Success Stories

Science IMPACTS

The Challenge:

Climate change has led to diminished rainfall and increased temperatures in Jordan, one of the ten most water stressed countries in the world. Severe water shortage and excessive grazing has led to a major loss of biodiversity, soil erosion and land degradation. Thus, controlling land degradation and promoting vegetation growth is crucial to reduce the pressure on rangelands and provide sources of feed for sheep and goats that are most critical to livelihoods in the rural communities of the Jordanian *Badia* (dry rangelands).

Effective Mechanized Rainwater Harvesting: Coping with climate change implications in the Jordanian *Badia*

Research on micro-catchment rainwater harvesting techniques by ICARDA and Jordanian scientists has led to the establishment of semicircular bunds on contour ridges and furrows (using GPS laser-guided Vallerani machine) and runoff strips in two communities of Jordan *Badia*. As an outcome of this research, an effective micro-catchment laser-guided system was identified for rainfall harvesting, which has led to improved water availability, increased vegetative cover and improved soil health, and provided rural communities substantial sources of feed for sheep and goats.

ICARDA Science for Better Livelihoods in Dry Areas

IFAD Investing in rural people

ARAB FUND FOR ECONOMIC & SOCIAL DEVELOPMENT

OFID

USAID FROM THE AMERICAN PEOPLE

CGIAR RESEARCH PROGRAM ON Dryland Systems

Issue: 7-FEB 2016

With a semiarid climate, Jordan is characterized by high dependence on rainfall and scarcity of water resources. Precipitation trend analysis shows a 5-20% decrease in the last four decades. Per capita water availability is projected to decline from the current low of 106 m^3/year to 90 m^3/year by 2025, whereas global average is 24,776 m^3/year[1]. *Badia*, or the rangeland region in Jordan, which constitutes around 90% of the Kingdom, is representative of the vast drier environments of West Asia and North Africa (WANA) region, an area greatly in need of efficient rainwater management measures.

Despite its low levels of rainfall (less than 200 mm/year), *Badia* constitutes an important source of grazing for livestock breeders. Due to low productivity rural populations seek alternative income-earning opportunities elsewhere. This increased migration leads to the collapse of traditional land, water and vegetation management systems, causing further degradation.

Technologies for improved rainwater management in Jordan

In a project on Community-Based Optimization of the Management of Scarce Water Resources in Agriculture in West Asia and North Africa, which started in 2004 with funding support from Arab Fund for Economic and Social Development (AFESD), International Fund for Agricultural Development (IFAD) and OPEC Fund for International Development (OFID), ICARDA established several benchmark research sites in different agroecosystems including Jordan *Badia* for the implementation of integrated watershed management approach. GIS-based land suitability analysis was performed to integrate biophysical and socioeconomic factors into a comprehensive site characterization map.

In the two communities of Mharib and AlMajidyya micro-catchment water harvesting techniques, like contour ridges and furrows, runoff strips and bunds were designed and established. Vallerani machine, a plow with a hydraulic arm for intermittent pit excavation along the natural contour of the slope, was used for excavating furrows. Scientific research led to a low-cost Contour Laser Guiding (CLG) system, based on GPS guidance technology, which was adapted and implemented to the Vallerani unit. For the sustainability of the project, communities were actively engaged and they agreed not to graze the newly planted shrub for at least two years after planting, a time needed for the establishment of drought tolerant Atriplex species as a source of fodder shrubs. This system reduced the pressure on rangelands and also provided sources of nutritious feed from the drought tolerant Atriplex species.

Laser guiding GPS-based system that allows the Vallerani unit to excavate contour lines without costly topographic work

Field of Vallerani contour bunds after construction

[1]AQUASTAT Database, FAO; http://www.fao.org/nr/water/aquastat/main/index.stm

Results and scaling out

The integrated approach that was used in the *Badia* recovery to sustain plant cover and conserve soil from degradation has resulted in community resilience to harsh environment and to the severe effects of climate change. The use of mechanized Vallerani system has allowed the implementation of rainwater harvesting package at a large scale. The main beneficiaries are the herders and rural communities of marginal lands where sheep and goats are the main source of income for better livelihoods. This system has enabled them to grow fodder shrubs and reduce pressure on rangelands for livestock grazing in areas where rainwater is not enough to support stable and sustainable production and better livelihoods.

Beneficiary farmers are enjoying more than double the yield for barley and 1.6 times for rangeland and forage shrubs production compared to those grown without rainwater harvesting. Highly degraded lands have been rehabilitated by this improved vegetation, thus mitigating land degradation. The GPS-guided micro-catchment rainfall system has reduced cost and time required to delineate contours for the plow to follow, and tripled the construction capacity (up to 30 ha/day), improved efficiency and precision, and substantially reduced the cost of establishing micro-catchments.

Mechanized contour ridges planted with atriplex halmus restoring vegetation of the degraded Badia after two years of implementation

Atriplex halimus shrubs receiving large amount of harvested rainwater in the mechanized Vallerani bunds

In partnership with Jordan's National Center for Agricultural Research and Extension, USDA-Agricultural Research Service, Texas A&M University, Jordanian Ministry of Agriculture, and University of Jordan, another project on Water and Livelihood Initiative, funded by the United States Agency for International Development, focused on improving livelihoods of participating rural communities and reducing land degradation at pilot sites using the Vallerani rainwater harvesting package. Under the *Badia* Restoration Program, Jordan's Ministry of Environment has purchased three new Vallerani machines for the rehabilitation of rangelands in the *Badia* region. It has substantially facilitated wide dissemination of this technology.

In Jordan, the Vallerani rainwater harvesting package developed through scientific research has been implemented on over 3864 ha of rangeland so far, with adoption rates tripling since the start of the project. Biodiversity has increased by capturing 67-73% of available seeds in the harvested area compared to 3-6% in the control sites. Around 40-50% of precipitation is prevented from being lost by evaporation at the intervention sites.

Feasibility of using mechanized rainwater harvesting technique

Planting barley using mechanized rainwater harvesting technique:

- 17% economic internal rate of return (EIRR) as compared to 7.8% in traditional way of planting

Planting shrubs using mechanized rainwater harvesting technique was more feasible than planting shrubs in traditional way:

- 13% EIRR as compared to 7.4% in traditional way of planting
- The contribution of environmental benefits in the calculation of return on investment for rainwater harvesting techniques have led to increased EIRR of 17% compared to 13%

(Source: Akroush, S., Shideed, K. and Bruggeman, A. (2014) 'Economic analysis and environmental impacts of water harvesting techniques in the low rainfall areas of Jordan', Int. J. Agricultural Resources, Governance and Ecology, Vol. 10, No. 1, pp.34–49.)

Shrubs grown on contour furrows provide a good source of feed for the livestock, thus benefitting herders

GIS-based land suitability analysis conducted by ICARDA team suggests that a total area of 2.7 million ha in Jordan has the potential for adoption of this package, with further prospects of scaling out on an area of 300 million ha in WANA countries. IFAD is contributing to these efforts through 'Agriculture Resource Management Project (ARMP) II', a development project, where tenders for the purchase of three Vallerani machines were done in 2015. The valuation and assessment of environmental benefits associated with implementing rainwater harvesting techniques provide encouraging justification for public investment in scaling-out of these techniques in the dry areas of Jordan. The scaling-out efforts will achieve higher success if water harvesting interventions are included in plans for integrated land and water resources development taking into consideration all the necessary technical, agricultural, socioeconomic and institutional aspects and inputs.

(Photo credit: T. Oweis)

ICARDA Science for Better Livelihoods in Dry Areas
IFAD Investing in rural people
ARAB FUND FOR ECONOMIC & SOCIAL DEVELOPMENT
OFID THE OPEC FUND FOR INTERNATIONAL DEVELOPMENT
USAID FROM THE AMERICAN PEOPLE
CGIAR RESEARCH PROGRAM ON Dryland Systems

Contact Person: Theib Oweis, T.Oweis@cgiar.org **For publications,** Visit www.icarda.org or www.icarda.org/publications-resources