Conservation agriculture for building climate change resilient farming systems

Cactus-barley alley cropping under conservation farming is being tested through CRP DS in Zoghmar community in Sidi Bouzid (Tunisia)

Conservation agriculture, which is based on enhancing natural biological processes above and below the ground for resource-saving agricultural crop production, provides sustained production levels while concurrently conserving the environment. It has successfully emerged as a climate change resilient farming system.

“We were expecting a bumper crop this year,” said Mohamad Qatawneh in Karak governorate in Jordan. However, unexpected freezing temperatures during late April shattered all his hopes. The barley crop was badly affected. Mohamad could harvest very little grain. He sat despondently staring at his nearly empty barn.

Similar devastation was seen in Tunisia. But that was caused by an excessive heat wave last April. Taoufik Ben Amr, a community leader in Chouarnia, Siliana (Tunisia), seems to have identified the real cause. “Climate has become the biggest risk factor for us”, he complained. Yields of wheat and barley in Tunisia and Jordan were lower than the long term averages despite good rains.

Climate is changing globally, but dry areas of the world are worst affected by the erratic climate events. Scientists predict that droughts and heat waves will become more common in dry areas and will significantly reduce already lower crop yield, livestock productivity and overall farming system performances.

Climate change resilient farming systems

ICARDA scientists have been investigating climate change resilient farming systems for two decades. Conservation Agriculture (CA) has been found to be one of the key tools for combating climate change. ICARDA's investigations into CA started in 2000 first in Central Asia, and then extended to North Africa, West Asia and South Asia. CA is based on three main principles; i) no or minimum soil disturbance, ii) organic soil cover and iii) diversified crop rotation.

CA practices have a direct influence on climate regulation through carbon sequestration and greenhouse gas emissions, and regulation and provision of water through soil physical, chemical and biological properties. Perhaps the most important benefits of CA for the dry areas are related to better soil and water retention and storage as compared to conventional agriculture. Soils under CA have very high water infiltration capacities reducing surface runoff and thus soil erosion significantly. This improves the quality of surface water reducing pollution from soil erosion, and enhances groundwater resources. Stored soil water is very helpful during spells of drought (Photo 1).

Undisturbed soil and soil cover serve multiple purposes. Some of the benefits can be obtained in the short term while others take longer time to realize. An immediate benefit of CA is the reduction in the use of fossil fuels and greenhouse gas emissions associated with ploughing or cultivation of soils. Since crops are directly seeded without tilling the ground, farmers save fuel and reduce gas emissions (Photo 2). No till fields act as a sink for CO_2. If conservation farming is applied on a global scale, it could provide a major contribution to control air pollution in general and global warming in particular. Farmers applying this practice could eventually be rewarded with carbon credits.

Photo 1: Water infiltration and storage of soil water is much greater in the case of CA (left) as compared to conventional field (right), which benefits during prolonged drought periods.

Box 1: Benefits of Conservation Agriculture

In the short-term:

1. Reduced wind and water induced soil erosion
2. Increased rain water capture and retention
3. Improved water infiltration into soil
4. Reduced evaporation and water loss
5. Creation of microclimate for the emerging crops.

In the long-term:

1. Increased organic matter and fertility of soils
2. Improved soil structure
3. Protection and improvement of soil biological activity
4. Reduced input requirements (fertilizers and pesticides)
5. Suppressed annual weeds.

Photo 2: Eliminating tillage helps in the reduction of soil erosion and fuel consumption, one of the many benefits of CA.

Alley Cropping

While conservation farming is a promising option to grow field crops under semiarid conditions, alley cropping with rows of cactus and barley growing in the inter-rows, is another option to tackle the same objective. Cactus is a drought-tolerant range species having high water use efficiency. The rows of cactus create micro-environment enhancing water availability for barley. Combining cactus-barley alley cropping and zero-till is a cost-effective and an environmental friendly option improving food-feed production while saving water.

Photo 3: A farmer settled in Zoghmar community in Sidi Bouzid (Tunisia) experiencing the benefits of zero-tillage farming in dry areas with minimum inputs

Cactus-barley alley cropping under conservation farming is being tested by ICARDA through CGIAR Research Program on Dryland Systems (CRP DS) in Zoghmar community in Sidi Bouzid (Tunisia). Alley cropping shrubs and cactus with barley, oats, feed legumes or native vegetation, and dual-purpose barley varieties have significantly reduced the cost of feeding livestock and reduced farmers' dependence on rangelands. Farmers who were initially unsure about the benefits of conservation farming can now see the results for themselves. 'I had heard that zero-tillage holds promise to produce in dry areas with minimum inputs. Now I'm testing this and feel convinced,' said a farmer settled in Zoghmar community in Sidi Bouzid, Tunisia (Photo 3).

Crop livestock integration under CA

Livestock are also adversely impacted by climate change. Heat stress tends to increase disease incidences, reduce fertility, and reduce milk production for livestock. Droughts reduce pasture and rangeland productivity, reducing the access to quality feed resources.

The third principle of CA, diversified crop rotation, encourages farmers to plant food and forage legumes or other crops instead of continuous cropping of wheat or barley. It also allows them to diversify their operations and increase the resilience of their system to external shocks such as extreme climate events.

Livestock is one of the best insurance for farmers in dry areas and most of them own it. However, under continuous cereal production systems farmers cannot produce high quality nutritious forage and are forced to rely on expensive external sources. Through an IFAD funded "Crop-livestock integration under conservation agriculture" project ICARDA has been looking at ways to design climate resilient diverse farms in dry areas. ICARDA is the only international center working on such integrated systems in the dry areas.

With these climate resilient diverse farms in dry areas, ICARDA hopes to enhance agricultural resiliency to climate change. These farms will also improve prospects for community empowerment and self-reliance in the face of climatic variability.

Photo 4: Crop livestock integration under Conservation Agriculture (Photo courtesy: Dryland Systems)

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