CONSERVATION AGRICULTURE: ADAPTATION TO CLIMATE CHANGE IN SYRIA

Conventional agriculture (CV) is a traditional production system used by the vast majority of farmers in the world. It relies on the intensification of the farming system.

Regarding land management, conventional farmers require many operations to create a fine seed-bed to plant their crops. Additionally, to maintain soil fertility, application of fertilizers is a common practice to restore soil nutrients taken up by the crops. There is a growing recognition that this land management practice damages soils and restricts its capacity to raise yields in a sustainable way. Therefore, the potential of CV is limited.

In addition, Climate Change plays a key role in current and future agriculture. Several predictions indicate that droughts will increase in frequency and intensity, accelerating desertification. Besides, the alteration in the patterns of rainfall during agricultural season will increase along time, especially in semi-arid areas. These predictions will have a negative effect in the agricultural production, thus in food security. Last but not least, the increasing competition for water between the agricultural sector, the industry and urban consumers requires drastic improvement in the water use-efficiency.

Conservation Agriculture represents a sustainable system to strengthen farmers' livelihoods by reducing the effects of Climate Change

Conservation agriculture (CA) aims to achieve sustainable agriculture from an environmental and economic point of view, resulting in improved farmers' livelihoods through the application of three key principles:

- **Minimal soil disturbance**, owing to reduced or no-tillage, preserving soil organic matter and improving the soil structure.

- **Permanent soil cover** with crop residues to protect the soil and suppress weeds without a high need for chemical herbicides.

- **Diversified crop rotation**, enhancing soil micro-organisms and disrupting pests and diseases.

Advantages of Conservation Agriculture (CA):

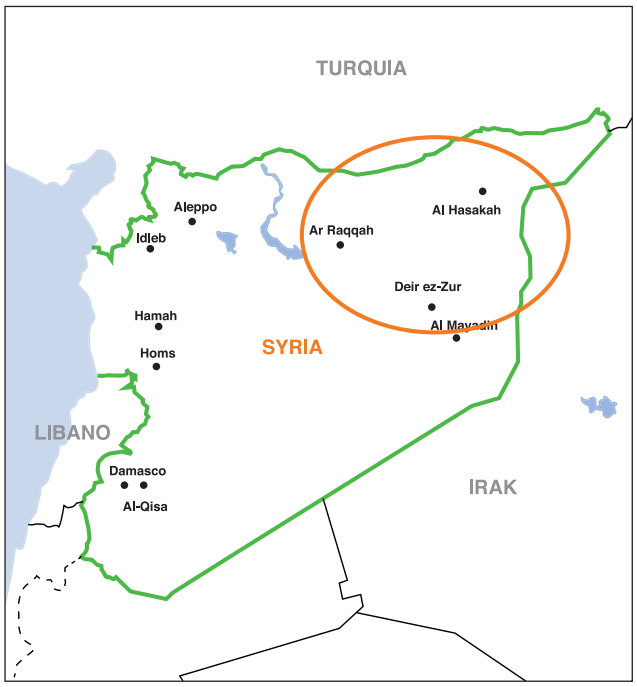
- Reduces land and water pollution and soil erosion
- Improves **soil structure (increasing its capacity to retain water)**
- Reduces long term dependency on external inputs
- Enhances environmental management
- Improves water quality and water use efficiency

Furthermore, CA helps mitigate climate change by **reducing emissions** of **greenhouse** gases, **decreasing the use** of **fuel** and **nitrogen**-based fertilizers.

INDEX

1. ACF-SPAIN INTERVENTION

In 2010 ACF-Spain started a pilot project in Syria funded by AECID (Agencia Española de Cooperación Internacional para el Desarrollo), in partnership with ACSAD (Arab Centre for the Study of Arid Zones and Dry Lands) and with the collaboration of MAAR (Ministry of Agriculture and Agrarian Reform), given their expertise and presence on the field. In addition, to improve the local partners' technical capacities, ACF-Spain signed agreements with Universidad de Lleida (Spain), who provided technical guidance in conservation agriculture and with the Institute of Tropical Regions of Montpellier (France), providing technical expertise and training to the extension workers.



The target areas were the governorates of Al-Hassaka and Al-Raqaa, located in North-East Syria (map aside), where rain-fed agriculture relies on an average rainfall of 250-300 mm/year, aggravated by Climate Change.

60 farmers were initially selected to participate in this pilot project. Thanks to the interest of other farmers in the project, this amount increased up to 150 in 2014.

2. OBJECTIVES OF THE PILOT PROJECT

- **Introduction of CA through pilot farms**, starting with innovative farmers willing to adopt CA techniques. They received technical support from ACSAD and MAAR extension agents. Crops selected were lentils, barley and wheat due to their predominance in the region.

- **Evaluation of CA vs CV**: After each one of the three agricultural seasons, results of CA pilot farms were compared with the CV. The comparison was based on 4 key indicators: yields, seeding rates, labor and fuel consumption.

- **Dissemination of results to enhance adoption**: Dissemination of the results among partners and farmers of the target area, in order to increase the rates of adoption of CA.

3. RESULTS

Here below is a description of the results of CA vs CV regarding 3 variables: yields, seeding rate and fuel consumption in the 2011-2012, 2012-2013 and 2013-2014 agricultural seasons.

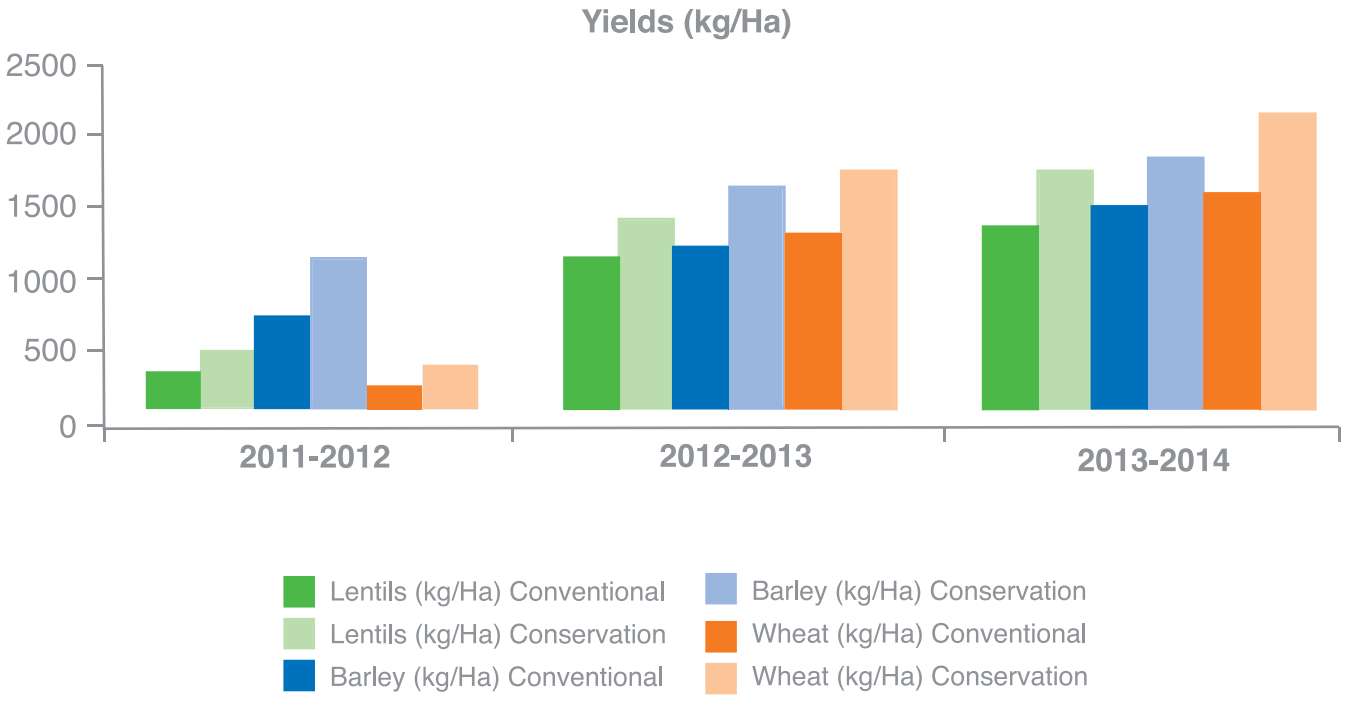
4. YIELDS

Yield is defined as the amount of harvested crop per area, represented in this case by Kg of grain/Ha. Economically, the yield represents the revenue in the farming activities.

Yields in the first year were conditioned by a severe drought in the area, especially in Al-Hassaka, therefore the yields of the study area have been lower than in normal circumstances.

In the graphic below it can be noticed that conservation agriculture provides higher yields than conventional agriculture. Wheat yields in the second year were 17% higher in CA than in CV; and 36 % higher for the third year. Lentils were roughly 25% higher for each year. Barley also showed higher yields under CA practices.

In average, along the three agricultural seasons yields under CA were 30.17% higher than under CV. Along the years, CA yields grow at higher rates than CV yields. Reason lies in the improvement of the soil properties (physical and chemical), and in better germination in CA practices.



Economically, this increase in yields can be translated into higher revenues generated by the farming activity. According to ACSAD's estimations, the differences between CA and CV for the season 2013-2014 were 75 USD/Ha (barley), 71 USD/Ha (wheat) and 160 USD/Ha in lentils. (Exchange is set up as 200SYP=1USD.

5. SEEDING RATES

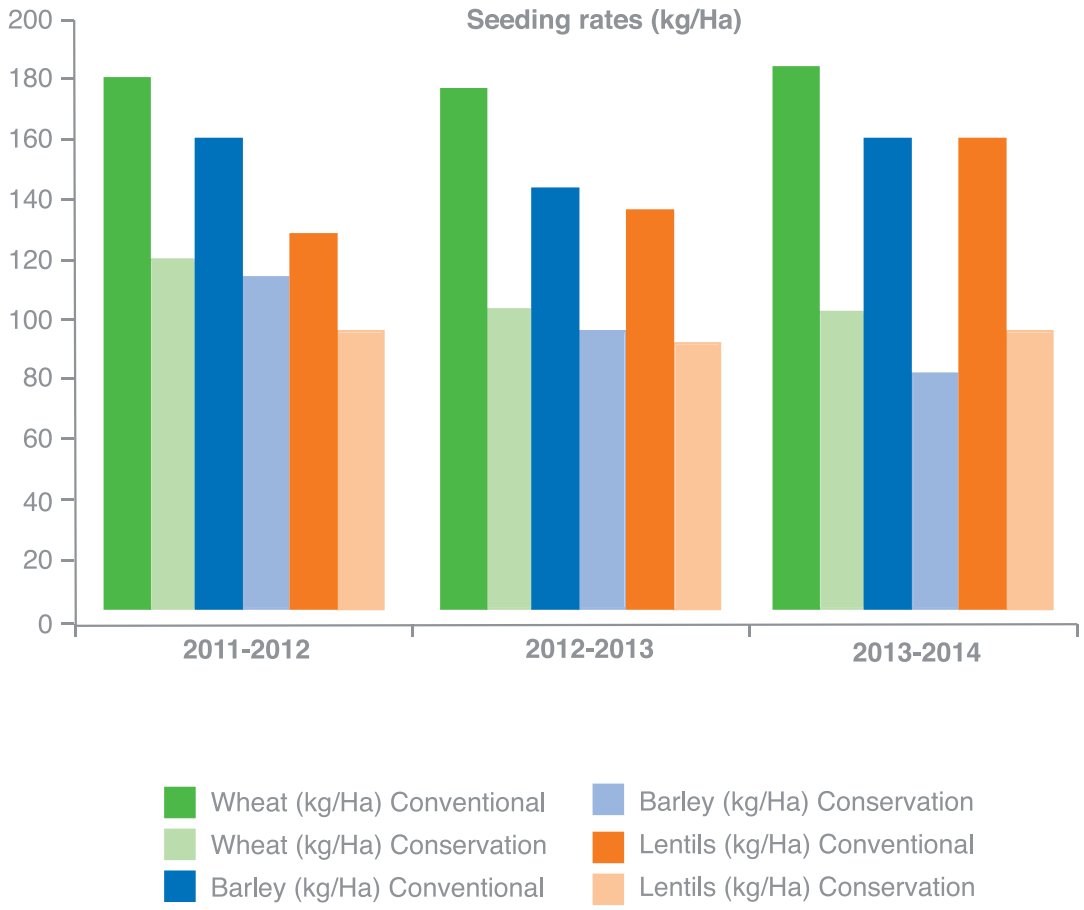
Seeding rate is defined as the quantity of seeds sown per unit land area to achieve the optimum plant density.

Conventional seeding machines are less accurate than precision seed drill used in CA since the former leave some seeds on the surface, which can be eaten by birds, or seeds are placed into deep layers, so they fail to emerge above the soil surface. Seed losses can reach in some cases up to 50-60%. The results in the following table show a considerable decrease in the seeding rates in farmers applying CA. Savings in quantity of seeds reach 80 kg/ha in wheat (2013-2014), 75 kg/ha in barley and 65 kg/ha in lentils. Average seeding rates (along the 3 agricultural seasons) in CA has decreased (compared to CV) in 35.5% for lentils, 35.2% for barley and 37.4% for wheat. This decrease is a result of better germination rates achieved by the use of direct precision seed drill.

The savings gained by the reduction in the seeding rates for the 3 agricultural seasons were estimated in 15.5 USD/Ha in wheat, 37.7 USD/Ha lentils and 11.16 USD/Ha for barley per year.

A direct precision seed drill is used in CA (with two compartments, for seeds and fertilizer). The application of seeds and the optimum amount of fertilizer at the same depth provides a better and a more uniform **germination**, as well as savings in the required amount of seeds.

©ACSAD

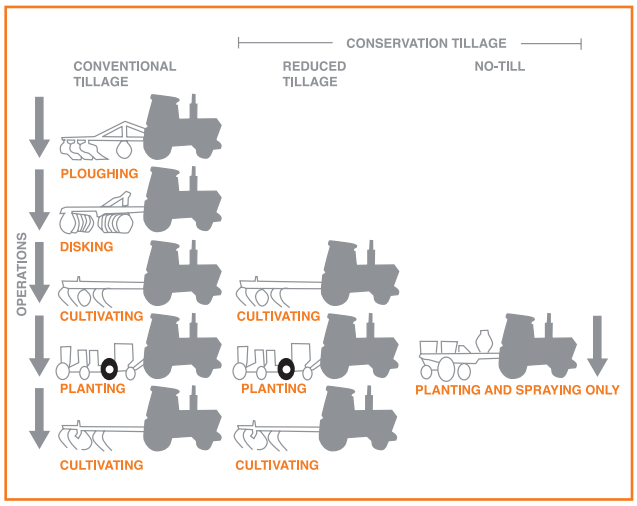

Seeding rates (kg/Ha)
200
180
160
140
120
100
80
60
40
20
0
2011-2012
2012-2013
2013-2014
Wheat (kg/Ha) Conventional
Wheat (kg/Ha) Conservation
Barley (kg/Ha) Conventional
Barley (kg/Ha) Conservation
Lentils (kg/Ha) Conventional
Lentils (kg/Ha) Conservation

6. FUEL CONSUMPTION

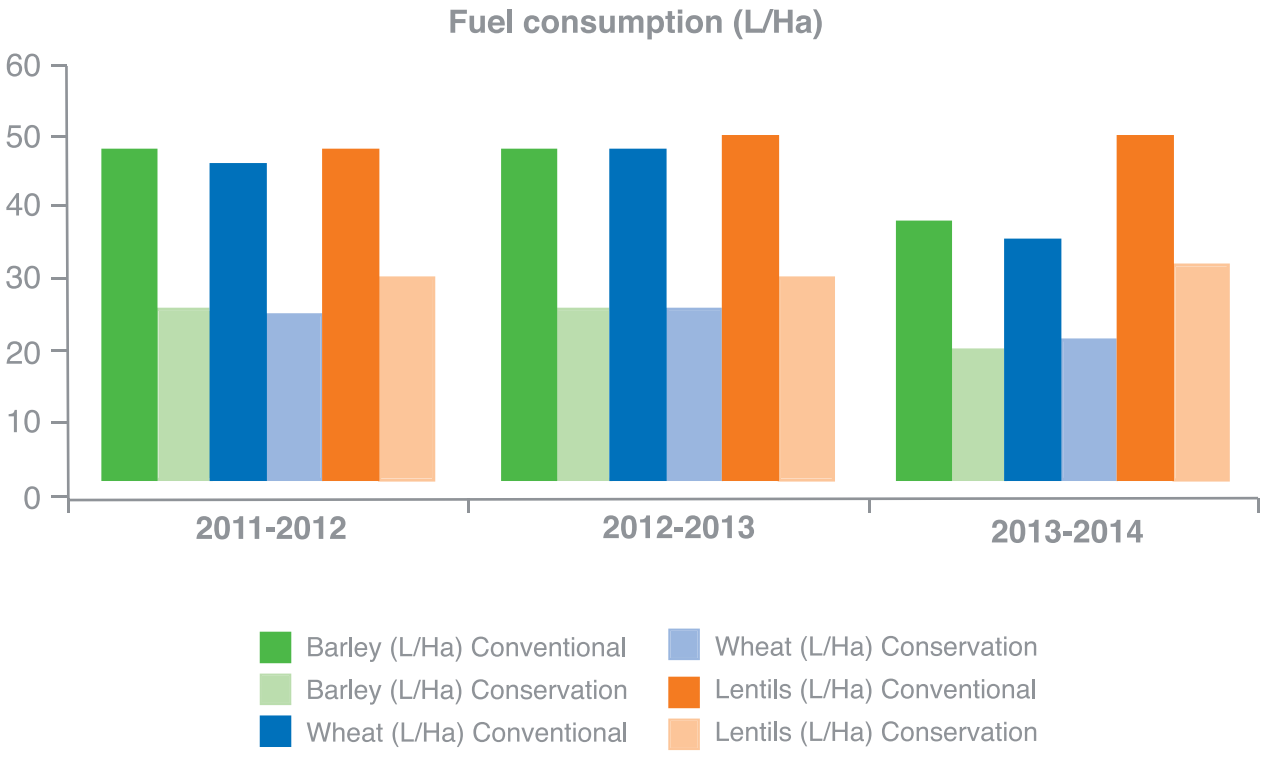
In Conventional Agriculture land preparation before seeding consists in tilling operations, carried out by a tractor or by animal traction, while in Conservation Agriculture seeding and fertilization are done in one operation with no previous tillage.

The reduced operations in CA meant a reduction in fuel consumption of 18 l/ha in lentils (35% fuel savings), 24 l/ha in barley (45 %) and 19 l/ha in wheat (43%).

The estimated savings were 16.92 USD/Ha in lentils, 18.82 USD/Ha in barley and 17.32 USD/Ha in wheat. This reduction has a significant impact in the farmers' economy due to the instability of the price and availability of fuel in the Syrian market.



Cultural practices are significantly reduced in CA compared to CV.



7. SOIL IMPROVEMENT

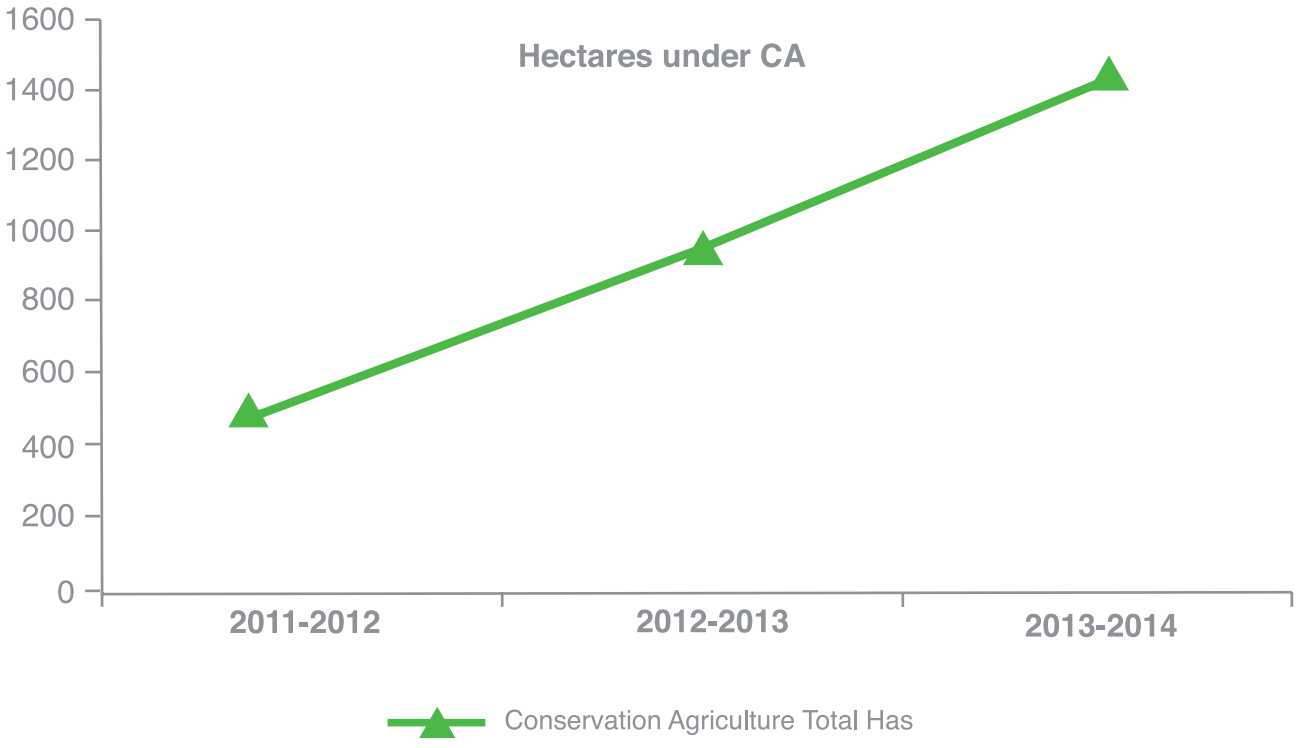
Added to the economic gains under CA, farmers applying this technique benefited along the project of improvements in the soil structure and composition. Soil analysis, at the beginning and at the end of the project, show an increase in the content of nutrients (N, P, K), organic matter, and soil moisture.

		K (mg.g-1)	P (mg.g-1)	N (%)	SMC (%)	SOM (%)
Al-Hassaka	2011	155	2.70	0.05300	0.23	0.45
	2014	178	4.23	0.07152	0.35	0.60
Al-Raqaa	2011	684	4.40	0.04550	0.28	1.38
	2014	710	6.23	0.08996	0.33	1.55

K: Potassium, P: Phosphorus, N: Nitrogen, SMC: Soil Moisture Content, SOM: soil organic matter.

8. CONSERVATION AGRICULTURE BUY-IN

The outstanding results in CA acted as a catalyzer for more farmers to adopt it, and to enlarge the area under this system for those already applying CA. The graphic below shows the steady increase in the number of hectares under CA, which almost tripled during the project.



9. CONCLUSIONS

- **Economic performance is improved in CA compared to CV:**

  Costs derived from seeds and fuel consumption are significantly **reduced** under CA. Added to this, yields increase has a positive impact in the farm incomes, generating **higher revenues** under CA than those generated by CV. Defining profitability as the difference between revenues and costs, **CA agriculture is more profitable than CV**. Higher profitability leads to improvements in the farmers' **livelihoods**.

- **Enhancement of the soil structure and properties:**

  Under CA the content of **NPK, organic matter and soil moisture** experienced a significant increase. These increments are directly attributable to CA practices, since they are not derived from a fallow period neither to chemical fertilization but to the vegetal cover and the limited mechanized labor.

- **Adoption and willingness to continue with CA practices:**

  Field survey at the end of the pilot project showed that **100% of farmers** that tested Conservation Agriculture in Al-Raqaa and 97% in Al-Hassaka were willing to continue applying CA practices. Results revealed that this high adoption of CA was mostly due to the remarkable reduction in production costs, and a substantial increase in yields.

Conservation Agriculture has a great potential for farmers in North-East **Syria to tackle**:

- The increase of environmental problems (water scarcity and land degradation)
- Erratic rainfall patterns
- Challenges of climate change

Capacity of replication and scaling-up:

- Conservation Agriculture improves farmers' **livelihoods** and strengthens **resilience** to adverse climate conditions.
- Conservation Agriculture is a suitable strategy against **climate change**, and can be replicated in other semi-arid zones in the globe.

Acción contra el Hambre
C/ Duqe de Sevilla, 3
28002 Madrid
900 100 822
www.accioncontraelhambre.org

ACCIÓN CONTRA EL HAMBRE
ACF INTERNATIONAL