# PART III

# Investing in sustainable agricultural intensification The role of conservation agriculture

## *A framework for action*

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This Framework summarises the actions proposed by delegates at a Technical Workshop, held at FAO's offices in Rome in July 2008, with technical support from the Tropical Agricultural Association (TAA-UK). It is intended principally for the use of persons who attended the workshop, so that it can serve as a common point of reference as they engage themselves in follow-up activities. It is also intended to serve as a source of information on Conservation Agriculture (CA) methods and the prospects for expanding their application for those interested in the subject.

Comments on this the Framework are most welcome, as are expressions of interest in participating in the cluster of Communities of Practice (CoP) that are expected to emerge in the coming months.

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# CONTENTS

# PREFACE

This Framework for Action is the outcome of a Technical Workshop, held at FAO headquarters (Rome) in July 2008, entitled: "Investing in Sustainable Crop Intensification: The Case for Improving Soil Health". The Workshop was attended by 96 stakeholders from 40 countries, representing governments and inter-governmental institutions, the private sector, research organizations, farmers and NGOs.

The Workshop took place against a back-drop of rising international cereal and fuel prices that have prompted increased concerns over:

- The world's ability to maintain a safe balance between food production and human needs, thus ensuring continuing global food security;
- *Fresh evidence of the vast scale at which scarce arable land is degrading;*
- *The long-term sustainability of the technologies on which agricultural intensification is now based;*
- *The rising cost of energy and its impact on the costs of food production;*
- *A growing scarcity of water available for agriculture;*
- *The need to reduce green-house gas emissions, especially from food production systems in order to mitigate climate change processes, and to enable agriculture to adapt to the impacts of climate changes.*

The consensus of the Workshop was that plough-based farming, as now widely practised, has unsustainable elements, whose continued promotion and application endangers global capacities to respond to the above concerns. The Workshop focused on ways through which farmers can attain higher levels of productivity and profitability while improving soil health and the environment. General agreement was that these outcomes will be achieved through the adoption and implementation of Conservation Agriculture (CA) principles and practices.

The delegates agreed that ample evidence now exists of the successes of CA under many diverse agro-ecological conditions to justify a major investment of human and financial resources in catalysing a shift, whenever and wherever conditions permit it, from tillage-based production systems to those based on minimal soil disturbance, organic residue retention, and crop rotations and combinations. This will lead to large and demonstrable savings in machinery and energy use and in carbon emissions, a rise in soil organic matter content and biotic activity, reduced carbon emissions, less erosion, increased crop water availability and thus resilience to drought, improved recharge of aquifers

and reduced impact of the apparent increased volatility in weather associated with climate change. It will cut production costs, lead to more reliable harvests and reduce risks especially for small landholders.

This Framework presents the joint thinking of the Workshop delegates on actions that would help to empower many more farmers to engage in management methods centred on CA principles, thereby enabling land to be farmed more intensively, productively, profitably and sustainably.

# 1. The central issue Can plough–based farming be replaced with more sustainable systems in order to safeguard the world's future food supplies?

The world's food supplies will increasingly depend on raising production per unit area of farmed land. The need now, therefore, is for farmers to take up more sustainable, productive and profitable ways of production that do not damage the soil, land and environment. However, the land management systems now applied in many areas of the world, and particularly in the tropical, subtropical and semi-arid regions, are damaging soils and limiting their capacity to generate rising yields on a sustainable basis. Amongst various technological alternatives, the workshop focused its attention principally upon CA based farming systems since they appear to have the potential to be applied on a global scale and to do much to ensure the future adequacy and security of the world's food supplies while improving farmers' livelihoods.

At present, the almost standard, world-wide preliminary to planting a crop requires farmers to either dig or plough their soil, turning it over in order loosen it and to bury weeds and the residues of previous crops, and then to harrow it to create a fine seed-bed. To maintain fertility, "modern" farmers, when they can afford it, rely largely on the application of inorganic fertilizers to replace the soil nutrients taken up by their crops. Most agencies that advise farmers on technology choices – and the firms supplying inputs – recommend that increased production should come from more frequent cultivation, higher levels of fertilizer and pesticide applications and the use of seed of improved varieties.

This type of farming has enabled global food production to expand in line with fast rising demand but there is a growing recognition that they are damaging top-soils and, in many situations, are no longer sustainable.

Moreover, they have not succeeded in ensuring that all people have enough food of adequate quality to eat or that levels of poverty are falling significantly amongst rural populations. Yet, at the international level, there are calls for a "New Green Revolution" in Africa[3], implicitly based largely on the promotion of these technologies. Substantially funded emergency measures to respond to the current food price crisis also focus on boosting output principally through making externally supplied inputs more readily available to farmers.

The problem is that, in many situations the combination of increasingly frequent inversion tillage, a failure to apply nutrients at sufficiently high levels to prevent "mining", and low levels of biomass restitution to the soil results in a progressive degradation of soil structure and fertility. This in turn may lead to increased production costs and reduced profitability of farming. Such degradation is the consequence of both mechanical damage to the soil (compaction and pulverisation) and an associated decline in its organic matter content and biodiversity, especially when crop residues are not retained. The result is a breakdown of soil aggregates and a reduction in the pore spaces within soils that are vital for their functioning as effective media for plant growth. Tillage also reduces numbers of soil fauna, most noticeably a reduction in earthworm numbers with their inherent capacity to aerate the soil and incorporate organic matter to depth.

These tillage-induced processes lead to physical changes in soil structure with subsequent reduction in a soil's capacity to absorb and hold the water and air needed for season-long plant growth, particularly in dry and drought-prone situations. Reduced *in situ* infiltration of rainfall, in turn, causes greater run-off over the land surface, raising the risks of erosion, catchment degradation and more variable stream-flows. Loss of organic matter also lessens the chemico-biological processes, so important in providing the humic gums which contribute to the stability of soil aggregates and release nutrients for uptake by plants.

The reduction in soil organic matter due to frequent tillage is particularly deleterious in tropical and subtropical conditions under which soil carbon is oxidised quickly. The recently published Global Assessment of Land Degradation and Improvement indicates that one fifth of the world's

[3] Significantly, however, NEPAD's Comprehensive Africa Agriculture Development Programme (CAADP) gives explicit priority to measures leading to sustainable land and water management, including better land husbandry. The Alliance for a Green Revolution in Africa (AGRA) stresses the importance of applying Integrated Soil Fertility Management practices, combining inorganic and organic sources of nutrients but is not explicit about the need for reducing tillage. The recently issued report of the High-Level Task Force on the Global Food Crisis, entitled Comprehensive Framework for Action, includes a Box on Sustainable Food Production Systems: Soil Fertility and Sustainable Agriculture.

cropland - that accounts for only 12% of the earth's land area - is degrading. This reduction in the inherent productive capacity of intensively farmed land is commonly masked by heavier applications of fertilizers, at an ever increasing cost. However, this is only a temporary solution, and, over time, the continued reduction in organic matter levels leads to reduced availability of plant nutrients and increased susceptibility to water stress, resulting in yield reduction that cannot be stopped just by applying more fertiliser inputs. In short, farming as now widely practised, is not sustainable in the long run, from either environmental or economic viewpoints. It is unfortunate that most governments and the international community continue to promote these farming methods throughout much of the intensively farmed areas of the world, contributing to massive, though largely un-noticed, damage to the fragile layer of top-soil on which the future supply of humanity's growing food needs depends.

However, the means of stopping, and with time, reversing these various forms of degradation are already known and farmers are applying them on substantial areas, and improving their livelihoods in the process. The "key" to a sustainable future is to move towards more ecologically friendly farming systems that are more effective in harnessing nature to sustain higher levels of productivity. Critical to this is an increase in the quantities of organic matter on and in the soil, so as to provide the surface-protection, energy and nutrients required by soil-inhabiting flora and fauna that constitute the "life" of a soil, playing a vital role in maintaining its porosity, enhancing its moisture holding capacity and extending the availability of nutrients to crops.

CA and other similar systems for intensive farming that lead to the progressive build-up of soil organic matter have been successfully tested and applied by farmers in many parts of the world over the past 40 years. Though these systems vary in the technologies applied across countries, climates, soils and crop types, their common features are that they enable farmers to create conditions favourable to biotic activity in the soil through:

(a) maintaining, to the extent that local conditions allow, a year-round cover over the soil provided by the current crop, including specially introduced cover crops and intercrops and/or the mulch provided by retained residues from the previous crop;

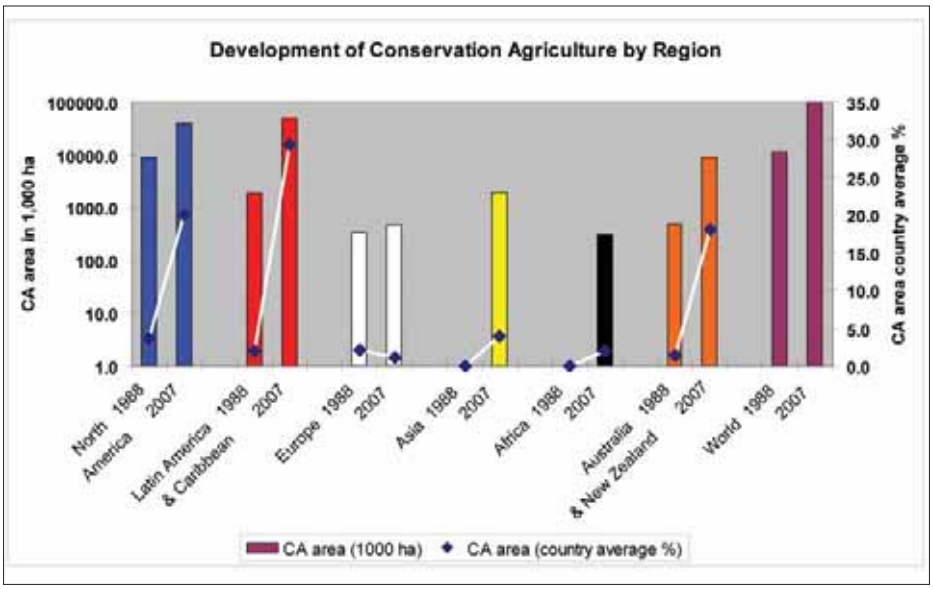
(b) minimising soil disturbance by tillage, eliminating tillage altogether once the soil has been brought to good condition, and

(c) diversifying crop rotations, sequences and combinations, adapted to local socio-economic and environmental conditions, which contribute to maintaining biodiversity above and in the soil, and help avoid build-up of pest populations within the spectrum of soil inhabitants.

Although much of the CA development to date has been associated with rainfed arable crops, farmers can apply the same principles to increase the sustainability of irrigated systems, including those in semi-arid areas. CA systems can also be tailored for orchard and vine crops with the direct sowing of field crops, cover crops and pastures beneath or between rows, giving permanent cover and improved soil aeration and biodiversity[4]. Functional CA systems do not replace but should be integrated with current good land husbandry practices.

Because of the benefits that CA systems generate in terms of yield, sustainability of land use, incomes, timeliness of cropping practices, ease of farming and eco-system services (Box 1), the area under CA systems has been growing exponentially, largely as a result of the initiative of farmers and their organizations (Figure 1). It is estimated that, worldwide, there are now almost 100 million hectares of arable crops which are grown each year without tillage. Except in a few countries, however, these approaches to sustainable farming

FIGURE 1:
**Development of Conservation Agriculture over the last 20 years by world region in total area (ha) and as average percentage across the adopting countries of the respective region.**




[4] The common constraint, given by farmers, to practising this latter type of inter-cropping is competition for soil water between trees and crops. However, careful selection of deep rooting tree species and shallow rooting annuals resolves this.

have not been "mainstreamed" in agricultural development programmes or backed by suitable policies and institutional support, and the total area under CA is still very small relative to areas farmed using tillage.

The successful spread of CA, however significant the potential benefits may be, requires that a number of constraints – including the widespread perception amongst farmers that inversion tillage is an essential part of crop production processes – have to be overcome (Box 2). The constraints tend to be most severe amongst small-scale farmers who already face many risks to their livelihoods. In some countries attempts to introduce CA have failed, not necessarily because the three CA principles have proven inappropriate but because the process of adaptation and promotion has not been suited to local socio-economic realities or been mainstreamed into farm extension programmes supported by strong cases of local CA successes.

The key issue faced by the Rome workshop and addressed in this Framework for Action, was how to accelerate the participatory adaptation and large-scale uptake, wherever appropriate, and in forms fitted to the diversity of local conditions and constraints, of CA-type systems. And in these ways to safeguard the world's capacity to produce a sustainable supply of food and other farm products for its future population, while at the same time providing farmers with sustainable livelihoods.

It was agreed that this acceleration will require nothing short of a revolution in the way farmers, their advisers, scientists and those who influence farming policies think about, decide and act regarding soil and crop management. The main focus of this Framework is, therefore, on defining the processes needed to induce and support this paradigm shift.

## BOX 1 **Sources of Benefits from Conservation Agriculture**

The adoption of CA practices will normally bring direct, though not always immediate, financial rewards to farmers. It will also generate other important economic, social and environmental benefits. To the extent that these are subject to market failures, the creation of incentives, policies and legislation to encourage adoption would be justified

**Financial benefits for farmers**

- Greater stability in yields;
- Higher ratios of outputs to inputs;
- Reduced demands for labour and much lower costs of farm power, through reduced tillage and weeding; *though not true initially in manually weeded systems.*
- Greater resilience to drought – through better water capture and soil moisture retention;
- Release of labour at key times in the year, permitting diversification into new on-farm and off-farm enterprises.

**Benefits to communities and society**

- Greater supply of environmental services from landscapes;
- More reliable and cleaner water supplies: lower treatment costs;
- Less flooding – through better water retention and slower run-off: less damage to infrastructure – e.g. roads and bridges.
- Better food and water security.

**Environmental benefits**

- Conserves soil and water and hence better hydrology and flows in rivers;
- Reduced incidence and intensity of desertification;
- Increased biodiversity both in the soil and the above-ground agricultural environment;
- Lower levels of soil sediments in rivers, dams and irrigation systems;
- Greater carbon sequestration and retention in soils; reduced emissions of greenhouse gases including those of carbon and nitrogen origin;
- Reduced need for deforestation – through land use intensification, and more reliable and higher crop yields;
- Less water pollution from pesticides and applied nutrients;
- Less soil compaction through reduced use of heavy farm machinery.

## BOX 2 **Constraints to adoption of Conservation Agriculture**

- **The mind-set of the plough.** The plough has become the symbol of agriculture and many, including farmers, extension agents, researchers, university professors and politicians have difficulty in accepting that agriculture is possible without tillage.
- **Competition for crop residues.** Most small-holder farmers manage mixed crop/livestock systems and rely on crop residues for animal feed and often fuel. CA systems need to incorporate components that provide for animal feed while at the same time enabling adequate soil surface residue cover. There is room to turn this constraint into an advantage through linking CA and intensive livestock production.
- **Social issues.** Communal grazing rights often apply in rural communities making it difficult for farmers to decide unilaterally that they will keep residues on their fields. Changes in communal and local policies may be required to allow for residue retention. Fire protection may also be necessary.
- **Weed control.** The principal function of tillage is weed control and so, when tillage stops, weed control becomes a major factor. In many cases controlling the weeds present at seeding time has been achieved with herbicides, especially the wide-spectrum "glyphosate". However, for farmers who do not have access to herbicides or the equipment to apply them, or want to engage in organic farming, manual weed control can be difficult and very time-consuming in the first years of practicing a CA system. After a few years of good weed control and use of cover crops, weed populations decline and become more manageable.
- **Sufficient fertility amendments.** The success of CA depends on adequate residue cover. In very infertile and degraded soils sufficient fertility amendments must be applied to increase production not only of the economic portion of the crop but also of the residues/cover crops.
- **Input market linkages.** Poor linkages may limit farmer access to fertilizer and other inputs for well managed crops.
- **Knowledge intensity.** CA is a knowledge intensive system and farmers, extension agents and researchers need to obtain, share and integrate new knowledge into their practices. Small-holder farmers are often poorly linked to knowledge and information systems, and even extension personnel in many developing countries may have little access to new information.
- **Land tenure.** Farmers that do not have secure access to land may be reticent to invest the time and effort in conserving and improving the land when this may not provide them with longer term benefits.

## BOX 2 **Constraints to adoption of Conservation Agriculture**

*(continued)*

- **Equipment.** Small-scale equipment for seeding crops without tillage is not readily available in many areas. Suitable equipment needs to be introduced, tested and adapted, and local manufacture stimulated where possible.
- **Excess soil water.** CA captures and conserves more water in the soil. As such it is not well adapted to soil types with poor drainage as it may exacerbate problems of waterlogging. However, permanent raised beds which ensure that part of the root system is in aerobic conditions offer a possible solution.
- **Time.** The principles of conservation agriculture need to be adapted to local biophysical conditions and farmer circumstances. This takes time, and massive short-term uptake of CA is difficult – a problem for politicians looking for short-term impact.
- **Policies.** Often the policies and procedures of governments and international institutions tend to favour short-term approaches to stimulating agricultural output and keeping consumer prices low, rather than encouraging sustainable land management and the creation of conditions in which farmers are rewarded with adequate livelihood prospects, including compensation for ecosystem services.

# 2. The ingredients of successful CA: Lessons from experience

Initial work on "no-till" or "zero-tillage" agriculture began in the USA in the 1950s. Amongst developing countries, Brazil has the longest experience in CA and since 1962 many useful "lessons learned" originate from there and from neighbouring Argentina and Paraguay. Their experiences have contributed to a better understanding of the long-term biophysical and environmental effects of CA application. They have also set important precedents for the engagement of farmers as principal actors in the development and adaptation of new technologies. Farmers in many other countries in Asia and Africa have also gained valuable but more recent experience on how to adapt the principles of CA to their own conditions.

Brazil took the initiative when herbicides (Paraquat/Diquat) and direct-drilling equipment became available in the US, and it became clear that conventional ploughing was leading to a severe environmental and economic crisis for farmers in southern Brazil. Progressive and wealthy farmers led the way, some traveling to the USA to learn about their soil conservation systems and to purchase direct-drilling equipment. Next, "common interest groups" were formed initially amongst large-scale farmers and later with small-scale farmers. CA has emerged mainly as a result of farmer innovation together with problem-solving support from input supply companies, state and federal research and extension organizations, universities, as well as long-term funding commitments from international donors such as the World Bank and GTZ. However the momentum for innovation and adoption has been, and still is, principally with farmers and their organizations.

Apart from enabling their land to be cropped more intensively without risk of degradation, CA attracted Brazilian farmers because it increased crop yields (at least 10-25%), greatly reduced surface runoff and soil erosion, and cut tractor use, resulting in big savings in fuel and production costs (see Box 1). Such benefits explain why today, South American farmers practice zero tillage CA on a continuous basis, year after year, on about 47 million hectares.

The main crops grown under CA include soybean, maize, wheat, sunflower, canola as well as cassava, potato and a number of horticultural and cover crops. CA practices are also being applied to perennial crops and to tree

crops. Soil cover is achieved by growing cash crops and cover crops either in association or sequentially. Main cover crops include oats, oilseed-radish, rye, lupins, vetches, mucuna (velvet bean) and pigeon peas, depending on the scale of farms. In some cases, especially amongst small-scale farmers, herbicide use can be reduced by direct-drilling seed into a cover crop that has been flattened using a knife roller. Specialised no-till equipment has been developed in Brazil and the Americas, including tractor-mounted, animal drawn and hand tools (including jab planters). These are being exported to Africa and Asia and being adapted there for local use and manufacture.

For their part, Asian and African countries have begun to take up CA practices only in the last 10-15 years, but have already acquired many useful lessons with respect to adapting the principles of CA to a vast diversity of conditions and constraints. Among the most encouraging experiences has been the CA work developed in dry environments (such as Kazakhstan and Tunisia) with highly innovative adaptations being made to the very demanding low winter temperatures and low and unpredictable rainfall. In DPR Korea, the introduction of CA has made it possible to grow two successive crops (rice, wheat) within the same year, through direct drilling of the second crop into the stubble of the first. The feasibility of growing potatoes under zero tillage has also been demonstrated in Korea.

Innovative participatory approaches are being used in Africa to develop supply-chains for producing CA equipment targeted at small holders. Similarly, participatory learning approaches such as those based on the principles of Farmer Field Schools are being encouraged to strengthen farmers' understanding of the principles underlying CA and how these can be adapted to local situations.

The corresponding programmes recognize the need to adapt systems to the very varied agro-ecosystems of the regions, to the extreme shortage of land faced by many farmers and to the competing demands for crop residues for livestock and fuel – problems that are particularly pronounced amongst small-scale farmers in arid and Mediterranean regions.

While large numbers of small-scale farmers – in Paraguay, China and various African countries – have taken up CA, experience indicates that adoption tends to be at a much slower pace than amongst larger-scale farmers. With food security among their major objectives, many small-scale farmers are hesitant to invest scarce labour, land, seed and fertilizer in cover crops that do not result in something to eat or to sell. They also suffer from restricted access to relevant knowledge as well as to inputs or credit. As a result, there is an increasing recognition of the need to encourage farmers to move towards full adoption of CA at their own pace, testing out promising approaches initially on small areas of their farms and progressively expanding as their confidence in the results develops.

The largest areas under CA nowadays are in the major grain exporting countries (USA, Brazil, Argentina, Canada, Australia) (Table 1). CA is being taken up rapidly in a number of Asian countries (DPR Korea, China, Kazakhstan).

**TABLE 1**

Conservation Agriculture adoption by country over the last 20 years in ha and in percent of total arable land (source: FAO AQUASTAT 2008)

Conservation Agriculture area in 1,000 ha

| | 1988-1991 | 1993-1996 | 1998-2001 | 2003-2007 |
|---|---|---|---|---|
| **Argentina** | 500,0 | 3.950,1 | 15.000,8 | 19.719,4 |
| CA area (%) | 1,8 | 13,9 | 51,5 | 66,8 |
| **Australia** | 400,0 | | | 9.000,0 |
| CA area (%) | 0,8 | | | 18,1 |
| **Bolivia** | | | | 550,0 |
| CA area (%) | | | | 16,9 |
| **Brazil** | 1.350,0 | 8.847,0 | 18.744,5 | 25.501,7 |
| CA area (%) | 2,3 | 13,5 | 28,2 | 38,3 |
| **Canada** | 1.951,2 | 4.591,8 | 8.823,5 | 13.480,8 |
| CA area (%) | 3,8 | 8,8 | 16,9 | 25,9 |
| **Chile** | | | | 120,0 |
| CA area (%) | | | | 5,2 |
| **China** | | | | 100,0 |
| CA area (%) | | | | 0,1 |
| **Colombia** | | | | 102,0 |
| CA area (%) | | | | 2,8 |
| **France** | 50,0 | | | 150,0 |
| CA area (%) | 0,3 | | | 0,8 |
| **Kazakhstan** | | | | 1.790,6 |
| CA area (%) | | | | 8,0 |
| **Mexico** | | | | 22,8 |
| CA area (%) | | | | 0,1 |
| **New Zealand** | 75,0 | | | |
| CA area (%) | 2,0 | | | |
| **Paraguay** | | 200,0 | 1.200,0 | 2.094,0 |
| CA area (%) | | 7,4 | 33,4 | 48,7 |
| **South Africa** | | | | 300,0 |
| CA area (%) | | | | 1,9 |
| **Spain** | | | | 300,0 |
| CA area (%) | | | | 1,6 |
| **United Kingdom** | 275,0 | | | |
| CA area (%) | 3,9 | | | |
| **United States of America** | 6.839,2 | 17.361,0 | 21.124,6 | 25.252,4 |
| CA area (%) | 3,7 | 9,6 | 11,8 | 14,3 |
| **Uruguay** | | | 753,5 | 1.082,3 |
| CA area (%) | | | 53,4 | 76,7 |
| **Venezuela (Bolivarian Republic of)** | | | | 300,0 |
| CA area (%) | | | | 8,7 |
| **World total** | 11.440,3 | 34.949,9 | 65.646,9 | **99.866,0** |

# 3. Goals and strategy

The evolving family of CA practices presents farmers and the various institutions supporting them with many productive opportunities to deal with current problems that are likely to become more stressful in the future: food and fuel price increases, labour shortages, water constraints, soil degradation, and adverse climate impacts.

The immediate **goals** of CA include increasing the productivity of land, water, labour and capital to meet human needs, while preserving the integrity of the natural ecosystems on which all life depends. Specifically, CA aims to conserve and enhance the quality of natural and human resources, while achieving greater profitability of agriculture for producers, assured supply and better-quality food for consumers, and greater and sustainable livelihood opportunities to raise standards of living broadly and equitably.

CA practices contribute to the **broader goal** of sustainable agriculture by the synergistic management of soil, water, plant and animal, labour, and soil biotic resources. While the main examples of CA have been developed and demonstrated in the domain of field crops, CA practices are applied also to plantation crops, livestock production, agroforestry, and enrichment of soil biodiversity to capitalize upon inter-specific interactions in supportive environments above- and below-ground.

As a result of the presentations and debates at this workshop, we are convinced of the desirability of enabling many more farmers around the world to take up CA practices, both in their own interest of securing a better livelihood and in the broader public interest of conserving the quality of agricultural lands so that they can continue to be productive. To achieve this goal, we are committed to sharing our collective knowledge and experience in introducing CA approaches to new countries and in supporting the accelerated adaptation and uptake of CA practices in countries in which they have already been introduced.

**Agronomic strategies** for CA aim at harnessing the abundant and diverse life forms that exist within soils to enhance their long term productivity. They include various combinations of:

- minimal or zero tillage;
- continuous soil cover often including green manure and cover crops;
- crop rotations, sequences and combinations;
- non-inversion weed control, including the use of allelopathy and smother crops;

- crop-livestock integration in farming systems;
- integration of perennial plants in farming systems;
- increase in biomass inputs to soil systems;
- optimization between organic and inorganic nutrient amendments;
- ecosystem-based and integrated management methods to control weeds, pests and diseases;
- erosion control infrastructure where needed;
- methods to increase soil absorption and retention of water (*in situ* "green water");
- enhancement of soil biological diversity and beneficial activity.

**Organizational strategies** include:

- participatory, farmer-centered research and development;
- greater assumption of responsibilities for agricultural innovation by farmer organizations, including catchment groups, and individual farmers;
- capacity building within such organizations and within specialized research and extension agencies especially to support scaling up;
- engaging the best modern scientific expertise for better understanding of below-ground processes and potentials driven by roots and soil biota;
- creation of incentives and certification of sustainable agriculture practices to recognize societal benefits and encourage uptake of sustainable farming systems; and
- establishment of a network of Communities of Practice (CoPs) bringing together diverse stakeholders around the world to give concerted support for changing mindsets, expanding institutional investments, sharing knowledge and experience, and promoting best practices.

# 4. Proposed actions

Set out below are summaries of the deliberations of 3 working groups that met during the workshop to identify critical issues, to set goals for what might be done about them, and to propose actions. At this stage, no attempt has been made to set priorities amongst the proposed actions, but these are expected to emerge from the further collective thinking within the proposed CoPs.

## 4.1 SCIENCE AND TECHNOLOGY DEVELOPMENT

*Strategic issues*

- CA is characterized by the three central principles of no-tillage, soil cover and crop rotations; but there are many specific technologies that have to be appropriately selected and combined to apply the three principles in practice in ways that are attractive to farmers in very different agro-ecological settings.
- Whatever the technology combinations, good crop, land and livestock management must be constantly assured for the system to function well.
- CA is not a static technology but a dynamic system that will differ depending on biophysical and socio-economic conditions and evolve over time. R&D programmes must respond to this need.
- The contributions of numerous branches of the technical and social sciences, economic disciplines, stakeholders and interest groups must be combined in developing technologies and systems that are adapted to varied conditions and users[5].
- Diverse providers and investors need to be involved in science and technology development for CA, including international agencies, multi-donor programmes, NGOs, government staff, academic institutions, commercial companies and agribusiness, each bringing different expertise but achieving synergy through using common disciplines and indicator sets.

[5] Disciplines include crop science (breeding and seed supply of both cash and cover crops, including legumes), soil science (physical, hydric, chemical and biological), crop management for dryland and irrigated conditions (rotations, beds, fertilizer), climate change (gaseous emissions and carbon), biofuel production, weed and pest control, livestock, engineering (machinery production and development), social-economic sciences (family, gender, labour, time, drudgery, alternate farm enterprises, the economics and benefits of CA uptake), as well as politics (local, regional and national policies and their implementation).

*Goals*

- Research and development programmes to provide a common framework of knowledge, including a set of indicators for information collection and dissemination, that (i) quantifies and demonstrates the link between CA and soil health that underpins all the other benefits (ii) compares the technical, social, economic and environmental benefits of CA to farmers and society with conventional agricultural practices, (iii) ensures continuing improvements in CA over time and (iv) allows for integration of CA into farming systems.
- Research and development to provide a platform to scale up CA from the plot level to the farm and landscape level, and to mitigate climate change and desertification.

*Priority actions*

- Quantify the process changes that demonstrate why CA-based systems are better and more sustainable than conventional agriculture systems, including generation of more rigorous information on the benefits to farm family livelihoods and the broader society.
- Evaluate capital losses from soil degradation and the economic gains to be derived from CA-linked rehabilitation.
- Develop crop/soil/livestock/economic system models that integrate the effects of CA systems; extrapolate results to other regions and conditions and indicate areas that require further research and understanding.
- Prepare "Frequently Asked Questions" (FAQs) or "mythbusters" to respond to the most commonly raised questions/misunderstandings about CA.
- Study the processes of innovation and diffusion of CA practices and the dynamics of on-farm and collective decision-making with the objective of understanding if and how uptake can be accelerated.
- Deepen understanding of management options and trade-offs of crop/livestock CA systems, including the increased productivity of marginal or degraded lands.
- Improve CA machinery to move beyond expensive imported equipment and create local manufacturing capacities and markets to meet growing demand: consider the special needs of small farmers with little cash or credit to buy CA equipment.
- Set up R&D programmes to refine choices of crops and rotations within CA.
- Building on current CGIAR centre initiatives, create a set of CA observation sites worldwide in major agro-ecosystems to provide focal points for strategic long-term research, applied on-farm research, farmer adaptation and impact assessment studies, training and learning nodes.

- To aid building the CA knowledge base, where possible use common indicators and benchmarks in monitoring and evaluating trials in different regions.
- Aim for synergies of inputs/outputs and cross-cutting scenarios by promoting active inter-country and inter–agency networking for data and information sharing.

## 4.2 UNDERPINNING SCALING-UP OF CONSERVATION AGRICULTURE

*Strategic issues*

- A single global strategy for up-scaling CA will not work: strategic approaches must be tailored to countries, regions or even local sites, reflecting specific technical, economic and social conditions.
- The needs, technologies and potentials for CA uptake by large- versus small-scale farmers are distinct, and must be tackled in a differential manner. Linking the learning and uptake processes of large and small farmers offers potential payoffs in speeding uptake, but effective and equitable links must be built.
- Upscaling cannot be hastened: the pace of local adaptation and dissemination of CA principles must be compatible with the capabilities of farmers, support services and other stakeholders.
- For small-scale, risk-averse farmers especially, introducing CA will often be stimulated by providing targeted incentives, and fair cost-sharing and risk protection arrangements over several years. These may be perceived as a just compensation for the many eco-services that adoption of CA is likely to generate for the benefit of society at large.
- Wherever possible, simultaneous uptake by farmers of all three CA principles is desirable to achieve greatest impact. But a step-wise approach to the introduction of the principles may at times respond better to farmers' constrained socio-economic situations, scarce resources and perceptions of risk.
- Ensuring the availability of well-prepared advisers and facilitators is key to minimize the potential negative effects of suboptimal performance of CA systems in the early years of their introduction.

*Goals*

- Location- and client specific knowledge and mechanisms to be available to all categories of target farmers that empower them to understand the CA principles, support them in transition to CA in their own situations, and transmit their experience to other groups.
- Farmers and communities to be empowered to recognize which technical approaches to CA principles are appropriate to their own situations, apply them and transmit their experience and ideas to others.

- Farmers and communities who take up CA to be willing to accept the risks of change and receive full value for the wider benefits to society that they thereby generate.

*Priority actions*

- Build CA introduction within the context of the overall functioning and dynamics of local farming systems and their changing environment; address economics, crop-livestock interactions, gender and cultural aspects, among others - but do not over-estimate possible rates of change.
- Ensure close partnering from the start among diverse stakeholders in adapting, promoting and supporting CA uptake – e.g. farmers and their organizations, research, extension services, service/input/credit providers, government agencies, NGOs, etc.
- Ensure that farmers assume a leading role in the process, developing as appropriate local, national and regional CA networks/task forces to facilitate capacity building, sharing of knowledge and active mutual learning.
- Develop knowledge management systems at the scales required to provide stakeholders with quality evidence on the performance of CA, its impact, successes and failures, under their diverse conditions (see section 3, below).
- Assess the specific needs of all target categories of potential CA adopters; tailor empowerment and support arrangements to their specific needs.
- Introduce CA principles pragmatically, based on understanding of realities on the ground. Start change using locally-available inputs and based on local knowledge and beliefs whenever possible.
- Demonstrate benefits of simultaneous uptake of all CA principles from the start but maintain an approach to adoption that remains flexible and compatible with farmers' willingness and capacity to implement CA.
- Pay special attention to the start-up phase of CA adaptation; unless skillfully organized and guided, failures are likely.
- Provide small-scale, risk-averse farmers with targeted incentives or cost-sharing to help them overcome a slow start up of CA, and cover the costs and risks of learning and adapting technology to their particular conditions.
- Link CA focus groups together through networks, forums and exchanges to share experiences and technologies, nationally and internationally.
- Include specific encouragements for larger-scale and more advanced CA practitioners to advise and mentor those at earlier stages of adaptation and uptake.

- Ensure adequate attention is given to supply chains for specialist inputs and equipment when they become necessary, as well as ensuring proper access to input and output markets.

## 4.3 CREATING SUPPORTIVE POLICIES, PUTTING IN PLACE INCENTIVES AND TAPPING RESOURCES

### a. Branding

*Strategic issue*

The basic principles of CA fully support the overall aims of sustainable agriculture. However they are often confused with other related, overlapping or complementary initiatives for changes to agricultural systems.

*Goals*

- The public, policy makers, agricultural scientists and farmers to be made aware that, without more attention to soil health, returns from further input intensification of agriculture will continue to decline. Uptake of CA principles is accepted as the future pathway towards sustainable and more profitable agriculture.
- CA principles support and facilitate other initiatives for sustainable agriculture and do not compete with other 'brands' such as Sustainable Agriculture or Eco-agriculture.

*Priority actions*

- Communicate that CA principles fit into the larger context of sustainable agriculture.
- Stress basic principles and understanding that there are a wide range of means of applying these principles in specific contexts.
- Engage NGOs as advocacy partners. Link into efforts that are already developing guidelines for sustainable biomass production.
- For the above, use the expanding CA knowledge bases recommended below.
- Enlist professional PR assistance.

### b. Positioning

*Strategic issue*

Investment in CA offers a tremendous opportunity to contribute simultaneously to progress in resolving major world issues related to food security and prices, reaching MDGs, energy saving, the environment and climate change adaptation and mitigation. There are many ongoing or planned initiatives in these fields within which CA must be positioned.

*Goal*

A CA approach to become integrated into large scale programmes and processes related to food, the environment, climate change, poverty alleviation, national/regional programmes, including. CAADP, AGRA, the operations of Conferences of the Parties on biodiversity, desertification and climate change, initiatives for food security and poverty reduction initiatives (PRSP), and the programmes of producer networks, large investors and International Financing Institutions (IFIs).

*Priority actions*

- "Sell" CA's win-win potentials for resolving current global issues affecting agriculture and the environment – e.g. slowing climate change through reduced fossil fuel use, reduced gaseous emissions, increased carbon sequestration from residue retention and build-up of soil organic matter; reduction of the impacts on food security of seasonal weather volatility; contributions to watershed repair through reduced runoff, improvements in water quality and reduced siltation; reduction of desertification due to reduced erosion and permanent ground cover; potentials created for biofuels through sustainable use of marginal land.
- Describe potentials for impacts on such issues within large and small-scale farming systems but show how required approaches differ.
- Build awareness of positive opportunities and constraints for CA within existing and transitional policy environments.
- Publicize CA: consider launching a CA Journal, also stress use of new media forms such as cell phones, DVDs and the internet.

### c. Advocacy and Capacity

*Strategic issue*

CA presents a paradigm change that offers the means to introduce new, beneficial systems that can raise the positive image of agriculture and farmers. However means and capacity for advocacy and change are at present inadequate.

*Goals*

- The advantages of CA to be understood and well known by the general public, political leaders, decision-makers and stakeholders. There is national enthusiasm and implementation capacity to advance paradigm change.
- Farmers to be seen as stewards rather than despoilers of national land and natural resources.

*Priority actions*

- Increase attention to agriculture sustainability issues in education and knowledge systems (see below).
- Create alliances with environmental groups (e.g., UNEP, WWF).
- Promote concepts of good environmental stewardship which can be well understood by the general public, various stakeholders and policy makers.
- Promote and acknowledge success and contributions of individual farmers and communities.
- Promote CA role in 'green water' management.
- Support and strengthen advocacy and PR by farmers and their networks to raise the positive image of farming.

### d. Knowledge

*Strategic issues*

v Knowledge systems need to give greater prominence to the successes and potentials of CA and its central role in maintaining agricultural sustainability and profits.

- The CA paradigm scarcely features in education and training programmes, most of which continue to teach inversion tillage as central to sound agricultural practice. Funding and curriculum reforms are needed to strengthen knowledge about CA principles, practice and potentials at various levels in education, training, research and development organizations, and as part of farmer training and empowerment.

*Goals*

- Knowledge and evidence of the potentials and beneficial results of CA to be well known to political leaders, policy makers, donors, the private sector and farmers.
- This knowledge to have secured public support for development of enabling national and local policies, strategies and programmes to promote CA investment.

*Priority actions*

- Classify and where possible quantify the benefits to society that can result from different approaches to CA adoption. Create public awareness and lobby for policy reforms that will adequately reward adopters or indemnify farmers against risks of change.
- Build and transmit knowledge of CA potentials to all relevant audiences, covering both 'legs' of the issue – needs of small scale and larger farmers.

- Support increased national capacities for knowledge management.
- Within knowledge management systems, assemble experiences covering the costs and benefits of CA, livelihood and social benefits, environmental benefits, also farmer decision/making processes in CA uptake and the dynamics of system change.
- Boost education and training on CA principles and benefits in universities, colleges and schools. Emphasize strategic training/research on appropriate knowledge areas (ecosystem, farm size, socio economics) within the different scientific disciplines, stressing commonality of the CA principles but diversity of the technologies and development approaches through which CA principles are applied. At tertiary level, test/validate the science and products of CA.
- Provide fiscal incentives and use PR and the public media to move education towards better understanding of CA and to overcome entrenched beliefs in the tillage paradigm.
- Assess and respond to knowledge needs along commodity value chains.
- Use large farmers to channel information to smaller farmers. Review and synthesize CA knowledge for wider dissemination.

### e. Policy and Incentives

*Strategic issues*

CA uptake may involve costs and risks to which farmers, especially small-scale farmers in resource poor settings, are averse. 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 CA adoption.

*Goal*

Specific enabling policies and incentives to be put in place by governments and international institutions seeking to broaden the uptake of CA and by relevant inter-governmental bodies.

*Priority actions*

Use or develop case studies and the knowledge necessary to justify policy change and incentives for CA uptake, including knowledge on increased agricultural output, C sequestration, reduced $N_2O$ and $CO_2$ emissions, energy efficiency, cost/benefit improvements, water productivity and watershed functions. Options include to:

- Assist in the evolution of national policies and community or individual incentives geared to CA uptake in general.
- Seek specific government endorsement or recommendation of CA.

- Provide for cost sharing for adaptation, promotion and dissemination of CA technology and to encourage local manufacture of small machinery.
- Encourage international institutions and donors that support CA to adapt their funding instruments to cover the full period necessary for CA to become a permanent element of production systems.
- Develop certification criteria for CA production systems and their products, as a means of increasing value-added for CA farmers.
- Explore incentives for biomass production and carbon retention by small farmers.
- Promote closer working between government and farmers, the private sector, technology generators/disseminators, and NGOs in policy reform, and the design and application of incentives for uptake of CA.
- Create a Competitive Grant Fund for CA research and education

# 5. Next steps

This initiative has grown out of an increasingly shared and deep understanding among persons from many countries, professions and institutional affiliations of the profoundly biological nature of agricultural systems' performance. Mechanical and chemical interventions can generally produce desirable short-term results and have enabled food production to respond successfully to an unprecedented rise in demand over the past half century. Experience and scientific evaluation, however, are showing that the technologies on which recent growth in farm output are based are less and less sustainable, as soil degradation is becoming an ever greater problem. The rapidly rising cost of petrochemical-based inputs, growing concern for human and soil health, and recognition of the links between intensive farming and climate change processes make it vital for the world's farmers to raise output using methods that do not further compromise the natural resource base for agriculture and diverse ecosystems.

The Workshop participants recognise the value of joint action and wish to contribute to the emergence of greater and sustainable institutional and human capacities to:

- acquire, evaluate, share and disseminate accurate, unbiased and diverse **knowledge** about the principles, practices and impacts of conservation agriculture;
- raise **understanding** in governmental circles, professional organizations and the general public of the benefits, limitations and solutions relating to CA;
- identify, share, enhance and give more ready access to multidisciplinary **expertise** on CA; and
- support diverse **initiatives** for research, extension, advocacy and evaluation of CA that can advance the state of the art and the effective application for CA.

The concept of 'Community of Practice' (CoP) (see Box 3) has emerged within development communities to formalize and strengthen the connections among like-minded persons who work in a variety of circumstances and seek collectively to improve both knowledge and practice. The participants in this consultation propose establishing a number of interconnected CoPs that can further the objectives of CA as discussed above. Modalities remain to be

### BOX 3 **Community of Practice (CoP)**

**The premises for a CoP:**

- The improvement of both theory and practice is greater from a **continuous interaction** between researchers and practitioners than from following the previous concept of a linear process where knowledge is generated and validated separately from practice, being subsequently 'extended' to practitioners;
- There is greater productivity from having **multi-sectoral cooperation** than having a standard 'division of labour' in that different kinds of institutions (public sector, private sector, NGO, academic, grassroots, etc.) have respective comparative advantages to contribute to a collective enterprise and learn from each other; and
- There is great power in bringing together **like-minded individuals** who operate from diverse institutional bases, who are agreed on the general goal even as they contribute different ideas and values about the means for achieving this; excitement and energy as well as information can be generated from heterogeneity that is encompassed within an 'envelope' of broad agreement leading to convergence of community members' perceptions and action.

**The value orientations that make a CoP effective include:**

- Concomitant valuation of knowledge/theory and of practice, privileging neither one over the other;
- Respect for diversity and for differences of opinion, within the framework of some broader shared objective and concern;
- Appreciation that the world is diverse and changing, and that ongoing, iterative learning is necessary and gratifying.

worked out in detail, with appropriate organizational and financial support, but the outlines of such an emergent capacity can be drawn.

Participants wish to establish and sustain a **multi-stakeholder knowledge management system** that will be suited to the needs of diverse users, and in particular of farmers who can benefit from more appropriate and effective CA practices. Such a system of CoPs, with some overarching identity and common purpose, will engage a variety of agencies, professional organizations, and publics to acquire mindsets and create programmes more supportive of CA.

Implementing the ideas sketched below will be the responsibility of a temporary Facilitating Group, representing all sets of stakeholders and acting on behalf of the participants in this consultation, operating under a charter of purpose that frames the goals and modes of operation which will be circulated to participants by email for concurrence before the Group begins

its work. Nominations and volunteers for the Group were solicited from all the participants before the end of the consultation, with the consultation's conveners asked to constitute an optimally sized Group with appropriate representation across sectors, roles, world regions, and disciplines.

Tasks for the Group over the 12 month after it begins work include, but are not limited to:

- Determine the most appropriate and sustainable **organizational arrangements** for the CoP/CoPs, with **administrative support** provided from one or more international organizations that want to facilitate the purpose of the CoP/CoPs.
- Identify possible sources of **financial support**, and enter into discussions with donor agencies to secure the resources needed to operate the envisioned international initiative.

Actions that the CoP/CoPs, when organized, could embark upon could include:

- Establishment of a **multi-functional presence on the internet** that can both provide information on CA and support interactive exchanges among CoP participants. Internet access and email have opened up opportunities for rapid, low-cost and highly interactive communication that we want to utilize. It should support collaborative efforts among individuals, organizations and communities as well as assist in problem-solving and ongoing innovation. Special efforts should be made for this information and these opportunities to be made available to agricultural communities.
- Maintenance of a **register of professionals and practitioners**, from a variety of disciplines and organizations and a variety of statuses who are willing to provide knowledge and support for CA initiatives at international, national, regional or local levels.
- Development of a **network of CoPs** that provide opportunities for greater contributions -- and outputs -- from participants in the overall CA-CoP. Possible focuses of specific CoPs would be:
  - *Knowledge for CA* – research agenda and priorities available to all persons interested; documentation on CA and evaluation of CA experience; exchange of research outputs, etc.
  - *Advocacy for CA* – public and professional communication; policy dialogue with decision-makers, etc.
  - *CA Application* – field support of CA initiatives, such as training modules; cumulative experience on participatory approaches, etc.
  - *Education for CA* – curriculum improvement in primary and secondary schools; enrichment of university and professional education.

Support for these CoPs might be worked out with several different institutions which are becoming higher-level stakeholders in CA such as GFAR, UNEP, international farmer organizations, and UNESCO, universities and NGOs. FAO is the international organization with the broadest interest and stake in CA and has indicated its willingness to provide the administrative support base for the overall CA-CoP.

- A first activity for the Facilitating Group would be to form task forces from among the workshop participants to draft within the next four months a short **policy paper on CA** and an **analytical paper on the costs and benefits of CA.** These papers could be used in discussions with donor agencies, international organizations, professional organizations, private sector and others.