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Whitfield, S, Dougill, A, Dyer, J et al. (3 more authors) (2015) Critical reflection on knowledge and narratives of conservation agriculture. Geoforum, 60. 133 - 142. ISSN 0016-7185

https://doi.org/10.1016/j.geoforum.2015.01.016

Critical Reflection on Knowledge and Narratives of Conservation Agriculture

Abstract

In the context of contemporary concerns about climate change and food security, conservation agriculture (CA) has emerged as a well-supported and central component of the agricultural sector development strategy across sub-Saharan Africa, including in Zambia. A variety of narratives about the benefits of CA over conventional agricultural systems underpin endeavours towards 'scaling up' CA and increasing rates of adoption amongst smallholder farmers nationwide. However, there is a knowledge politics underlying the translation of a weak evidence base around CA into persuasive narratives and financial and political support. In this paper, we trace the evolution of five narratives around CA in Zambia in relation to changing political agendas and the involvement of new public and private sector actors, and review the development of evidence bases and knowledge that support and challenge each of these narratives. We discuss the potential to open up space within this knowledge politics to alternative narratives and the contestation of the pervasive CA scaling up agenda. Critical reflection is essential to ensure that national and local evidence is more effectively used to guide national climate and agricultural policy developments and many international donor initiatives.

Key words: conservation agriculture; scaling up; knowledge; politics; Zambia

Introduction

Conservation Agriculture (CA) is both an agricultural technology and a set of land management principles, based on the practice of zero- or reduced-tillage, permanent organic soil cover, and crop rotations (FAO 2008). It has long been heralded by the international agriculture and development community as a sustainable approach to farming (Myers 1983, Unger 1990) and has been adapted in southern African from the Zimbabwean commercial farming sector to application to smallholders (Haggblade and Tembo 2003). In the context of small-scale and subsistence agriculture in sub-Saharan Africa, CA is central to national agricultural policies and the activities of non-governmental organisations alike, justified on the basis of a variety of success claims about its ability to increase productivity (and therefore enhance national food security), its low input requirements, and its contribution to climate change mitigation and social empowerment.

These claims have shifted and accumulated over time. As new concerns and priorities –land degradation, gender, climate change and others – have moved up and down the international agricultural development agenda, CA has been consistently pushed as an appropriate technological response. The amalgamation of these narratives underpins a contemporary push towards the setting of ambitious adoption targets and the 'scaling-up' of CA in Africa, as is evident in the declaration of the 2014 Africa Congress on Conservation Agriculture and the FAO's 2013 CA Scaling Up programme in Zambia.

A counterweight to these persuasive calls for increased investment in and efforts towards up-scaling CA is beginning to emerge in the form of critical commentaries that question the strength of evidence underpinning success claims, particularly in the context of eastern and southern Africa (Giller, Witter et al. 2009, Andersson and Giller 2012, Andersson and D'Souza 2014). An obvious conclusion (yet only implicitly acknowledged in the literature) in response to these contested claims about CA, is that they are inextricably political. A series of political framings of agro-ecologies, problems and research agendas; assumption-based interpretations of disparate bodies of evidence; and a variety of values and motivations, underpin the translation of evidence into success stories, the promotion of particular technologies and the closing down of alternatives (Sumberg and Thompson 2012).

Here we take the case of Zambia as one well-developed example of a country in which CA has received strong political support. We analyse the narratives through which CA has been promoted in the Zambian context and how these have evolved in response to changing political agendas; the involvement of new public and private sector actors in CA community of practice; and development of evidence bases and knowledge. This paper approaches the analysis of CA in Zambia through a political ecology lens, an approach that has been largely absent from current literature, yet one that is ideally suited to unpacking, engaging with, and challenging the assumptions and knowledge claims that underpin CA's promotion. By presenting a critical political ecology perspective, this paper aims to identify points of entry, and to open up space, within the knowledge politics around agricultural development in Zambia for the consideration of alternatives to its current agenda of up-scaling CA.

The specific objectives are to:

1. Identify the narratives through which CA has been promoted.
2. Trace the evolution of these narratives in Zambia in relation to the changing political agendas and the involvement of new public and private sector actors in the CA community of practice.
3. Review the development of evidence bases and knowledge that support and challenge each of these narratives.
4. Critically consider the appropriateness of the current scaling-up of CA agenda in relation to these findings and the political space for counter narratives.

Conceptual Framework and Methods

To analyse changing and contemporary endeavours to promote CA in Zambia from a political ecology perspective is to begin from the assumption that they are bound up with political agendas that are themselves inherently ecological; 'forms of access and control over resources…[with] implications for environmental health and sustainable livelihoods' (Watts 2000: 257). Political ecology studies have previously demonstrated the way that colonial legacies of conservation and control act to mutually reinforce enduring narratives of degradation (Cline-Cole, Main et al. 1990, Neumann 2005, Adams and Hutton 2007). Similarly, political ecologists have recognised that narratives of vulnerability become self-fulfilling within political framings, and associated management, of natural resource and climate change (Adger, Benjaminsen et al. 2001, Bulkeley 2001, O'Brien, Eriksen et al. 2007). Several of the key narratives of change and adaptation associated

with both the promotion and critique of CA – particularly in relation to degradation, vulnerability, and conservation – have also been the subject of sophisticated political ecology analyses (Blaikie and Brookfield 1987, Neumann 2005).

In this paper, a narrative is understood as a storyline about the future based on assumptions about the trajectories of one or more context components (e.g. the economy, politics, the environment, livelihoods etc.) often in relation to coupled problems and responses (Leach, Scoones et al. 2010). Narratives are typically articulated within the campaigns and communications of groups or evidenced in language of project reports and outputs, as well as in the language of everyday interactions (Wodak 1989, Hajer, Hoppe et al. 1993, Fairclough 2009). A narrative may be realised not simply because of the correctness of its assumptions, but the power of those communicating it to influence decision making and close down alternatives.

Hajer (1995) and Sabatier (1988) differently describe the relationship between actors, policy influence, and narratives. Within Hajer's discourse coalition concept, campaign groups form around persuasive arguments such that they become politically dominant. He recognises that the discourses that hold groups together are amenable to change through policy processes, debate and learning. In Sabatier's theory, powerful policy coalitions may be composed of actors that advocate a common solution to a variety of problems and issues, with the result of cumulatively forming a meta-narrative with powerful support. Both theories are considered here in analysing the politics of agriculture agenda-setting.

In this paper, we trace the changing community and narratives around CA in Zambia through the outputs of major CA projects. Key informant interviews helped to identify CA projects and policies in Zambia (including public and private initiatives), which formed the basis of our analysis. A discourse analysis of project reports (n=31), policy documents (n=7), press releases (n=4), CA review papers (n=2), and interviews with policy makers and project representatives (n=8), was conducted. These took place around the 1st Africa Congress on Conservation Agriculture, held in Lusaka in March 2014. Participation in the conference and discussions around it informed the initial concept and identification of key historical moments and information sources. Multiple sources were used to verify and triangulate information.

Documents and transcripts were marked with codes that correspond with three central components of the contemporary 'climate smart agriculture' narrative - adaptation, mitigation, and food security. Starting with these aspects allowed the historical pathway of the most recent narrative to be traced. However, it emerged that these codes did not adequately reflect the diversity of messages that have been associated with CA, which has a longer history than CSA. In order to accommodate these, a revised coding strategy was developed based on five key narratives, which are described in more detail in this paper. This coding strategy was used to attribute narratives to different projects, policies and actors which were organised chronologically to develop a picture of trends over time.

A systematic review of peer-reviewed and grey literature was also used to identify evidence bases and knowledge gaps in relation to each narrative. Key words from each narrative description were combined with a generic search term ("conservation agriculture*" AND Africa*) in two academic search engines (Web of Science and Google Scholar), and abstracts were screened for relevance to the eastern and southern African context. These were also ordered chronologically and cross

referenced with the review of narratives to identify the coincidence of new knowledge and narratives. Findings from our analyses are presented below.

Tracing the Development of 5 Narratives of CA in Zambia

Five key narratives in the promotion of CA in Zambia are outlined in Table 1. In each case, a framing of a problematic *status quo* (associated with conventional cropping systems) contrasts with a set of solutions offered by CA. The five narratives described are not mutually exclusive and rather than dominant narratives being usurped or replaced over the history of CA promotion in Zambia, it is more accurate to think of them as overlapping and accumulating. The narratives are closely interlinked, and in many cases, the validity of one narrative depends on the assumptions of another. The chronological description of changing institutions, policies, and CA projects in Zambia below, positions these narratives in relation to the contexts in which they have emerged and accumulated.

Narrative	Conventional Agriculture		Conservation Agriculture
1. Land Degradation → Soil and Water Conservation	− Mono-cropping depletes the soil of nutrients (making continued production dependent on inputs) − Tillage creates a compacted layer beneath the top soil that is impervious to roots and water, resulting in poor water infiltration and high rates of runoff and soil erosion. − Particularly vulnerable to extreme climatic events	→	+ Minimum tillage practices prevent the creation of plough pans, while improved soil structure increases infiltration and water and nutrient holding capacity. + Planting basins increase soil moisture storage and availability, enhancing drought resilience. + Crop rotations allow for nitrogen (N) fixation, which organically fertilises the soils, and for moisture and nutrients to be drawn from different soil depths. + Mulching, or organic soil cover, helps to prevent top soil weathering and erosion, with mulch decay contributing to increases in the organic matter content of topsoil.
2. Rising Input Costs → Reducing Input Dependency	− Rising fuel prices are resulting in increased costs for food producers both directly (.E.g. farm machinery and transporting products) and indirectly (e.g. fertiliser prices). − Smallholder farming is dependent on government fertiliser subsidies, although many lack access to these inputs.	→	+ Improved soil condition may reduce N and phosphorus (P) deficiencies. + Use of planting holes or basins allows for inputs to be carefully targeted rather than broadcast across the field. + Land preparation (ripping, dibble-stick planting or basin digging) is associated with reduced labour and machine-hours.
3. Food Insecurity → Increased Food Production	− Low productivity, coupled with population growth, is equated with persistent food shortage and reliance on imports and aid. − Yield gaps (the difference between actual and potential production) of over 50%.	→	+ Reduced yield gaps and increased aggregate national production; improved availability of, and affordability of food. + More stable production under varying environmental conditions
4. Emissions from Agriculture and Deforestation → Climate Change Mitigation	− Erosion of soil organic carbon (C) stores, the burning of crop residues, and the use of fossil-fuel intensive inputs, such as mechanised ploughs and chemical fertilisers. − As degradation impacts negatively on productivity, farmers are pushed into marginal environments or forced to clear forest to create new agricultural land.	→	+ Prevention of soil erosion and the maintenance of cover crops, and particularly where it is practiced in conjunction with fertiliser trees, increases C sequestration and storage + Reduced reliance on inputs reduces agriculture-associated emissions. + Improved agricultural practices and productivity reduces rates of land abandonment and pressure on forested areas, reducing emissions from deforestation.
5. Social Marginalisation → Empowerment	− Low productivity and unsustainable conventional agricultural practices, combined with unaffordable input costs, create a poverty trap, locking smallholder farmers into subsistence production. − Particular burden on women, who are disproportionately responsible for land preparation.	→	+ Increased productivity and reduced cost on inputs represents increased profitability and pathway out of poverty + Women are empowered because of the associated shift in the labour burden away from land preparation.

1 Table 1: Summary of Narratives of CA in Zambia

1980s: International Concerns for Degradation and Conservation

The international sustainable development agenda that rose to popularity in the 1980s and the associated interest in dryland degradation, underpinned research and development efforts that focused on improving soil health in southern Africa. In 1985 the Swedish International Development Agency (SIDA) funded the long-running Soil Conservation and Fertility Enhancement (SCAFE) project. This supported extension workers linked to Zambia's Ministry of Agriculture, Food and Fisheries (now the Ministry of Agriculture and Livestock (MAL)), to promote soil erosion prevention and agro-forestry techniques.

SCAFE evolved towards a more specific CA focus over time, with SIDA funds being directed to the Land Management and Conservation Farming (LMCF) and the Swedish Agricultural Successor Programmes (SASP). It has also expanded from an initial concentration of work in Zambia's Eastern Province towards national coverage, though continuing to promote a variety of CA-related practices including contour and conservation tillage, green manures and mulching. The narrative of CA of the mid-1980s, promoted within the SCAFE project and which has endured, is that land degradation caused by inappropriate management practices can be successfully addressed through the adoption of soil and water conservation practices (Narrative 1).

In the 1980s and 1990s, the endeavour towards developing CA for smallholders was taken on by a combination of non-governmental organizations (such as Zimbabwe's Foundations for Farming), and internationally funded government programmes (such as ConTill, implemented by the Zimbabwe's agricultural extension services and funded by GTZ). In Zambia the Golden Valley Agricultural Research Trust (GART) was established in 1993 through the Zambian National Farmers Union as part of the National Agricultural Research and Extension System (NARES), with a focus on the development and promotion of minimum tillage and CA technologies, among other objectives. Through support from the Norwegian government and the World Bank, the Conservation Farming Unit (CFU) was established in 1996 as part of the Agricultural Sector Investment Programme to coordinate and promote the adoption of CA among smallholders with an initial focus on Central and Southern Provinces. The narrative of degradation remains central to the mandate of the CFU today:

> *'Poverty is spreading, land degradation and deforestation are accelerating, and millions of farmers are busy depleting the soil upon which they and future generations depend… The combination of continuous soil inversion, the burning of crop residues and mono-cropping of maize are the principal causes of declining productivity and the degradation of arable land… When soils are judged to be exhausted, families in Zambia's maize belts migrate locally or long distances to fell virgin or rejuvenated woodland'* (Conservation Farming Unit, Aagard, 2010: 1, 4 & 7).

1990s: Structural Adjustment, Subsidies and Input Costs

Structural adjustment policies in the 1990s were associated with a temporary reduction of subsidies for fertilisers by the Zambian government, but owing to a lack of profitable opportunity for private sector investment it is one that largely failed to liberalize the market for agricultural inputs. In this context, two somewhat contradictory narratives and approaches to the promotion of CA gained traction. A small number of NGO and faith-based initiatives, such as those of the Kasisi Agricultural

Training centre, were researching the benefits of CA as an alternative low-input agricultural system, building on some of the principles of soil management established within SCAFE and on the evidence of CA developments outside of Zambia (Interview correspondent). Private sector cotton companies, such as Dunavant and Lonrho, also developed an interest in the precision fertiliser application aspects of CA as a way of reducing input cost (Haggblade and Tembo 2003; Interview Correspondent).

Conversely, the government, in spite of rhetorical commitments laid out in the 1991 Agricultural Sector Investment Programme to developing alternatives to fertiliser-dependent and maize-dominated agricultural sector, leant its support to non-governmental and third sector partners that offered to fill the input-provision gap. Initially in the form of famine a relief initiative implemented by the World Food Programme in 1995 – the Conservation Farming Relief Programme – and later by the Land Management and Conservation Farming Programme (LMCF) programme and government supported initiatives of World Vision, Catholic Dioceses of Monze and Development Aid from People to People, a model of input incentivised promotion of CA emerged. A number of projects began to offer input usually in the form of packages of fertiliser and seed to smallholder maize farmers on the condition that recipients implement CA practices, but these programmes did not promote low-input CA systems, and thus, to some extent, reinforced a status quo of input-dependent and maize-dominated agriculture (Interview Correspondent). This has become a well-established model of CA extension, including through the Conservation Agriculture Programme (CAP) and state-supported endeavours towards scaling-up CA.

Mid-2000s: Policy Support and the 'Climate Smart' Agenda

As efforts toward the promotion of CA across Zambia grew and diversified across an increasing number of organisations, funders and programmes, the Conservation Farming Liaison Committee, established under the ZNFU in 1995 with support from the World Bank and the EU, became a central coordinating body for developing technical messages, recommending research priorities and bringing in funding. It was chaired by the CFU, which came to represent an authoritative body in developing and defining technical CA packages. In the late 1990s and 2000s, a politically influential community of practice in CA, largely composed of those organisations that had implemented or subsequently followed the convention of high-input maize-based CA promoted through input package incentives, formed, with the CFU, FAO, and the Ministry of Agriculture and Livestock, as well as NGOs such as CARE and the Cooperative League of the United States of America (CLUSA), supported by continued funds from the World Bank, EU, and development funds from Norway, Sweden, Finland and Canada. At this point, CA was integrated into the National Agricultural Policy (2004-2015) and later the sixth National Development Plan (2011-2015).

The efforts of the CA community of practice were organised around a number of large scale programmes, such as the Land Management and Conservation Farming Programme (LMCF) and later the Conservation Agriculture Programme (CAP), which had two implementation phases (CAP I and CAP II) running from 2007-2011 and 2012-2015 respectively, and Conservation Agriculture Scaling Up for Increased Productivity and Production Programme (CASPP) established in 2009.

CAP and CASPP are coordinated projects implemented through the CFU and the MACO (now MAL) respectively, and which aimed to promote CA in 12 districts across the western, southern, central and eastern regions (and expanded under CAP II) through the provision of training sessions, technical support and extension services. The programmes implement a coordinated extension programme, in which MACO extension staff, trained through the CFU, operate in agricultural camps throughout the districts and provide support to a network of lead farmers, described as Own Farm Facilitators.

Within these programmes and the National Agricultural Policy, there was growing concern with adaptation to climate change in agricultural production, in particular, the challenge of sustainably intensifying agriculture and achieving national food security in the context of increased climatic variability. This emphasis on climate change adaptation and sustainable intensification is evident in CAP reports (Aune, Nyanga et al. 2012). The Zambian National Adaptation Programme of Action (NAPA) (2009) outlines the need to adapt land use practices (crops, fish and livestock). It highlights a pre-existing MACO project on Conservation Tillage as highly relevant to adaptation; and a DANIDA Natural Resources Management Programme that includes support for CA and agroforestry. The UNDP has funded a project to implement part of the NAPA called Adaptation to the effects of drought and climate change in Agro-ecological Regions I and II in Zambia. CA has also been identified as a baseline activity that has assisted in helping coping with changing climate (FAO 2013: 29). It is in this context of climate stress and adaptation that a narrative of CA as a resilient and sustainable agricultural intensification mechanism for increasing food production and addressing national food insecurity emerges (Narrative 3).

Late-2000s: Agroforestry, Mitigation, and the REDD agenda

In spite of structural adjustment policies, agricultural input subsidy programmes became re-established in Zambia, in the form of the Fertilizer Support Programme in 2002. Programmes of low-input and organic CA, such as those of the Kasisi Agricultural Training Centre, have operated largely without the support of the Conservation Farming Liaison Committee and the traditional funders of the CA community. However a new alliance of this community with agroforestry, building on the SCAFE project and established connections with the World Agroforestry Centre (ICRAF), has seen growing research and development efforts around fertiliser tree CA and 'evergreen agriculture' (Garrity, Akinnifesi et al. 2010), at the GART research station.

In the more recent context of international climate policy discussion around Reduced Emissions from Deforestation and Degradation (REDD) policy since the late-2000s and interest in reducing emissions from land use and land cover change, a narrative of CA as climate change mitigation is beginning to emerge. This reflects both assumptions about the protection of soil carbon stores, and that improving the productivity of marginal land will reduce land abandonment and the need for agriculture to encroach upon the forest (Narrative 4).

> *With regard to climate change… mitigation [, the] government will continue to promote increased use of sustainable farming practices that include conservation farming* (6th National Development Plan).

CA climate change mitigation mechanisms are mentioned in Zambia's 6th National Development Plan and in CAPII project documents, but the extent to which Zambia embraces CA as a Nationally Appropriate Mitigation Activity (NAMA) is yet to be seen. The UNFCCC Low Emission Capacity Building Programme includes the identification of NAMAs and Zambia is receiving funding under this programme, however, the registry of NAMAs maintained by the UNFCCC has no records yet for Zambia[1]. Zambia is also yet to finalise its REDD+ strategy. CA was highlighted as an 'activity of relevance' in the original Joint Programme Document for UN REDD Quick start funding (UN-REDD 2010). CA was evaluated as a potential Forest Management Practice with relevance for REDD in the FAO's preliminary country study, although a clear distinction is not made between 'agroforestry' and 'CA with trees'. Independent initiatives under REDD+ place a greater emphasis on CA. For example, in 2009 Bio Carbon Partners established a carbon trading project in the Lower Zambezi area which has achieved accreditation under the Verified Carbon Standard REDD+ methodology in 2013. This permits the trade of verified carbon credits, calculated on the basis of avoided unplanned deforestation and forest degradation (BioCarbon Partners 2013), indicative of a growing interest in CA as a mitigation measure and associated carbon trading as an opportunity for generating development finance.

2010s: Gendered Impacts and Social Empowerment

Narratives relating to social empowerment, particularly in terms of women's roles within the household and farmer engagement in social institutions and markets are now evident within the language of CA programmes, such as in the LMCF.

Non-governmental organisations such as CARE and Concern Worldwide have promoted this narrative, which attempts to link CA to broader notions of human development beyond increasing on-farm production (Concern Worldwide 2013). The NORAD CAP report makes reference to the '*many benefits [of CA] for women*' (p.3), associated with earlier land preparation and reduced weeding, which are often responsibilities that fall on female members of the household (Norad 2011) (Narrative 5)This appears to be, as a delayed response to the push towards mainstreaming gender and empowerment concerns within the activities of development funders initiated in the 1990s, without a clear reason for its absence from previous discourse around CA, particularly given the explicit commitment towards women's empowerment within the government's Agricultural Sector Investment Programme of the early 1990s as well as in the broader objectives of a number of the organisations and funders engaged in CA in Zambia. As discussed later, a possible explanation for this is the limited and highly context specific nature of evidence in support of this narrative.

Broader notions of social empowerment and CA as a means towards market access, is broadly evident across CA promotion and is linked directly to claims about productivity increases as a result of CA practice. LMCF makes reference to increased marketable output as a means of opportunity for market participation and bringing farmers out of a subsistence poverty trap (Narrative 5). This resonates with the sustainable intensification (again consistent with high-input CA) and commercialisation goals of recent government strategy documents, such as the National Agricultural Policy (2004-2015) and 6th National Development Plan (2011-2015) (see Table 2).This narrative is also evident in the case of the Kansanshi Foundation Conservation Farming initiative, established in

[1] As of October 2014

2010, which promotes CA as part of corporate social responsibility and outreach programmes of a private sector mining company. Following a model of agriculture learnt from the Zimbabwe-based Foundation for Farming organisation, the Kansanshi programme trains community cooperative groups around the Solwezi copper mine in CA techniques, with the aim of supporting a sustainable community-based industry that reduces reliance on mining and charcoal production.

A summary timeline of the projects, policies, actors, and their associated narratives described above is presented in Table 2.

1

2 Table 2: Key Projects and Policies in the Recent History of CA in Zambia

Date	Project/Policy	Description	Organisations	Related Narrative
1985 – 1999	Soil Conservation and Fertility Project (SCAFE)	A component of Agricultural Sector Investment Programme, which promotes a wide variety of erosion control methods (bunding, contour tillage, vetiver grasses) and fertility enhancement techniques (crop residue management, cover crops, green manures, mulching, conservation tillage) through extension support to farmers (initially in Eastern Province and later nationally).	Funded by SIDA Implemented through MAFF (now MAL) With support from the Regional Soil Conservation Unit	Soil/water conservation
1995 – 2006	Conservation Farming Relief Programme	Provided maize inputs, initially as relief aid following the 1995 droughts in Eastern Province. The continuation of this input support was tied to conditions on farmers to use planting basins and compost.	World Food Programme	Soil/water conservation Increased production/food security
1995 -	Lonrho and Dunavant Cotton conservation farming initiatives	Private cotton companies worked closely with CFU to train out-growers in CA practices, using a lead farmer model, predominantly in cotton belt of central province. Dunavant provided training programmes and market (purchasing price) incentives for the use of CF best practices.	Lonrho and Dunavant Cotton	Reduced input dependency Increased production/food security
1999 – 2006	Land Management and Conservation Farming (LMCF) (1999-2002) and the Swedish Agricultural Successor Programme (SASP) (2003-2006)	An extension of the SCAFE programme from 1999. LMCF promoted a wider package of land management practices (such as agroforestry) across Zambia's AEZs, with broader aims of farmer group empowerment, food security, and combatting HIV/AIDS.	SIDA Implemented through MACO (now MAL)	Soil/water conservation Increased production/food security Social empowerment
2004	Integration of CA within National Strategy Documents	Conservation farming recognised as important component of national strategy for increasing crop production within the National Agricultural Policy (2004-2015); 5th National Development Plan (2006-2010)	Government of Zambia	Increased production/food security
2007-2011	Conservation Agriculture Programme (CAP) and CA scaling Up for Increased Productivity and Production Project (CASPP).	The CAP and CASPP, implemented through the CFU and MACO respectively, aim to promote CA in 12 districts, through the provision of training sessions, technical support and extension services. The CAP provides outreach via Own Farmer Facilitators (OFFs) and the CASPP through MACO extension staff.	NORAD CFU MACO (now MAL)	Soil/water conservation Increased production/food security

2009	Farmer Input Support Programme and Farmer Input Support Response Initiative (FISRI)	The government's input subsidy programme is designed to supply more farmers (though with smaller input packages) than previous subsidy programmes with reduced price fertiliser and seed inputs and involve local leaders in the selection of beneficiaries. FISRI is a companion initiative to build capacity within the Department of Agriculture and Own Farmer Facilitators (OFF) – lead farmers in the CAP model. OFFs are supported through FISRI through the provision of additional input vouchers.	MACO (now MAL) EU financial support FAO technical support	Soil/water conservation Increased production/food security
2009	Lower Zambezi REDD+ Project	Integration of CA as a mechanism to reduce pressure on land t forest boundaries a pilot REDD+ project that became certified for voluntary carbon trading in 2013	BioCarbon Partners	Soil/water conservation Increased production/food security Climate Change mitigation
2010	Kansanshi Mine Conservation Farming Programme	Establishment of demonstration plots and training for farmers in CA in Ndola and Solwezi to help promote food security and sustainable land management amongst communities resettled from, and in close proximity to, the mine.	First Quantum Mines	Soil/water conservation Social empowerment
2011	6th National Development Plan (2011-2015)	The national development plan cites CA as part of the strategy: to achieve climate change adaptation and mitigation; to diversify and attain national and household food security; and to promote soil management for sustainable agricultural production and growth	Government of Zambia	Soil/water conservation Increased production/food security Climate Change mitigation Social empowerment
2013	CA Scaling Up (CASU) Initiative	Programme to increase CA support and outreach to over 300,000 small-scale farmers by promoting practices based on CA through extension services in nine out of Zambia's ten provinces	EU, FAO, MAL	Soil/water conservation Reduced input dependency Increased production/food security Climate Change mitigation Social empowerment

The accumulation of these varied narratives of CA is evident in the latest CA Scaling Up Initiative. Eleven million Euros have been assigned by the FAO and EU to the MAL (2013-2017) to support the scaling up programme mentioned in the NAPA. Particularly through input supply incentives (through

e-vouchers) and increased extension services, the programme of work aims to establish a network of 21,000 lead farmers and 315,000 follower farmers across 31 districts in 9 provinces (FAO 2013). The justification for the investment draws on all five of the narratives of CA that we have identified in our analysis (FAO 2013). It represents a coordinated effort amongst the public sector, the CFU and NGOs that have been instrumental in the recent history of CA in Zambia, operating under an all-encompassing and persuasive narrative of multiple successes.

CA Evidence Bases and Knowledge Gaps

In this section we review the accumulation of evidence bases around each of the five narratives and consider the extent to which they have been shaped by knowledge, before going on to reflect critically on the broader knowledge politics that has underpinned the CA scaling-up agenda and to discuss implications for the opening up and closing down of pathways of agricultural change.

The story of conservation agriculture in Zambia is not simply one of changing actors and contexts, but of growing evidence bases and research endeavours. Mutual reinforcement between interest and investment in research and the growth of an evidence base adds weight to persuasive narratives of CA success. Research institutions themselves can become a key part of discourse and advocacy coalitions, but they also play a role in identifying, responding to, and critically reflecting on knowledge gaps, with the potential to undermine and reshape dominant narratives and support counter-narratives. Based on a systematic review of academic sources, we briefly trace the growth of the research endeavour – in the form of trial station and on-farm agronomic studies and social science and economics research – around CA in Zambia, with a particular focus on the relationship between changing knowledge and narratives.

Controlled Experiments towards Improving Agronomic Understanding

Agronomic trials of conservation tillage in southern Africa began in the late 1980s, conducted in Zimbabwe through the GTZ-funded Conservation Tillage Project, led by Horst Vogel, which set up experimental stations near Harare and Masvingo (Vogel 1994, Vogel 1995). The findings of these trials, which compared soil erosion and weed pressures under different tillage systems, supported a growing body of research from the United States, Canada and Australia about the benefits of reduced tillage. Although the publication of this research coincides with the establishment of the CFU in Zambia, the documented history of the CFU places more emphasis on personal connections to, and evidence from, the Agricultural Research Trust (ART) facility in Harare, which, inspired by minimum tillage observations from outside of Africa, were working to develop and trial techniques and technologies. That CA is a regionally-developed and context appropriate technology, rather than a product of, sometimes contentious, north to south technology transfer, has arguably been a part of its political appeal, and a southern Africa-centred evidence base around CA has gradually been built, initially through the trail stations of ART and the CFU who have published the results of maize and cotton yield differences under varied tillage (but generally high input) systems internally (e.g. Shitumbanuma 2010), and later through independent research published through academic journals through academic journals

A series of well-cited papers from the International Maize and Wheat Improvement Centre (CIMMYT) researchers Christian Thierfelder and Patrick Wall – that demonstrate higher water

infiltration rates under CA compared with conventional agriculture (Thierfelder and Wall 2009); the soil property benefits of crop rotations (Thierfelder and Wall 2010, Thierfelder, Cheesman et al. 2012); and the productivity benefits of CA (Thierfelder and Wall 2010) – present data from a series of controlled field trial experiments of maize in Monze (Zambia) and Mazowe (Zimbabwe) conducted between 2005 and 2009. Data collected from household surveys and on-farm observations has added weight to trials station evidence about the productivity benefits of CA under a broader range of conditions (narrative 3) (e.g. Rockström, Kaumbutho et al. 2009, Umar and Nyanga 2011). Other CGIAR centres, such as CIAT and ICRISAT, have also contributed to trial station evidence to understand the impact and optimal design of CA in southern Africa (Chivenge, Murwira et al. 2007, Mashingaidze, Madakadze et al. 2012) and ICRAF is developing on farm trials to improve understanding of the mechanics of evergreen agricultural systems (Garrity, Akinnifesi et al. 2010). CIMMYT CA trial station research is largely funded through the International Fund for Agricultural Development and German International Development funds.

The research of these actors is facilitating a growth in understanding of the mechanisms that link CA practices (particularly zero tillage and mulching), with water infiltration, soil moisture retention and sub-surface soil structure. This is adding weight to the narrative of soil and water conservation in particular (narrative 1). As the narrative with the longest history in Zambia it makes sense that it has the most well-established evidence base. However, the interaction of different tillage practices, soil cover types and crop rotations under different agro-ecological conditions, and the implications of these interactions for soil stability and water are inevitably only partially understood. Some mechanisms – e.g. the effects of tillage systems on populations of macrofauna and sub-surface biotic processes (Chan 2001, Giller, Corbeels et al. 2011); the relationship between residue properties and nitrogen mobilisation in soil (Giller, Witter et al. 2009) – have been the subject of very little investigation. Within this field of research, evidence about the mechanisms and effectiveness of soil carbon sequestration within CA systems is limited to a long term study of the impacts of tillage on soil carbon stabilization conducted by CIAT (Chivenge et al., 2007), but there has been limited research into the effects of CA on carbon stocks at lower horizons or the impacts of reduced soil mixing on CO_2 emissions. When coupled with a lack of understanding about the specific drivers of deforestation in Zambia, the evidence base underpinning the climate change mitigation narrative around CA (narrative 4) is currently very weak (Powlson, Stirling et al. 2014).

Investigating the Macro-, Micro-, and Socio-Economics of CA

Recent research into the household economics of smallholder farming, the impact of structural adjustments and subsidy policies, and national maize prices, conducted by the Indaba Agricultural Policy Research Institute in Zambia, is providing retrospective insight into the appropriateness of, and the market-level enabling conditions for, a maize CA-based national agricultural strategy (Ngoma, Mulenga et al. 2014). Observations that CA adoption is dependent on the supply of provision of input packages (usually fertiliser and seed) through extension programmes, and that high rates of dis-adoption ensued following the expiration of this input support (Arslan, McCarthy et al. 2014, Ngoma, Mulenga et al. 2014) raises questions about the validity of a reduced input dependency narrative around CA (narrative 2).

Researchers from Michigan State University, the University of Zambia, and the Norwegian University of Life Sciences are leading a growing body of research into the drivers of CA adoption and dis-adoption and contributing to understanding about the relationship between technologies and techniques of CA and the resource endowments of smallholder farmers (Grabowski et al., 2014). This work provides information about the broader economics of CA, and information about the markets for cover/rotation crop products; the accessibility of those produce (and associated inputs) markets; the opportunity costs associated with using crop residues as mulch; fertiliser use under precision application systems; and the affordability and importance of herbicide and pesticide inputs (Ngwira, Aune et al. 2012, Umar, Aune et al. 2012, Grabowski, Haggblade et al. 2014).

Within the food security narrative around CA (narrative 3), there is very little reference made to research that links the presumed relationship between CA and productivity, to broader concepts of food security, such as food availability, entitlements, health and nutrition. There is a lack of understanding about the social, economic, cultural and political drivers of food insecurity at local and national levels (Misselhorn 2005, Dorosh, Dradri et al. 2009). Nor is it known the extent to which the promotion of CA systems, which have predominantly revolved around maize production, with little or no application to alternative cereals such as sorghum or millet, are acting to encourage or lock farmers into a maize dominated agriculture (Brooks, Thompson et al. 2009) and diet, or how CA might be designed to improve nutrition.

Assumptions about the relationship between increased productivity (through CA) and the transition of smallholder farming to commercial production are problematic (in narrative 5). Research from CIMMYT socio-economists, IFPRI, and the Future Agricultures Consortium, has established that such transitions are subject to a variety of constraining factors in the context of smallholder agriculture in southern Africa (Chirwa and Matita 2012). At the household-level factors include remoteness and the condition of infrastructure; social capital and cooperation; consumption preferences; household assets and endowments; regulation and institutions; and whole farm economics (Chirwa and Matita 2012, Fan, Brzeska et al. 2013), and are shaped by broader supply and demand dynamics and prices (Alemu 2007). These constraints are well understood but easily lost in narratives of productivity-centred growth, transitions to commercial production, and poverty alleviation.

Evidence regarding the claimed empowerment of women and reduced female labour burden under CA is also limited (narrative 5). Recent evidence from social impact studies conducted in CA project communities in Malawi, by Concern Universal (2011) and Concern Worldwide (2013), which indicate particular savings in pre-planting land preparation and weeding under CA, add weight to this narrative. However, the relationship between tillage and mulching practices, agro-ecological conditions, herbicide use, health, and weed pressures, remains poorly understood (Nyanga, Johnsen et al. 2012).This complex relationship has important implications for realised labour burdens.

Evidence Bases, Assumptions and Knowledge Politics

Whilst there is growing research into the design, impacts, and enabling conditions of CA across disciplines, there is a striking lack of reference to peer-reviewed literature within CA project reports. In most cases the establishment of evidence bases lags behind the success claims contained within the narratives of the CA community. The complexity of CA practice and the spatial and temporal variability of physical and social conditions and constraints, means that there are so many

combinations of practice, outcomes, agro-ecological conditions and thresholds to be tested that knowledge gaps are inevitable. Cumulatively, existing evidence is pointing to the reality that the mechanisms and virtues of CA are not universal, and challenging the appropriateness of a scaling-up agenda based on the setting of ambitious nationwide adoption targets, an approach that leaves little room for flexibility in the adaptation of CA practice to the constraints and conditions of local farm systems. Whilst there is an arguable need for improved evidence bases that evaluate CA performance and socio-economic impact at local levels it is unclear whether such evidence alone would be sufficient to challenge and transform financially- and politically-supported agendas of scaling up. If such research is limited to post-hoc evaluations, framed by existing conventions, i.e. testing persuasive narratives that are already shaping investments and policies, the space for counter-evidence to be produced and influence alternative pathways of agricultural development is restricted.

Emerging critical literature, particularly from Wageningen University, has highlighted some of the knowledge gaps alluded to above and has hinted at a problematic knowledge politics that closes down space for this critical reflection. The title of Giller et al.'s (2009) paper refers to their view as that of the 'heretic':

> *"We do not doubt that agriculture is possible without tillage, yet when we question whether CA is the best approach, or whether the suitability of CA in a given setting has been established, the reactions are often defensive. It seems as if we assume the role of the heretic – the heathen or unbeliever – who dares to question the doctrine of the established view."* (Giller et al., 2009: 24)

This highly-cited paper, at least within the academic community, has seemingly opened up space for a more critical reflection on knowledge gaps around CA in southern Africa (Giller, Corbeels et al. 2011, Andersson and D'Souza 2014, Whitfield, Dougill et al. 2014). The extent to which this has influence in shaping research agendas and investments remains to be seen. Such perspectives were in a notable minority at the first Africa Congress on Conservation Agriculture in 2014 and, as discussed in the next session, were absent within its concluding declaration.

Discussion: Unpacking CA Knowledge Politics

Over the recent history of CA in Zambia, five narratives around (1) soil and water conservation; (2) reduced input dependency; (3) increased productivity; (4) reduced agricultural and deforestation emissions; and (5) social empowerment, have emerged and accumulated. Rather than representing evidence-based claims, endeavours towards building evidence bases around each of these narratives has lagged behind the popularisation of these narratives within project outputs, policy, and rhetoric. These narratives are, it is argued, inherently political. They have been built in response to new political agendas, circumstances, and priorities, and this evolution has seen new actors and projects become a part of the CA community.

This community appears to be a model example of Sabatier's (1988) advocacy coalition, in which a group of actors is brought together by a common solution, CA, and has grown in number and political influence, as a varied set of concerns and priorities have become attached to, and associated with, this solution. As is typical of an advocacy coalition, over time its members and its narratives have developed into an inseparable unit. The recent scaling up endeavour, for example,

involves a community of public and NGO-sector organisations that simultaneously proclaim the multiple wins associated with CA, without an obvious delineation of these concerns across the different contributors and one that presents a persuasive success story in justification of scaling-up. in spite of supporting evidence that is in some cases weak and contested

However, there is also some evidence of a diversification of discourse, particularly in relation to the types of CA system that are advocated. Over its recent history in southern Africa and in Zambia in particular, CA has been adapted for smallholder applications, new ripping technologies and land preparation techniques have been advocated in different contexts, and agroforestry and fertiliser tree techniques have become popular amongst some groups, particularly in response to new climate policy / REDD-related concerns.

A core coalition appears to have emerged around the response to structural adjustment policies and national government has supported and acted to advance the promotion of, relatively conventional high-input maize-based CA, in which programme partners provide inputs, filling a gap initially left by removed fertiliser subsidies. This CA system and its associated model of incentivisation, has been replicated over consecutive programmes that have involved a common cast of organisations, including the government's agriculture ministry. Organic and low input CA has been advocated largely outside of this core group, and with limited donor support.

Many of the claims about CA benefits – social empowerment, food security, market access, and carbon sequestration – are dependent on this assumption of improved productivity under CA. There is a growing body of agronomic research that compares the productivity of CA with conventional systems, both in controlled field trials and through on-farm surveys. Whilst this evidence is lending support to the narratives about increased productivity under certain agro-climatic conditions and CA applications (inputs, mulch applications, tillage systems), it is not universal or conclusive with regard to CA impacts, particularly where CA is being practiced in resource constrained agricultural systems (Powlson et al., 2014). Selective references to this body of evidence to underpin a broad range of claims about the benefits of CA reflect a subtle knowledge politics that is underpinning CA and the difficulty of challenging dominant narratives through evidence alone.

Discrepancies within the narratives advanced by the CA community also exist to some extent around claims about women's empowerment and its role as a technology of climate change mitigation. It is here that Hajer's (1995) discourse coalition concept is relevant for interpreting the nature of the CA community. In Hajer's theory, political power is tied to the persuasiveness of discourse, and this persuasiveness and the mobilisation of actors around a particular discourse, is subject to change through evidence, communication and learning. Peripheral narratives of women's empowerment and climate change mitigation, which are simultaneously associated with weak evidence bases, represent particularly important areas for research and learning, with the potential to revel new insight about the contextual appropriateness of CA and even undermine some of the success claims around it. This will be an important counterpoint to the calls for blanket upscaling of the technology and a pre-occupation with aggregated adoption rates.

The extent to which an increased research endeavour can challenge the advocacy, and increasing dominance, of CA as an overarching agricultural strategy in Zambia, is less clear however In Sabatier's coalition, power is more closely tied to the actors themselves and they might exercise this in framing research around support for particular political agendas or closing down dissenting

knowledge, to the point that such perspectives appear unscientific (Leach, Scoones et al. 2010) or even heretical. The accumulation of multiple narratives about the benefits of CA, particularly in relation to food security, poverty alleviation and social empowerment, supports the feeling of a moral urgency around the scaling up of CA. This is reflected in the language of the declaration of the 1st Africa Congress in Conservation Agriculture, held in Lusaka in 2014:

- *Acknowledging that CA is set to become a major contributor to achieving CAADP's goal of 6% annual growth in the agricultural sector which employs 80% of Africa's rural population;*
- *Noting the documented impact and feedback from practicing CA farmers across Africa and in other developing regions, and its significantly positive impact on their incomes, livelihood, well-being and on empowerment of women farmers;*
- *Further noting that CA is one of the best food security and profitability options for farmers*

…We call for commitment from all national and international stakeholders in the public, private and civil sectors to support the up-scaling of CA as a climate smart technology to reach at least 25 million farmers across Africa by 2025

'One of' was added to this text at the last minute when participants in the concluding delegate forum challenged the phrasing of the draft declaration, produced by the conference select committee, which claimed that CA was '*the best* food security and profitability option for farmers'. It is in response to this point that research endeavour, if it is affect to change in the context of powerful consensus around scaling-up CA, may be more effective. In an extension of Hajer's theory, Roe (1994: 32) describes narratives as organisation of ideas, understandings and values that 'underwrite and stabilize assumptions for policymaking'. According to Roe (1994) acceptable metanarratives, which become the foundation of policies, are the result of a resolution between a conventional narrative and its counter narratives, a process that is continually occurring. The understandings and ideas that underpin the apparent consensus around scaling up CA may be contestable, as has been shown in the above description of knowledge gaps. However, the implication of Roe's theory, and one that is prescribed to here, is that transformation will depend not on critiques of evidence bases, which are but one component of the broader knowledge politics around CA, but on the construction of alternatives to its overarching consensus on scaling up. In other words, it is not in evaluating and critiquing the productivity, social impact, or mitigation potential of CA as an agricultural technology that a change to this consensus thinking is likely to be effected, but in identifying the value, in light of the heterogeneity and variability of farming systems, of its alternatives and adaptations; building a case for multiple pathways of agricultural change (Leach, Scoones et al. 2010) as a counter to scaling up agendas that act to close down to a single broadly adopted pathway.

A critical reflection on knowledge gaps and the assumptions that underpin narratives of CA and appreciation of their political nature, as has been contributed to in this paper, is a step towards identifying and opening up the political space for narrative renegotiation. The danger is that the persuasiveness and power of existing narratives, whether this power is attached to actors or to the narratives themselves, limits space for contestation and suggesting alternatives. Importantly, opening up to alternatives involves not only identifying and addressing knowledge gaps, as is increasingly being done through research, but also engaging with this politics. Pursuing the central pillars of climate smart agriculture – sustainable increases in productivity, building resilience to

climate change, and reducing greenhouse gas emissions – is an important endeavour that is currently benefitting from international support and a political window of opportunity. CA is emerging as a dominant response in Zambia, but it remains to be seen if critical voices and alternative advocacy can challenge this dominance.

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