Managing Soil Carbon to Mitigate Climate Change:

A Sound Investment in Ecosystem Services

A Framework for Action

This framework summarizes the actions proposed by 60 delegates from America, Africa, Asia, Australia and Europe at an international Conservation Agriculture Carbon Offset Consultation held on October 28 – 30, 2008, at the Beck Agricultural Center, West Lafayette, Indiana, United States. This Consultation was jointly organized by the Food and Agriculture Organization (FAO) of the United Nations and the Conservation Technology Information Center (CTIC), with technical support from the United Nations Framework Convention on Climate Change. It is intended principally for the use of people who attended the Consultation, so that it can serve as a common point of reference as they engage themselves in follow-up activities, as well as a guidance document for institutions and countries considering carbon schemes for agricultural land management. Currently, soil carbon sequestration does not fit under any of the market-based mechanisms of the Kyoto Protocol, and soil carbon is not included as an option in either Article 3.3 or 3.4 of the Kyoto Treaty. The evolution of national and international policies on carbon credits and the replacement of the current Kyoto treaty in 2012 provide opportunities to promote carbon credits in conservation agriculture.

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TABLE OF CONTENTS

ABSTRACT

Global agriculture policies on carbon credits will have to change radically if the world is to avoid future food insecurity and associated large-scale environmental and social problems. Hunger, poverty, rural livelihoods, nutrition and human health are critical issues worldwide that need to be address in ways that are environmentally, socially and economically sustainable. The scientific evidence is clear that even under the most optimistic projections, global climate change may profoundly affect water supplies that are vital to our environment, economy and public health. People are beginning to focus on the imperative to reduce greenhouse gas emissions and their own carbon footprints.

Agricultural systems have contributed to human-induced climate change and, in turn, human-induced climate change threatens agricultural productivity. In many countries, access to food has been taken for granted, and farmers and farm workers have been poorly rewarded for acting as stewards of almost one-third of the Earth's land area used for agricultural production. Conservation agriculture, if adopted in every agricultural region, can be part of the solution – producing food, fiber and energy in ways that minimize environmental impacts and provide economic benefits for the agricultural communities. Delegates at the Consultation agreed that by incorporating aspects of conservation agriculture into the Kyoto Protocol's Clean Development Mechanism (CDM) in the form of stewardship incentives may lower the costs of emission reduction and environmental quality projects as well as reward farmer stewards for their work.

The broad objectives of this review are to:

1. Outline the steps necessary to assess the potential in the existing global carbon offset markets related to conservation agriculture
2. Describe possible public finance mechanisms evolving around the Clean Develop Mechanism and the United Nations Framework Convention on Climate Change
3. Promote agriculture and specifically conservation agriculture to be recognized and qualified within mechanisms and schemes for stewardship incentives
4. Emphasize and highlight the enabling economic aspects of the Clean Develop Mechanism for promoting conservation agriculture.

INTRODUCTION

Global environmental change concerns us all. Scientists have assembled the evidence for climate change and emphasized its anthropogenic causes. In a remarkably short time, scientists have concluded that warming of the climate system is “equivocal" and there is a "very high confidence that the globally averaged net effect of human activity since 1750 has been one of warming" (IPCC, 2007). This type of process of discovery and explanation can be seen at work in dealing with other environmental problems such as acid rain, radioactive waste, biodiversity loss and desertification. The scientific method with its appeal to rationality, consistency and truth provides the knowledge necessary to identify ways of dealing with the problems but, in itself is not a sufficient basis for appropriate action. Science may lay out the possibilities but cannot affect the solutions that require social interaction and policy implementation. A complementary approach between science and policy analysis and development is an essential step toward addressing problems that have global implications.

NEED

Soils are the fundamental foundation of our food security, global economy and environmental quality. Soil quality is largely governed by soil organic matter (SOM) content, which is a dynamic pool and responds effectively to changes in soil management, primarily tillage and carbon inputs resulting from biomass production. Maintaining soil quality and soil health can reduce problems of land degradation, decreasing soil fertility and rapidly declining production levels that occur in large parts of the world which lack the basic principles of good farming practices. In view of the rapidly expanding global population and, therefore, the pressure on the finite amount of land available for agricultural production, we must learn and communicate the importance of protecting our soils and natural resources. Rattan Lal, The Ohio State University, says "Soil, and specifically sound soil management, is essential in our continued quest to increase the production of food, feed, fiber, and fuel while maintaining and improving the environment, and mitigating the effects of climate change. Being the essence of all terrestrial life and ecosystem services, we cannot take the soils for granted. Soil is the basis of survival for present and future generations."

When used inappropriately, agricultural practices can cause serious soil losses. Excessive tillage often leads to unintended consequences of water, wind and tillage erosion. If the degradation of agricultural soils continues unchecked, the world may face serious problems in feeding a growing population. There are different causes for this inadequate use of the soil. In many developing countries, hunger is forcing poor people to cultivate areas that are not suitable for agricultural use and that can be converted into agricultural land use only with major and costly efforts, like construction of terraces.

Soil loss through erosion, however, is only one consequence of the way agricultural soils are treated in mechanized agriculture. The loss of rain water that cannot infiltrate in the soils to replenish the ground water reserves might be the more serious long-term result of excessive tillage.

Consequently, the way soil is cultivated must be drastically changed. Soil erosion and water loss are controlled not only by mechanical means but also by a living and stable soil structure that depends on the soil carbon pool and its quality. Maintaining soil quality can reduce problems of soil degradation, decreasing soil fertility and rapidly declining production levels that occur in large parts of the world that would benefit from adoption of conservation agriculture.

The essence of true soil conservation is carbon management. By properly managing the carbon in agricultural ecosystems, we can have less erosion, less pollution, clean water, fresh air, healthy soil, natural fertility, higher productivity, increased biodiversity and sustainability. Dynamic soil quality encompasses properties that can change over relatively short time periods (e.g. SOM, labile SOM fractions, soil structure components, and macro porosity) in response to human use and management with agronomic practices. The SOM is both inherent, as total SOM related to particle size distribution, and dynamic, as it is related to ongoing inputs of organic matter to the soil. A dynamic part of soil carbon cycling is directly related to the "biological carbon" cycle.

There is general agreement that although soil is part of the climate change problem, it also can be an integral part of the solution. The extent to which soil emits greenhouse gases (GHGs) and to what extent the processes leading to these emissions can be reduced will need further work to be better understood and quantified. However, it is clear that reduction of emissions from agricultural activities can be addressed by restoring degraded/desertified ecosystems, adopting appropriate soil management practices, including conservation agriculture, maintaining carbon in soil and, if at all possible, by increasing soil carbon and reducing GHG emissions and the use of emission-creating inputs.

Enabling and encouraging broader adoption of conservation agriculture practices through market-based mechanisms will create the catalyst necessary to elevate agriculture's role as a key part of a global approach to mitigating climate change.

CURRENT CONDITION

The United Nations Framework Convention on Climate Change (UNFCCC) was adopted on May 9, 1992, by the Intergovernmental Negotiating Committee established for its negotiations and was opened for signatures in June 1992 at the Earth Summit, held in Rio de Janeiro, Brazil. It came into force on March 21, 1994. The Convention aims to stabilize GHG concentration in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.

The adoption of the Kyoto Protocol in December 1997 was a significant step toward tackling the problem of global climate change at the dawn of the 21st century. The Protocol states that sinks and sources of carbon must be accounted for "taking into account uncertainties, transparency in reporting, and verifiability." Included are three carbon market-based mechanisms that allow credits for projects aimed at reducing anthropogenic emissions from sources or enhancing anthropogenic removals by sinks of greenhouse gases. The three mechanisms are: Emissions Trading (ET), the Clean Development Mechanism (CDM) and Joint Implementation (JI). An emission reduction project refers to a business initiative that receives funding because of the cut in emissions of GHGs that will result from it over and above what would have occurred in the absence of the project. To prove that the project will result in real, permanent, verifiable reductions in GHGs, a project design must be provided and validated by an approved third party in the case of CDM or JI projects. After implementation of the project, the emissions reductions are verified by a third party before formal issuance of the certified emissions reductions.

The CDM is an arrangement under the Kyoto Protocol allowing industrialized countries with a GHG reduction commitment (called Annex 1 countries) to invest in projects that achieve reduction in emissions through investments in developing countries. This bilateral arrangement allows cost effective means of emission reductions as opposed to more expensive emission reductions in developed countries and simultaneously provides an opportunity for sustainable development in developing countries. A crucial feature of an approved CDM project is that the planned reductions would not occur without the additional incentive provided by emission reductions credits, a concept known as "additionality." The CDM allows net global GHG emissions at reduced global cost by financing emissions reduction projects in developing countries where costs are lower than in industrialized countries. For the first commitment period (2008-2012), the Kyoto Protocol allows credits for sequestration of carbon only through afforestation and reforestation (A&R) project activities.

Soil carbon sequestration currently does not fit under ET, CDM or JI and neither Article 3.3 nor 3.4 of the Kyoto Protocol specifically include soil carbon as an option. Yet, this is precisely what is needed to commodify soil carbon and create another income stream for resource-poor and small size land holders. Indeed, this is an essential pre-requisite to widespread adoption of recommended management practices in the developing countries where the problems of food insecurity and soil/environmental degradation are extremely severe.

APPROACH FOR CHANGE

The term "conservation agriculture" implies conformity with all three of its pillars: (i) minimum soil disturbance, (ii) diverse crop rotations and/or cover crops and (iii) continuous plant residue cover. The foundation underlying these principles is their interactions with and contributions to soil carbon, the primary determinant of soil quality.

Storing carbon in soils reduces atmospheric levels of carbon. The amount of carbon released from soils depends directly on the volume of soil disturbed during tillage operations. Therefore, the less soil is disturbed, the better the conservation of soil carbon. No-till (NT), zero till (ZT) and direct seeding (DS) are often used interchangeably to denote minimum soil disturbance and are associated with many environmental benefits. Conversely, intensive tillage with ploughing and powered tools like rotary cultivators leads to uncontrollable carbon loss in soils and to a degradation of soil fauna and biodiversity. Therefore, intensive agriculture that avoids inversion tillage and emphasizes carbon management with conservation agriculture has potential to offset some CO_2 emissions and may be a small but significant player in sequestering carbon and mitigating GHG emissions.

A successful conservation agriculture program that significantly sequesters carbon will maximize carbon inputs, minimize carbon outputs and achieve an economic balance that will favor the producer.

The reduction of carbon outputs is achieved by reducing mechanical soil disturbance, which leads to increased mineralization and soil carbon loss, as much as possible. Through the increase of the biomass production in the system and the retention of as much biomass as possible, the carbon inputs can be increased. Both elements together lead to significant carbon sequestration.

Experts at the Consultation agreed that the three principles of conservation agriculture are generally suitable to achieving significant carbon sequestration; however specific quantification of the principles for different agroecological zones is required.

- For minimum soil disturbance, preference is given to permanent no-till systems that exclude any form of tillage. Localized tillage may be required in some climatic situations, and these situations need to be quantified.
- The options for crop rotations with cover crops will vary widely according to the climatic zones. For the purpose of carbon sequestration, the rotations must include crops which contribute sufficient carbon and nitrogen to the soils.
- The need and possibilities for residue retention in order to provide carbon to the soils varies widely across agroecological zones. Minimum amounts will have to be specified for each situation.

Conservation agriculture systems that follow the three principles will sequester soil carbon. The potential for carbon sequestration with such systems depends on the degree of soil degradation. Degraded soils have the highest potential for restoring carbon through a regeneration process.

Conservation agriculture also includes the integration of crop and livestock production and controlled traffic. These complimentary practices might be required to reduce energy inputs and avoid soil compaction. Emissions of other relevant greenhouse gases, such as methane, N_2O and NOx, can be reduced as well under conservation agricultural systems that avoid compaction, provide adequate water, manage nutrients and other inputs, and reduce fossil fuel use.

Widespread adoption of comprehensive conservation agricultural systems will result in myriad environmental services, not the least of which is mitigation of climate change. Before this practice can have significant global impact, however, regional, state, national and international initiatives must be implemented to achieve the critical mass necessary to arrest the growth of greenhouse gases in the atmosphere. Market-based initiatives – that pay farmers for the carbon they store in the soil – will have the greatest success and bring the greatest reward for the economy and the environment.

BENEFITS FROM CONSERVATION AGRICULTURE

In order to recognize the environmental benefits – and potential for mitigating climate change – of conservation agriculture, more farmers in every country need to change their operations, adopt new practices and follow the principles.

While the adoption of conservation agriculture practices normally may bring direct, though not always immediate, financial rewards to farmers, changing a cropping practice carries risks, and the direct profitability expected through adoption of the new practices may be subject to market failures. Financial incentives, policies and legislation, therefore, are necessary to encourage adoption and long-term maintenance of conservation agricultural systems. The ecosystem and environmental services benefiting all of society justify the time and expense to develop these mechanisms that will enable farmers to transition to conservation agriculture systems. As more and more people depend on fewer farmers it is imperative that each farm not only contribute to the world's supply of food, feed, fiber and fuel but also play a critical role in addressing climate change.

Promotion, adoption and reward of conservation agriculture will have far reaching benefits, touching farmers, their communities and society as a whole.

Financial benefits for farmers

- Greater stability in yields over varying climate years and with unfavorable weather
- Higher ratios of outputs to inputs
- Greater resilience to drought through better water capture and soil moisture retention
- Reduced demands for labor and much lower costs of farm power (fossil fuels) and greenhouse gas emissions, through reduced tillage and weeding
- Release of labor at key times, permitting diversification into new on- and off-farm enterprises
- Better cycling of nutrients and lower losses of plant nutrients through accelerated erosion caused by inversion tillage
- Higher profit margin because of increase in use efficiency of inputs
- Increased land value over time because of progressive improvements in soil, water and air quality
- Decreased compaction
- Opportunities for diversification

Benefits to communities and society

- More reliable and cleaner water supplies, which leads to lower treatment costs
- Less flooding through better water retention and slower run-off means less damage to infrastructure, e.g. roads. canals, ports and bridges
- Improved air quality with decreased wind erosion
- Better food and water security
- Economic and industrial development opportunities

Environmental benefits

- Favorable hydrologic balance and perennial flows in rivers to withstand "extreme weather events"
- Reduced incidence and intensity of desertification
- Increased biodiversity both in the soil and the above-ground agricultural environment for nutrient cycling
- Lower levels of soil erosion and sediments in rivers, dams and irrigation systems
- Greater carbon sequestration and retention in soils resulting in reduced emissions of GHGs including CO_2 and CH_4
- Reduced need for deforestation because of land use intensification and more reliable and higher crop yields
- Less water pollution from pesticides and applied fertilizer nutrients
- Decrease in hypoxia of coastal ecosystems

Policy and financial instruments, such as stewardship incentives, would invest in the full potential of conservation agriculture. Market-based mechanisms could harness arable agriculture for the purpose of climate change mitigation while at the same time stimulating the adoption of a sustainable way to intensify agricultural production.

POLICY CHANGES REQUIRED FOR CLIMATE CHANGE MITIGATION THROUGH SOIL CARBON MANAGEMENT

The value of ecosystem services associated with conservation agriculture must be more clearly understood and quantified. A policy framework is needed to address the economic, social and technical issues related to environmental quality and sustainability. To some, excess carbon in the atmosphere is a problem because of its contribution to global warming; to some limited carbon in the soils is a problem leading to environmental degradation. Soil carbon sequestration in conservation agriculture offers the opportunity to bring these two concerns together and provide a mutually beneficial solution. New integrated policies are required to encourage acceptance and application of new technology related to soil carbon benefits.

No-tillage based cropping systems like conservation agriculture are not currently eligible for carbon credits under mechanisms like the Kyoto Protocol for a number of reasons. Soil carbon is considered a nonpoint source and spatially variable in the field, requiring a large number samples for a field average. Being very dynamic, soil carbon can change drastically as a result of inversion tillage and low-diversity cropping systems. While technology is improving, the total carbon changes may be relatively small for many agricultural management practices and thus long periods may be required to quantify small differences in carbon accumulation.

Increasing focus is given to conservation agriculture as a fundament for sustainable production intensification, though much more policy support is needed. This was also stated during a recent consultation, “Investing in Sustainable Agricultural Intensification, The Role of Conservation Agriculture,” (held by FAO on Aug. 10, 2008, in Rome, Italy) which resulted in a framework for action in support of conservation agriculture. The foundation for growth provided in that document needs extension through specific mechanisms to reward improved carbon management on the land.

In addition, the recent visionary action taken by U.S. Senator Sherrod Brown and several colleagues in the U.S. Senate of the 110th Congress to pass Senate Resolution 440 on June 23, 2008, helped to usher in legislation that recognizes soils as an "essential" natural resource. This resolution recognizes the importance of soil and the importance of soil professionals in managing our nation's soil resources. It also places soil on par with water and air. For the first time, soil is recognized as impacting climate, water and air quality, human health, biodiversity, food safety and overall agricultural production. It is viewed as a dynamic system which performs many critical functions and services vital to human activities and ecosystems sustainability. As such, soil management deserves a coherent and effective legislative framework aimed at the protection and sustainable use of the soils.

The European Commission’s effort, "Can Soil Make a Difference?" (June 12, 2008, Brussels, Belgium), on decreasing soil degradation and the change in attitude toward soil carbon is the type of forum that needs to be implemented globally. The forum, attended by the European Ministers of Environments, encouraged a strong dialogue between soil scientists and policy makers. These noble actions require some form of economic support to gain rapid acceptance and application to the land.

ACTIONS

Considering the above, the delegates of the Conservation Agriculture Carbon Offset Consultation arrived at the following proposed action plan:

Goal
To address social, environmental and economic incentives for promotion of conservation agriculture by identifying specific enabling policies, strategies and mechanisms that governments and international institutions can implement to leverage carbon investments, support suitable soil management concepts for agricultural land, and provide encouragement to broaden the adoption of conservation agriculture technologies.

Strategic issues
No-till farming, an integral component of conservation agriculture, is presently practiced on about 100 million hectares (Mha), or about 6% to 7% of the world's cropland area. Since the 1960s, however, researchers have proven conservation agriculture's positive economic and environmental benefits in temperate regions; in the 1970s, similar benefits were proven in the tropics, including West Africa. The slow adoption of this important technology is attributed to a range of biophysical, social, economic and policy factors including land tenure. Furthermore, some soils and environments are not conducive to adoption of no-till farming without additional steps to improve edaphological conditions. No single management system can be universally applied to diverse soils and ecoregional environments. Therefore, it is important to prepare a soil/ecosystem guide to adoption of no-till farming and other recommended management practices for sustainable management of soil and water resources in a changing environment.

Fair price
Costs of ecosystem services are difficult to quantify and are often overlooked in policy development. Increase in adoption of conservation agriculture may involve costs and risks to which farmers, especially small-scale farmers in resource-poor settings, are averse. The cost of social and environmental benefits accrued from conservation agriculture must be shared by all of society. Appropriate policies and incentives must be put in place to share costs and risks and recognize the public goods value of environmental benefits generated by widespread conservation agriculture adoption. Creating another income stream for farmers through payments of ecosystem services is an important strategy that cannot be over-emphasized. The price for carbon should also reflect both the on-site and off-site value and societal gain in order to provide a real incentive for farmers.

Conditions for trading
In the European Union, carbon markets are developing for industrial sources with minimal emphasis on agricultural sources. In the U.S. and Canada, voluntary public markets and a few private markets have evolved and appear to be working. These markets will struggle until a new national policy is adopted and coordinated with an international policy (yet to be developed). The combined efforts of the UNFCCC and the ICCP to identify and define benefits of carbon management and soil carbon sequestration supported by solid scientific evidence are critical in the development of the stewardship incentives. At this point, the financial and economic institutions will be required to "polish" a comprehensive global system with stewardship incentives for promoting carbon and environmental benefits.

Processes for carbon trading must be simple, transparent, consistent, comparable, complete, verifiable and efficient. Agreement about carbon gains under clearly defined management and climatic conditions must be sought and means of verification established. Protocols defining field practices as well as verification and monitoring for carbon markets need to be developed in a harmonized and standardized way with local adaptation to specific agroecological conditions.

Modelling can be used to fill gaps, and locally calibrated remote sensing tools can be used to facilitate verification.

Aggregation
Methods and procedures need to be developed and introduced to aggregate areas and activities, particularly in regions dominated by smallholder farming. This could include harnessing of satellite-based GIS technologies for verification. The program must cover several scientific protocols and follow the approved government process providing security to both buyers and sellers. There are several different farming changes that can result in the creation of credits. They are based on best management practices and site-specific parameters controlled primarily by soil, climate and crop production systems.

Policy issues
Some elements of existing carbon markets are not conducive to facilitating the integration of good agricultural practices into these markets. One of these elements is “additionality,” which might give to perverse incentives. For this reason the concept, or at least its application, should be reconsidered for carbon credits to conservation agriculture. This is particularly the case were conservation agriculture is already practiced for many years without any recognition yet of the carbon stored in the soil.

A key challenge that exists is how to encourage a change in practice that leads to a wider environmental benefit. Policy instruments such as subsidies, technology standards, educational programs and other such tools may be used to bring about change. Governments must enact appropriate policies and measures that effectively decrease CO_2 emissions, enhance carbon sequestration and reduce greenhouse gas levels in the atmosphere.

Policymakers should understand that including cropping agriculture and biomass production for bioenergy into carbon trading and investment would result in much greater impact than only related to climate change. Greater adoption of conservation agriculture -- as means for sustainable intensification of agricultural production -- has significant potential to stimulate rural development and contribute to poverty alleviation. The recent increase in the use of biomass for bioenergy places additional emphasis on carbon management for maintaining soil quality. Removal of crop biomass for bioenergy must not destroy the protective layer that prevents soil erosion and provides carbon return to the soil to maintain nutrient cycling and biological activity.

Several stakeholder groups, including farmer organizations, environmental NGOs, international development banks and country governments, would potentially be interested in harnessing carbon markets for their agenda. These groups should be mobilized for a concerted effort to integrate conservation agriculture and soil carbon sequestration into global incentive-based programs, such as carbon credit trading. Through these groups parties of the UNFCCC could be influenced to include conservation agriculture as viable option for climate change mitigation qualifying for carbon market mechanisms in the post Kyoto negotiations.

Priority actions

1. Prepare a science-based synthesis documentation on how conservation agriculture and soil carbon management provide ecosystem services. This should include identifying optimized measurement methodologies and determining the potential of soil carbon sequestration for defined crop management systems and ecoregions of the world.
2. Develop standardized protocols for applying science-based information to conservation agriculture projects that provide ecological goods and services using internationally accepted guidance, such as ISO 14064 for greenhouse gas emission reductions.

3. Enable conservation agriculture to be recognized within any renegotiated Clean Development Mechanism formed by the United Nations Framework Convention on Climate Change after the current expiration in 2012.
4. Promote closer interaction between government agencies, farmers, private sector, technology generators and disseminators, and non-government organizations in policy reform, as well as for the design and application of stewardship incentives for broad acceptance of conservation agriculture.
5. Seek government endorsement of conservation agriculture for development of national and international policies to value ecosystem services.
6. Support adoption of conservation agricultural technologies through payment for ecosystem services (e.g., soil carbon sequestration and water quality benefits).
7. Mobilize the commercial sector to recognize the importance of ecosystem services provided by conservation agriculture, particularly its role in soil carbon sequestration, for the support of conservation agriculture at global or at least regional levels for both large and small farmers

SUMMARY

Soil carbon is the foundation of soil quality, and healthy soil is essential for sustainable global biofuel/bioenergy and food production systems. While tillage-based agriculture damages the soil, conservation agriculture builds soil quality, protects water quality, increases biodiversity and sequesters carbon. This environmentally beneficial and economically viable method of production agriculture should be supported and endorsed through policy mechanisms so that worldwide adoption is increased and global benefits are realized.

Market-based mechanisms should recognize the value of soil carbon stored through conservation agriculture practices and compensate farmers for implementing those practices and providing the greater ecosystem services. Policy discussions should focus on establishing permanent or indefinite carbon sinks, preventing carbon losses and agreeing on measures. It should further be determined whether possible limitations in the applicability of the actual regulations of carbon markets for soils under field crops can be justified through the potential of carbon sequestration in this sector. Through a systematic assessment of the roles of crops in the carbon cycle, it is possible to determine a value for the potential of carbon sequestration.

The potential of conservation agriculture – from improvement of soil quality on one small farm to the mitigation of global climate change – is too incredible to ignore. The Consultation delegates outlined this framework for action so that potential can soon be realized.

More work is needed – through research, application and policymaking – to expand the current understanding and adoption of conservation agriculture. With increasing concerns for global food and energy security, economic stability and environmental sustainability, the time for action is now.

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Review results and presentations of the Consultation at www.conservationinformation.org.

FURTHER READINGS

FAO, 'Investing in Sustainable Agricultural Intensification The Role of Conservation Agriculture A Framework for Action', developed at a Technical Workshop, held at FAO headquarters (Rome) in July 2008, entitled: "Investing in Sustainable Crop Intensification: The Case for Improving Soil Health" (www.fao.org/ag/ca/doc/proposed_framework.pdf)

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