemination
- More studies on agro-ecological control of pests and termites

- Strengthening of by-laws on grazing and land titles
- Tailor programmes to the diversity of farmers' needs
- Allow for adaptation of CA practices accompanied by research

Table 2: SWOT analysis - Kenya

Strengths	Weaknesses
<ul style="list-style-type: none"> • Soil improvement in areas with high clay content • Less labour • Active role of women • Long term established structures 	<ul style="list-style-type: none"> • CA = farming with herbicides • Forage planting not yet up-scaled • CA and root crops • Sunk costs for own equipment • Knowledge gaps in spite of CA programmes • Lack of visible support services
Opportunities	Threats
<ul style="list-style-type: none"> • Planting forages = reducing competition • CA is gradually becoming institutionalised • More visible support structures; e.g. inputs • More knowledge on soil functions 	<ul style="list-style-type: none"> • CA fields attract more wildlife during droughts • Sunk costs and loss of business for service providers (ploughing) • Overly ambitious expectations

The recommendations given for Kenya include:

- Maintain the efforts in dissemination, knowledge transfer (e.g. soil functions, CA practices) and Institutionalising CA (local, regional, national)
- Upscale forage production
- Keep improving availability of machinery and services
- Tailor programmes to gender and demographic categories

11.0 Plenary session 9: Group discussion on research needs and policy advice

The group discussion on research needs and policy was facilitated by Sara Kaweesa. She divided the participants into two groups to discuss on the two or three major research and policy needs that are very critical in transforming CA promotion and adoption in Africa.

After discussion the participants presented on the various outputs of their discussion. After further brainstorming the two major research and policy needs identified were;

10.1 Listed Research Needs

1. Independent research on herbicides
2. What are the applicable options for weed control?
3. What are the local integrated weed control systems?

4. Do herbicides work for smallholder farms?
5. Economies of scale in weed control
6. Mechanical weed control
7. Millipedes menace and mulch
8. Horticultural and root crops under CA
9. Forage production and manure management
10. CA equipment needs under different farming systems and agro-ecologies
11. Tradeoff between crop production and livestock feeds
12. Business models under small-scale farming
13. Timing of CA yields at the starting point – i.e. maximum yields, bench marks,
14. Immediate vs long term benefits e.g. soil health
15. Database of existing information – for farmers doing CA
16. Modalities of CA implementation (adoption studies)
17. Crop rotation/integration for increasing organic matter
18. CA on slopes/flat landscapes

Discussions on the most important research needs zoomed on the following below:

- Forage production under CA; the tradeoff between crop production and livestock feeds under CA
- Crop performance under CA particularly horticultural crops
- Independent research on the impact of chemicals used in CA
- The business case for CA under smallholder farming systems
- Economies of scale in weed control; management or technical options under smallholder farms
- Manure or biomass management in CA

10.2 Listed policy needs/gaps

1. Increasing commercialization
2. Cross visits between farmers
3. Coordination role of Government for service providers, quality checks
4. Insurance for unforeseen events/risks
5. Incentives/friendly financial mechanisms for CA inputs
6. Private sector needs, tax exemptions on inputs and services
7. CA supportive policies and be reinforced (accountability) implemented
8. Payments for ecosystem services for CA adopters

Discussions on the most important policy needs zoomed on the following:

- Incentives/friendly financial mechanisms for CA inputs
- Private sector needs, tax exemptions on inputs and services
- CA supportive policies to be reinforced (accountability) and implemented

12.0 Field Visit to Machakos CA farmers

The participants proceeded to Machakos County and visited one CA farmer (Ruth Mitila) in Kola Ward, Machakos subcounty. The other farmer targeted to be visited (Ann Kilonzo) had an emergency that morning and hence could not host the participants.

Main achievements witnessed at Ruth Mitila's farm were;

- Farmer has improved her yields over the years from 1.2 tons/ha of maize to 2.6 tons/ha
- Assured harvest even in worst seasons where other farmers have a crop failure
- Saved time to engage in other enterprises and household chores
- Participation and support of the spouse in CA activities
- Children enjoy the CA practices as they are not heavy and 'dirty' tasks as is the case for conventional practice
- More income from increased yields and additional crops like cover crops
- Terracing has increased the amount of fodder for livestock in the farm
- Farmer has continued disseminating the CA messages to other farmers and is now working with four farmer groups that are practising CA in the area
- She has trained many visitors – both farmers, policy makers and technicians



Figure 3: INCAA workshop participants during the field visit

The farmer also gave her challenges and wishes as:

- Residue retention a bit challenging especially in harsh seasons due to livestock feed
- Lack of skilled labour or service providers for CA activities e.g. ripping, subsoiling, shallow weeding (local workforce perceive these tasks as difficult since they are not used to them)
- Need to be supported to visit other farmers to also experience what other CA farmers are doing

13.0 ANNEXES

ANNEX 1: Programme

Wednesday, 12 th July		
Time	Activities	Responsible
10:00	Arrival and registration	ACT, Kenya
10:15	Participants introduction	all
10:30	Welcome address	JKUAT, Kenya
10:40	Project introduction	ZALF, Germany
10:50	Promotion of CA in Africa	ACT, Kenya
11.10	Tea Break	All
11:25	Experiences from Laikipia	Laikipia government, Kenya
12:00	Field survey Kenya	University of Evora, Portugal

12:30	Field survey Burkina Faso	University of Evora, Portugal
13:00	Lunch Break	All
14:00	Transformative learning approaches Theory and approach applications in Burkina Faso and Kenya	ZALF, Germany
14:45	Lessons learnt from comparing the two case studies	ZALF, Germany
15:45	Group discussion on research needs and policy advice	BOKU, Austria
16:20	Coffee break	All
16:30	End of workshop	
Thursday, 13th July		
8.00 – 15:00	Field trip to Machakos County (farmer Ann Kilonzo and Ruth Mitila), Departure from JKUAT at 8.00am	ACT, Kenya

ANNEX 2: Workshop Participants

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ANNEX 3: Photo story



Figure 4: Sara Kawaasa (L) and Margaret Evanson (R) making presentations during the workshop at AICAD



Figure 5: Mr and Mrs Mitila (L) and Mrs Mitila (R) during the field visit to their farm by the INCAA team in Machakos



Figure 6: Group discussion during the workshop (L) and the discussion with the host farmer visited in Machakos (R)

ANNEX 4: Link to INCAA final workshop

https://drive.google.com/drive/folders/0B9uN5R_nhswVM191TDBOSjFjVjA?usp=sharing

INCAA - INnovative Conservation Agriculture Approaches: Food Security and Climate Action Through Soil and Water Conservation

Deliverable 3.1

Report on the inventory of theories and
concepts – framework to methods for assessing
institutional and individual influence on CA
innovation

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Executive Summary

The aim of this report is to prepare an inventory of theories and concepts that could be used to help understand the supporting and hindering factors that drive the acceptance of Conservation Agriculture (CA) by farmers in the African context. A second main focus of the inventory is to examine the capability of these theories and concepts serving as background frameworks for methods used in analysing institutional influence on the CA innovation system. The report forms the basis for the selection process of models and tools to be tested in the different INCAA case study regions.

Its due-date is at a relatively early stage of the project with only little knowledge on the specific research questions as well as the availability of data sources in the different regions. Therefore, the report is deliberately named ‘inventory’, presenting the theories and concepts based on information published in the international literature and tapping as well from past EU projects such as CA2Africa (www.ca2africa.eu).

While the theories and concepts reviewed in this report could all be potentially suitable for use in the INCAA project, an ideal theory or concept for application that fulfils all requirements does not exist. Each theory or concept puts emphasis on particular aspects and processes and it depends on the particular institutional aspect targeted to be addressed or examined in detailed.

However, after subjecting these theories and concepts to strict and critical evaluation, selected lists of fitting ones within the context of CA innovation are suggested to be operationalized via an expert knowledge based assessment tool QAToCA II – which will be an improved version of QAToCA¹, Ndah et al. (2012; 2014) developed and applied within the frame of CA2Africa project. This will serve as a guideline during the process of assessing the socio-economic and institutional factors that hinder the rapid transformation of CA from an invention to an innovation within the INCAA project. Special emphasis will be on the multi-stakeholder learning component, institutional aspects as well gender balance – aspects earlier neglected or only passively tackled under past projects on CA promotion in Africa.

¹ Qualitative expert Assessment Tool for CA adoption in Africa (QATOCA)

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1 Introduction

In order to achieve the main objectives of development cooperation in Africa (i.e. poverty reduction, food security, sustainable natural resource management, mitigation of climate change etc.), measures to stabilise and increase soil productivity need to be taken without delay (Steiner 1998). Most studies have argued that the above objectives cannot be achieved under conventional tillage-based systems which are held accountable for soil degradation and continuous decline in crop yields (Hobbs 2007; Steiner 1998). Moreover, the unsustainable use of resources under such systems degrades elementary land use functions of present and future generations. This underlines the need to widen the analysis to overall sustainability based on equal consideration of social, economic and environmental impacts.

Considering the above thoughts, small-scale farming in Africa and agricultural systems worldwide has continued to face a double challenge: 1) to increase production and 2) to preserve natural resources simultaneously (Mueller et al. 2012).

While conventional agriculture, which often involves intensive tillage, has been held accountable for soil degradation (Baudron et al. 2005), Conservation Agriculture (CA) is promoted to stop soil degradation, reduce water evaporation, maintain biodiversity and reduce greenhouse gas emissions. CA, based on minimal or no-tillage is increasingly seen as a promising alternative for highly productive and sustainable farming (Hobbs 2007). Born in the Americas out of a necessity to combat soil degradation and low profitability, it is promoted as a concept for resource-efficient agricultural crop production based on an integrated management of soil, water and biological resources combined with external inputs (Giller et al. 2009). FAO (2008) has further referred to it as a cropping practice that relies on three main principles believed to enhance the biological processes above and below the ground, namely: 1) minimum or zero-tillage; 2) maintenance of a permanent soil cover, and 3) integration of crop rotations/associations.

In spite the above mentioned advantages, CA in Africa has remained an invention, yet to reach the stage of an innovation, compared to other continents such as Southern America (Derpsch et al. 2010). Following Senge (1994) and Spelman et al. (2009, 2011), we define an innovation as a social process of adapting and incorporating knowledge, driven or constrained by the needs, capabilities and opportunities of actors within a social system. Innovation implies that the use of knowledge has reached a scale that has societal impact.

From the above perspective, a range of studies aimed at identifying factors influencing CA innovation in Africa (for an overview: Giller et al. 2009, Derpsch et al. 2010) have conclude

that (1) the CA package did not necessarily meet the needs (increased yields), capabilities (labour requirements and burden) and opportunities (input provision) of farmers in the specific region; or (2) that the agricultural innovation system that should support the emerging practices of CA could not support an innovation process. The issue here is not so much emphasis on limited adoption of CA but on the slow process of this technology becoming an innovation – with its positive economic and social impact on those practising it in Africa still not clearly visible.

It is in this light that the INCAA project aims at analysing and establishing learning processes at the interfaces of science, agricultural support systems and farming communities. The underlying question of the project is: *“how can a science-driven technology (CA) and local realities of agricultural innovation systems be integrated in an effective learning process?”*

INCAA takes to the forefront the concept of social learning in innovation which Cundill & Rodela (2012) defines as a process that takes place through the deliberate interactions among multiple stakeholders, during which participants learn to work together and build relationships that allow for collective action. The embedded institutions, roles, and norms driving the behaviour of actors involved in such a learning process become important. This report therefore, specifically reviews, synthesises and outlines an inventory of concepts as well as theories which potentially form background to methods - for assessing the institutional and individual drivers and constraints of CA innovation. The inventory is expected to form a basis for adapting and designing a qualitative participatory expert assessment approach for analysing institutional factors which influence CA innovation process in Africa.

2 CA innovations – the case of Africa

Knowler and Bradshaw (2007) concluded on basis of a world-wide study that there was a lack of universal variables that explain the up-take of innovations and that the efforts to promote innovations e.g. CA, need to be tailored to local conditions. This resonates with the conclusion of Erenstein (2002) that the potential of CA is site-specific and depends on the local biophysical, socio-economic and cultural environment. The FAO website on CA (<http://www.fao.org/ag/ca/>) states that there are four requirements for the adoption of CA practices:

- It must bring the farmer a visible and immediate benefit, economic or otherwise.
- The benefit must be substantial enough to convince the farmers to change their on-going practices (e.g. from conventional to CA farming).

- For the technology to be disseminated widely, the costs incurred at least in the long run must be able to be covered by the farmer.
- The introduction of CA should be followed up by an extension service for a long period of time in order to redress post decision problems not initially envisaged by the farmer.

The number of changes in farming practices required to implement CA can be substantial, whereas the magnitude and value of these changes are likely to be household specific. Consequently, the private returns to adopting CA are likely to vary over farm households. Farmers in Africa like other parts of the world, often attribute a substantially higher value to immediate costs and benefits than those incurred or realized in the future, due to the immediate constraints of production and food security that they face. Yet, while some studies have proven that CA yields immediate returns to farmers, others have contradicted this by confirming that benefits of employing CA are only realized in the longer term (Giller et al. 2009). Analysis of the reasons for widespread uptake of CA practices in the United States of America indicates that the labour and capital savings resulting from herbicide use in mechanized farming were a major incentive. There seems to be consensus that the longer-term benefits and prevention of soil erosion were less important in driving uptake of the technologies (Sandretto & Bull 1996). In many agricultural systems of Africa, traditional land preparation and weeding are very labour intensive and farmers may find the use of herbicides attractive – but often lack the cash to invest in them (Ehui & Pender 2005) as well as lack the technical know-how for using them successfully.

Institutional elements required for all successful strategies for agricultural intensification include a stable macroeconomic environment, provision of inputs through markets where these markets function; development of market institutions where they do not exist; public and private investment in an appropriate mix of physical, human, natural, and social capital (Albrecht *et al.* 1989).

Like most farming systems, African farming systems are highly heterogeneous in terms of agro-ecological, socio-economic and cultural environments, resource endowment of farmers, farm management practices, and production strategies (Hoffmann 2005, Ndah 2008). It is acknowledged that positive change in Africa is hampered by broader socio-economic and cultural constraints, and opportunities for CA necessarily require local adaptation. In Africa, options for crop management that show great promise under controlled experimental conditions frequently gain little foothold in practice. Most often this is not due solely or even mainly to technical problems. More commonly the lack of adoption occurs because farmers

are constrained in required resources and for this reason, investment in a new technology not only influences what must be done in a field, but involves trade-offs in resource allocation with other activities from which the farmers generate their livelihood. Key resources that are constrained comprise land, labour at key periods during the cropping cycle, feed for livestock, manure for soil amendment as well as knowledge about CA. Insufficient social capital and financial resources to invest in external inputs and implements are equally constraining factors.

Due to the limitation of the conventional modelling frameworks such as bio-economic and bio-physical models in assisting in the understanding of contextual issues influencing CA within the complex farming systems of Africa, much more generic approaches are used for institutional assessment and evaluation of further innovation potentials. Conceptual models and adoption theories can be used to capture and understand the functioning of the innovation processes and systems related to CA development, and eventually to understand success and failures with CA adoption in Africa.

3 Inventory of theories and concepts

3.1 Background

While CA innovation is successful in some contexts (e.g. South America), its introduction in Africa and expected dynamism that goes with a so much valued innovation as such has remained minimal. The reasons for this are site-specific and may include:

- The specific agro-environmental circumstances (e.g. dry conditions)
- The insufficiently developed and adapted technology
- Lack of appropriate knowledge for applying it by farmers
- The strong economic constraints faced by African small scale farmers
- Its societal acceptance as an innovation
- The availability of needed resources
- The general adoption context, and the lack of an “enabling” environment
- Attitudes and role of stakeholders within the CA innovation system,
- Type and quality of linkages between the stakeholders.

Because there are numerous interdependencies, it is important to clarify and prioritize the opportunities and threats for further up-scaling as well as understand innovation processes related to the CA system. That is why it is important to look at the technical, social,

environmental and economic context. To do this in a systematic and logical way, under the frame of the INCAA project, we will build on the inventory of theories and concepts made under the frame of CA2Africa project (www.ca2africa.eu) (Uthes et al. 2011c). After a further a critical analysis of these concepts, work steps will be identified by relating the concepts to CA and knowledge gaps. In the following sub sections, these theories and concepts are further critically examined revealing their strengths and weaknesses in the conceptualization process of a CA innovation.

3.2 Selection criteria and motivation

Following Uthes et al. (2011b) on the theoretical processes underpinning adoption couple with knowledge of CA adoption in Africa the following list of selected criteria for theories have been generated:

- *Does theory or frame capture attributes (characteristics) of the object of adoption (CA as an innovation) and influence in its adoption and diffusion process?*
- *Does theory or frame capture forces (inhibiting and driving forces) which specifically influence the subject of adoption and possible impact in the adoption diffusion process?*

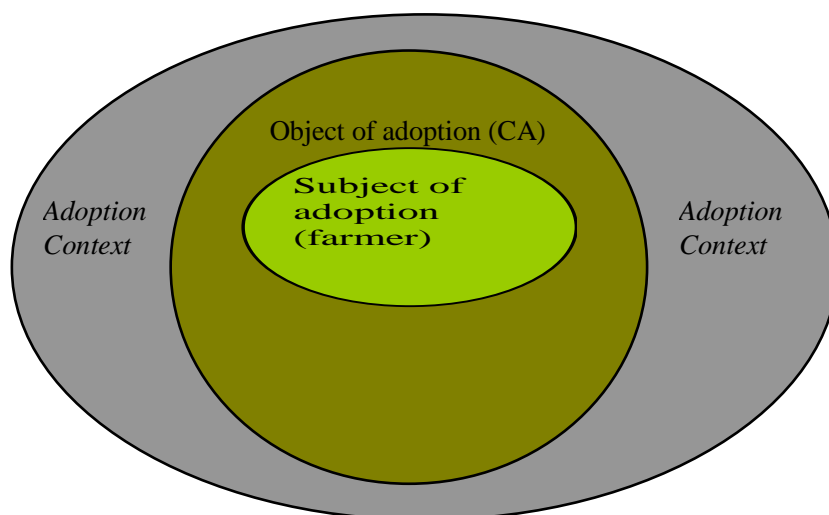


Figure 1: Selection criteria for theories and concepts

Source: (Uthes et al. 2011b)

- *Does theory or frame captures stages in the innovation and diffusion process and categories as well as characteristics of various classes of adopters throughout the diffusion process?*
- *Does theory or frame captures issues relating to the adoption context?*
- *Has theory or frame been applied in adoption/diffusion studies or CA studies before?*

The selected adoption theories (frameworks) for this report are therefore those that meet one or two of the listed criterias i.e. on the basis that they are able to capture or conceptualize specific aspects related to the context , subject, and object of adoption (Figure 2). By *subject of adoption*, we refer to the farmer with his personal attributes e.g. level of education, personal contact, closeness or further away from the CA innovation champions or generally his personal believes and perception of the innovation etc. By *object of adoption* we refer to CA as an emerging innovation with its attributes e.g. relative advantage, complexity, divisibility, compatibility with societal norms etc. Lastly, the *context of adoption* ranges from institutional context at the village and farm level, to regional and country wide via government policies towards CA innovation (Figure 2). The economic conditions (markets) cutting across the entire value chain from production, through processing and consumption are closely reflected within this context. Based on these considerations and following Uthes et al. (2011c) below are selected and critically analysed concepts and theories that can possibly serve as frameworks in analysing CA innovation in Africa. [Graphical representations and brief summary of these theories are found at the Appendix of this report].

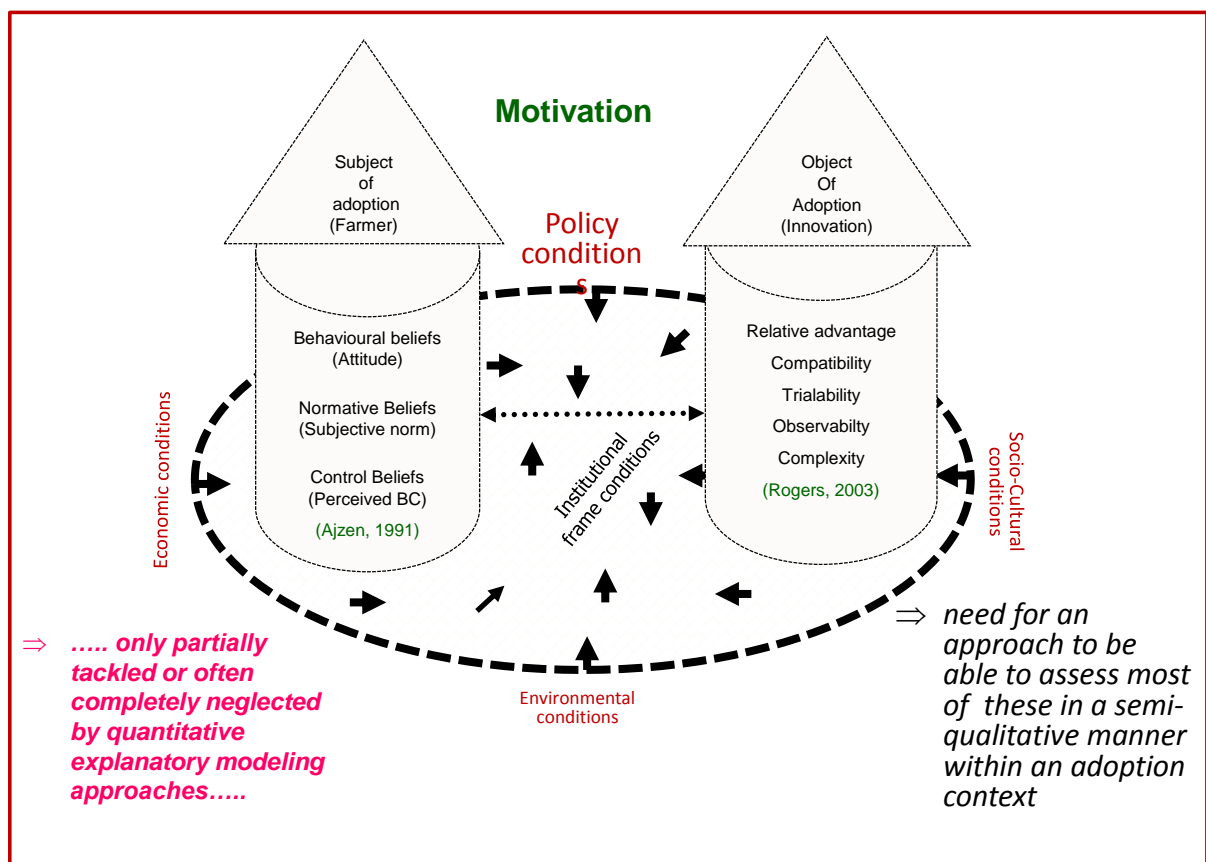


Figure 2: Categories of institutional factors which either motivate or discourage innovation

3.3 Selected theories, concepts and critical review

3.3.1 Theory of psychological field

Lewin (1943) states with this theory that human behaviour is seen as a result of the interplay of diverse forces that create a set of circumstances through the dynamic interaction of man and his environment.

According to Lewin (1943), the interaction of situational forces with the perceived environment can be described as a field of forces, a system in tension or a psychological field. Human behaviour can be described as follows: A person (P) in his subjectively perceived environment feels something is worth striving for; he then mobilizes his personal powers to achieve this goal.

$$b = f(P, E_{subj.})$$

Where;

behaviour (b) is a function of an individual's subjectively perceived environment (P, E_{subj.})

When something negative or undesirable occurs, he activates his personal powers in the same way to avoid the negative situation. Ways of reaching targets and avoiding negative situations can be blocked or impeded by barriers or inhibiting forces (for instance; lack of knowledge, uncertainty about outcome, insufficient capital, cultural practices, lack of opportunities for scaling etc.).

Summary implication and critical assessment of Lewin's theory towards the adoption decision process of CA innovations in Africa

Relating this theory to farmers' adoption of innovations, behaviour can be likened to their adoption behaviour towards e.g. CA. It is therefore a function of each specific farmer and his psychological state as well as his subjectively perceived environment (adoption context). To understand behaviour towards CA in Africa, it is vital to examine the perceived opportunities and threats found within the psychological field of the respective farmers which are all influential to their adoption behaviour. It is as well important to examine these forces from the perspective of the farmers if the objective is to achieve a sustained adoption beyond the promotion phase. This is done using situation analysis which helps capture the opinion of the target group and their subjective perception towards the respective innovation e.g. CA. Nevertheless, this assumes that the farmer has the sole influence over his adoption decision making process. The theory fails to consider cases where farmers might be forced to adopt

innovations based on the institutional or policy frame conditions or following the sudden occurrence of natural disasters (floods, storm) as well as severe impact of global change episodes (e.g. Climate change, market trends, etc.). Under such conditions, farmers are left with no choice than to basically adopt certain innovations even if this clashes with their subjective perception as suggested by Lewin (1943), - though such adoption might be short-lived.

3.3.2 Theory of Behaviour modification

Following Hruschka (1994), the theory refers to those forces conducive or facilitating the goal or target attainment as driving forces (DF) while those negatively influential to target attainment are described as inhibiting forces (IF). Inhibiting forces for technology adoption (e.g. CA or Fish Farming) might include for instance, lack of subsidies, limited liquidity (for labour hiring, buying herbicides, legumes seeds for soil coverage, etc.), lack of machinery, and limited knowledge. On the other hand, driving forces or forces conducive to positive target might include, for example, financial assistance, technical advice, training, provision of inputs, linkage with market outlets, etc. Similar to Lewin (1943), Hruschka (1994) confirmed that behaviour (in this case adoption) results from the psychological field of inhibiting and driving forces. These forces are therefore always present in a state of equilibrium or disequilibrium with varying degrees of tension between them. According to Hruschka (1994) an existing state of equilibrium can be changed (for instance, from conventional farming to CA) by:

- the introduction of driving forces
- the removal of inhibiting forces or
- Combining these two processes

This implies:

$$CB = +DF - IF$$

Where: *CB* = Change in Behaviour

DF = Driving Forces

IF = Inhibiting Forces

Once such forces are identified in the farmers' decision making process, the chances of diffusion can be estimated and consequences for promotion programs can be concluded (Hoffmann 2005; Rogers 2003).

Summary implication and critical assessment of Hruschka's theory towards the adoption decision process of agricultural innovations in Africa

Situating this theory in the context of CA promotion in Africa, the theory conceptualizes the likely picture of farmers' change in behaviour from conventional farming to CA or from crop production to fish farming. A farmer practising conventional farming in Africa is assumed to be at a state of equilibrium implying the driving and negative forces to his practice are equal. For such a farmer to adopt CA farming this will imply a change in behaviour hence the old state of equilibrium needs to be disturbed. Possible observed benefits that CA farmers enjoy by practising CA such as increased yields, labour savings, etc. are the driving forces to encourage a disturbance of this equilibrium on the side of potential adopters. On the other hand, lack of CA knowledge, cost of CA machineries, seeds, etc. are some of the inhibiting forces in Africa that might work against this change. Like Lewin (1943), for promotion of agricultural innovations in Africa to be effective, it is but vital to carefully identify these influential forces for every specific innovation and to design measures in re-enforcing the driving forces as well as removing those forces considered to be performing inhibiting roles. However, same as Lewin (1947), Hruschka makes too much generalisation on the issue of driving and hindering forces without specifically categorising them under environmental, institutional, policy, individual or characteristics of the innovation involved as is often the case in reality.

3.3.3 Diffusion of Innovation Theory

As suggested by Rogers (2003), empirical studies have shown that there is usually a typical "S" shape for the diffusion curve when innovations establish themselves in a social system; According to Hoffmann (2005) at the onset, adoption rate is low; it then rises gradually and falls again towards the end. However at the beginning, adoption is sometimes particularly hesitant and accelerates increasingly only in the final phase; this gives rise to a "J" shaped curve (See Appendix). Rogers (2003) uses the concept of individual innovativeness theory to explain who adopts an innovation at which time. He therefore illustrates this with a bell-shaped curve depicting the following categories of adopters:

- The first category is called "*innovators*" (~ 2.5%). These are the *risk-takers* and pioneers who lead the way. They are the venturesome and educated persons in the society.
- The second group is the "*early adopters*" (~13.5%). They climb on board the train early and help spread the word about the innovation to others. They include the social leaders, and the most popular and educated persons in the society.

- The third group is the “*early majority*”. They constitute ~34% of the potential adopting population. The innovators and early adopters convince the early majority and gives assurance on sustainability of the innovation. The people in this group are those who make a deliberate attempt to adopt the innovation and have acquired information through the many informal social contacts at their disposal.
- The fourth group is the “*late majority*”. This group as well constitutes 34% of the potential adopting population. Adopters here wait to make sure that the innovation is in their best interests. These are the individuals who are highly sceptical and resist adopting until absolutely necessary.
- The final group is the “*laggards*” (~16%). Like the late majority, members of this group are highly sceptical and in many cases, they never adopt the innovation. Those that fall in this category include the traditional, lower social class in the society (Rogers 2003).

In addition to the above diffusion theory, Rogers (2003) further identified a certain number of characteristic determinants that render an innovation more or less apt for easy adoption as follows:

Perceived attributes

- ***Comparative advantage*** is the degree to which an innovation (CA) is perceived better than the idea it supersedes (conventional agriculture). It is positively related to its rate of adoption. For instance, the rate of adoption of CA will be high if the target groups of adopters perceive it has significant advantages over conventional farming and other practices in their vicinity.
- ***Complexity*** is the degree to which an innovation (CA) is perceived as relatively difficult to understand and to use. The complexity of an innovation (CA) as perceived by members of a social system is negatively related to its rate of adoption.
- ***Trialability*** is the degree to which an innovation (CA) may be experimented at a limited basis (field level) or adopted in stages (zero or minimum tillage; crop rotation; mulching, one at a time). The higher the trialability, the higher the chances of adoption.
- ***Observability*** is the degree to which observers are able to see the results of an innovation (CA). The higher the observability, the higher the adoption rate. If CA increases yields visibly (or decreases costs visibly, such as by saving labour), then there is a high possibility that it will be adopted.

- **Compatibility**; this is the degree to which an innovation (CA) is perceived as consistent with the existing values, past experience and needs of potential adopters. The more the innovation is compatible, the higher the chances of adoption.

Type of innovation decision

The innovation decision process is the process through which an individual (or other decision making unit) passes from first knowledge of an innovation to forming an attitude towards the innovation. Such an attitude can be reflected in a decision either to adopt or to reject the innovation. This can be either optional from the point of an individual farmer, collective from a group of farmers or is forced by the authority to do so.

Communication Channels/Scaling up strategy

This is the means by which a message moves from source to receiver. Communication is categorized as either interpersonal or mass media in nature and as originating from a specific or diverse source. The more diverse the source of information is, the faster the rate of adoption. For instance, use of mass media and other diverse means of disseminating CA knowledge through social groups and denominations will have a better chance of adoption in Africa rather than relying solely on interpersonal communication between individual farmers.

Social system: norms, network interconnectedness

These are the socio-cultural practices and norms within the village and community level, the interconnectedness of the various actors in the CA innovation system (network) at village, regional levels and beyond which can be influential to the rate of adoption. For instance, collectivism, land tenure ship and accessibility are all factors that influence the rate of CA adoption depending on how they are handled within the various communities and regions across Africa. The higher the interconnectedness of a group of adopters, the higher is the chances of diffusion, and vice versa.

Promotion efforts

Promotion efforts refer to the past and present efforts made to promote the innovation by the parties involved. This can be national as well as international bodies. Looking at the CA system in Africa, this will refer to all the institutions at national, regional and international levels involved in the research and promotion of CA practice.

With specific reference to CA as an object of adoption, in Africa some of the above attributes (characteristics) might have a detrimental role to play in its adoption decision process. Though CA is considered a single innovation, its perception in line with some of the listed

attributes might vary with the varied and heterogeneous categories of adopters under the different socio-economic and cultural regions across the region.

Summary implication and critical assessment of Rogers's theory towards the adoption decision process of CA agricultural innovations in Africa

Relating this theory to CA promotion in Africa, it helps to visualize the entry points for a population of potential adopters and the diverse reactions of farmers vis-à-vis the technology. It also follows from applying Rogers's model that technology adoption in Africa can be hesitant from the start to finally accelerate at the final stage or it can rise slowly and fall again towards the final phase. Roger's model helps to clarify the fact that not all potential farmers can adopt innovations at the same time as well as not every member of the society might even find some innovations worth adopting. While some farmers will find CA in Africa attractive to them at different stages in the course of the diffusion process with varied reasons responsible for their behaviour, some will eventually find it not completely attractive at all and as such hang on to old traditional farming practice at all cost no matter the magnitude of promotion efforts put in place. Nevertheless, the above theory shows the following characteristics; (1) considers the role of individuals, (2) does tend to focus on attitudes (such as lead farmers), neglects the role of farm's structure and constraints, (3) considers an innovation (e.g. CA) as a fixed technology, and not an emerging one.

3.3.4 Hohenheim Diffusion Concept

Similar to Rogers (2003), Hoffmann (2005) adds more value to the concept by examining the diffusion phases as well as characteristics of adopters who fall in the various phases of diffusion as follows:

- I. **The innovator as a troublemaker:** The first person to practise an innovation in a social system is called an innovator (Hoffmann 2005). Hoffmann (2006) further qualifies the innovator at this early stage as one who experiences a problem for which he will like to find a solution. For his peers, his activity is not only seen as strange, but an indication that their methods are old fashioned and outdated. His peers will put up their defence mechanism rejecting the innovation and the innovator and regard him as a troublemaker (2005).
- II. **The critical phase:** While Rogers (2003) terms the second category of adopters the early adopters, Hoffmann (2006) adds to this by terming this phase "*the critical phase*". He stresses that not everybody reacts negatively to the innovator (for instance, CA promoters). Some either because of their closeness to him as friends, relatives, etc., keep

contact and refrain their mistrust and rejection. Some see themselves in a comparable situation with the innovator. “Available data show that the diffusion process sustains itself with no further need of support when about 10 to 20% of potential adopters have taken up the innovation” (Rogers 2003).

- III. **Transition to self-sustaining process:** At this phase, what is currently new, is going to be the future norm. While the first few adopters make the activity attractive, adoption by influential persons bring in a new dynamism into the process. A deviant behaviour on the part of the innovator as initially regarded is now felt to be a new approach. At this stage, farmers may no longer adequately check whether the innovation is beneficial or not hence there is increased risk of misguided adoption of the innovation. This phase is synonymous to the *early majority* category mentioned by Rogers (2003) as composed of deliberate adopters of the introduced innovation.
- IV. **Final phase of the wave:** While Rogers (2003) separates this group in his theory to *Late majority* and *Laggards*, Hoffmann (2005) simply terms the two categories as the *Final phase of the wave*. He mentions that if the innovation is assumed not to be equally appropriate and advantageous for all concerned, the adoption rate sinks slowly and gradually after reaching the peak. Just as the innovator from the onset was closest to the innovation and the first to adopt, there are now people for whom inhibiting forces are far stronger than the driving forces.

If classified according to their pattern of psychological forces in relation to the decision on adoption, the adoption curve for all potential adopters will form approximately a normal distribution but with *four phases* in the diffusion process as opposed to *five phases* in the case of Rogers (2003). This has similarities with the phases of an innovation process and scaling-up such as those proposed by the EU IN-Sight project (www.insightproject.net).

Summary implication and critical assessment of Hoffmann’s concept towards the adoption decision process of agricultural innovations in Africa

In the context of Africa therefore, Hoffman’s model calls for paying attention to the possibility that agricultural innovators may face social rejection in some communities. It can equally be used as a diagnostic framework to assess those who first try out an innovation in a farming community. It could equally be used to check if this conforms to his hypothesis - that the very first adopters are often those closest to the innovators, later joined by those who find themselves in comparable situations. This concept also calls attention to the eventual existence of specific measures taken by promoters of agricultural innovations in Africa to

always reinforce the confidence of the innovators through outside contacts once they start facing social rejection from within their communities. Nevertheless, a key weakness to this concept is that Hoffmann focuses his attention mostly on individuals, whereas most “constructionist” theories refer to overall networks and institutions as structures influencing the spread of innovations.

3.3.5 Theory of Planned Behaviour

According to Ajzen (1991), this theory helps to understand how an individual behaviour (in this case adoption decision) can be altered. The theory can be used to predict behaviour, because behaviour can be deliberate and planned. It stems from the discovery that behaviour appears not to be completely voluntary and under control. Human action is guided by three kinds of considerations:

- Behavioural Beliefs: beliefs about the likely consequences of the behaviour (e.g. consequence of adoption of CA)
- Normative Beliefs: beliefs about the normative expectations of others (e.g. expectation of researchers, policy makers, and promoting organizations on farmers adoption of CA)
- Control Beliefs: beliefs about the presence of factors that may facilitate or impede performance of the behaviour-adoption (e.g. driving and inhibiting factors to the adoption of CA).

Ajzen's three considerations are crucial in circumstances such as CA promotion when trying to change behaviour or attitude towards a practice (e.g. CA). In their respective aggregates, behavioural beliefs, normative beliefs, and control beliefs in combination lead to the formation of a behavioural intention which ends up with a favourable or non-favourable behaviour. As a general rule, the more favourable both the behavioural beliefs which lead to attitude, the normative belief which lead to subjective norm and the control beliefs which lead to perceived control, the stronger should be the person's intention to perform a behaviour (see graph in Appendix).

Summary implication and critical assessment of Ajzen's theory towards the adoption decision process of agricultural innovations in Africa

The theory can help in conceptualizing the situation of CA promotion in Africa. For CA adoption to take place, for instance, farmers will always consider what gains and trade-offs are there in adopting it, what expectations are there for them from the side of promoting organizations, neighbours, friends and relatives, and lastly which opportunities and threats are in place that could influence their adoption behaviour. It is therefore vital to understand these

self-reflexive scenarios that individual farmers undergo before finally making the decision to adopt or not. Such a conceptualization beforehand can provide indicators to which assisting mechanisms can be designed to better help the farmer in his adoption decision process. Nevertheless, like the case of Hoffmann above, the theory is limited to the role of individual (farmer's) behaviour leaving out the influence of networks and institutions in the adoption decision making process.

3.3.6 Dynamics of CA Adoption

Specifically referring to CA farming, Triomphe et al. (2007) state, *“usually farmers who are willing to follow the path to a more sustainable agriculture, embark on a long journey that takes them several years or even longer”*. This journey is assumed to consist of consecutive phases, each characterized by use of specific practices that increasingly incorporate practice and mastery of the three principles of CA (minimum tillage, rotation, permanent soil cover) (Triomphe et al 2007). They further emphasise that no journey towards adoption appears to be linear, and no journey seems to comprise the same sequence of phases, although some paths are more commonly followed than others. The authors illustrate their model with a graphical representation of four archetypes representing possible journeys, (see Appendix) from a hypothesized entry point (current farmer practice) to a hypothetical end point (CA practice of some kind) as a function of time.

Summary implication and critical assessment of Triomphe's concept towards the adoption decision process of agricultural innovations in Africa

Contrary to other models, who adopts an innovation, to what degree and why, is not specified in the graphic illustration by Triomphe et al (2007). Another major difference of this theory, compared to Rogers (2003) or Hoffmann (2006) is that an innovation is not assumed to be fixed, but on the contrary changes over time. In addition, the authors do not consider that there is necessarily one unique desirable target or end point in terms of technology adoption in Africa. Nevertheless, a major weakness of this concept is that there is no reference made to the ‘enabling environment’, nor to the ‘individual factors’ influencing adoption of innovation.

3.4 Selected conceptual models and critical review

A conceptual model is a combination of interrelated concepts but not expressed in mathematical form and primarily not concerned with quantification. Usually, diagrams, such

as maps, graphs, charts, balance sheets, circuit diagrams, and flowcharts, are often used to represent such models (<http://brent.tvu.ac.uk/dissguide/hm1u0/hm1u0text3.htm>).

Two specific conceptual modeling processes exist; knowledge acquisition and model abstraction (Kotiadis 2008). Model abstraction refers to the simplifications made in moving from a system description to a conceptual model while knowledge acquisition is the process of finding out about the problem situation and arriving at a system description (Lundvall 2004, World Bank 2006). The latter was applied in the CA2Africa project by finding out about the problem situation (adoption process of CA in Africa) and arriving at a meaningful description of the CA Innovation System. Kotiadis and Stewart (World Bank 2006) further state that Soft Systems Methodology has tools that can help a modeller with knowledge acquisition and model abstraction. These tools are drawing rich pictures, undertaking for instance, analyses 1, 2 and 3, and constructing a root definition and the corresponding purposeful activity model.

3.4.1 Innovation Systems Approach

The World Bank (2006) defines an innovation system as a network of organizations, enterprises, and individuals focused on bringing new products, new processes, and new forms of organization into economic use, together with the institutions and policies that affect their behaviour and performance. An innovation system involves the interaction of individuals and organizations possessing different types of knowledge and resources within a particular social, political, policy, economic, and institutional context (World Bank 2006). It involves different actors and institutions working in dynamic interaction, all contributing to the development of different dimensions of a given innovation: technologies, institutional arrangements and policies.

According to the World Bank (2006) the perspective of the innovation systems concept recognizes the importance of research activities but gives more attention to (1) the interaction between research and related economic actors, (2) the attitudes and practices that promote interaction among actors and the learning that accompanies it, and (3) the creation of an enabling environment that encourages interaction and helps to put knowledge into socially and economically productive use.

Summary implication and critical assessment of World Bank's concept towards the adoption decision process of agricultural innovations in Africa

In effect, innovation system's approach adopts a holistic view of the adoption decision making process of farmers. It considers the various actors and linkages involved in this

network as opposed to the linear approach of most adoption theories whose analysis narrowly reflect only on the individual adopter, the technology and the promoter. Adoption of innovations under this concept is regarded as a collective and continuous development process. The appeal of this concept applied to the understanding of adoption of agricultural innovations is that it allows for identifying which stakeholders, coordinating mechanisms, policies or components are lacking (diagnostic) or may be needed (recommendation (Corbeels et al 2009). Nevertheless, under this wider concept, the specific role and subjective perception of individual farmers become less visible hence small scale farmers in the wider adoption decision process can easily be neglected.

3.4.2 The Innovation Policy Terrain

This model is described in the 2nd edition of the OSLO Manual (2008). It consists of four domains representing four core areas of influence on innovation systems. The nested structure of the model conveys the concept of a hierarchy of interdependence within the system. Though initially intended to cover the scope of technological product process, the scope and four domains discussed can be effectively integrated in the case of the CA System. The four core areas with much similarity to other models review on this section include:

- *Framework Conditions*
- *Science and Engineering Base*
- *Transfer Factors*
- *Innovation Dynamo*

The innovation policy terrain acknowledges the systems approach to innovation by placing a promoting firm/institution represented by the “*Innovation Dynamo*”, within the other domains. Speirs et al (2008) further stressed that the “*Transfer Factors*” domain is an acknowledgement of the importance, not only of the domains individually, but also to the linkages or connectivity between domains within the innovation system. These two domains both exist within the “*Framework Conditions*” and the “*Science Base*” domains, which represent the wider conditions within which an innovating firm operates. These conditions are determined by factors that include: the basic education system; financial institutions; legislative and macroeconomic issues.

However, Speirs et al (2008) confirm the proposition made by the OSLO manual (OECD 1997) stating that no model is definitive and ideal but indeed acknowledge the limitations of all available innovation systems models. With direct reference to CA promotion in Africa, the key message is the importance of linkages once the various components of the system are

identified. Such linkages referred to be the model as transfer factors need to be examined and improved upon. This could possibly be scaling up factors and strategies within the CA system. Threats and opportunities directly fall within the frame conditions while the CA research institutions, market structures and others form the basis upon which the whole system depends for support (generally refereed by the model as the Science and Engineering base). For a proper analysis and promotion of CA in Africa, the listed components and linkages need careful consideration.

3.4.3 Actor-Network Theory (model)

Originating from the works of Michel Callon (1991) and Bruno Latour (1992) their theory describes the progressive constitution of a network in which both human and non-human actors assume identities according to prevailing strategies of interaction. Actors' identities and qualities are defined during negotiations between representatives of human actors and non-human actants. In this perspective, "representation" is understood in its political dimension, as a process of delegation. The most important of these negotiations is "translation," a multifaceted interaction in which actors (1) construct common definitions and meanings, (2) define representatives, and (3) co-opt each other in the pursuit of individual and collective objectives. In the actor-network theory, both actors and actants (non-human actors) share the scene in the reconstruction of the network of interactions leading to the stabilization of the system. But the crucial difference between them is that only actors are able to put actants in circulation in the system.

The primary assumption of an actor-network theory is the concept of a heterogeneous network. That is, a network containing many dissimilar elements. These coextensive networks comprise of both social and technical parts. Moreover, the social and technical parts are treated as inseparable by the Actor-Network Theory. When dealing with the CA system, the actor-network involved could include human actors such as the farmer, the extension worker, the researcher, the different service and resource providers, the various institutions involved as well as non-human actors such as herbicides and fertilizers used, legumes seeds, residues and the product involved. It also includes other, less obvious actors such the pastoralist and their livestock, producers of conventional farming tools who might be affected negatively etc. The task of trying to identify all the heterogeneous elements in an actor-network can be difficult and this is what the authors called "problem of selection". Actor-network theory claims that any actor, whether person, object, or organization, is equally important to the overall functioning of the system and the more all necessary actors involved in a particular

system are identified the higher the chance of a smooth functioning system (<http://carbon.ucdenver.edu>).

If the CA system in Africa is conceptualized in line with the perspective of the Actor Network theory, its order begins to break down when certain actors are removed or omitted in its promotion process. For a sustained CA development in Africa therefore, there is the need for a careful consideration of most of the actors that assist in the functioning of this system be them human or non-human.

Other conceptual models with similar conceptualisations to the two above but with a higher focus to the national level include:

- A Generic National Innovation System; OECD (1997)
- Elements of National Innovative Capacity; Porter and Stern (2004)

3.5 Summary outcome: theories and concepts as frameworks for analysing CA innovation

Though these selected theories and conceptual models all provide frameworks with potentials for contributing to studying the adoption processes and the institutional background of CA, each theory or concept has its strength as well as limitations in conceptualising the CA system (Table 1). This has mostly to do with the specific angle or dimension each of them addresses: for most of them this is only one of the many necessary angles which form the inherent complexity of the whole CA development and diffusion process – a step towards moving from an invention to an innovation. For example, some concepts / models focus mostly on individuals and factors affecting his/her behaviour, but ignore the more institutional ones. Others suffer from the opposite problem: they focus on institutions and policies, but overlook the individual dimensions. What each model brings to the overall framework in terms of levels, factors, processes, is illustrated in Table 1.

The selected adoption theories help in conceptualizing:

- *the specific agro-environmental circumstances*
- *the insufficiently adapted technology*
- *the knowledge of farmers*
- *the economy of small scale farmers*
- *the societal acceptance of innovations*
- *the availability of resources.*

On the contrary, the listed conceptual models do assist in the diagnosis of issues related to:

- *CA adoption context,*
- *Stakeholders within the CA innovation system,*
- *Type and quality of linkages between the stakeholders.*

Table 1: Adoption theories and conceptual models as frameworks

Assessment criteria: Does the concept / model / frame addresses or potentially applies to?	Unit of Assessment	Diffusion theories and conceptual models as frameworks									
		Lewin (1947)	Albrecht et al (1989)	Rogers (2003a)	Hoffmann (2005a)	Rogers (2003b)	Ajzen (1991)	Triomphe et al. (2007)	World bank (2006),	Callon (1991) & Latour(1992)	OECD (1997) a OECD (1997) b OECD(1997) c
n=not applicable											
Attributes of innovation (e.g. CA) and their influence in the adoption and diffusion process	Yes, No or n	N	N	Y	N	Y	N	N	N	n	n
Forces or factors influencing farmers and their possible influence in the adoption diffusion process	Yes, No or n	Y	Y	N	N	N	Y	N	N	N	N
The various stages in the diffusion process	Yes, No or n	N	Y	Y	Y	N	N	Y	N	N	N
Categories as well as characteristics of various classes of adopters throughout the adoption diffusion process	Yes, No or n	N	Y	Y	Y	N	N	Y	N	N	N
Contextual issues relating to the adoption	Yes, No or n	N	Y	Y	Y	Y	N	Y	Y	Y	Y
Adoption/diffusion studies	Yes, No or n	Y	Y	Y	Y	Y	Y	Y	Y	N	N
Adoption of CA or similar types of innovations	Yes, No or n	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Issues relating to the capacity of CA promoting institutions	Yes, No or n	N	N	n	N	N	n	N	Y	Y	Y
scaling-up strategy or diffusion process	Yes, No or n	Y	Y	Y	N	N	n	Y	N	N	N
Political and institutional frame conditions of an innovation such as CA	Yes, No or n	N	n	N	N	N	Y	N	Y	Y	Y
Economic conditions of CA	Yes, No or n	N	n	N	N	N	N	N	N	Y	Y
Perception of the community towards CA	Yes, No or n	N	Y	Y	Y	Y	Y	Y	N	N	N
Capturing / reflecting project goals	Yes, No or n	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Which target group does it specifically take into account?	target group; or indicate "all actors in an IS	farmers							all actors in an IS		
Which spatial scale does it take into account	Farm (F)/Village level (V), Village/Regional level (VR)	F/V	F/V	F/V	F/V	F/V	F/V	F/V	V/R	V/R	V/R
Complexity of innovation dealt with (from simple to systemic)	Yes, No or n	N	Y	Y	Y	Y	N	Y	Y	Y	Y
Innovation as an emerging / evolving technology	Yes, No or n	N	Y	N	N	N	N	Y	N	N	N
Innovation as a fixed set technology	Yes, No or n	Y	N	Y	Y	Y	Y	N	Y	Y	Y

Y= yes, N = no, n.a.=not applicable

V/R-Village and Regional level, F/V-Farm and Village level

While all models bring a unique contribution, the conceptual models and innovation systems approach proposed by the World Bank (2000); Lundvall (2006) are especially interesting: not

only as they have been designed and tested specifically for the field of agriculture, but because they offer the most generic (encompassing) framework for analysing CA innovation system and process. Coupled with considerations about the nature of the adoption process (e.g. included in “*Determinants of Adoption*” and “*Diffusion of Innovation*” (Rogers 2003), or in *Dynamics of CA adoption* (Triomphe 2007), this constitutes the backbone upon which a Qualitative expert Assessment Tool for CA Adoption (QAToCA) has been built (see next chapter and Ndah et al. 2012) and on which the improved version of QAToCA II will be further adapted and developed within the frame of the INCAA project.

4 Theories and concepts as basis for an institutional assessment method (QAToCA)

It is on the basis of the above theories and concepts that the QAToCA approach (Ndah et al. 2012) was developed. As a self-assessment tool, this approach focuses on supporting the activity of regional experts, research teams and managers of development projects with a focus on CA, by enabling them to assess the relevance and orientation of on-going CA efforts along a systematic list of questions and criteria. The tool allows for an assessment of the relative CA adoption potential in different regions, and for diagnosing the supporting and hindering factors to CA adoption in a given case study.

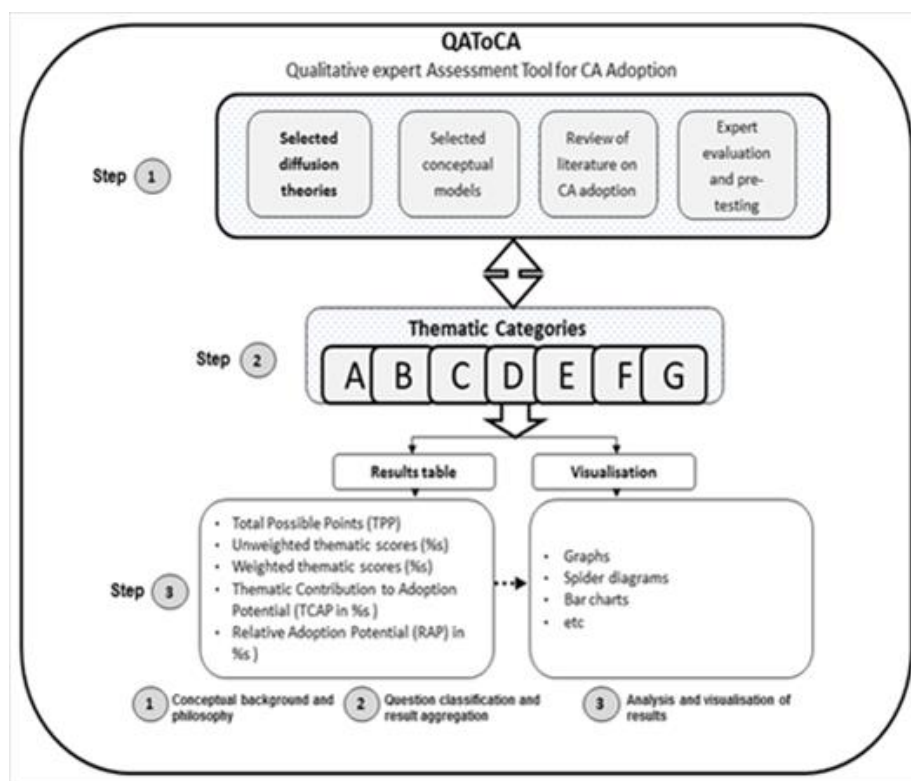


Figure 3: Work flow and development steps of QAToCA (Ndah et al 2012)

The conceptual background and development steps of the tool include: (i) a review of adoption theories and conceptual models of innovation to identify relevant factors in the CA adoption process; (ii) the development of operational questions, assessment indicators and answer statements; and (iii) the development of the computer-based tool, including pre-testing (Figure 3). These steps also reflect the pathway through which data is captured, analyzed and visualized using the approach (see step 2 and 3 - Figure 3).

Questions tackled by the tool are structured into seven (A to G) thematic areas as follows: (A) characteristics of CA as an object of adoption; (B) capacity of promoting organizations, (C) attributes of diffusion strategy; (D) institutional frame conditions at the regional level; (E) institutional frame conditions at the village level; (F) market conditions at the village and regional levels; and (G) the community's perception at the village and regional levels. Underpinning each of these categories are specific operational questions which address the particular situation under each theme.

In total, the tool comprises 53 operational questions which are each linked to one assessment indicator. Each of the indicators is in turn linked to three possible pre-formulated answer statements with scores of 0, 1 and 2 respectively. The order of the statements, and the resulting scoring associated with choosing each of them reflects their relative assumed influence on the adoption potential (from highest positive influence—with a score of 2, to negative influence—with a score of 0). The users of the approach have to assess which of these statements applies best in the region under consideration. Scores are aggregated for each category (A-G), as specified in equation 1, to identify which of these areas is potentially responsible for the state of CA adoption potential in a given study area.

$$RT_x = \frac{\sum_{i=1}^n a_i}{n * A_{\max}} * 100 \quad (\text{equation 1})$$

with

RT_x —relative adoption potential for thematic area x (in %)

n —total number of operational questions in thematic area x

a_i —value (2, 1, 0) corresponding to the answer statement selected for operational question i

A_{\max} —maximum possible value (2) for operational question i

Table 1: Contribution of theories and concepts to thematic areas of the assessment tool

Theory/Concepts	Relevant aspects considered for the operational questions in the respective thematic areas of QAToCA	Thematic areas of QAToCA
Rogers (2003 pp 207)	The aspects of perceived attributes of an innovation (complexity, trialability, compatibility, observability, relative advantage) as determinants for the adoption of innovations	A
Rogers (2003)	The extent of change agents' promotion efforts as a determining variable to adoption	B
Rogers (2003 pp 207)	The concept of communication channels as a determining variable to adoption of innovations	C
Triomphe et al. (2007)	The suggestion of possible pathways towards adoption of innovations (e.g. CA), implications of this on planning the dissemination strategies of organisations. For instance, use or no use of incentives	
Hruschka (1994)	The concept of behavioural change through phases by either removal of inhibiting forces, adding driving forces or both. Implication of this on promotion of innovation and adopted dissemination strategies.	
Rogers (2003 pp 206)	Type of innovation-decision process (collective, optional, authority) as determinants for the adoption of innovations	D E
World Bank (2006)	Use of the "Innovation Systems approach": that stresses on the need for all actors and their interactions jointly involve in the production and use of knowledge. It equally deals with the rules at both the institutional and policy context that shape the processes of knowledge access, sharing and learning.	
Rogers (2003 p 213)	Relative advantage and market forces as determinants to adoption of innovations	F
Lewin (1943)	Individuals and subjective perception of innovations (environment) as an explanation to human behaviour, behaviour as a function of a field of forces	G
Rogers (2003 pp 208)	Nature of social system, structure, roles, norms and traditions as preconditions for explaining rate of adoption of innovations	
Rogers (2003pp 252)	Innovativeness and adopter categorisation (innovators, early adopters, early majority, late majority, laggards) with implication of this on rate of adoption of innovations	
Hoffmann (2006)	The aspect of phases of diffusion process (innovators as disruptive elements, the critical phase, transition to self-propelling and finale phase of the wave) and implication on adoption of innovations	

Thematic areas

A: Characteristics of CA as an Object of Adoption (ObjectofAdopFarmVillLev)

B: Capacity of Promoting organisations (CapacityofPromOrgVillRegLev)

C: Attributes of Diffusion Strategy (AttrOfDiffusStratVillRegLev)

D: Institutional Frame Conditions at Regional Level (InstFramCondRegLev)

E: Institutional Frame Conditions at Village Level (InstFramCondRegVillLev)

F: Market Conditions at Village and Regional Level (MarkCondVillRegLev)

G: Community's Perception at Village and Regional Level (ComPercepVillRegLev)

The QAToCA tool is applied by filling out an Excel spreadsheet based on the answers provided by several experts for one case study, using a workshop-like meeting and adopting a participatory approach (Greenwood et al. 1993). With the assumption that no expert has

knowledge about all levels considered in the tool, the best selection composition and criteria for such a focused group workshop should include a diversity of stakeholder representatives: researchers; extensionists/promoters of CA; farmers with appropriate CA knowledge (adopters), farmers who have adopted CA but stopped practicing it or who considered adoption but then did not implement it (non-adopters); and if possible, service providers (agro-business dealers). This group is guided through the questions by a facilitator who has good knowledge of the tool and provides enough time for thorough discussions among the participants (approx. half a day to one day). Discussions are documented, reflecting the diverse opinions within the group if they arise. Based on these recommendations (Ndah et al. 2012), the tool was applied during the second half of 2011 to assess the CA adoption potential in SSA.

4.1 Limitations of QAToCA - entry point for QAToCA II

In the past three years, the QAToCA approach (Ndah et al. 2012) has been widely applied in case studies across Africa. In the course of wide dissemination through conferences and peer review publications, some weaknesses and limitations to the approach have been pointed out both by reviewers of peer review papers and users of the tool, such as:

1. [*“.....questions are too restrictive and the evaluation scale is too narrow,” [.....] and, “the tool is compact and there is need to expand to capture all factors and opportunities and have a wider scale of evaluation....”*]
1. [*“.....the assessment benefits mostly from discussions of opposing views and therefore the tool will not provide an in-depth understanding of the situation if used by an individual.....”*]
2. *Questions on [“.....who should or should not be part of a QAToCA workshop so as to guarantee unbiased and reliable outcomes?...”.....are still far from being satisfactorily handled (i.e. should focus be more on non-CA adopters, adopters or professionals in the field of CA.....”]*).
.....

It is in the light of the above limitations that INCAA project provides a unique opportunity for improvement and/or addressing some of these weaknesses. Specifically, as part of WP3 of the project, the following considerations will be integrated and fine-tuned to generate a new and improved version of the approach such as, namely:

Structural improvement

- 1) Expanding the tool to be able to capture perceived global change episodes in and beyond SSA e.g. Climate change issue, increasing role of quality and safety of products, increasing diversification of markets
- 2) Expanding the approach to cover all aspects and sectors (stakeholders) in the CA innovation system as well as relating it to a Value chain orientation
- 3) Opening the approach to accommodate agricultural innovation challenges beyond CA and beyond SSA.

Methodological improvement

- 4) Altering the group composition of a QAToCA workshop as well as size and to observe the effect of this on the results
- 5) Testing the approach on one counterfactual site as this will strengthen the credibility of its outcome as well as minimize the possibility for site selection bias

5 QAToCA II and INCAA project - how this differs from past projects

The main purpose of **CA2Africa** project (2010-2013) was using simulation models and modelling frameworks to assist the ability in better understanding and targeting innovative technologies such as CA within complex farming systems of Africa. The project focused on assessing and learning jointly from past and on-going CA experiences under which conditions and to what extent does CA strengthen the socio-economic position of landholders in Africa. Emphasis was made on the field, farm, and village/regional scales. However, the joint learning component was only introduced and never given the deserved emphasis given the time frame of the project - a main component of bridging science-practice-interface which is a pre-condition for a functioning innovations system.

On the other hand, the **ABACO** project (2012 - 2015) closely related in content to INCAA, has focused on reducing the vulnerability of smallholder farmers to climatic variability by building capacity through co-innovation platforms to design, evaluate and implement targeted technological options for and mechanisms to promote adoption of conservation agriculture (CA) based on agroecology principles to combat land degradation and food insecurity in semi-arid regions of Africa. Like the case of CA2Africa, ABACO introduces the concept of co-innovation platforms – a step towards collective learning processes with high need for mentoring and supporting it towards a sustainable level. However, the project is soon to run

out (April 2015) meaning the desired efforts (gains) of such co-innovation processes towards sustaining the CA innovation system might become short-lived.

It is in view of this that in drafting the **INCAA** project the authors, after examining the shortcomings towards CA technology adoption in SSA, see it as **an invention** yet to reach the full **innovation stage**. From this background, the INCAA project is designed as an action research process that will target the challenging (and often missing) interfaces of science-driven technology and local realities in innovation systems. The project aims at building on the experiences of past projects (CA2Africa, ABACO) in mentoring and analyzing a learning process that supports the innovation of CA in Sub-Saharan Africa. Unlike QAToCA in the past project (CA2Africa), QAToCA II, to be developed within the INCAA project will address the specific objective of *“fostering joined learning of stakeholders to test and validate CA tools as well as create space for joint learning for an innovation process towards CA including institutional and individual dimensions”*.

A special feature of QAToCA II will be a strong consideration and integration of the role and perception of women in its multi-stakeholder learning workshops. Specific questions will strive to investigate whether there are any existing local gender conventions which influence negatively the successful introduction and dissemination of CA innovation. To realise this, an effort will be made to ensure a fair representation and participation of women and men during the planned multi-stakeholder workshops. Studies such as Doss and Morris (2001) reveal that gender-linked differences in the adoption of technologies e.g. modern maize varieties and chemical fertilizer result from gender-linked differences in access to complementary inputs. It is therefore worthwhile to investigate if this is the case with the adoption of CA innovation. This is important as for example in most small-scale farming context in sub-Saharan Africa, women often have limited ownership and control over resources such land, and other forms of capital which limits their ability to adopt innovations on sustainable basis.

In addition, for the analysis of CA applicability, QAToCA II will be covering institutional and individual drivers and constraints of CA innovation. It will be applicable to all stakeholders involved in the CA innovation system. Its application will further be complemented with further qualitative elements such as participatory stakeholder mapping, stakeholder characterization and leverage point identification closely supported by the Centre for Development Research (CDR-BOKU). This will allow for a systematic assessment of the issues which covers the institutional arrangements (i.e. market conditions, credit access, transport possibilities and associated costs, attributes of scaling up, political/institutional

frame conditions at local and regional level, the role of implementing organisations or community's perception of CA.

After a complete draft and testing of the tool, the question catalogue will be answered collectively by a focus group in each case study in a workshop-like meeting and with enough time for discussion. Like the case of QAToCA, QAToCA II's entire assessment will be managed by a trained local facilitator who has good knowledge of the tool.

6 Conclusions

It has been the aim of this report to give an overview of theories and concepts to be used for the analysis of the economic, social as well as institutional factors that influence a CA innovation process. The theories and concepts reviewed in this report could all be potentially suitable for use in the INCAA project. However, an ideal theory or concept for application that fulfils all requirements does not exist. Each theory or concept puts emphasis on particular aspects and processes and it depends on the particular institutional aspect targeted to be addressed or examined in detail.

However, given the limits of applicability of biophysical and economic models when it comes to analyzing contextual issues influencing the adoption of CA, the category of conceptual models and adoption theories selected (Uthes et al. 2011a) in this report have been further critically examined and subjected to an evaluation criteria. Selected lists of fitting concepts and theories that are helpful in this context have been made operational for the purpose of this project in the form of an expert knowledge based assessment tool (QAToCA II).

This Qualitative Expert Assessment Tool (QAToCA II) suggested for development will be an adapted version from the Qualitative expert Assessment Tool for CA Adoption (QAToCA) (Ndah et al. 2012) that has been developed during the last years in the frame of CA2Africa project. This will serve as a guideline during the process of assessing the socio-economic conditions that hinder or promote the adoption of Conservation Agriculture within the INCAA project with a particular emphasis on the learning and gender component – earlier neglected by the first version of the tool. It may also reveal areas where further research is needed on the farm and field level. For the next months, the work of WP3 will focus now on ways on how to develop and test a catalogue of questions for the QAToCA II tool within the context of the INCAA case studies in Kenya and Burkina Faso.

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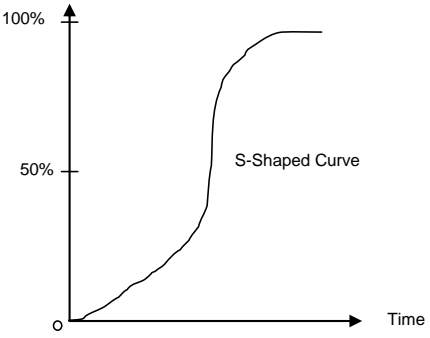
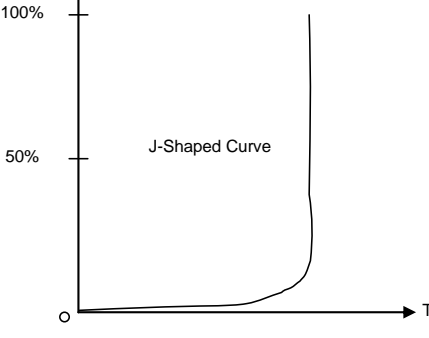
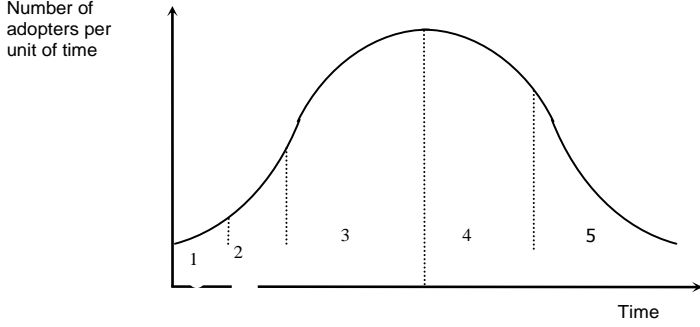
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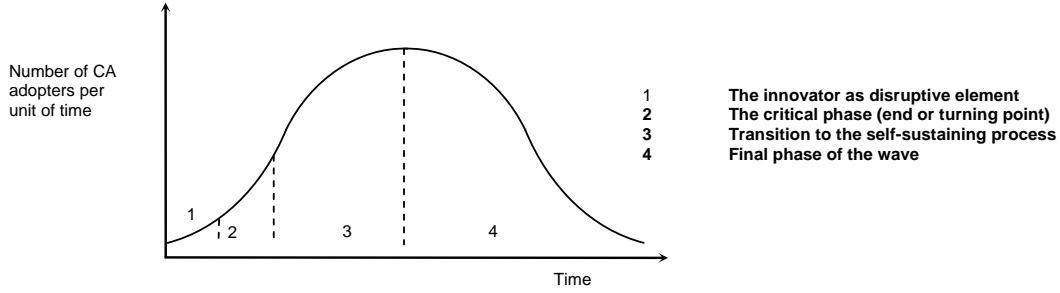
Appendix

Conceptual Models and Adoption theories in brief

Framework	Theory of Psychological Field
Scope	Conceptualization of Psychological field within which an individual (farmer) experiences obstacles that prevent him from reaching his target (Adoption)
Scale	Farm, Village
Graphical representation	
Key message	Theory focus on the concept that for a change of behavior to occur (for instance changing from Conventional farming to CA), this depends on/is a function of the individual (farmer, b) and his subjectively perceived environment ($E_{subj.}$) i.e $b = f(P, E_{subj.})$
Key publications	Lewin (1947)

Framework	Theory of Behaviour Modification
Scope	Conceptual illustration of behavioural change phases and how inhibiting and driving forces interplay in the behavioural change process (Adoption)
Scale	Farm, Village Level
Graphical representation	<p>The diagram illustrates the Theory of Behaviour Modification across three phases over time. A horizontal axis represents 'Time'. A vertical line separates Phase 1 from Phase 2, and another separates Phase 2 from Phase 3. In Phase 1, 'Inhibiting forces' (downward arrows) and 'Driving forces' (upward arrows) are shown. The driving forces are initially weaker than the inhibiting forces, but they increase, leading to a 'Disturbance of former equilibrium'. In Phase 2, the driving forces continue to increase, eventually overcoming the inhibiting forces, leading to a 'Shift to new equilibrium'. In Phase 3, the driving forces and inhibiting forces are balanced at a higher level, leading to 'Stabilisation of modified behaviour'. A timeline at the bottom maps these phases to 'Perception of problem', 'Stages of implementation', and 'Solution to problem or relapse'.</p>
Key message	Theory focus on the concept that for a change of behaviour (CB) to take place (for instance changing from Conventional farming to CA), there is need for the addition of Driving forces (DF) to CA as well as removal of some Inhibiting forces (IF) or both i.e. $CB = +DF - IF$
Key publications	Albrecht et al.(1989); Hoffmann (2005); Lemma (2007); Ndah (2008)

Framework	Diffusion of Innovation Theory
Scope	Conceptual illustration of possible diffusion phases (a, b), categories of adopters in the adoption process (c)
Scale	Village/Regional Level
Graphical representation	
<div><div><div><p>Total Percentage Adoption</p></div><div><p>(a)</p></div></div><div><div><p>Total Percentage Adoption</p></div><div><p>(b)</p></div></div><div><div><p>Number of adopters per unit of time</p><p style="text-align: center;">Time</p></div><div><div><p>1 <i>Innovators-Venturesome, educated</i></p><p>2 <i>Early adopters-Social leaders, popular, educated</i></p><p>3 <i>Early majority-deliberate, many informal social contacts</i></p><p>4 <i>Late majority-sceptical,</i></p><p>5 <i>Laggards- traditional, lower social economic class</i></p></div><div><p>(c)</p></div></div></div></div>	
	Theory states that there are two possible paths for the adoption process. First, it can take off swiftly once the innovation is introduced and falls at a later stage (s-shaped curve). Second, it can delay at the early stage and take off swiftly but at a later stage (J-shaped curve). In any case, the adopters are classify in categories from 1 to 5 and when display as number of adopters per unit of time, this forms are bell-shape curve or normal distribution as shown in “b” above.
Key publications	Rogers (2003); (Ndah 2008); (Kriesemer and Grötz 2008); Hoffmann (2006)

Framework	The Diffusion Theory: Hohenheim Concept
Scope	Conceptual illustration of phases in the diffusion process
Scale	Village/Regional
<p>Graphical representation</p>  <p>Number of CA adopters per unit of time</p> <p>1 2 3 4</p> <p>Time</p> <p>1 The innovator as disruptive element 2 The critical phase (end or turning point) 3 Transition to the self-sustaining process 4 Final phase of the wave</p>	
Key message	Concept describes the various phases in adoption diffusion process. States that an innovation goes through four phases with the innovator regarded in the first as a trouble maker or disruptive element. The second phase is regarded as the critical phase and the adoption process is assumed to at least start off. It is assumed to move into a self-sustaining process once it crosses stage three. The last phase called final phase of the wave is assumed to be a natural phase for every innovation as it will always have a life span after which it is replaced by a much modern a better discovery.
Key publications	Hoffmann (2005), Ndah (2008), Lemma (2007)

Framework	Determinants of Adoption
Scope	Conceptual illustration of determinants of adoption
Scale	Farm /Village/Regional level
Graphical representation	<pre> graph TD A[Variables determining rate of adoption] --> B[Attributes of innovation: relative advantage, compatibility complexity, Trialability, observability.] B --> C[Innovation decision: Optional, collective, Authority] C --> D[Communication Channels: mass media or interpersonal] D --> E[Social system: norms, degree of network connection] E --> F[Extent of change Agents Promotion efforts] B --> G[Rate of adoption of innovation (CA)] C --> G D --> G E --> G F --> G H[Dependent Variable] --> G </pre>
Key Message	<p>Rogers (2003) refers to an innovation (CA) as a dependent variable while those factors which determine its rate of adoption are called independent variables. Attributes of an innovation (trainability, compatibility, relative advantage, complexity and Observability) are identified as the very first determinant of adoption. This is closely followed by the Innovation decision, Communication channels of the set innovation, the nature of the social system and lastly by the extent/capacity of the promoting agents. Each of these the listed attributes have a negative or positive role to play towards the adoption process. For instance, trialability, observability, compatibility are all positively correlative with the rate of adoption unlike complexity which has a negative correlation etc.</p>
Key publications	Rogers (2003), Hoffmann (2005), Ndah (2008), Lemma (2007), Sattler et al (2003)

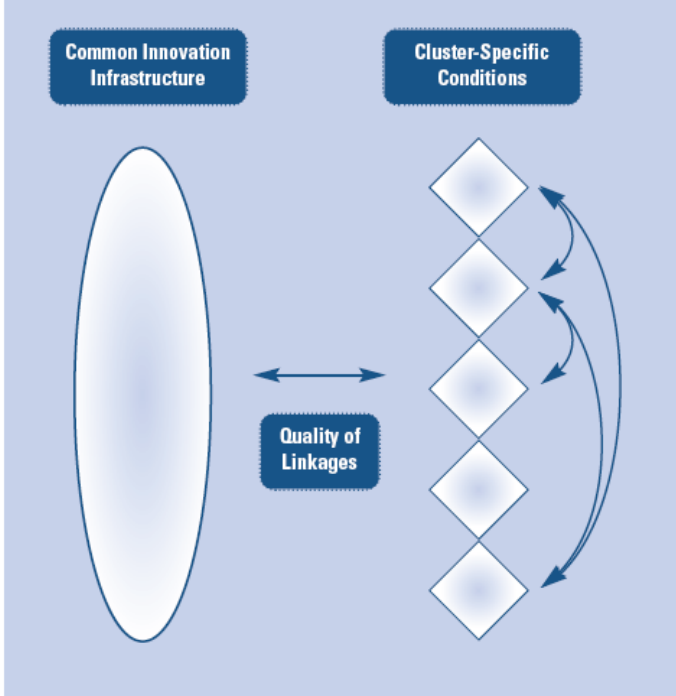
Framework	Theory of Planned Behaviour
Scope	Conceptual illustration of beliefs and factors which influence intention and behaviour (For instance adoption behaviour)
Scale	Farm/Village
Graphical representation	<pre> graph LR OB[Outcome Beliefs] --> ATB[Attitude Toward the Behaviour] NB[Normative Beliefs] --> SN[Subjective Norm] CB[Control Beliefs] --> PBC[Perceived Behavioural Control] ATB --> BI[Behavioural Intentions] SN --> BI PBC --> BI BI -.-> B[Behaviour] PBC -.-> B </pre> <p>The diagram illustrates the Theory of Planned Behaviour. It shows three parallel belief structures: Outcome Beliefs leading to Attitude Toward the Behaviour, Normative Beliefs leading to Subjective Norm, and Control Beliefs leading to Perceived Behavioural Control. All three of these intermediate factors (Attitude, Subjective Norm, and Perceived Behavioural Control) have solid arrows pointing to Behavioural Intentions. Finally, Behavioural Intentions and Perceived Behavioural Control have dashed arrows pointing to the final outcome, Behaviour.</p>
Key message	<p>Theory states that human action is guided by three kinds of considerations:</p> <ul style="list-style-type: none"> • Behavioural Beliefs (beliefs about the likely consequences of the behaviour-adoption) • Normative Beliefs (beliefs about the normative expectations of others) • Control Beliefs (beliefs about the presence of factors that may facilitate or impede performance of the behaviour-adoption). <p>Ajzen's three considerations are crucial in circumstances such as projects (e.g. CA2Africa) when considering attitude towards a practice (CA). In combination, the three considerations lead to the formation of a behavioural intention. As a general rule, the more favourable the attitude and subjective norm and the greater the perceived control, the stronger should be the person's intention to perform the behaviour (adopt CA).</p>
Key publications	<p>Ajzen (1991) Wauters (2005)</p>

Framework	Framework for understanding dynamics of CA adoption
Scope	Conceptual illustration of possible phases of adoption (Adoption pathways)
Scale	Farm/Village/Regional / project
Graphical representation	<p>The graph illustrates the dynamics of Conservation Agriculture (CA) adoption over time (Cycles / Years). It shows four distinct pathways starting from 'Current practices' (at t_0) and moving towards 'Mature CA practices'.</p> <ul style="list-style-type: none"> a. « Quick » & full adoption: the dream come true: A red solid line showing rapid, full adoption. b. Step-wise adoption: A blue solid line showing gradual, incremental adoption. c. Intermittent CA use: A black solid line showing adoption that fluctuates over time. d. « failure » to adopt CA is also common...: A green dashed line showing a failure to adopt or a return to current practices. <p>Other labels include 'Entry points' (a blue oval), 'Current practices' (a blue oval), 'permanent full CA' (a blue oval), 'RT?' (a box), 'End of project' (a box), and a yellow box asking 'Do we subscribe to the intrinsic diversity of CA adoption pathways?'.</p>
Key message	<ol style="list-style-type: none"> 1 Entry points (how to start changing current practices) and end points (in the graph: mature CA practices) vary from situation to situation 2 Adoption pathways are diverse, and may not all need to adoption of permanent, full CA 3 Failures and non-adoption may be an outcome 4 Projects may trigger initial adoption but this does not mean it will be sustainable over time
Key publications	Triomphe et al. (2007)

Framework	A stylized Innovation System
Scope	Conceptual illustration of various sectors in an innovation system
Scale	Village/Regional/International level
Graphical representation	<p>The diagram illustrates a stylized innovation system. At the core is a green circle labeled "Interaction" with lines connecting to four central actors: "Suppliers", "Clients", "Financing Institutions", and "R&D Institutions". This core is enclosed by a dashed green circle labeled "Traditional Habits and Practices of Actors". Surrounding this is a ring of six institutional and policy elements: "International Trade Agreements", "Intellectual Property Agreements", "Technological Trajectories", "National Policies", "Agricultural Policies", and "Market Structures". The outermost ring consists of six external factors: "Increased International Investment & Knowledge flows", "Sanitary and phytosanitary Standards", "Licensing", "DNA Genotyping", "Global Concentration", and "Agricultural Policies". Arrows indicate interactions between these layers.</p>
Key message	<p>Concept of Innovation is stressed as a system which comprises of all actors and their interactions involved in the production and use of knowledge and the rules and mechanisms at both the institutional and policy context level that shape the processes of knowledge access, sharing and learning". Further consideration is given to the following aspects:</p> <ul style="list-style-type: none"> • <i>It is necessary to take into account the dynamics of the innovation process over long periods of time (20 years or more)</i> • <i>It is necessary to identify and characterize key actors, their attitudes, their practices, their roles</i> • <i>Linkages with markets are crucial but as a structuring factor for innovation and as a driving force for innovation.</i> • <i>Coordination and collaboration among stakeholders is at the heart of a successful innovation process / system</i> • <i>The « Enabling Environment » needs to be taken into account in its divers dimensions (institutions, policies, etc.)</i> • <i>Research an important but no sufficient component of a successful innovation</i>
Key publications	<p>(World Bank 2006) (Lundvall 2004) (Mytelka 2000)</p>

Framework	The Innovation Policy Terrain
Scope	Conceptual illustration of various sectors in an innovation system
Scale	Local/Regional level
Graphical representation	
Case studies	<p>Model uses a nested structure to graphically illustrate the concept of a hierarchy of interdependence within the system. Though initially intended to cover the scope of technological product process, the scope and four domains discussed can be effectively integrated in the case of CA System. According to the model, the following listed core components conceptualises an Innovation System and this have much similarities to other conceptual models:</p> <ul style="list-style-type: none"> • <i>Framework Conditions</i> • <i>Science and Engineering Base</i> • <i>Transfer Factors</i> • <i>Innovation Dynamo</i>
Key publications	<p>OECD (1997) Speirs et al (2008)</p>

Framework	Generic National Innovation System
Scope	Conceptual illustration of various sectors in an innovation system
Scale	Local/Regional level
Graphical representation	<p>The diagram illustrates the Generic National Innovation System at the Local/Regional level. It features several interconnected components:</p> <ul style="list-style-type: none"> Demand: Includes Consumers (final demand) and Producers (intermediate demand). Framework conditions: Includes Financial environment; taxation and incentives; propensity to innovations and entrepreneurship; mobility, etc. Company system: Includes Large companies, Mature SMEs, and New TBFs. Intermediaries: Includes Research institutes and Brokers. Education and research system: Includes Professional education and training, Higher education and research, and Public sector research. Political system: Includes Government, Governance, and STI policies. Infrastructure: Includes Banking, venture capital, and IPR and information systems. <p>Arrows indicate the complex interlinkages between these actors, showing a networked structure.</p>
Key message	Based on a synthesis of ideas from innovation systems research (OECD 1997), this model portrays a complex interrelation of systems actors all representing a greater level of demarcation. Compared with the Innovation Policy Terrain (1997), this model is much detailed with more actors and linkages within the domains represented by connecting arrows. The importance of these linkages for the system is a pointer to the fact that innovation is now seen more as a network or collective activity.
Key publications	OECD (2008) Speirs et al (2008)

Framework	Elements of National Innovative Capacity
Scope	Conceptual illustration of various sectors in an innovation system
Scale	Local/Regional level
Graphical representation	
Key message	<p>Like other Conceptual models, this model uses the following three elements to conceptualise an Innovation System.</p> <ul style="list-style-type: none"> • <i>The Common Innovation Infrastructure</i> • <i>Cluster-Specific Conditions</i> • <i>Quality of Linkages</i> <p><i>Focus is on the fact that an innovation system is govern by the Common Innovation Infrastructure which might be the human and financial resources devoted to innovation as well as the public policies impacting on innovation and the economy's level of technological sophistication. On the other hand, the idea of an innovating 'cluster' is consider as a: "...geographic concentration of interconnected companies and institutions in a particular field."</i>(for instance CA) .The Quality of Linkages on the other hand is defined as the relationship between the common infrastructure and the Cluster specific conditions</p>
Key publications	<p>Porter and Stern (2008)</p> <p>Speirs et al (2008)</p>

QUALITATIVE EXPERT ASSESSMENT TOOL for CA ADOPTION (QAToCA 2.0)

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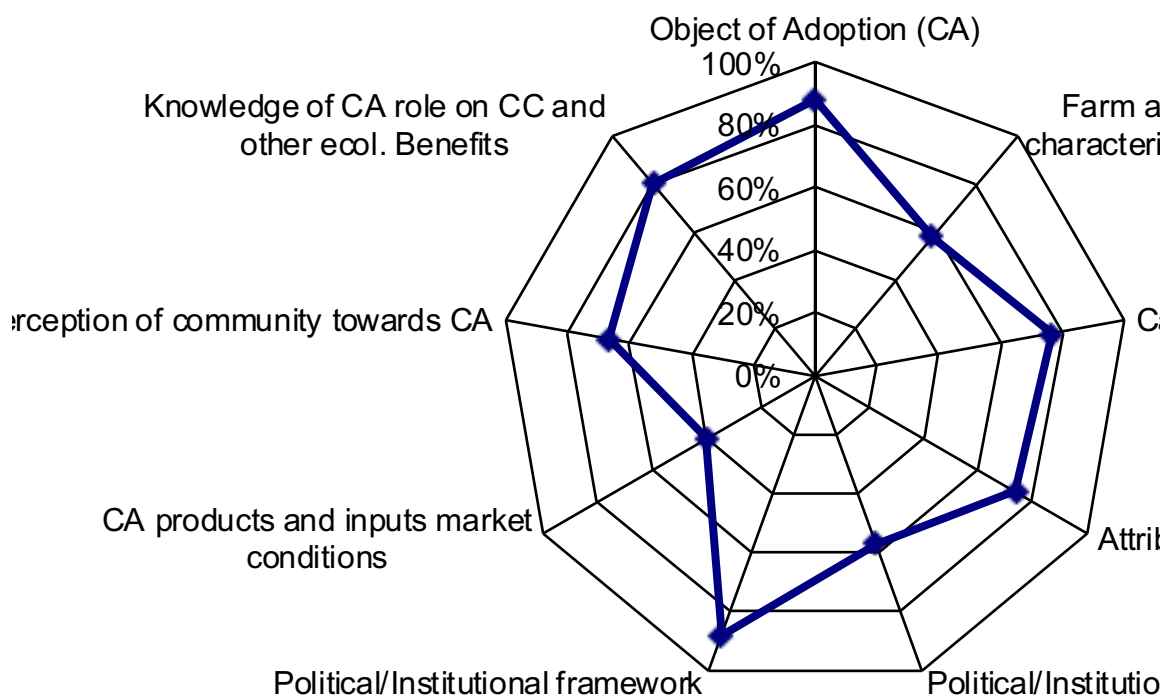
C.....Capacity of implementing institution									Decision rule: Please enter "x" in the scale on left to which extent you agree with the statement.	Comments: Please state any supportive comment(s) to your judgement in (iv)
Village/Regional level										
Operational Question	Indicators for assessing dissemination potential	Statement	Strongly agree	agree	Partly agree	disagree	Strongly disagree	Not sure		
(i)	(ii)	(iii)							(iv)	
C1	Has the organisation a well-designed overall concept, e.g. a binding rule system and a transparent structure?	Concept of Organisation	The promoting institution has a clear, transparent and binding framework of rules; and a common vision and goal and there is a common strategy to achieve stated objectives		x					
C2	Has the organisation well-educated technical and management staff?	Availability and Quality of human resources	The promoting institution has employed a multi-disciplinary team consisting of technical staff with expertise in project management		x					
C3	Has the organisation a strong leadership with good reputation among the beneficiaries?	Leadership and Reputation	The leadership of the organisation is trustworthy, has managerial competence and a good reputation among the beneficiaries, donors and staff		x					
C4	Has the promoting organisation access to an already existing structure of branch offices or other organisations and stakeholders based in the target area?	Organisational linkage to other CA organisations in the region	The organisation has branch offices and extensive network to other CA promoting institutions working in the same region and uses such contacts to broaden its efficiency and scope e.g. farmers organisations, extension workers, CA research bodies etc			x				
C5	Does the promoting organisation have experience with the CA target group?	Organisational linkage with target group (CA and non CA farmers)	The organisation has worked in the area before and is known and respected by the target group		x					
C6	Has the promoting organisation access to well-established networks to CA donors, policy-makers, researchers and the private sector?	Organisational linkage with other stakeholders in the CA innovation systems	The organisation is able to identify and collaborate with relevant cooperation partners/networks (donors, policy makers and researchers)		x					
									91	

[illegible]

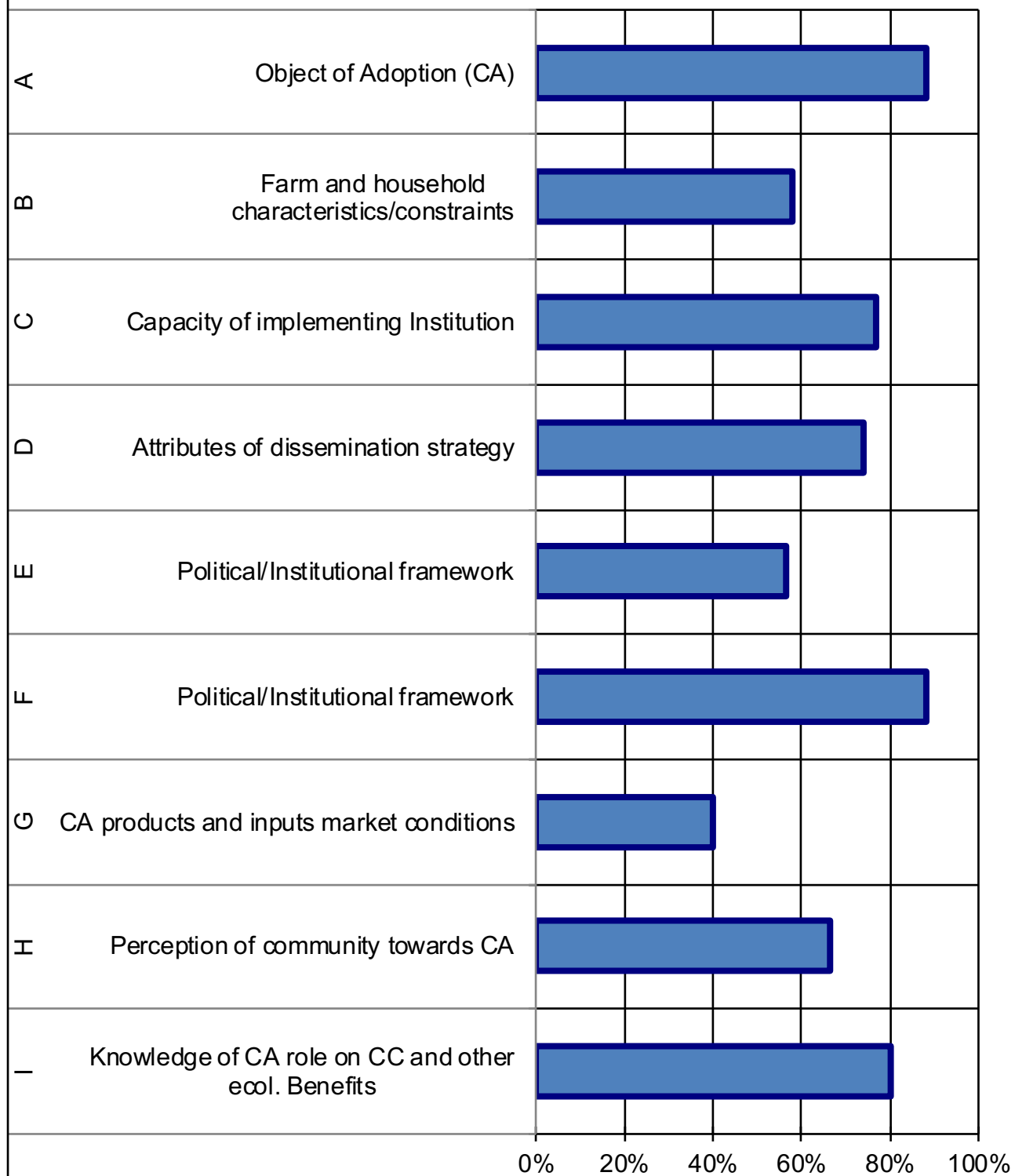
Maximum possible points	Total points achieved	Percentage achieved (unweighted) (Points achieved/total points)	Percentage achieved (weighted with equal strength for each level)
25	22	88%	88%
45	26	58%	58%
30	23	77%	77%
50	37	74%	74%
30	17	57%	57%
25	22	88%	88%
25	10	40%	40%
30	20	67%	67%
15	12	80%	80%
275	189	69%	70%

Relative Likelihood of adoption

Relative Likelihood of CA-Adoption per c



Relative Likelihood of CA-Adoption per component





ACT AND PARTNERS' CONSERVATION AGRICULTURE DISSEMINATION MATERIALS

S No.	Product Type	Product Description	Resource link
1	Websites and portals	ACT home Website	www.act-africa.org
		FACASI project website	http://facasi.act-africa.org/
		AfricaMechanise	http://africamechanize.act-africa.org/
		CA4FS website	http://ca4fs.act-africa.org/
		ICAAP website	http://icaap.act-africa.org/
		Conservation Agriculture Working group	http://carwg.act-africa.org/
2	Books	Conservation Agriculture for Africa: Building Resilient Farming Systems in a Changing Climate. CABI International, 289 pgs.	http://www.cabi.org/bookshop/book/9781780645681
		2WT and CA cartoon book	https://goo.gl/vK6UJZ
		Book of Condensed Papers of the 1 st CA Congress	https://goo.gl/NzxwcU
		CA Manual	https://goo.gl/cX62RZ
		ACT CA Books and Manuals	https://goo.gl/HHra9m
3	Special CA Journal Issue	The Role of Conservation Agriculture in Sustainable Production Intensification for Smallholder Farmers in Africa".	http://www.mdpi.com/journal/environments/special_issues/conserv_agric_Africa
4	News alerts	ACT CA news alerts (monthly)	http://goo.gl/YfPKzD
		FACASI newsletters	https://goo.gl/PZ6GwU
5	Videos	ACT YouTube Channel	https://www.youtube.com/channel/UCofLj9eI5ShyQny3xcWR4DA
		ACT website video gallery	https://goo.gl/tt78en
		Farm Mechanization using Two wheel Tractors in Arumeru and Mbulu District Tanzania	https://www.youtube.com/watch?v=O9_5EMvDyky&t=31s

		Revitalizing small scale agriculture in Zimbabwe Conservation Agriculture using the 2 wheel tractor	https://www.youtube.com/watch?v=MZ1G7yX0ki0&t=98s
		FACASI Video Maize and Wheat production using two wheel tractors	https://www.youtube.com/watch?v=Q7Ej20NzZ28&t=73s
		Farm Mechanization and Conservation Agriculture Kenya Video	https://www.youtube.com/watch?v=togiZfnfsnk
		Powering Smallholder Agriculture in Eastern and Southern Africa	https://www.youtube.com/watch?v=oe8J2ee4rAU&t=48s
		Exchanging Experience with Conservation Agriculture	https://www.youtube.com/watch?v=pAdNE4sUNOg&t=29s
6	Photo stories and photo books	FACASI photo stories and photo books	http://goo.gl/8iETVv
7	Reports	Report Consultative Meeting on a Mechanization Strategy	http://africamechanize.act-africa.org/wp-content/uploads/2017/05/Nairobi-Meeting-Report-FINAL.pdf
8	Information series and CA Promotional Materials	ACT Promotional Materials	https://goo.gl/GeZF2C
9	Presentations	ACT CA presentations	https://www.slideshare.net/ACTillage/presentations

Conservation Agriculture for Africa

Building Resilient Farming Systems in a Changing Climate

Edited by Amir Kassam, Saidi Mkomwa and Theodor Friedrich

Tillage agriculture has led to widespread soil and ecosystem degradation globally. This is especially so in Africa where traditional and modern tillage-based agricultural practices have become unsustainable due to severe disturbance and exploitation of natural resources, with negative impacts on the environment and rural livelihoods. In addition, agriculture in Africa today faces major challenges including increased costs of production and energy, the effects of climate change, and the lack of an effective paradigm for sustainable intensification, especially for small- and medium-size holdings. Africa is facing a serious challenge to food security and as a continent has not advanced towards eradicating hunger. In addition, the population is still growing much faster than on most other continents. This pressure has led to the emergence of no-till Conservation Agriculture as a serious alternative sustainable agriculture paradigm. In Africa, in recent years, Conservation Agriculture techniques and methods have spread to many countries, as greater development, education and research effort are directed towards its extension and uptake.

This book is aimed at agricultural researchers and scientists, educationalists, and agricultural service providers, institutional leaders and policy makers working in the fields of sustainable agriculture and international development, and also at agroecologists, conservation scientists, and those working on ecosystem services.

This book:

- Focuses on research and development initiatives in Africa aimed at building resilient farming systems based on Conservation Agriculture principles and practices.
- Summarises the status of Conservation Agriculture in Africa today and prospects for its future development in Africa as a basis for sustainable agriculture intensification.
- Describes case studies showing the performance of Conservation Agriculture in Africa.

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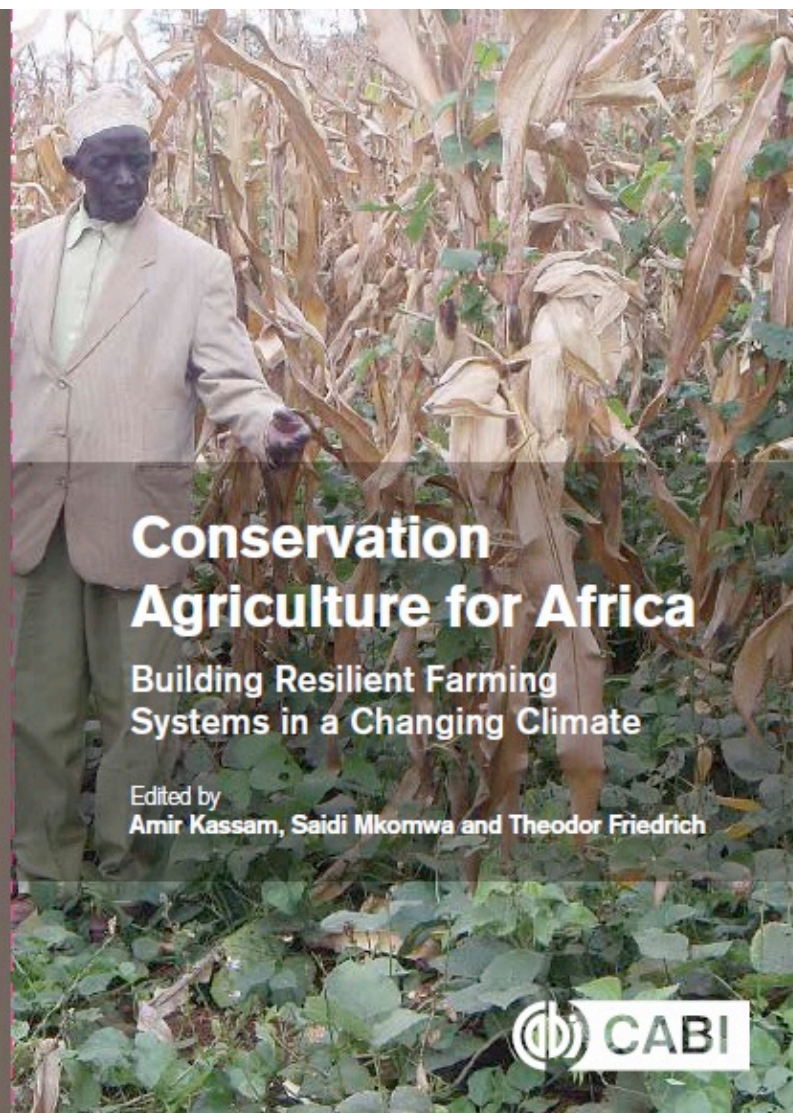
Front cover: It is a photo of a CA farmer (lato), Swaleho Shabani, from Karatu District, Tanzania. The main crop is maize and the cover crop is dolichos lablab.

Space for bar code with ISBN included

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