CONSERVATION AGRICULTURE IN CENTRAL ASIA:
Status, Policy, Institutional Support, and Strategic Framework for its Promotion

FAO Sub-Regional Office for Central Asia (FAO-SEC)

December 2012

CONSERVATION AGRICULTURE IN CENTRAL ASIA:
Status, Policy, Institutional Support, and Strategic Framework for its Promotion

FAO Sub-Regional Office for Central Asia (FAO-SEC)

December 2012

Contents

Foreword

FAO Sub-Regional Office for Central Asia (FAO-SEC) in cooperation with the International Maize and Wheat Improvement Center (CIMMYT), the International Center for Agricultural Research in the Dry Areas (ICARDA) and the national counterparts in 2012 conducted a study on the status of Conservation Agriculture (CA) in Central Asia[1] to develop policy recommendations for promotion of CA. This is a working document compiled by Dr. Amir Kassam summarizing the outcomes of above study. The document was presented and discussed in the Regional Workshop on "Save and Grow": Promotion of Conservation Agriculture and Modern Plant Protection Methods, which was conducted on 4-6 December 2012 in Antalya, Turkey. The document is based on the national and regional material made available by FAO-SEC, CIMMYT and ICARDA; on relevant published articles and reports; and on contributions from several researchers who have worked in the Central Asia region during the past 10 years or so. The document was reviewed and finalized taking into account the contributions made by the Workshop participants in general, and in particular the three Working Groups that reviewed the current status of CA in the region and suggested possible ways forward for the promotion of CA (Annex I).

The term "Save and Grow" comes from the title of a publication that was launched by FAO in July 2011 (FAO, 2011). It represents as "a new paradigm: sustainable crop production intensification, which produces more from the same area of land while conserving resources, reducing negative impacts on the environment and enhancing natural capital and the flow of ecosystem services." While the publication is "A policymaker's guide to the sustainable intensification of smallholder crop production", the principles and concepts are scale neutral and apply to all ecologies where agriculture can be practiced.

The Foreword by the FAO Director General states:

"The present paradigm of intensive crop production cannot meet the challenges of the new millennium. In order to grow, agriculture must learn to save. Consider, for example, the hidden cost of repeated ploughing. By disrupting soil structure, intensive tillage leads to loss of nutrients, moisture and productivity. More farmers could save natural resources, time and money if they adopted Conservation Agriculture (CA). It aims at sustainable production intensification that can enhance agricultural output and productivity as well as ecosystem services."

Given the heterogeneous nature of the land resource base, agricultural production systems, socio-economic condition, limited experiential and research knowledge about CA in the Central Asia region, it is proposed to develop a broad regional strategy for the promotion of CA, and individual sets of policy guidelines for each country in the region, as well as country-specific CA development strategies and action plans. So this document should be seen as a first step in the process of

[1] Central Asia region comprises seven countries for the purpose of this working document: Azerbaijan, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Turkey and Uzbekistan.

formulating country-specific policy guidelines, strategies and action plans for the promotion of CA in the Central Asia region.

Many individuals have helped, directly and indirectly, in compiling this working document on CA in the Central Asia region. Special thanks are expressed to Theodor Friedrich, Hafiz Muminjanov, Aziz Nurbekov, Josef Kienzle, Alexey Morgounov, Murat Karabayev, Mekhlis Suleimanov, John Lamers, Pat Wall, Ken Sayre, Raj Gupta, Josef Turok, Akmal Akramkhanov, Fawzi Taher, Avetik Nersisyan, David Feindel, Berthold Hansmann, Sanginboy Sanginov, Irfan Gultekin, Imran Jumshudov, Abduhakim Isamov, Omurbek Mambetov, Dossymbek Sydyk, Alisher Kasymov, Ubaidulla Abdullaev Malik Bekenov, Aleem Pulatov and Kurt Steiner for their contributions and support.

1. Introduction

Conservation Agriculture (CA)[2] is defined as a production system in which crop, soil, nutrient, pest, water and energy management components and operations are based on a sustainable ecological foundation provided by three interlinked principles of: (1) minimum soil disturbance (no-till direct seeding); (2) maintenance of soil cover (mulch cover from crop residues and cover crops); and (3) diversification (rotations and/or associations) of crops, including cover crops. CA principles are applied through locally-formulated and locally-adapted practices to all agricultural production systems, including arable, horticulture, tree crops, plantations, agro-forestry, organic and crop-livestock systems with manual, animal-drawn or mechanized farm power (FAO, 2011; Kassam et al., 2011).

Tillage-based systems can be productive but they are not sustainable ecologically and economically in the long-run because the rate of soil degradation (from erosion and other forms of loss of soil quality) is generally higher than that of the natural soil formation and self-recuperation capacity (Montgomery, 2007). The degradation of the soil follows from the loss of soil organic matter and the associated soil life and structure due to excessive rates of oxidation resulting from tillage (Reicosky, 2001, 2008). The relevance of CA for international, national and local agricultural development is that, unlike tillage-based systems, it is capable of simultaneously improving crop productivity as well as other ecosystem services such as soil health, erosion control, clean water, carbon sequestration, nutrient, carbon and water cycling, and pest management (Kassam et al., 2009; FAO, 2011).

The capacity of CA specifically to address the improvement of sustainability – through enhanced functioning of its biological components – should spur innovative policy-making, thinking and action at government levels in the search to revitalize agriculture on all degraded lands of any degree, where increasing expenditures are required just to maintain yields at a level average. With CA it is also often possible to rehabilitate rainfed and irrigated agricultural land that has been abandoned due to degradation and loss in production capacity.

This document presents: some of the generic policy opportunities that exist for the adoption and uptake of CA; the status of CA in the Central Asia region; the challenges to CA adoption and uptake that exist in the region; and the conditions that need to be taken into account in designing and promoting policy and institutional support strategies for up-scaling CA.

[2] The definition and description of CA adopted for this document is that given at: www.fao.org/ag/ca

Figure 1. Map of Central Asia

At the Regional Workshop in Antalya, it was agreed that there was a need to facilitate follow-up work on the formulation of country-specific policies, strategies and action plans for the promotion of CA. As a guide to this follow-up work, a regional strategic framework for CA in the Central Asia region has been included as an Annex to be used as a 'road map' (Annex II).

2. Policy Opportunities for Conservation Agriculture in Central Asia

Major changes in ecological awareness and knowledge have been occurring globally during the past three decades in the understanding of the root causes of agricultural land degradation and sub-optimal agricultural performance. This understanding has increasingly become a basis for the promotion of sustainable production intensification, sustainable agricultural land management, and rehabilitation of degraded agricultural land. Experiential knowledge from the farming communities and formal scientific knowledge from research community have been accumulating from all continents regarding the role of CA in sustainable agriculture intensification, improving food security and enhancing livelihoods and the environment. This is why FAO is promoting CA as a 'Save and Grow' production system.

These developments serve to strengthen policy-related opportunities for promoting the testing, adaptation, adoption and dissemination of CA to address the following five major challenges faced by the Central Asia region, as well as internationally, namely:

(1). The concerns regarding pervasive food insecurity and poverty, high prices for food, production inputs and energy, wide-spread degradation of agricultural land resource base, resource scarcity, and climate change;

(2). The continuing high environmental impact of tillage-based agriculture, leading to economically and environmentally sub-optimal productivity in rainfed and irrigated agriculture, soil and agro-ecosystem degradation, pollution of water systems due to water erosion and leaching of agrochemicals, salinization and vulnerability to climate change;

(3). The short-comings of the relatively high-cost tillage-seed-fertilizer-pesticide-credit approach to agricultural development and sustainable livelihoods for the resource-poor small farmers trapped in a downward spiral of land degradation, fragile economies and ineffective policy and institutional support;

(4). The increasing preference for agro-ecologically-based production systems that are environmentally more benign, offer improved productivity from less inputs as well as greater environmental services, and are 'climate-smart' in terms of adaptation and mitigation;

(5). The natural and man-made disasters and crises which often lead to emergencies involving large rural populations whose agriculture systems and livelihoods have to be rehabilitated through relief and development measures.

Much has been written about the above concerns and situations (McIntyre *et al*., 2008; Foresight, 2011; UNEP, 2012). These concerns and situations are creating opportunities for transforming tillage-based agriculture that is increasingly being recognized to be ecologically and economically unsustainable into CA system (Shaxson et al., 2008; Friedrich et al., 2009; Kassam et al., 2009; FAO, 2011).

Conservation Agriculture enables producers to intensify production sustainably, improve soil health and minimize or avoid negative externalities. CA is able to support and maintain ecosystem functions, and services derived from them, while limiting agro-chemical and mechanical soil interventions - required for intensifying the production - to levels which do not disrupt these functions. Thus, intensification with CA can allow harnessing efficiency (productivity) gains as well as producing ecosystem benefits. CA offers these potential benefits to all producers, whether they operate on small or large scale of farm size, and to all types of soil-based systems of agricultural production, and to society at large (Pretty, 2008; Friedrich et al., 2009; Kassam et al., 2009; Pretty et al., 2011):

(i) Higher stable production, productivity and profitability with lower input and capital costs;
(ii) Capacity for climate change adaptation and reduced vulnerability to extreme weather conditions;
(iii) Enhanced production of ecosystem functions and services;
(iv) Reduced greenhouse gas emissions.

CA principles translate into a number of locally-devised and applied practices that work simultaneously through contextualized crop-soil-water-nutrient-pest-ecosystem management at a variety of scales. According to FAO (2008, 2012), the adoption of CA has resulted in savings in machinery, energy use and carbon emissions, a rise in soil organic matter content and biotic activity, less erosion, increased crop-water availability and thus resilience to drought, improved recharge of aquifers and reduced impact of the variability in weather associated with climate change. It can also result in lowered production costs, leading to more reliable harvests and reduced risks.

CA has been transforming tillage-based agriculture over large areas, especially during the past 20 years or so in North and South America, and in Australia. In the last ten years CA has been spreading in Asia and Africa, as well as in Europe. At present, there are some 125 M ha of arable crop land under CA, corresponding to about 9% of the global crop land, spread across all continents and agro-ecologies (Table 1) (Friedrich et al., 2012), with some 50% of the CA area being located in the developing countries.

Table 1: Extent of Adoption of CA Worldwide (countries with > 100,000 ha)

Source: Friedrich et al. (2012); www.fao.org/ag/ca

Country	CA area (ha)	Country	CA area (ha)
USA	26,500,000	South Africa	368,000
Argentina	25,553,000	Venezuela	300,000
Brazil	25,502,000	France	200,000
Australia	17,000,000	Zambia	200,000
Canada	13,481,000	Chile	180,000
Russia	4,500,000	New Zealand	162,000
China	3,100,000	Finland	160,000
Paraguay	2,400,000	Mozambique	152,000
Kazakhstan	1,600,000	United Kingdom	150,000
Bolivia	706,000	Zimbabwe	139,000
Uruguay	655,100	Colombia	127,000
Spain	655,000	Others	409,440
Ukraine	600,000		
Total			124,794,840

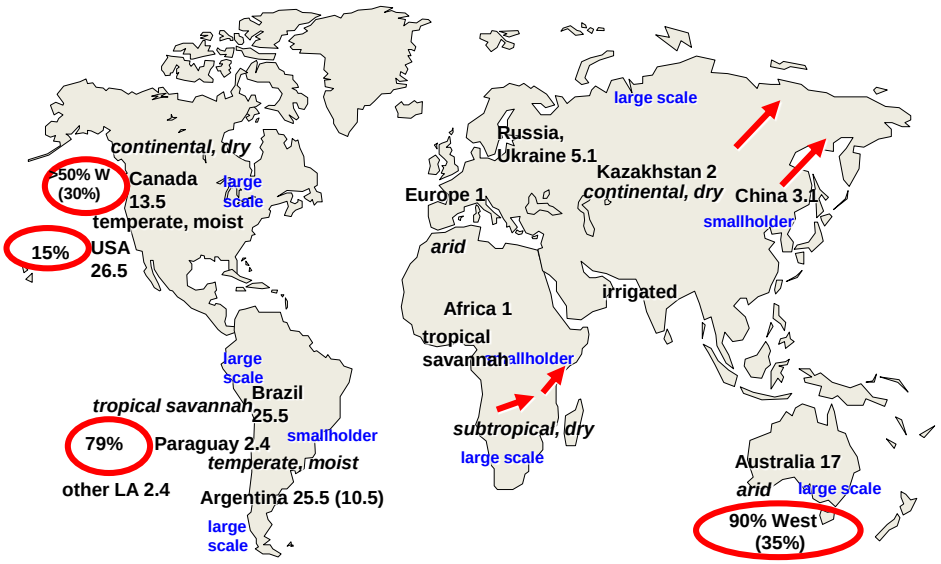

Figure 2. The spread of Conservation Agriculture globally -- 125 million ha

During the past decade or so, CA has been spreading at the annual rate of some 7 M ha as more development attention and resources are being allocated towards its dissemination by governments, public and private sector institutions, international research and development agencies, NGOs and donors (Kassam et al., 2010; Friedrich et al., 2012). However, as described in the following section, CA has not taken-off in the Central Asia region except for Kazakhstan where there are 1.6 M ha of wheat-based system under CA. Kazakhstan serves as a good example that shows that accelerated transformation from tillage-based system to CA is possible if policy and institutional support can be provided to farmers.

3. Status of Conservation Agriculture in the Region

This section is based on the outcomes of the study on status of CA and country reports presented by CIMMYT (Kazakhstan) (Karabayev et al., 2012), ICARDA (Azerbaijan and Uzbekistan), Irfan Gultekin (Turkey), FAO-SEC (Kyrgyzstan and Tajikistan) and in Nurbekov et al. (2013) .The review information presented in Nurbekov et al. (2013) on the status of CA in Kazakhstan, Uzbekistan, Tajikistan, Kyrgyzstan and Turkmenistan has also been used for this section.. The review by Kienzler et al. (2012) of CA in these five countries also provides useful information on the state of the knowledge base on CA in the Central Asia region. Overall, evidence illustrates a favourable impact of CA, but the evidence base needs to be improved, calling for more adaptive research, taking into account the different agricultural environments and socio-economic conditions.

Adoption and spread of CA practices would need increased information dissemination, awareness, and learning among farmers and policymakers about the benefits of CA.

Figure 3. No-till planting under rainfed conditions in Northern Kazakhstan

Figure 4. No-till planting under irrigation in Azerbaijan

Of the seven Central Asia countries, only Kazakhstan, Uzbekistan and Azerbaijan have farmland under CA, but all the countries are keen to promote the transformation of their agriculture from tillage-based systems to CA. In Turkey, research on no-till system including with raised beds has been carried out over the past two decades with favourable results in different parts of the country, and there are locally manufactured direct seeders, but there does not seem to be any systematic effort directed towards the dissemination of CA (Gultekin, 2012). It appears that in Tajikistan (Muminjanov and Sanginov, 2012) and Kyrgyzstan, some elements of CA can be found within several donor funded projects implemented in the past. However, their geographic coverage and number of beneficiaries (mostly farmers) are relatively small.

Figure 5. Testing no-till drill in Tajikistan

According to the Ministry of Agriculture of Kazakhstan, in 2011, no-till and conservation tillage practices were introduced on an area of 11.7 M ha, which is 70% of all the area sown to wheat in Kazakhstan (Sydyk et al., 2008, cited in Nurbekov et al., 2013). In 2011, the country harvested record gross yield of grain of 20 M t corresponding to a yield of 1.7 t ha^{-1} (Sydyk et al., 2008). These results were achieved due to the introduction of CA practices, although the area under full CA in Kazakhstan is only 1.6 M ha.

CA is still not widely practiced among the farming population in the irrigated areas of the lower half of Central Asia. Current activities are mainly concentrated in research institutes to integrate CA principles into existing production systems.

Over the last 20 years, Uzbekistan has been researching ways of introducing grain crops into existing crop rotation mainly with cotton and alfalfa (ICARDA, 2012). Earlier only cotton or winter wheat was grown. However, now with well-proven research findings, timely planting of winter wheat in standing cotton has shown promising results. As a result, annual area under planting of winter wheat into standing cotton reached 600,000 ha in Uzbekistan (Qilichev and Khalilov, 2008, cited in Nurbekov et al., 2013). However, there is a claim that direct seeding of winter wheat with minimum soil disturbance after cotton harvest is annually implemented in 25,000-50,000 ha in Tajikistan (Muminjanov and Sanginov, 2012).

Earlier research on raised-bed planting is relevant and useful nowadays as winter wheat has become another strategic crop to provide food security in most countries of the region. The researchers of South-Western Research Institute for Livestock and Plant production (Kazakhstan) studied and recommended raised-bed-furrow technology for the cultivation of winter wheat in central irrigated zone of Southern Kazakhstan. Cultivation of winter wheat on raised-beds with lowered seeding rate 2.0 and 3.0 M of germinable seeds per ha; and application of mineral fertilizers at the rate of $P_{45}N_{90}$ kg ha^{-1} in ridges ensures steady yields of winter wheat with a reduction in production cost.

A model was proposed by Suleimenov et al. (2004, 2006) that grouped the rainfed and irrigated-based zones into three main crop-based production systems: (1) the northern Kazakh steppes; (2) the warmer foothills of Kyrgyzstan and Southern Kazakhstan where a mixture of rainfed and irrigated agriculture is practiced, and (3) Tajikistan, Turkmenistan and Uzbekistan where irrigated bed and furrow or basin systems are used (Table 2). Wheat, cotton and livestock are the most important commodities in the region. However, with a trend towards diversification, oil crops such as sunflower could also become important. The results of research on adaptive cropping systems and CA conducted since 2003 have been introduced across 230-347 ha in Southern Kazakhstan region.

Several collaborative research and development projects have been implemented to promote CA in Uzbekistan. The projects are demonstrating appropriate management techniques for rehabilitation and improvement of salt-affected and gypsiferous irrigated lands to support food security in the country. Some of the studies and guidelines produced by these projects serve as useful reference materials for others. No-till and raised-bed planting technologies tested in Karakalpakstan and Tashkent provinces proved technically and economically suitable for local conditions; and can provide similar or higher crop yields while saving considerable production resources and costs including fuel, seeds and labour. Experience and results gathered with the introduction of CA were positive for adoption of sustainable farming systems in Karakalpakstan and Tashkent, and are ready to be disseminated more widely in Uzbekistan.

A B

Figure 6. Assembling no-till drill in Kazakhstan (A) and Azerbaijan (B)

In Azerbaijan, research on CA in raised beds has shown good results with cropping systems involving wheat, beans, maize, sorghum and sunflower. CA has been shown to reduce erosion and increase soil organic matter; it has shown to save on inputs including water, seeds and energy, and to increase profit. In addition, CA experience is being applied in awareness creation, participatory technology development and dissemination.

In Kyrgyzstan, there has been similar research on CA in raised beds with similar benefits. There are now some 300 hectares of no-till wheat in Kyrgyzstan, and more adaptive research linked to extension activities is being planned for the future with FAO and other partners.

A

B

Figure 7. Covering soil surface with crop residues allows improvements in soil moisture (A) and health (B)

In Turkey, there has been considerable research done on no-till and CA systems with results generally similar to those obtained in Azerbaijan and Kyrgyzstan but there has not been a serious attempt to promote the dissemination and adoption of CA. This is beginning to change and projects are being formulated and implemented that aim at the introduction and adoption of CA. Turkey already manufactures no-till direct seeders that are exported to countries within the region and beyond.

Figure 8. Adoption and promotion of CA requires proper tools such as jab planter

Table 1: Salient information about dominant cropping systems in the five Central Asia countries according to agro-ecological zones

Country/region	Major production system	Cropping intensity (%)	Growth period (days)	Distinguished features of the agro-ecology	Production constraints
Kazakhstan (northern parts)	Rainfed spring wheat–fallow systems	60–80, rainfed	210-240	Rainfed cereal systems, steppes, long cold winters	Drought, cold and water stress (precipitation 300–400 mm), soil erosion
Kazakhstan (southern parts)	Extensive cereal–livestock systems Irrigated cotton/wheat based systems, rice, rangelands	50–60, rainfed	30–89	Rainfed rangelands with mixed crop–livestock systems, high Mg-soils, saline groundwater	Drought, cold and water stress (precipitation 250–350 mm), 12–14°C, Mg-soil, erosion
Kyrgyzstan (Osh, Chu and Fergana Valley)	Irrigated agriculture on sloped and valley areas	40–60 or more	60–119	Sloped lands (up to 10%), supplemental irrigation, generally fresh but shallow groundwater table	Drought and heat (precipitation 200–300 mm), saline water use, 16–22°C
Tajikistan (South West/North West)	Irrigated systems (cotton–wheat) Agric. on sloped land of 5–16%	40–60 or more	60–150	Pastoral systems/irrigated agriculture on sloping lands, saline groundwater	Drought (precipitation 250–350 mm), 7–9°C, sloped land, mechanization. Water erosion by irrigation, drainage congestion
Uzbekistan (irrigated)	Irrigated cropping systems, cotton–wheat (mostly furrow irrigation)	More than 60	60–119	Irrigated crop production, drainage water use, soil salinity, long growing season, double cropping	Drought and heat (precipitation 250–500 mm), 16–20°C, salinity, water erosion
Turkmenistan (irrigated)	Rainfed pastoral/cereal production systems (mostly furrow irrigation)	30–60	30–59	Crop–livestock systems, saline groundwater, overgrazing, soil salinity	Drought and heat (precipitation 200–350 mm), 14–18°C, water scarcity, salinity

Source: Modified after Gupta et al. (2009), De Pauw (2008) and Kienzler et al. (2012) cited by Nurbekov et al. (2013)

Some of the striking features of CA experience noted and reported by many farmers in the region include reduction in inputs such as fuel, seed and water and in wear and tear of tractors and machinery. The other benefits include reduced soil erosion due to reduced soil disturbance and soil cover, and enhanced carbon sequestration.

4. Challenges Encountered in Scaling CA in Central Asia

Based on the information compiled by colleagues from FAO-SEC, CIMMYT, ICARDA and National programmes as well as the information provided in the review by Nurbekov et al. (2013), several challenges that hinder the spread of CA in Central Asia can be recognized. They are elaborated in the following sections.

4.1 Government policies and institutional support

Preceding sections indicate that the Governments in Central Asia do not have clear cut policies on which kind of agriculture paradigm they wish to support to meet their future needs for food security, ecosystem services, climate change adaptability and mitigation as well as to respond to higher costs of energy and production inputs, and environmental degradation and the need to rehabilitate the productive capacity of agricultural lands. The current status of Government position is to continue with tillage-based agriculture as much as possible as acceptable approach to agriculture intensification. Only Kazakhstan Government has taken a policy decision to promote and support no-till farming for rainfed production through subsidy on equipment (see Box 1). However, its policies towards CA and CA-based ecosystem management have some way to go yet to achieve a nation-wide change in the farming paradigm. While there are some research institutions or researchers who have been active in CA related research in the region, by and large research institutions do not explicitly implement a comprehensive CA-based research programme in order to support the mainstreaming of CA systems as a preferred production paradigm for the future.

The Central Asian and Caucasus Association of Agricultural Research Institutes (CACAARI) in its statement on regional research priorities recognizes the need for capacity development in research and extension in the area of CA; but it is one topic amongst several reflecting perhaps that CA is an option amongst several other technologies rather than an approach that involves a paradigm change in the way farming is carried out, and the mainstreaming of CA research to generate new knowledge on the different aspects of CA management as well as the benefits that are possible from CA at the farm, community and landscape level. Research is one amongst several institutional responsibilities that need to be aligned towards generating new knowledge regarding CA so that the full potential of CA can be harnessed with locally formulated practices to suit the diversity of ecological and socio-economic contexts. Others involve extension, input suppliers, including machinery and equipment, and output value chain and market access. In addition, several other institutions exist to address issues related to agriculture such as irrigation and water resource management, natural resource management and land degradation, livestock, climate change adaptability and mitigation. In general, public institutions are expected to operate within the policy environment of

governments, and similarly private institutions have to align themselves to government strategies. Given the almost complete lack of official policy on CA in Central Asia region, public and private institutions can by and large decide independently on what kind of agriculture to promote and support, resulting in confusion and wastage of human and financial resources.

Box : Support for Conservation Agriculture in Kazakhstan – Subsidy and research

In the Republic of Kazakhstan, the state policy is oriented to the expansion of sowing areas under Conservation Agriculture. Moreover, in agricultural research, the priority area of study is resource-and-water saving technology (Conservation Agriculture) of cultivation of agricultural crops in all regions of the country.

In compliance with the Resolutions of the Government of the Republic of Kazakhstan №221 dated 4th March 2011 and №938 dated 22 August 2011, the Ministry of Agriculture identified flexible strategy of subsidizing farmers.

The amount of subsidies in case of using Conservation Agriculture is significantly higher (3-4 times) versus conventional technology. Government subsidies for adopting CA practices also have accelerated adoption. For example in 2011, the Government subsidies for adopting no-till practices were slightly over 6 US Dollars per ha Kazakhstan (Kazakhstan Farmers Union, 2011; Kienzler et al., 2012).

Regrettably, in irrigated farmlands in Southern Kazakhstan Conservation Agriculture technologies are being introduced slowly. It is believed that the main reasons are lack of planting machines and a lack of knowledge by the farmers of No-Till technologies (Karabayev et al., 2012).

Respectively, agricultural researchers for the last years often (2-3 times a year) are organizing Farmers' Days, training workshops and scientific-practical conferences with invitation of foreign scientists.

An enabling government policy and institutional environment is needed to promote the mainstreaming of CA. This in practice requires that all the stakeholders must become engaged in the management of production and of the natural resource base in a sustainable manner. However, it is also necessary for the governments to create an enabling environment to promote farmers' interest in undertaking sustainable soil and production management as well as the maintenance of ecosystem services. For this, farmers must be assisted to empower themselves by forming associations so that farmers can work together in testing CA practices and sharing experiences and results as well as in articulating their needs for equipment, information, advice and incentives. Also, there should be effective integrated development planning and policies backed up by relevant research and advisory/extension systems, and the mobilization of private sector stakeholders , for both rainfed and irrigated systems (Kassam et al., 2012b).

Providing policy and institutional support to farmers for CA adoption is an important necessary step in establishing ecological sustainability of production systems. When CA can be adopted over large areas such as watershed and provinces, landscape level benefits can be harnessed through appropriate government-supported schemes. Such schemes could be for carbon offset trading e.g. in Alberta, Canada, or for water-related services in the Paraná basin III, Brazil, or for erosion control e.g., in olive groves in Andalucía, Spain (Kassam et al., 2012c).

4.2 Changing the tillage mind-set

An important component of the strategy for promotion of no-till technologies for soil conservation is building scientific and technical capacity, teaching new technologies and agricultural methodologies to the specialists and farmers, conducting various training courses and programs for personnel, drawing from international experience, providing consulting services and field days led by highly-qualified specialists, and building public awareness of the modern agricultural technologies. CA involves a change in mind-set – without this it becomes too easy to resort to tillage when any problem occurs in a newly implanted CA system (Karabayev et al., 2012 One of the biggest challenges to the widespread adoption of CA in northern Kazakhstan is that of changing the tillage mind-set. This has been the case in all other countries where CA has spread, and we believe Kazakhstan will be no different. However, there is clear evidence that the system works under the conditions of the region; and there are some hard-working enlightened individuals who see that the principles of CA are not only functional, but important to halt the marked, albeit slow, soil and land degradation in the region. There are currently some 13.5 million ha of CA in Canada (Friedrich et al., 2012), much of it under conditions similar to that in northern Kazakhstan. Thus, farmers in the region can benefit from both the positive experiences and lessons learned by their Canadian counterparts (Karabayev et al., 2012).

4.3 Skills required to operate CA equipment

In addition to the change in mind-set, all the skills that are required under conventional tillage management are also required for management of CA systems. The major differences are the operations of no-till seed drills and herbicide sprayers.

Operation of no-till seed drills requires the knowledge of the variety of the openers and coulters and their effects on the groove shape and seed placement. Groove shape and seed placement play important role in seed germination under moist soil conditions. To master such skills, the operator must have deeper knowledge of different soil types whereas in conventional tillage system field preparations for sowing are uniform in terms of the use of machinery. Depending on the surface residue levels, the operator should be able to select the appropriate coulter types and make necessary adjustments to seed the no-till crop.

Figure 9. Spraying herbicides to manage weeds

Traditionally, herbicide application in Central Asia is done largely with air blast sprayers, therefore there is limited knowledge of other types of sprayers such as rotary plate, boom, ultralow volume that produce different sizes of droplets. In CA, boom sprayers are widely used, which are fitted with different types of nozzles to target leaves. Exploitation of boom sprayers requires good understanding of nozzle types, angles produced by nozzles to insure good coverage, pressure, preparation of solutions to name few. There is also a need for improving legislation and developing the national capacity on pesticide applying equipment registration, inspection and operator licensing.

4.5 Availability and accessibility of suitable implements

Numerous experiments with locally made and imported seeders have been conducted and seeders have been tested for the common raised-bed systems as well as flat seeding. In irrigated cotton-wheat systems, the replacement of moldboard plowing with conservation tillage reduced cotton yield, but not of wheat (Suleimenov et al., 2004). Hence a modified system was suggested: the use of the moldboard plow for cotton and the use of conservation tillage for wheat. Prior to introducing CA practices, seeding equipment was adapted in Uzbekistan (Tursunov, 2005; Egamberdiev, 2007). As a first step, seedbed preparation and planting/seeding was tested in North-western Uzbekistan (Tursunov, 2009, cited in Nurbekov et al., 2013). The modifications in an imported Indian no-till seeder included the introduction of a seeding-depth regulator, appropriate soil openers for planting into the hard and mulched soil, the seeding blade that now is suitable for various crops, and an adoption of the row distance regulator. The modified seeder became suitable for planting cotton and wheat on permanent beds (Tursunov, 2009).

Figure 10. Planting no-till wheat on permanent beds after cotton

In a five-year study, Ospanbaev and Karabayev (2009) concluded that the use of a raised-bed seeder advanced the possibilities of crop planting by up to 30 days compared to conventional systems, which is a substantial encouragement for the spread of CA practices. In another joint farmer-researcher managed trial in Uzbekistan, implements for the bed-and-furrow system (BFS) typical for local cotton production and no-till (NT) technologies were compared (Pulatov et al., 2001). The research focused on the performance of NT and BFS planters and the effects of sowing with NT drill, BFS planter, and conventional tillage on crop yield, irrigation and income. Findings from NT and BFS planting showed that savings in time and labor as well as the user-friendly machine construction and the simple technology appealed to farmers and researchers. The use of implements suitable for CA practices increased yields through an earlier establishment of the crops and decreased crop establishment costs through a reduction in tillage costs which was underlined by the participating farmers (Pulatov et al., 2001).

Evidence worldwide shows that a wide-spread adoption of CA practices is unlikely if the suitable equipment is not readily available at acceptable costs (e.g. Knowler et al., 2001; Friedrich and Kassam, 2009). Although national policies in Central Asia countries prioritize agriculture, the necessity to increase the accessibility and affordability of locally made CA implements suitable for seeding in untilled and mulched soils and in the presence of stubbles and/or a cover crop is still underestimated. Moreover, practices such as land leveling and no-till raised bed planting can provide employment opportunities to jobless rural youths and employment in small-scale manufacturing and transport related sectors as shown in other countries (Gupta and Sayre, 2008).

The ‘Matchuskov’ seeding shoes still cause considerable soil movement and longer (front to back), narrower shoes which cause less lateral soil velocity, would be an improvement. Recently, chisel points from India have been imported in Kazakhstan, and a new modification to the standard seeding shoes has been made by Dr. V. Dvurechenski. Manufacture of these was tried at both the Agromash factory in Astana, Kazakhstan, and a factory in Omsk,

Siberia, with the latter giving better results because of the hardness of the steel used, and therefore the extended life of the shoes (Karabayev et al., 2012).

4.6 Knowledge and experience of residue supply and management

In virtually the entire Central Asia region, crop stubbles, essential for CA, are either burned due to a lack of suitable, powerful tractors for plowing, or, more commonly, residues are removed and fed to livestock. Also, currently some of the Central Asia nations such as Uzbekistan still have tillage regulations that limit the possibility for farmers to leave crop residues on the field. Studies thus far have therefore compared mainly the cases of 100% crop residue retention or no retention (e.g., Egamberdiev, 2007; Kienzler et al., 2009a; Tursunov, 2009; Devkota, 2011a; Devkota, 2011b; Ibragimov et al., 2011). Research on intermediate levels, rates and residue management practices have been usually beyond the scope of these initial studies. Only Devkota (2011b) concluded from her findings in a cotton-wheat-maize rotation that the retention of all crop residues after each cropping cycle is unnecessary to improve soil quality. The mulch layer from a retention of 8-10 t ha^{-1} wheat straw obstructed seeding, irrigation and fertilizer management in cotton-winter wheat rotation. The retention of 14 t ha^{-1} standing residues on permanent beds for rice reduced soil temperature and resulted in a delayed germination and reduced yields (Devkota, 2011a). Previous studies outside Central Asia (FAO, 2012) indicated that the retention of 4 t ha^{-1} crop residues was sufficient for CA practices. However, given the scarcity of findings, additional research is needed to clarify this component. Research should in this case concentrate on identifying suitable and manageable levels of partial residue retention and residue management so as to achieve the expected agronomic benefits and consider the alternative demands from farmers. Also, research topics related to crop residue management should examine options for an expansion of fodder crops as to reduce farmers' dependence on crop residues for livestock feed (Kienzler et al., 2012).

After independence in 1991 from the Soviet Union, Uzbekistan and Turkmenistan maintained the notion of strategic crops under a state order system, while in the rest of the Central Asia states, the order was abolished or replaced by other crops. Turkmenistan and Uzbekistan still regulate and own the majority of the economic and land resources, while Azerbaijan, Kyrgyzstan, Kazakhstan and Tajikistan have introduced a certain level of freedom for farmers in using land and selection of crops. Nevertheless after almost two decades since the changes were introduced, the knowledge, design and equipment available in the different countries in many aspects still 'mimic' the former Soviet agricultural system. The most common crop rotations in Central Asia such as cotton-wheat, wheat-fallow or wheat-rice rotations (Gupta et al., 2009) thus leave little scope for diversifying the system especially under the current agricultural legislation prevalent in some Central Asia nations, thereby failing to harness the benefits of crop rotations, which is an important component of the CA practices. Also, in the absence of private land tenure, expectedly farmers for instance in Uzbekistan and Turkmenistan refrain from CA practices for a longer time span, although after only several years typical environmental benefits of CA emerge such as an increase in

soil organic matter (Egamberdiev, 2007; Funakawa et al., 2007; Sommer and De Pauw, 2010).

4.7 Weed management

Weed infestation is not only common in CA, but rather CA causes a change in the dynamics of weed growth that are already present in traditional production systems. Effects of crop rotation on weeds has been intensively studied in cotton growing areas during 1975-1984 (Tursunkhodjaev and Bolkunov, 1981; Ismailov, 2004) with different combinations of cotton-alfalfa-wheat rotations. The principles still hold true that crop rotation helps to suppress weeds and appropriate strategy is needed for CA as well.

Weed control is one of the principal reasons for soil tillage, and when tillage is reduced or avoided, weed control is one of the major management challenges that must be tackled. As CA became more readily possible with the advent of herbicides one can expect that in most instances, in the first years of CA, the use of chemicals for weed control may increase. However, the principal herbicide used for weed control in the growing crop or prior to crop establishment is Glyphosate – a herbicide for the total control of weeds. Glyphosate is relatively benign environmentally: it has very low mammalian and invertebrate toxicity; it is tightly bound to clay particles in the soil and so is not leached; and is broken down by soil microbes, generally within about three months. As soil erosion is drastically reduced under CA, the chance of Glyphosate getting into waterways into CA fields is very low, and even then it is so tightly bound to the clay particles that it is not released into the water. However, one concern is the widespread use of Glyphosate in CA systems, and the appearance of Glyphosate-resistant weeds: populations of eleven weeds resistant to Glyphosate have been reported worldwide (International Survey of Herbicide Resistant Weeds, 2006).

Effect of different type of herbicides on productivity of no-till winter wheat was studied by Nurbekov (2007) in Karakalpakistan, Uzbekistan. The overall weed infestation observed in conventionally tilled wheat with application of Puma Super in spring, was essentially equal to that found in no-till wheat with Dafosat applied in the fall followed by spring-applied Puma Super. Some recommendations on herbicide applications to control specific weeds have already been developed for Kazkhstan. In Northern regions of Kazakhstan, during the early growth of wild oats (usually when soils warm up to 10-12°C), it is recommended that herbicide Glyphosate (which has uniform impact) should be applied before planting of cereals. Herbicides could be applied at minimum dose – up to 1.0 l ha-1. Favorable environment, such as mass sprouting of wild oats, cool weather, sufficient soil moisture, provides highly efficient suppression of this weed.

Meanwhile, application of these herbicides in minimum dose costs 2.0-2.7 times cheaper than the use of counter-wild oats herbicides, and is 1.6 times cheaper compared to crop management activities aimed at control (Sydyk et al., 2008b, cited in Nurbekov et al., 2013). Moreover, since this method does not require large number of machines, practically any farmer can afford it.

When the herbicide Target was applied at the rate of 1 l ha-1 in no-till directly seeded winter wheat, high yield of 4.0-4.4 t ha^{-1} was achieved in the rainfed areas in high rainfall years, whereas in medium rainfall years the yield was in the range 2.6-3.2 t ha^{-1}. In 2006-2008, the application of herbicide Aroma (50% emulsifiable concentrate) at 1.5 and 2.0 l ha^{-1} with direct seeding, demonstrated greater efficiency. Treatment at the rate of 1.5 l ha^{-1} reduced the number of weeds down to 24.8 plants per m^2 from the initial number of 124 plants per m^2, while under the higher rate these numbers were 21.6 plants per m^2 and 128.2 plants per m^2, respectively. Reduction of fresh biomass of weeds compared to control fluctuated within 74.0-74.6%, depending on the rates of herbicide treatments.

The other two principles of CA, no-till and maintenance of soil cover, also contribute to suppressing weeds in CA systems which promote integrated weed management. Not tilling the soil promotes the rotting of the weed seed bank in the soil over time, and avoids the burying of weed seeds into the soil that can protect them. Similarly, mulch cover can suppress weeds and also helps to kill weed seeds with humic acids that are released from the decomposing organic residues. Little work has been done in the region on integrated weed management, and should be encouraged in the future.

In should be noted that the quality control and certification of chemicals, including herbicides, is still not fully in place. Thus, very often low quality and hazardous herbicides are used by the farmers. On the other hand, the price of herbicides is high and not all farmers, especially small-scale farmers can afford their application.

5. Conditions and Strategies for Up-Scaling CA that have Policy and Institutional Support Implications

Internationally, in general, scientific research on CA lags behind farmers' own discoveries (Damrosch, 2004; Bollinger et al., 2006; Goddard et al., 2008). Similarly, knowledge and service institutions in the public and private sectors tend to be aligned to supporting conventional tillage-based production systems. Further, there is limited policy experience and expertise to assist in the transformation of conventional tillage-based systems to CA systems for small and large farmers in different ecologies and national contexts (Friedrich & Kassam, 2009; Milder et al., 2011; FAO, 2011).

The typical adoption process for successful new concepts and technologies follows an 'S' curve, when sufficient conditions exist for adoption and wider uptake, with a relatively slower start to adoption, possibly preceded by farmers' own trials on e.g. parts of the 'package' and/or parts of their land, leading then into exponential growth, and slowing down towards a plateau (Alston et al., 1995; Rogers, 1995).

The reasons for farmers to change from one production system to another vary according to location, but in most cases erosion problems, weather problems (drought) and unfavourable profit margins are the most important motivations for farmers.

5.1 Conditions for CA Adoption and Uptake

The adoption of CA is a process of change and adaptation based on experiential learning over a period of time. To put CA principles into local practice requires that farmers must become engaged in the process of testing, adapting and learning, and sharing experiences with other farmers.

The support to foster the necessary conditions - the 'enabling environment' - for the introduction of CA and transformation of tillage-based systems towards CA systems must be mobilized at the individual, group, institutional and policy levels within the private, public and civil sectors for adoption and spread. If this is not achieved dis-adoption of CA might occur.

5.1.1 Reliable local individual and institutional champions

Wherever CA has been successfully introduced or its spread is making steady progress, there have been local champions - usually farmers - whose own examples have encouraged the process.

Local and national champions, both individuals and institutional, are now being supported increasingly by international champions. Such champions are an absolute necessity to promote and sustain adoption of CA practices and subsequent on-farm innovations and must operate in all sub-sectors related to production systems and service providers at local, national and international levels, if CA practices are to be mainstreamed globally over the coming decades.

5.1.2 Dynamic institutional capacity to support CA

CA is a dynamic system in development and constant adaptation. The institutions that are set up to support CA need to be similarly dynamic so that they can respond to farmers' varied and changing needs. As well as policymaking departments, these institutions include the research and development programmes on which much of the technical knowledge of CA is based. Whatever technological combinations are used by farmers, R&D activities must help to assure that good husbandry of crops, land and livestock (Shaxson, 2006) can occur simultaneously for the system to function well.

Biophysical, ecological, agronomic and social sciences must be combined with the views of stakeholders to develop systems that can be adapted to varied conditions facing farm families adopting CA. This means that the diverse providers of information need to be involved in broad programmes to develop the science and technology for CA. Such institutions include international agencies, multi-donor programmes, NGOs, national government staff, academic institutions, commercial organizations and agribusiness with their diverse points of view.

5.1.3 Engaging with farmers

Support for any production systems, whether CA or otherwise, must be oriented towards

solving farmers' problems that inhibit productivity. The farmers would need support to understand and absorb new concepts and principles, enable an intellectual change in the mind-set to CA. Thus, engaging with farmers and providing them with the necessary support is critical for successful adoption and uptake of CA.

(a) The importance of working with farmers

Assisting farmers to improve the husbandry of land through CA must start with a thorough understanding of the present situation, of which the farmers themselves have the most detailed knowledge (FAO, 2001a). From the outset *they* must be the deciders of what is to happen once the root causes of land degradation and sub-optimal production systems are understood. Farmers must be the principal point of focus, as they make the ongoing decisions about how the land will be used and managed.

Sufficient attention needs also to be given to enabling issues, such as rural finance, service and input supply infrastructure, marketing and value-chain development, organizational or policy issues. Changing over to a new system and ways of doing business carries a perceived and sometimes real risk of failure, and this aspect must be taken into account in the initiatives that are designed to promote and assist the transition towards effective CA.

Farmers can be ingenious in problem-solving, and if they pick up the conceptual part of CA, they may well innovate and adapt the practices to their own conditions (WOCAT, 2007).

(b) Importance of farmers' organizations

Farmers tend to believe trusted peers more than their formal advisers when discussing innovations. Making it easy for them to exchange ideas and experiences helps strengthen their own linkages and reinforce recommendations. Farmer participation in technology development and in participatory extension has emerged as responses to such new thinking (Pretty et al., 2011).

Interested farmers may have already coalesced into informal groups with common interests. In the case of small farmers, such groups can form the basis for mechanisms such as Farmer Field Schools (FFS) or farmer clubs and associations, with guidance from experienced advisors, for 'learning by doing'.

In the case of larger farmers with good operational and management capacity, the fastest development of suitable technologies is usually achieved through groups of innovative and pioneer farmers who are part of a community and exchange their experiences through specific networks, and thus build social capital (Meyer, 2009; Junior et al., 2012).

5.1.4 Providing knowledge, education and learning services

CA involves a fundamental change in the way agricultural production is conceived and how it relates to environmental stewardship (Kassam et al., 2009) in the future at the farm, national and regional levels.

One necessary change will be to inculcate in schoolchildren – and then right up through graduate and postgraduate education – the opportunities for a broader focus on ecologically-based, resource conserving agriculture based on the core CA principles in all settings for sustaining the production of crops *and water* from landscapes, and for protecting the environment and biodiversity.

Both researchers and advisory staff need to be kept up to date with the different ways by which the principles of CA are put into practice in different agro-ecologies, their effects on the resource base and the environment, and socio-economic results. This means having the capacity to work across the traditional science disciplines and to work closely with farming communities. Recognizing the realities of CA technical education and vocational training in universities, colleges and schools will include CA principles and benefits in their curricula. Such training would stress the commonality of the principles of good land husbandry as expressed in CA and show how they can be applied through diverse technologies and development approaches.

Research and extension need to be able to operate at different scales simultaneously. They need to be able to assess the landscape-scale benefits of adopting CA whilst also providing evidence of how well CA performs on individual landscape units, farms and farming communities.

(a) There is need to enable scientists and extension agents to recognize and characterize the problems related to CA adoption and facilitate problem solving.
(b) There is need to build up a nucleus of knowledge and learning system for CA in the farming, extension and scientist community.

5.1.5 Mobilizing input supply and output marketing sectors for CA

With farmers grouping together into associations, potential suppliers of inputs and technical advice will become aware of potential commercial opportunities, and can be encouraged to join, and provide supplies to the farmers themselves. Usually some 'kick start' is necessary to break the deadlock of farmers not adopting because of lack of available technologies and equipment and the commercial sector not offering these technologies for lack of market demand. Policies facilitating procurement with credit lines, promoting technologies with technical extension programmes and introducing supportive tax and tariff policies are important for building up the long term commercial development of suitable input supplies for CA.

Arrangements for marketing the crops and for selling farm inputs require attention at the time of beginning the CA revolution in a country where these may not work adequately well. This has implications for improving the bringing together of suppliers and purchasers to work as a team with government field staff and others in responding to farmers' needs and requirements.

(a) Ensure accessibility and affordability of required inputs and equipment
(b) Financing and enabling the initial stages.

5.2 Bases for designing and Implementing Policy and Institutional Support Strategies

Having made a commitment to mainstream CA, it is important for a government to make a policy that will ensure that sufficient and appropriate support to farmers' efforts be provided and maintained, to share costs and risks taken by small farmers during the period of changeover. This period might be up to five years in each instance of uptake to farmers having developed full confidence in managing the new system. Because uptake would not all occur at the same time, such assistance would necessarily be on a 'rolling' basis.

Finance should be available for study tours, field days and other opportunities for farmers to meet each other and discuss CA matters of mutual interest as a potent way of stimulating innovations, e.g.:

- Benchmark demonstration areas for CA
- Staff training on CA principles and modes of application
- Field days and study-visits for farmers
- Participatory and interdisciplinary learning process for CA development
- Operational research with farmers as partners.

Effective demand in the market and the value chains beyond production are also important in ensuring that farmers can receive an attractive return for their effort to produce safe and nutritious food and other ecosystem products using sustainable practices such as CA. Policies and institutions that encourage and enable the integration and verification of CA practices and their products into practical programmes in which farmers can receive monetary benefits for delivering certain ecosystem services need to be established

5.2.1 The need to sensitize policy-makers and institutional leaders

Both the field demonstrations and technical discussions generated by the growing spread of CA methods and successes, as told by farmers and others, will also make government department heads, policy-makers, institutional leaders and others aware of benefits, and of the desirability of backing the initiatives. It is important that policy makers come to a full understanding of the implication of the CA system. This makes it easier for them to justify supportive policies, which in the end are beneficial not only for the farming community but for everyone and hence for the policy makers and their constituency. On the other hand it is important for policy makers to think in long term developments and in integrated approaches, even across sectors and ministries (Pieri et al., 2002).

5.2.2 Formulating enabling policies including for rapid up-scaling

Although it is not possible to distil a generic set of policy and institutional support guidelines that could constitute initial interventions for promoting the transformation towards CA systems, and effective sequence of strategic actions could be as follows:

1. Identify what are the limiting factors to farmers making improvements to their livelihoods (which may not always primarily be financial) to catch their attention.
2. Identification of factors limiting crop yields and what could be done to alleviate these.
3. Identify one or more farmers already undertaking CA and demonstrating its agronomic, financial and/or livelihood benefits, and set up study visits.
4. Or: set up demonstration for researchers and advisory staff and farmers' groups leaders, to catch their interest.
5. Initiate 'learning by doing' e.g., through participatory forms of investigation and learning. Gain insight into what farmers know already and how they would tackle the apparent problems in the light of new knowledge introduced.
6. Determine what are optimum means of achieving CA's benefits for different situations of farm size, resource-endowments, through on-station and on-farm research and benchmark demonstration, observation, FFS etc. and Field Days on farms already attempting CA. Record-keeping, analysis and feedback loops, Operational Research, are all important
7. Importing suitable samples of equipment (e.g., jab planters, direct seeders for animal or tractor power, knife rollers, walking tractors with no-till seeder attachments, etc.) to be able to demonstrate their use at the beginning.
8. Interact with any already-established farmers' groups, e.g., co-operatives, to gain interest and support.

A facilitating policy environment can be an important determinant of whether CA is adopted or not and how fast. In cases where policy has been weak or ineffective, much of the successful diffusion of CA has occurred because of support from the private sector, farmers groups or other non-governmental organizations. In some countries, existing policies have both encouraged and discouraged CA at the same time.

While CA so far has spread mostly without policy support, it would need a supportive policy environment for accelerated spread. However, there is no 'one size fits all' policy in support of CA: whether this comprises direct interventions, indirect incentives via research and development activities, or a mix of the two. Since the principles of CA are based on an understanding of: farm-level biophysical and socio-economic conditions, farm management objectives, attitudes to risk and complementary relationship between stewardship and profits, policies in support of CA need to be formulated on a similar appreciation.

The main implication of this is that most policies to support CA adoption and spread must be enabling and flexible, rather than unitary and prescriptive. Allowing the design of location-sensitive programmes which draw on a range of policy tools would ensure that policies are designed which both accommodate and promote the location-specific nature of CA and its on-farm and landscape level benefits (Pretty, 2008; Kassam et al., 2009; FAO, 2011; ECAF, 2012; Kassam et al., 2012).

However, one area where a more uniform policy may be appropriate is in the development of social capital, to promote the precursor conditions for collective action – such as the development of group extension approaches (FAO 2001b) when dealing with smallholders

who are operating in poverty stricken situation with degraded resource base and poor access to markets.

Within this flexible policy framing, however, there are five other issues policymakers need to consider:

(i) 'Sustainability' as justification for policy support for rapid up-scaling:

The capacity of CA specifically to address the improvement of sustainability – through improved functioning of its biological components – should spur innovative thinking and action at government levels in the search to revitalize agriculture on all degraded lands of any degree, where increasing expenditures are required just to maintain yields at a level average.

(ii) Policies relating to farm-level risk management, especially of those associated with the time of making the switch from 'tillage agriculture' to no-till production systems, and thus to the generating and sustaining of associated environmental benefits.

(iii) Basing macro-level landscape management policies on understanding of micro-level realities about e.g. soil conditions, farming systems, etc.:

(iv) Compatibility between relevant policies ['Policy coherence'], to enhance positive synergies between policies which affect farmers', and others' decision-making in favour of initiating and developing CA.

(v) Policies to actively encourage knowledge sharing – vertically: between different levels of government and of other relevant institutions; and horizontally: within and between different farmers, researchers, advisory staff, NGOs, and other 'stakeholders'.

5.2.3 Putting a political emphasis on policy and institutional support

In general it has been observed that issues like soil health and soil productive capacity, unless they result in catastrophic dimensions of erosion and cross-border 'dust plumes', do not inspire or attract policy makers. On the other hand, marshalling facts and experiences about benefits – both social and technical - as positive contributions towards alleviation of current problems, and to avoidance of future problems foreseen, are likely to garner more-enthusiastic political support.

6. Prospects for CA in Central Asia

CA is one of the most promising agricultural land use options that has been developed in our times. CA is more a system's approach to agriculture production management than a single technology because it offers a way to produce more with less while at the same time preserves and enhances many of the ecological functions a natural soil has to offer in a natural ecosystem. CA also offers economic benefits to farmers who apply it. Generally, an immediate cost reduction due to reduced cultivation and machinery operations can be felt right after the introduction of CA. There are a number of challenges that CA faces throughout

the largely agricultural region of Central Asia including lack of crop diversification on small-size farming areas, knowledge about CA systems among extension and technical staff, knowledge about CA at decision-making levels, farmers' ability to decide on diversified crop rotations, and the implements needed for use in the CA. Nevertheless, farmers in the region of Central Asia are now becoming increasingly aware of CA as a new, promising technology. Awareness comes in the form of accepting no-till as a viable system in growing crops as opposed to the earlier total rejection of agriculture without tillage. Particularly for irrigated areas, large programmes by different institutions need to be carried out to adapt CA to local conditions and to generate research results to advice farmers accordingly. For example, in Uzbekistan and Kazakhstan, the Governments provide research grants to institutions, and they have approved a number of applications from different research groups for addressing water and crop issues in CA systems.

Only Kazakhstan has managed to implement supportive policies for CA, and as a result the area under CA-based practices increased from zero ha in 2000 to 1.6 M ha in 2011 with continued expansion according to a recent assessment conducted by CIMMYT (FAO 2012). Usually manufacturers, importers and dealers are proactive with the objective of increasing the demand for CA implements. Yet, the present political systems in Central Asia indicate that the public rather than the private sector is now being called upon to initiate and lead such efforts.

Agriculture in the region is diverse, and has a great potential to revitalize the withered economies of the Central Asian countries via improved productivity (efficiency) and higher total output through CA-based agriculture development. After independence in 1991, the production of fodder crops such as maize and alfalfa sharply decreased along with reduction in area under rice and vegetables (melon). CA will have to shoulder the largest burden of making sustainable intensification of production systems a reality for food, fodder and fibre crops and livestock in Central Asian countries.

The demand for food and fodder production will continue to grow in Central Asia countries, and at least Kazakhstan has the potential of becoming a significant grain exporter at the regional and international level. Wheat, cotton and livestock are the most important agricultural commodities in the region, and with a trend to diversification, oil crops such as rapeseed, sunflower, safflower and soya could likewise become important commodities, similar to the Canadian model.

Minimal soil disturbance or no-till is one of the principles of CA. No-till fields act as a sink for CO_2; and the CA applied on a global scale could provide a major contribution to control air pollution in general and global warming mitigation in particular. Given the importance of agriculture for most of the regional economies and for the rural livelihoods, there is a need for research on what may be the role of CA and adaptation and mitigation options to climate change in agriculture in the region. CA also can assist in the adaptation to climate change, by improving the resilience of agricultural cropping systems, and hence by making them less vulnerable to abnormal climatic situations.

To reduce climate change impact, tillage agriculture should be assisted to transform into CA. The transformation can deliver climate-smart agriculture, producing profitable food, feed and fibre as well as other ecosystem services. Adapting to climate change requires a robust agricultural system, which can deal with the changes in climate and in its variability, and in pest dynamics. Integrated production technology such as CA is a hardy system which deploys preventive measures as a priority and is the best choice for preparing for adaptation to climate change. Climate-friendly agricultural practices focus on increasing the carbon and water content in soil (e.g., by using cover crops, farming with perennials, reduced soil disturbance or rotational grazing), minimizing the need for chemical fertilizers (responsible for nitrous oxide emissions) and managing livestock systems to reduce methane emissions. Low-Greenhouse (GHG)-emission farming systems include all systems that incorporate the three principles of CA including CA-based arable systems, CA-based crop-livestock systems as well as CA-based organic farming systems.

Within a CA-based crop rotation, different root systems influence different soil horizons and improve the efficiency of soil nutrient use. In general, the soil structure becomes more stable and soil functions in CA systems can support a range of ecosystem services (Kassam et al., 2009, 2012a, 2012c).

The evidence from Central Asian countries shows that CA practices are suitable for the existing major cropping systems). However, most of the results come from collaborative projects largely initiated and funded by international organizations. CA is not a single or uniform technology that can be immediately applied anywhere in a standard manner. Rather, it represents a set of principles that encourage the formulation of locally adapted practices, approaches and methods, which need to be tested, evaluated and then adopted or implemented under various biophysical and socio-economic conditions. Further research is necessary, for instance to study in details the effects of various CA crop rotations and mulch cover on weed management, nutrient, pest and water management, on residue levels, sowing depth, dates, density, and on fertilizer and irrigation rates; and impact assessment on livelihoods and environmental conditions. To make results applicable on a wider scale, state programmes should become more active in conducting research and extension.

Earlier studies that looked at minimizing tillage primarily focused on weed control. However, with the advent of the herbicides such research studies can be revived. Such studies can incorporate issues of sustainability which earlier were not considered in research studies due to the fact that anything except yield was of secondary concern. Sustainability is nowadays mainstreamed in many fields and CA can be a viable option in achieving or moving towards a more sustainable and affordable agricultural system.

Considerable knowledge has been generated about CA practices in Central Asia region, first in rainfed areas and, more recently, in irrigated areas. In fact, the potential of CA for sustainable agricultural development has been demonstrated in the region, and outside the region with similar environments (e.g., Baig and Gamache, 2009; Lindwall and Sonntag, 2010; Kassam et al., 2010, 2012; ECAF, 2012). Building the technical and scientific capacity of national partners will be essential for moving to large-scale CA adoption and uptake.

Researchers, extension workers and farmers will continue exchanging experience and knowledge about the new CA methods. Consequently, for the foreseeable future, facilitating national development strategies for up-scaling of CA, conducting training courses with national partners remain a high priority in the efforts undertaken by FAO, CIMMYT, ICARDA and other international organizations such as IFAD, ADB, EU and national donors, to promote CA in the region. However the study on status of CA covered only Central Asian countries, but other former Soviet countries also expressed interest and were invited to the workshop and actively participated in discussions.

7. Concluding Remarks

From global evidence, as well from evidence within Central Asia region as well from the deliberations of the Regional Workshop on 'Save and Grow', CA potentially represents a more-secure paradigm of agriculture than that which is based on tillage of the soil. Consequently, CA does deserve close attention because of its wider socio-economic and environmental implications and possibilities for faster spread.

The lack of general knowledge and understanding about CA as well as a supportive enabling environment for its promotion, and the fact that the national institutions, public and private, are mainly serving tillage-based agriculture, are the main reasons for CA not spreading faster in the Central Asia region. However, the evidence of increased adoption and uptake in other regions and continents during the recent years indicates that this situation can change, and the uptake of CA can be expected to accelerate over the coming years.

As seen already, there are a number of good reasons for farmers not immediately/spontaneously adopting CA, despite the acknowledged advantages. Farmers have to first overcome a number of hurdles. Foreseeing/knowing these hurdles and problems allows developing strategies to overcome them. Crises and emergency situations, which seem to become more frequent under a climate change scenario, and the political pressures for more sustainable use of natural resources and protection of the environment on the one hand, and for improving and eventually reaching food security on the other provide opportunities to harness these pressures for supporting the adoption and spread of CA and for helping to overcome the existing hurdles to adoption. Thus, actual regional challenges are providing at the same time opportunities to accelerate the adoption process of CA and to shorten the initial slow uptake phase.

In this regard, it is vital that all national knowledge systems in the Central Asia region must increasingly align their work in research, education and extension to helping to understand the root problems and the role CA systems and practices can play to then facilitate policies for accelerated adoption. Research in particular must help to solve farmer and policy constraints to CA adoption and spread (rather than comparing CA with conventional systems which is of only academic value and not advancing the further development).

There is growing evidence from farmer fields, landscape-based development programmes and scientific research in most agro-ecologies across all continents that CA is very largely positive for productivity, profit and environment. As all the benefits of CA take several years to fully manifest themselves, fostering a dynamic CA sector requires an array of enabling policy and institutional support over a longer term time horizon, including the availability of necessary inputs and equipment, and the fostering of farmer-driven innovations. Undertaking these improvements will enable governments, civil institutions and farmers to progress together.

What Needs to be Done Now?

The core agro-ecological elements of sustainable intensification systems are the practices that implement CA's three principles, plus other best practices dealing with crop management, as well as the integration of pastures, trees and livestock into the production system and supported by adequate and appropriate farm equipment and power. This concept and the practical implications must be placed at the centre of any effort to intensify production at any farm scale.

The following are the suggested action points for policymakers in Central Asia countries based on the outcome of the Regional Workshop on 'Save and Grow':

- Formulate a regional strategy and action plan for policy and institutional support for mainstreaming of CA in the Central Asia region, including the formation of a Central Asia regional CA stakeholder task force to coordinate and facilitate regional and national level actions. In this regard, a draft regional strategic framework is provided in the Annex II.
- Formulate national strategies and action plans for the mainstreaming of CA in each Central Asia country as the preferred production paradigm for agricultural development, including the formation of national CA stakeholder task forces to coordinate and facilitate national level actions. The draft regional strategic framework in the Annex II serves as a 'road map' for the formulation of national strategies and action plans.
- Establish clear and verifiable guidelines, policies and protocols for agricultural production systems which qualify as sustainable intensification, including as integral elements Conservation Agriculture, Integrated Pest, Nutrient, Weed and Water management and other desirable practices.
- Institutionalize the new way of farming as officially-endorsed policy in public sector education and advisory services.
- Establish a conducive environment to support this new kind of agriculture, including the promotion of CA farmer associations, provision of suitable technologies, and of inputs through the commercial supply markets.
- Establish incentive mechanisms such as justifiable payments to eco-effective land users for environmental or community services.

- As adoption levels increase and the sustainable intensification becomes an accessible option to every farmer, introduce penalties for polluting or degrading ways of agriculture as additional incentive for late adopters.

References

Alston, J.M., Norton, G.W. and Pardey, P.G. (1995). *Science under Scarcity: Principles and Practice of Agricultural Research Evaluation and Priority Setting*. Ithaca: Cornell University Press.

Baig, M. N. and Gamache, P. M. (2009). *The Economic, Agronomic and Environmental Impact of No-Till on the Canadian Prairies.* Alberta Reduced Tillage Linkages. Canada.

Bolliger, A., Magid, J., Amado, T.J.C., Skora Neto, F., Ribeiro, M.F.S., Calegari, A., Ralisch, R., De Neergard, A. 2006. Taking stock of the Brazilian "Zero-Till Revolution": a review of landmark research and farmers' practice. Advances in Agronomy 91: 47-110.doi: 10.101§6/S0065-2113(06)91002-5.

De Pauw, E. (2008) *ICARDA Regional GIS Datasets for Central Asia: Explanatory Notes.* GIS Unit Technical Bulletin. International Center for Agricultural Research in the Dry Areas (ICARDA).

Derpsch, R. 2004 History of crop production, with and without tillage. *Leading Edge* 3: 150-154

Devkota, K. (2011a). *Resource utilization and sustainability of conservation based rice-wheat cropping systems in Central Asia.* PhD dissertation. ZEF/Rheinische Friedrich-Wilhelms-Universität Bonn, Germany.

Devkota, M. (2011b). *Nitrogen management in irrigated cotton-based systems under conservation agriculture on salt-affected lands of Uzbekistan.* PhD dissertation, ZEF/Rheinische Friedrich-Wilhelms-Universität Bonn, Germany.

ECAF (2012). Making *Sustainable Agriculture Real in CAP 2020: The Role of Conservation Agriculture.* European Conservation Agriculture Federation (ECAF). Brussels, Belgium. 43 pp.

Egamberdiev, O. J. (2007). *Dynamics of irrigated alluvial meadow soil properties under the influence of resource saving and soil protective technologies in the Khorezm region.* PhD dissertation. National University of Uzbekistan.

FAO (2001a). The Economics of Conservation Agriculture. Rome: FAO.

FAO (2001b). *Conservation Agriculture: Case Studies in Latin America and Africa.* Soils Bulletin No. 78. Rome: FAO.

FAO (2008). *Investing in sustainable crop intensification: The case for improving soil health.* Report of the International Technical Workshop, FAO, Rome, July 2008. Integrated Crop Management Vol. 6, FAO, Rome (www.fao.org/ag/ca/)

FAO (2011). *Save and Grow: A policymaker's guide to the sustainable intensification of smallholder crop production.* Rome: FAO. 98 pp.

FAO (2012). FAO CA website at: www.fao.org/ag/ca (accessed 15 November 2012).

Fileccia, T. (2009). Conservation agriculture and food security in Kazakhstan. Working Paper, FAO Investment Centre Division, June 2009. Rome: FAO.

Foresight (2011). *The Future of Food and Farming*. The Government Office for Science, London.

Friedrich, T. and Kassam, A. H. (2009). Adoption of Conservation Agriculture Technologies: Constraints and Opportunities. Invited paper at the *IV World Congress on Conservation Agriculture.* 4-7 February 2009, New Delhi, India.

Friedrich, T., Kassam, A. H., and Shaxson, F. (2009). Conservation Agriculture. In: *Agriculture for Developing Countries. Science and Technology Options Assessment (STOA) Project.* European Parliament. European Technology Assessment Group, Karlsruhe, Germany.

Friedrich, T., Derpsch, R. and Kassam, A.H. (2012). Global overview of the spread of Conservation Agriculture. *Field Actions Science Reports Special Issue* (Reconciling Poverty Alleviation and Protection of the Environment) 6: 1-7.

Funakawa, S., Yanai, J., Takata, Y., Karbozova-Saljinikov, E., Akshalov, K. and Kosaki, T. (2007). Dynamics of water and soil organic matter under grain farming in Northern Kazakhstan - Toward sustainable land use both from the agronomic and environmental viewpoints, in: Lal, R., Suleimenov, M., Stewart, B.A., Hansen, D.O., Doraiswamy, P. (Eds.), *Climate Change and Terrestrial Carbon Sequestration in Central Asia.* pp. 279-332. Taylor & Francis, London, UK.

Goddard, T. et al. (eds) (2008). No-Till Farming Systems. WASWC Special Publication No. 3. Bangkok, Thailand.

Gültekin, I. (2012). Report on the Status of Conservation Agriculture in Turkey. Consultant's Report.

Gupta, R. and Sayre, K. (2008) Conservation Agriculture in South Asia - Some Lessons Learnt. *Professional Alliance for Conservation Agriculture, (PACA) Newsletter* 3: 1-3. New Delhi.

Gupta, R., Kienzler, K., Martius, C., Mirzabaev, A., Oweis, T., De Pauw, E., Qadir, M., Shideed, K., Sommer, R., Thomas, R., Sayre, K.D., Carli, C., Saparov, A., Bekenov, M., Sanginov, S., Nepesov, M. and Ikramov, R. (2009) *Research Prospectus: A*

Vision for Sustainable Land Management Research in Central Asia. ICARDA Central Asia and Caucasus Program. Sustainable Agriculture in Central Asia and the Caucasus Series 1. CGIAR-PFU, Tashkent, Uzbekistan. 84 pp.

ICARDA (2012). Report on the Status of Conservation Agriculture in Uzbekistan. ICARDA, Tashkent, Uzbekistan.

ICARDA (2012). Report on the Status of Conservation Agriculture in Azerbaijan. ICARDA, Tashkent, Uzbekistan

Junior, R.C., de Araújo, A.G. and Llanillo, R.F. 2012. No-Till Agriculture in Southern Brazil. Factors that facilitated the evolution of the system and the development of the mechanization of conservation farming. FAO and IAPAR. 77 pp.

Karabayev, M., Wall. P., Sayre, K. and Morgounov, A. (2012). Conservation Agriculture Adoption in Kazakhstan: History, Status and Outlooks. CIMMYT Report.

Karabayev et al.(2012) Report on the Status of Conservation Agriculture in Kazakhstan. CIMMYT, Astana, Kazakhstan

Kassam, A.H., Friedrich, T., Shaxson, F. and Pretty, J. (2009). The spread of Conservation Agriculture: Justification, sustainability and uptake. International Journal of Agriculture Sustainability, 7(4), 292-320

Kassam, A.H., T. Friedrich and R. Derpsch. (2010). Conservation Agriculture in the 21st Century: A Paradigm of Sustainable Agriculture. European Congress on Conservation Agriculture, October 4–6, 2010, Madrid, Spain.

Kassam, A.H., Friedrich, T., Shaxson, F., Reeves, T., Pretty, J. and de Moraes Sa, J.C. (2011). Production Systems for Sustainable Intensification -- Integrating Productivity with Ecosystem Services. Technology Assessment – Theory and Prexis, Special Issue on Feeding the World, July 2011.

Kassam, A., Friedrich, T., Derpsch, R., Lahmar, R., Mrabet, R., Basch, G., González-Sánchez, E.
and Serraj, R. (2012a) Conservation agriculture in the dry Mediterranean climate. *Field Crops Res.* doi:10.1016/j.fcr.2012.02.023

Kassam, A., Freidrich, T., Shaxson, F., Pretty, J., Bartz, H., Mello, I. and Kienzle, J. (2012b) The spread of Conservation Agriculture: policy and institutional support for adoption and uptake. *Int. J. Agric. Sust.* (submitted).

Kassam, A.H., Basch, G., Friedrich, T., Shaxson, F., Goddard, T., Amado, T., Crabtree, B., Hongwen, L., Mello, I., Pisante, M. and Mkomwa, S. (2012c). Sustainable soil management is more thant what and how crops are grown. In: Principles of Soil Management in Agro-ecosystems. Eds. R. Lal and Stewart, R.A. (In press).

Kienzler, K.M., Lamers, J.P.A., McDonald, A., Mirzabaev, A., Ibragimov, N., Egamberdiev, O., Ruzibaev, E. and Akramkhanov, A. (2012). Conservation agriculture in Central

Asia—What do we know and where do we go from here*? Field Crops Research* 132: 95–105.

Knowler, D., Bradshaw, B. and Gordon, D. (2001). *The economics of Conservation Agriculture.* Land and Water Division of the food and agriculture organization. FAO, Rome, Italy.

Lindwall, C.W. and Sonntag, B. (eds) (2010). *Landscape Transformed: The History of Conservation Tillage and Direct Seeding.* Knowledge Impact in Society. Saskatoon: University of Saskatchewan.

McIntyre, B.D., Herren, H.R., Wakhungu, J. and Watson, R.T. (eds) (2008). *Agriculture at a Crossroads: Synthesis.* Report of the International Assessment of Agricultural Knowledge, Science, and Technology for Development (IAASTD).Washington, DC: Island Press.

Meyer, T. 2009. Direct Seed Mentoring Project Final Report, Spokane County Conservation District, WA/USA

Milder, J.C., Majanen, T. and Scherr, S. (2011). Performance and Potential of Conservation Agriculture for Climate Change Adaptation and Mitigation in Sub-Saharan Africa. An assessment of WWF and CARE projects in support of the WWF-CARE Alliance's Rural Futures Initiative. Ecoagriculture-CARE-WWF-ICRAF.

Montgomery, D. (2007). *Dirt, the erosion of civilizations.* Berkeley: University California Press,

Muminjanov, H. and S. Sanginov, S. (2012). Information on the status of CA in Tajikistan. Unpublished Report.

Nurbekov, A. et al. (2013). Conservation Agriculture in Central Asia: Past and Future. CABI: Wallingford (In press).

Ospanbaev, J. and Karabayev, M.K. (2009) Outlook for not-till technologies of crop growing in South and Southeast Kazakhstan, in: Suleimenov, M., Kaskarbayev, J.A., Skoblikov, V.F., Dashkevich, S.M. (Eds.), *No-till With Soil Cover and Crop Rotation: A Basis for Policy Support to Conservation Agriculture for Sustainable Production Intensification.* pp. 195-199. Astana-Shortandy, Kazakhstan.

Pieri, C., Evers, G., Landers, J., O'Connell P. and Terry, E. 2002. *No-Till Farming for Sustainable Rural Development.* Agriculture and Rural Development Working Paper. Washington DC: World Bank.

Pretty, J. (2008). Agricultural sustainability: concepts, principles and evidence. *Phil Trans Royal Society of London* B 363 (1491): 447-466.

Pretty, J., Toulmin, C. and Williams, S. (2011). Sustainable intensification in African griculture. *International Journal of Agricultural Sustainability* 9(1): 5-24.

Pulatov, A., Choudhary, A. and Akramkhanov, A. (2001). Status of conservation tillage practices in Uzbekistan. In: Gill, M.A. (Ed.), *International Workshop on Conservation Agriculture for Food Security and Environment Protection in Rice-Wheat Cropping Systems*. Lahore, Pakistan

Reicosky, D.C. (2001). Conservation Agriculture: global environmental benefits of soil carbon management. *1st World Congress on Conservation Agriculture,* Vol.1, 3-11. 1-5 October 2001, Madrid, Spain.

Reicosky, D.C. (2008). Carbon sequestration and environmental benefits from no-till systems. In *No-Till Farming Systems*. eds. T. Goddard, M.A. Zoebisch, Y.T. Gan, W. Ellis, A. Watson and S. Sombatpanit, 43-58. Special Publication No. 3. Bangkok: World Association of Soil and Water Conservation (WASWC).

Rogers, E.M. (1995). *The Diffusion of Innovations.* New York: Free Press

Shaxson, T.F. (2006). Re-thinking the Conservation of Carbon, Water and Soil: A Different Perspective. *Agronomie* 26:1-9.

Shaxson, T. F., Kassam, A. H., Friedrich, T. and Boddey, R. (2008). Underpinning Conservation Agriculture's Benefits: The Roots of Soil Health and Function. In: '*An International Technical Workshop: Investing in Sustainable Crop Intensification: The case for Improving Soil Health*' FAO, Rome: 22-24 July 2008, Integrated Crop Management Vol.6-2008, Appendix 1.

Sommer, R. and De Pauw, E. (2010). Organic carbon in soils of Central Asia - status quo and potentials for sequestration. *Plant Soil.* 338: 273-288.

Suleimenov, M.K., Akhmetov, K.A., Kaskarbayev, J.A., Khasanova, F., Kireyev, A., Martynova, L.I. and Pala, M. (2004) Developments in tillage and cropping systems in Central Asia, in: Ryan, J., Vlek, P.L.G., Paroda, R. (Eds.), *Agriculture in Central Asia: Reserach for Development.* pp. 188-211. ICARDA, Aleppo, Syria.

Suleimenov, M.K., Pala, M., Paroda, R., Akshalov, K., F., K., Martynova, L.I., Medeubaev, R., (2006) New technologies for Central Asia. *Caravan* 23: 19-22.

UNEP (2012). Avoiding Future Famines:Strengthening the Ecological Foundation of Food Security through Sustainable Food Systems. A UNEP Synthesis Report. UNEP, Nairobi, Kenya.

WOCAT 2007. *Where the land is greener: case studies and analysis of soil and water conservation initiatives worldwide*. H. Liniger and W. Critchley (eds). Netherlands: CTA-FAO-UNEP-CDE.

ANNEX I

Working Group Outcomes at the Regional Workshop

Three working groups were established and each was requested to discuss the following five topics, and the consolidated outcome is presented below. However the study on status of CA covered only Central Asian countries, other former Soviet countries also expressed interest and were invited to the workshop and actively participated in discussions.

1. **<u>What is already in place in each country that is conducive to CA uptake and spread?</u>**

   - Understanding the problem (e.g., Kazakhstan, Uzbekistan subsidize plant protection activities), and favourable environment for applying CA (ex: degraded lands, saline soils, etc.);
   - CA is being applied in a number of the countries (Kazakhstan, Moldova, Turkey), or it is being partially applied in Azerbaijan, Tajikistan, Kyrgyzstan, Uzbekistan,)
   - There is ambition and knowledge, and national policies are being developed in most countries (e.g., strategic plans, amendments in legislations of the countries, except Armenia) ;
   - There is partial availability of agricultural equipment to introduce CA (local production of CA equipment established in Turkey)
   - Good international experience and cooperation

2. **<u>What is working against CA uptake and spread?</u>**

   - Mind-set of tillage-based agriculture – not ready to abandon the conventional tillage mind-set
   - Land fragmentation does not enable the adoption of CA in certain areas
   - Regulatory framework does not contribute/promote the introduction of CA
   - Lack of sufficient financial resources to purchase equipment, herbicides and fertilizers, but this appears to be an excuse for not adopting CA
   - Poor technical basis and insufficient study of CA, specially a lack of long-term data
   - Deteriorating phytosanitary conditions (e.g. weeds) at the initial stage of introducing CA

- Risks for agricultural producers (decline of yield at the initial stage of introducing CA)
- Lack of research in soil structure
- Lack of knowledge, information and awareness among producers (e.g., lack of guidelines on CA)

3. **What are the challenges that need to be addressed?**

- Lack of country-specific strategy to promote and up-scale CA
- Insufficient development of scientific basis (research of soil, crops, pest) in each country
- Training for capacity development, and raising awareness of farmers and field staff about the advantages of CA
- Support for safe phytosanitary conditions
- Machinery supply and affordability, organizing government support through subsidies, credits and leasing
- Production of local equipment for CA in order to lower cost
- Freedom for farmers in crop selection and rotation planning (e.g. for Uzbekistan and Belorussia)

4. **What is needed to create opportunities for CA uptake and spread?**

- Establishment of CA farmer associations
- Establishment of national platforms (task forces), networks and FFS for dissemination of information and participatory extension of CA
- National strategies and action plans and tactics
- Legislative framework to provide policy and institutional support to agricultural producers, specially at the initial stage to mitigate risks
- Financial support and establishment of services responsible for introduction of CA
- Pilot CA dissemination projects supported by FAO for each country

5. **How do we move forward, including working arrangements?**

- Development of regional project supported by FAO or any development partner under which a strategy can be worked out

- Develop national agrarian and scientific and technological policies to promote CA including legislative framework which determines the terms for supporting agricultural producers at the initial stage in order to create risk mitigating and stimulating measures for agricultural producers
- Create a system of associations, NGOs, national and regional networks on promoting the technology
- Promote consciousness and mind-set of farmers and scientists to adopt and promote CA
- Establish a system of agricultural service (equipment, machinery, chemicals and others) to support CA uptake and spread
- Expand research on CA to generate new knowledge
- Integrating CA into education, training and extension systems
- Promote domestic and foreign investment to support CA

ANNEX II

Conservation Agriculture for the Central Asia Region: A Strategic Framework

2013 -2030

Achieving sustainable increases in agricultural production

FAO Sub-Regional Office for Central Asia (SEC)
December 2012

Contents

Foreword

This document was compiled by Dr. Amir Kassam, Consultant, FAO-SEC. It is based on the earlier work on the FAO Conservation Agriculture Strategy for Sub-Saharan Africa, and on the deliberations of the Regional Workshop on 'Save and Grow': Promotion of Conservation Agriculture and Modern Plant Protection Methods, 4-6 December 2012, Antalya, Turkey.

Achieving food security and intensifying agriculture sustainably remains central to many national and regional programmes and policies in Central Asia region. Although agricultural productivity has increased in some countries in the Central Asia region, many countries remain net importers of food and are thus exposed to environmental and economic factors prevailing in the food exporting countries. Average staple cereals yields for the region have slightly increased over the past 20 years, but they still remain low compared to grain yields in developed countries. Poor farming methods, increasing soil degradation and consequent desertification are some of the causes of this low productivity. Droughts and/or prolonged dry spells often worsen the situation by resulting in severe crop damage or complete crop failures. With the majority of the population in the Central Asia region dependant on both rain-fed and irrigated agriculture for their livelihoods, technological options that increase agricultural productivity and help to buffer farmers against the negative impacts of climate-related and other constraints should be promoted. One such option is Conservation Agriculture (CA) which is an approach to managing agro-ecosystems for improved and sustained productivity, increased profit and food security while preserving and enhancing the resource base and the environment. It is also an approach to rehabilitate degraded agro-ecosystems.

Despite its proven benefits, CA is still practiced on a very small area in the Central Asia region due to lack of knowledge among stakeholders and to limited policy and institutional support from national governments.

This strategic framework presents the relevance of CA to sustainably increasing agricultural output, productivity and profit whilst enhancing both the resource base and ecosystems. It presents the vision, goal, mission and strategy for CA in Central Asia over some 15-year time horizon, and also the key elements upon which the strategy is based. In developing the strategy, FAO and regional stakeholders have identified the development opportunity provided by CA as well as the constraints that must be overcome to mainstream CA in a targeted manner involving all stakeholders who have a role in ensuring success. The document discusses ways to improve and measure outcomes over the longer-term.

The purpose of the strategic framework is to serve as a road map to the formulation of country-specific strategies and action plans for the promotion and up-scaling of CA. To achieve this, it was proposed at the Antalya Regional Workshop on 'Save and Grow' that a regional stakeholder task force and national stakeholder task forces will be established to coordinate and facilitate the promotion and up-scaling of CA.

Abbreviations and Acronyms

CA	Conservation Agriculture
CGIAR	Consultative Group on International Agricultural Research
CIMMYT	International Wheat and Maize Improvement Centre
DRM	Disaster Risk Management
FAO	Food and Agriculture Organization of the United Nations
FAO-SEC	FAO Sub-regional Office for Central Asia
FAO-TCI	FAO Technical Cooperation Investment Centre Division
ICARDA	International Centre for Agricultural Research in Dry Areas
M&E	Monitoring and Evaluation
MoA	Ministry of Agriculture
NGO	Non-Governmental Organization

1. Introduction

This document presents a strategic framework for promoting and up-scaling Conservation Agriculture (CA) in Central Asia[3] in order to enhance sustainable increases in production and reduce risks. The framework aims to:

- Develop a common understanding on CA.
- Outline an action plan for expanding CA in Central Asia
- Elaborate approaches to sustain and institutionalize CA through national structures
- Define stakeholder role for achieving the spread and impact of CA.

The document presents stakeholder's vision, mission and goal for CA in Central Asia over a period of some 15-year time horizon. It underscores the relevance of CA towards achieving sustainable production, food security and increased farm profitability levels, while enhancing the resource base and conserving ecosystems.

In developing the strategic framework, FAO and its partners (e.g., national programmes, CIMMYT, ICARDA) and other stakeholders in the region have identified opportunities provided by CA as well as the constraints that must be overcome by stakeholders to mainstream CA in relevant national, sub-regional and regional plans, programmes and policies. The document discusses ways to improve and measure impacts in the short to long term. Because FAO operates at the national, sub-regional and regional level, the strategic framework is based on a corporate approach to formulation and implementation, and has attempted to be inclusive in capturing region-wide organizations. The regional strategic framework for Central Asia provides a 'road map' for the formulation of national strategies for the promotion of CA involving policy and institutional support to farmers.

The national strategies will provide the FAO country and sub-regional offices with a mechanism to ensure that governments, civic society, sub-regional and regional bodies, donors and international agencies are aware of FAO's capacity and comparative advantage in promoting CA in Central Asia region. The strategy and the associated action plan for each nation reflect the diversity of experience and progress that exists in the different parts of the region. For example, Kazakhstan is relatively more advanced than the other nations in the adoption and spread of CA, followed by Uzbekistan and Azerbaijan, respectively. Kyrgyzstan, Tajikistan, Turkmenistan and Turkey have no significant area under CA as yet but have been taking serious interest in testing the performance of CA. Thus, the pace at which the different nations would move forward would reflect the current diversity in experience, expertise and stakeholder awareness.

[3] For the purpose of this document, Central Asia region comprises seven countries: Azerbaijan, Kazakhstan, Kyrgyzstan, Tajikistan, Turkey, Turkmenistan and Uzbekistan.

2. Why Conservation Agriculture?

The agricultural resource base of Central Asia comprise largely of the arid and semi-arid climates and strongly continental, with hot summers and cold winters. Average annual precipitation, which is concentrated in the spring and winter, is about 270 mm, and vary from 600 to 800 mm in the mountainous zone, and 80-150 mm in the desert regions. The key climatic constraint is a high within season and between season rainfall variability. The production potential of these agro-ecological zones in the lowlands and highlands for arable production and for livestock has been further reduced by inappropriate agricultural land use practices and poor management including nutrient mining and high mechanical soil disturbance. Conventional tillage has exacerbated the decline in soil fertility and biodiversity, soil loss, degradation and compaction. This is also true for the irrigated production where cotton is produced under tillage system.

The increase in populations of both people and livestock, droughts and floods and poor access to yield enhancing technologies and low marketing opportunities for agricultural produce, has also caused reduction and/or stagnation in agricultural productivity and worsened food insecurity and malnutrition. This situation will only worsen, unless drastic changes in farming practices are adopted by farmers for sustainable production, and for reducing risks linked to climate change.

There are many technical options available to improve agricultural productivity, for example with high quality seeds, fertilizer and pesticides. However, under the above described scenario, such improvements will neither be sustainable, nor economically feasible in the long term. The FAO Strategic Objective A aims to combine sustainability with intensification as elaborated in its 'Save and Grow' publication. Since it minimizes or eliminates soil degradation and builds a foundation for a functioning ecosystem, CA is considered to be *the* entry point in making the intensification sustainable, as well as rehabilitate degraded rainfed and irrigated agro-ecosystems.

Livestock is an integral component of the production systems in many of the agro-ecological zones of Central Asia. The potential of crop-livestock integration in CA systems has not been adequately exploited and competition for crop residues for livestock feed and mulching is high because of low biomass production in these systems. CA provides an opportunity to increase *in situ* biomass production to integrate crop-livestock systems for increased productivity and resilience. For small scale farmers, the integration of livestock and trees into the CA farming systems is considered to strengthen livelihood and resilience.

Given the present knowledge and circumstances, CA is the most appropriate sustainable option available to increase productivity, income and food security in the region. It offers an opportunity for commercialised production and substantially improves resource use efficiency. It can be practiced by any farmer and offers a viable solution for poor farmers to address their productivity constraints, particularly high labour costs and tillage constraints. Further, CA will help farmers to adapt to and mitigate the effects of climate change and variability.

CA has been shown to be relevant and appropriate at all levels of farm power and mechanization, from manually operated hand tools to equipment drawn by animal traction to operations performed by heavy machinery. CA is not only for vulnerable small farmers but also for small or large scale commercial

farmers whose ecological as well as economical risks can be lowered by CA. Benefits of CA to the farmers relate to improved yields and input use efficiency, greater profit, improved soil characteristics, reduced soil erosion and increased resilience to climate variability and change. CA has been shown to work successfully in countries such as Kazakhstan, Uzbekistan, Azerbaijan and Turkey and yield increases in the range of 14-41% have been reported for grain crops. However, all the countries in Central Asia have a desire to initiated programmes to support the introduction and spread of CA. While CA represents innovative systems for agricultural development and sustainable livelihood, rapid spread of CA also needs to be supported by policy and institutions, including the availability of affordable locally manufactured or imported CA equipment and machinery including animal drawn or tractor drawn direct seeders.

3. What is Conservation Agriculture?

Conservation Agriculture (CA) is an approach to managing agro-ecosystems for improved and sustained productivity, increased profits and food security while preserving and enhancing the resource base and the environment. CA is characterized by three linked principles, namely (www.fao.org/ag/ca):

1. Continuous minimum mechanical soil disturbance (no-till, direct seeding).
2. Maintenance of permanent soil cover (residues and cover crops).
3. Diversification of crop species grown in sequences and/or associations (a diversified cropping system).

CA is more than no-till. The above three principles are universally applicable, in combination with other good agricultural practices, to all agricultural landscapes and land uses with locally adapted practices that address local opportunities and constraints. CA enhances biodiversity and natural biological processes above and below the ground surface. Soil disturbance from mechanical tillage is reduced to an absolute minimum or avoided, and external inputs such as agrochemicals and plant nutrients of mineral or organic origin are applied optimally and in ways and quantities that do not interfere with, or disrupt, the biological processes. Critical to this is the 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 facilitates good agronomy, such as timely operations, and improves overall land husbandry for rain-fed and irrigated production. Complemented by other known good practices, including the use of quality seeds, and integrated pest, nutrient, weed and water management, sustainable mechanization approaches, etc., CA is a base for market-driven sustainable agricultural production intensification. It opens increased options for integration of production sectors, such as crop-livestock integration and the integration of trees and pastures into agricultural landscapes.

The successful spread of CA requires that a number of constrains – including the widespread perception amongst farmers that inversion tillage is an essential part of crop production processes – have to be

overcome. Moreover, the design of any CA effort should consider the needs of the communities and farming systems and the market context, and be cognizant that CA should be pursued as a permanent undertaking, ideally with a five year initial investment period. CA practices may be applied incrementally, starting with minimum-tillage on a small area and at high standards of management.

4. Vision, Mission and Goal

CA is linked to FAO's Strategic Objectives which aim at sustainable crop production intensification as a means to eradicate hunger, reduce rural poverty, improve food and agriculture systems, and increase livelihood resilience, and CA is seen as a main mechanism for sustainable agriculture development including in Central Asia region. CA is also part of FAO's Disaster Risk Management Strategy where it is an option for disaster risk prevention and mitigation.

Vision
A region free of hunger and malnutrition where increased access to food and increased productivity of agriculture contribute to improving the living standards of all, especially the poorest, in an economically, socially and environmentally sustainable manner.

Mission
Within the framework of the above vision and FAO's operational strategy, the CA strategy for Central Asia aims at helping to build a food-secure region for present and future generations.

Goal
CA up-scaled and mainstreamed in national, sub-regional and regional policies and programmes contributing to the achievement of the Millennium Development Goals

Key outcome
Increased and sustained agricultural productivity, production and profitability in Central Asia for farmers as key beneficiaries.

The achievement of the above key outcome will be determined by the Plan of Action of each nation implemented at the country level whose formulation and implementation will be facilitated by the national stakeholder task forces or working groups.

5. Critical Success Factors for CA Adoption and Up-scaling

The following are considered to be the critical success factors or strategic focal areas for CA adoption and up-scaling:

- Coordination and cooperation
- Policy support for CA in national programmes
- Targeting CA interventions
- Partners and stakeholders participation
- FAO's technical capacity
- Private sector participation

- Farmer-centered participatory adaptive research
- Monitoring and evaluation
- Communication and advocacy
- Defined roles and responsibilities
- Availability of adequate financial resources

Details on each strategic focal area are elaborated in the ensuing sections of the strategy, and these will be further elaborated in each national strategy.

5.1 Coordination and Cooperation

The key elements of CA development and scaling-up are coordination and flexibility in, implementation and supporting innovative approaches. FAO will facilitate the coordination of CA development and rolling out by partners and stakeholders. The coordination will ensure harmonized implementation of CA principles and approaches as well as monitoring. Where appropriate, FAO will support the establishment or strengthening of national and regional multi-stakeholder task forces that are responsible for promoting and implementing CA. FAO, through its unique intermediary position, and being lead organisation for food and agriculture will continue to support the establishment and/or strengthening of CA coordination mechanisms that incorporate all relevant stakeholders at the country and sub-regional levels. The national coordination platforms will facilitate the development of CA implementation plans based on this strategy and the integration in national policies and frameworks/platforms. This will require the building of capacity at the national level to establish country specific work plans.

5.2 Policy Support for CA in National Programmes

One of the key elements of successful adoption and up-scaling of CA is policy support in national programmes. This means that there must be proactive buy-in at the policy level backed-up by significant institutional support in a range of services from both public and private sector before CA can be embedded in national programmes. Such policy support would be reflected through mainstreaming appropriate CA interventions in policies of relevant developmental sectors which include agriculture, environment, education, commerce, trade and industry. A key area related to resource mobilisation and requiring national policy-level intervention is the provision of necessary support for appropriate engagement of national CA practitioners (representing the public and private sector) in the development of national action plan process to ensure that CA interventions are adequately covered in all national plans. In particular, FAO will work to mobilise policy support for CA in terms of research and extension, supply of CA related equipment and machinery, linking input subsidies with adoption of CA. Investments in agriculture intensification will have to be allocated increasingly towards the adoption and up-scaling of CA and FAO would provide policy guidance and support to governments as well as ensure that politicians and decision-makers are made adequately aware and convinced of the large range of benefits that can be harnessed for the producers and the society though the large scale adoption of CA.

5.3 Targeting CA Interventions

In designing CA interventions, FAO and the collaborating stakeholders will consider the characteristics of agro-ecological conditions and farming systems in each nation. FAO will promote CA to strengthen

production system sustainability and intensification within its Disaster Risk Management (DRM) framework that links emergency and rehabilitation activities to longer-term development and technical assistance activities.

Support to CA will be tailored to the requirements of different small farmer categories. FAO will support policy development that addresses the needs of all CA stakeholders. Technical support will be provided to potentially productive farmers for increased household food security and income generation. Where needed, vulnerable farmers will be provided with material and technical support, with an emphasis on productivity and profitability. Across all levels the focus will be on community level engagement to ensure buy-in by all stakeholders.

The corporate strategy recognises the different target levels of implementation and coordination. At the regional and sub-regional level, the focus will be on building coordination and cooperation backed-up with an effective communication and advocacy effort as well as support to operational planning, monitoring and resource mobilisation activities. Networking and information sharing will be an important activity at the regional and sub-regional level and so will the identification of some of the service providers in the key areas such as equipment and machinery, training, etc. The regional and sub-regional targeting will be formulated by the respective sub-regional working groups.

The targeting of beneficiaries, particularly the small farmers, can only be done at the national level taking into account the potential demand for sustainable intensification and need for CA, readiness to adopt CA as reflected by the national policy and institutional capacity to support CA interventions, including the support from the private sector on the input supply. In general, national level targeting of beneficiaries and geographical areas will be facilitated by the national working group on CA in each country, consistent with the country's sector and national development plans. In those countries where CA does not have an explicit policy support in the production intensification strategy, then the national policy-makers and institutional and corporate/business leaders will be a special advocacy target group.

Each sub-region has its own particular resource endowment, socioeconomic conditions, range of production systems, and agricultural and economic development opportunities. Each sub-region has its particular level of adoption and spread of CA with its particular national level commitment towards CA. Further, FAO's own experience with CA in each sub-region is at different levels. Thus, the strategy calls for flexibility and adaptability according to the specific situation in each sub-region and in each country.

5.4 Partners and Stakeholders

Successful development and scaling-up and out of CA requires flexibility and participation of various stakeholders and partners. Collaboration between FAO and stakeholders will be guided by principles of good (true) partnership (transparency, mutual trust, respect, commitment, continual consultation/communication, accountability, knowledge and benefit sharing).

FAO will work with partners and stakeholders at the regional and national level, including governments, private sector, farmer organizations, civil society, NGOs, and research and development partners in generating and mobilising support for the implementation of CA in the sub-regions, facilitating the integration of CA into national and regional agricultural plans, programmes and policies, including training, research, education, markets, extension and budgeting.

FAO will engage stakeholders at regional (e.g., ICARDA, CIMMYT) and national (e.g., MoA) platforms for problem analysis, programming, planning, resource mobilization, implementation, monitoring and evaluation, and lessons learning and dissemination. FAO's engagement with stakeholders will build on their respective comparative advantages, geographic and sectoral coverage.

FAO will work closely with existing CA networks to maximize exchange of information and expertise for capacity development of stakeholders.

5.5 FAO's Technical Capacity

FAO, as a leading agricultural organization, has made CA part of its strategy for agriculture development to achieve the FAO strategic objective of sustainable intensification of crop production in the Central Asia region and is advocating for CA support. FAO will realign and strengthen its technical capacity needed to generate and respond to opportunities to promote CA as part of its sustainable production intensification strategy. To achieve this, expertise will be mobilized for national and regional coordination and technical assistance. FAO with its multi-disciplinary approach will provide technical and policy support and advice when needed at every stage of any CA-based initiatives.

CA is not a single technology but a set of complementary practices that are implemented simultaneously by the farmers to obtain full benefits. These practices cover a large range of expertise from equipment and mechanization to cover crops and residue management to pest (weeds, pathogens and insects) management to nutrient and water management. In addition, there is crop and cropping system management expertise that is also required to support the development of good quality CA. Thus, the need for multi-disciplinary teams with CA expertise is essential for the success of this strategy and FAO sub-regional offices will make certain the required expertise is added to the various teams as appropriate to successfully implement this strategy. At the same time, FAO will strengthen its in-house collaboration and facilitate the greater sharing of in-house expertise across the sub-region and countries.

5.6 Private Sector Participation

Development and up-scaling of CA must be supported by access to inputs (seeds, agrochemicals, equipment, implements), finance, research and knowledge, and training. Inputs such as soil additives (fertilizer, lime), seeds, herbicides and pesticides are generally more available under the existing input support systems. On the other hand, access to CA equipment and machinery and other inputs, such as herbicides and cover crop legume seeds, may not be readily accessible. FAO will facilitate the creation of an enabling environment for timely access to quality inputs and CA equipment, where possible. In the short-term, there may be a need for importation and adaptation of equipment through existing regional and global capacities and suppliers. In the medium to long term, private sector is expected to import and manufacture equipment. FAO will particularly facilitate access to essential inputs of equipment and cover crop seeds. CA equipment hire services providers will be provided with technical and training support so that they provide farmers with timely and high quality services that are economically viable. Here, the role of private sector is particularly important and FAO will seek the greater involvement of private sector. Additionally, the CA-based farming value system is much more sensitive to environmental concerns and soil health so that improved factor productivity with CA corresponds to lower use of agrochemicals. In many instances, good quality seeds of local adapted varieties can also offer excellent

performance under CA. FAO will ensure that in promoting the spread of CA due care will be taken to optimise the use of purchased inputs and where possible local adapted varieties and local cover crop species will be encouraged. This will require the promotion of public-private partnership in input/output markets. Farmer access to input/output markets is critical for sustainable CA adoption and up-scaling. While markets for staple crops and export crops are better developed, there are major challenges with respect to other crops which are used in crop rotations (legumes, oilseeds). FAO will also support partnerships that link farmers to output value chains and markets.

Beyond equipment and inputs, FAO sees an important role for private sector in research, training, extension and finance. This will be encouraged as appropriate.

5.7 Farmer-Centred Participatory Adaptive Research

CA is knowledge and management intensive and requires the support of both research and extension agents working together with farmers. Participatory approaches to testing and sharing experiences is an important part of up-scaling. This occurs through different mechanisms such as Farmer Associations, farmer networks with lead farmers, farmer co-operatives, lead farmer-based producer groups, or farmer clubs, in which generation of site specific knowledge and experience is key to successful adoption and spread of CA. Links with CGIAR centres and national programmes operating in specific agro-ecological zones will be established and strengthened to ensure that recommendations within the realm of CA can be discussed with and tested by the farming community. It is also important for research and extension to undertake short-term and longer-term on-farm benchmark applied and adaptive research that can help identify solutions regarding constraints to CA adoption by the farmers as well as serve as hubs for convergence of innovations and inputs from different stakeholders. Research and extension must also be able to demonstrate the relevance and feasibility of CA in different parts of the country and between countries. FAO will strengthen its linkage with research and extension in line with adequate policy support and facilitate their greater participation in up-scaling of CA. Research on critical issues, selected in cooperation with relevant stakeholders for obtaining evidence on the benefits of CA and also to understand the technical and policy constraints to CA uptake and spread will be supported.

5.8 Monitoring and Evaluation

FAO along with national institutions and international organizations will establish a comprehensive Monitoring and Evaluation (M&E) system from the sub-national and national levels to the sub-regional and regional levels. Its purpose is to measure the status of CA implementation, quality of activities and processes, development of information and, to provide evidence of change and impact on livelihoods resulting from CA interventions. It also aims to provide a synthesis of resource materials and information on lessons learned for programme planning, advocacy and communication, and for decision-making by a range of stakeholders in public and private sectors. The M&E system will be a critical and integral component of FAO's CA strategy and incorporated from the outset in the programme design.

Through sub-national and national coordination mechanisms, M&E will focus on changes in productivity, socio-economic and, livelihood changes as well as on environmental impacts. Through national coordination mechanisms, short, medium term and long term CA verifiable and measurable targets will be established. They will be based on the status of capacity, existing and planned projects and the

constraints that exist particularly in terms of training expertise. Targets will be formulated with a focus on sustainable impacts, taking into account both quantity and quality of interventions. Country specific targets would be amalgamated and updated to form consolidated regional targets. The information gathered as such will be used to create advocacy products for influencing strategic direction and form the basis of accountability. The national M&E strategies will contribute to M&E systems at the sub-regional and regional level.

Baseline benchmarks of livelihood circumstances, productivity, soil quality and health, cost-effectiveness etc, will be established for individual countries and within each sub-region. In the short term, the M&E would focus on rates of productivity and, its effects on food security and income generation. In the long term, the focus would be on changes in socio-economic and livelihood conditions and on institutional and environmental parameters. FAO will be cognizant of the fact that CA interventions will have different time frames for realizing results. The M&E system will also establish a result-based justification for up-scaling and establishing outreach and, through feedback mechanisms opportunities to readjust regional and/or country specific action plans.

The adoption of CA will be measured by changes in the application of production practices which in turn is expected to lead to measurable changes in input use, derived outputs and factor productivity, profitability and risks. For such changes to be ecologically sustainable, they are expressed in ecosystem service parameters at farm and at landscape level and, in the state of economic, social and environmental circumstances. Thus, the strategy would imply measurements of change at both, the micro (field plots) as well as macro (landscape) level. The M&E is expected to bring out the pattern of adoption of CA's core principles. This process of change can be monitored to assess the impact both during the transition stage e.g. changes in runoff and erosion, in soil moisture conditions and impact of dry spells on production, etc and at the time when all expected benefits have been realized.

To establish result-based impact pathways, FAO and national and international stakeholders propose a 15-year planning and implementation horizon to guide overall direction of interventions and to show commitment to the long term nature. This horizon will show how CA links to national and regional strategic agricultural development plans.. Within this framework FAO will implement projects through rolling national and regional action plans each with their own M&E system. Some will be in the realm of shorter term emergency interventions while others in the medium and longer term development interventions. The main value of this approach is to provide evidenced based information to improve project planning and target formulation through feedback linkages.

5.9 Communication and Advocacy

The objectives of the communication and advocacy strategy will be to facilitate effective internal as well as external communication, information sharing and awareness creation, and catalyse and support the desired changes consistent with the goal of this CA strategic framework for Central Asia region and the countries within it.

For internal communication the focus will be on information sharing, including lesson learned, good practices, technical and policy briefs, to enable the different FAO programmes and units to work better together as One FAO and strengthen FAO CA strategy and pool of expertise.

FAO will communicate to increase stakeholder knowledge and awareness of CA and its benefits, facilitate lesson learning and sharing of best practices, and advocate for resource mobilization and an enabling environment. For external communication, FAO will communicate its role as one of the lead CA organization working alongside international organizations in the Central Asia region and the national programmes. The communication messaging and vision will be formulated to address different target audiences and delivered through different mediums (print and electronic) and processes.

The national communication strategies will be developed through the national coordination mechanisms and the national communication strategies will feed into the regional communication strategy.

5.10 Roles and Responsibilities

For the successful implementation of CA, all structures of FAO will support the common goal. The responsibilities of FAO will be addressed and coordinated at various levels – sub-national/national, sub-regional, and regional/headquarters in emergency and rehabilitation activities and in regular development activities, as well as in linking emergency programme phase with development phase. However, in essence, activities will reach across the various levels because of their nested relationships. Each level has its specific competency but within each level FAO has clearly defined mandates that must be implemented in a complementary manner. The country units are supported and back-stopped by interdisciplinary teams at the sub-regional level who in turn are supported by the Regional Office for Europe and Central Asia and by Headquarter staff from regular programme as well as from TCI. The FAO country level staff work in an integrated and inter-disciplinary manner with a range of national ministry staff and staff from national institutions and harness the synergies within FAO across country, sub-regional and regional/HQ level as well as with all the stakeholders who are engaged in up-scaling CA.

The following list illustrates the roles and responsibilities of FAO at various levels:

Headquarters/Regional Level

- Advocacy, publicity and promotion in the short and long term
- Provide link to relevant international global agreements, conventions and protocols
- Standardization and harmonization
- Resource mobilization
- Support innovation and spread relevant information
- Operational support to programmes and projects

Sub Regional

- Monitoring and evaluation, documentation and dissemination of lessons and best practices
- Advocacy, publicity and promotion
- Coordination –facilitation, standardization, harmonization
- Capacity building at all levels of implementation
- Resource mobilization
- Support and communicate innovation
- Technical support to programmes and projects

Country Level

- Advocacy, publicity and promotion
- Coordination –facilitation, standardization, harmonization
- Capacity building at all levels of implementation
- Monitoring and evaluation, documentation and dissemination of lessons and best practices
- Resource mobilization
- Support innovation, e.g., input delivery mechanisms and carbon trading and communicate to other levels
- Technical support to programmes and projects

5.11 Financial Resources

FAO will advocate a common resource mobilization strategy involving systematic approach complemented by a communication and advocacy strategy. The key objective will be to mobilise resources for partners at the national level who are involved in mainstreaming CA in national programmes.

Implementation and development of CA in each of the sub-region will require appropriate funding if it is to make a significant impact in the sub-region in the near future. To date, many countries have only undertaken small-scale projects but if wide-scale promotion and adoption is to be achieved then it will require relatively high levels of funding over the next fifteen years. FAO will emphasize dialogue and contact with donors, governments and regional bodies that are promoting CA. At both regional and country level FAO will focus on its key roles of coordination, networking, information collation and dissemination, and policy. One of the coordination functions would be to develop a costed country CA plan with stakeholders. This plan would be the basis for joint resource mobilization and allocation.

FAO will focus on ensuring the effective implementation of country level programmes where there is an emphasis on directing resources to district and village levels, where the impact at farm level, and