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The Role of Water Harvesting in Rangeland Rehabilitation in Dry Areas in Jordan

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Abstract

More than 90% of Jordan is arid, with only 5% of total cultivated area, while the total area of the country is about 89.296 km2.Rainfall with the rangeland areas is low, erratic with variable distribution and intensity. Most rainfall is lost by evaporating or as ***runoff*** without benefits due to unfavorable rainfall characteristics, soil surface conditions and thin vegetation cover. Deterioration of rangelands is as a result to drought periods frequency and overgrazing activity that may accelerate the desertification process .There for ***water harvesting*** is considered an important option for improving the management of rainwater and vegetation cover in arid and semi-arid regions.

The main problems that facing agriculture development in dry areas are soil erosion , land cover degradation, risk of production sustainability and decreasing land productivity that negatively affect the demographic distribution (farmers migration to cities) and enhancing poverty. . Most farmers are working as animal owners in agro-pastoral system looking for water availability and rangelands rehabilitation to meet their animals' needs and improve their livelihoods.

Two sites were selected in Jordanian Badia (Mohareb and Sabha) with mean annual rainfall not more than 200 mm .As apart of project (Watershed Management In Dry Areas),***contour ridges*** were downloaded and planted by Atriplex with participation of local communities .In addition to that numerous of cisterns (50 m3 capacity-each) were constructed and rehabilitated for rainwater harvesting .Farmers' priority is water collection for drinking ,domestic uses and watering animals that improve the livestock production revenue and livelihood of households living there.

The contour ridges spacing lays between 8-10 m and slope ranging between 8-12% (recommended by previous researches) that may doubled the soil moisture content in relating to control .Soil moisture content ,rainfall data and seedlings lengths were measured and collected .Field days and training workshops were held for farmers as technology transfer activity to meet the main goal of the project . However the correlation between the moisture content and biophysical yield wasn't achieved yet because it was the first growing season without significant yield, so it was as a demonstration to encourage the local farmers to adopt the water harvesting techniques and to participate effectively in implementing of project's activities.

Keywords: Water harvesting , Contour ridges, watershed management ,runoff, , soil erosion, soil moisture .

Rationale (Problem to be solved)

The pre-eminent problem facing agricultural development in Jordan is water scarcity, which arises from an unfavorable spatial and temporal rainfall distribution in the country and depletion of its groundwater resources. There is a risk that current agricultural practices become unsustainable because of accelerated erosion, decreased soil fertility and loss of biodiversity. Due to undefined property rights the long-term investments in the land are almost non-existent, and community cohesion and collective action have been weakened. There is no simple solution to these problems but the systematic analysis of factors that hinder or promote sustainable resource use are needed as inputs for decision-makers to design land management strategies. Linkages between the actual demand for animal products and the organized production process along the supply chain are often weak. Supply chain analysis allows clarification of information and identification of knowledge gaps that are determinant for sustainable production of high-value products; it is an integrated approach to address resource management options that contributes to enhance the strategies for the rainfed agriculture sub-sector (www.moa.gov.jo).

This report describes the main activities that have been carried out during the last months (July 2003 – June 2005), in particular, sites selection, survey works, downloading contour lines, contour ridges implementation, rehabilitation of collecting wells, soil sampling and analysis (physical and chemical properties, GPS records, rainfall data collection, soil moisture content, plant growth rate measurements and replanting seedlings.

The team held several meetings with the local community to spread knowledge of the effects of introducing a new, reliable, but limited, source of water on the output and incomes of local households and farming systems. The National Center for Agricultural Research and Technology Transfer (NCARTT) has a research program integrated with watershed management that was designed with the local community and institutions in a participatory approach.

Objective

To assess the technical and socioeconomic benefits of water-harvesting and income generating interventions in low rainfall areas. To assess the role of property rights and collective action, markets and social capital in the adoption of improved water-harvesting and range management techniques. To assess the dairy-products and wool supply chain in marginal areas.

The specific objectives are :

- Increase the land productivity by improving the soil moisture conditions.
- Transfer the water harvesting technology to be adopted by local farmers throughout the demonstrations.
- Increase rainfall-water use efficiency through farm scale water harvesting and soil management .

- To collect rainfall water by cisterns or reservoirs for drinking water ,animal watering ,supplementary irrigation and other domestic uses.
- Introduce easy and economic water harvesting techniques for arid areas receiving annual precipitation <200mm to make it productive.
- Develop means to effectively utilize runoff water for various agricultural practices.
- Improve natural plant cover and introduce economic crops suitable for local environment.
- Optimization of water use.

Data Gathering and Analysis

Soil samples were taken for full analysis (chemical and physical parameters) in addition to soil moisture content for different dates illustrated in Table (1).

Soil sampling outside the contour

Soil sampling inside the contour

- Climatic data has been collected: rainfall data (Table 2 and 3) and soil moisture content (Table 4).Long time rainfall data (Table 5).

- GPS readings were taken to identify the geographical location of the study area on the maps using GIS and RS Technology (Table 6).

Table 6 Mohareb Location – readings taken by GPS

Point	X Coordinate (JTM)	Y Coordinate (JTM)	Altitude (meter)
1	424182	507181	879
2	424182	506956	884
3	424343	506872	881
4	424287	507106	867
5	424322	507095	866

- Random sample for 20 seedling sample was taken to measure the length of these seedlings where it was (33.9cm). This should be followed by another measurement during the growth season.

Measuring seedlings' length

Results and Utilization

The main target underlying this sub-project is to enhance land productivity in dry areas where water is the most limited resource for agriculture and domestic utilities.

Researches have shown that opportunities exist in various agro-ecologies to maximize water use efficiency within a package of integrated management practices.

This activity is based on community participation in research and development testing and adopting improved water management options on the farm level.

The dry areas are characterized by low and highly variable rainfall which usually inadequate for economic crop production. Also, rainfall distribution is highly erratic both within and between the rainy seasons, most of it comes sporadic, intense and unpredictable storms, usually on crusting soils with low infiltration rates, resulting in surface runoff and uncontrolled rill and gully water flow.

Most of the rainwater is lost either directly by evaporation from soil surface or by runoff where it eventually evaporates if not intercepted or collected, in addition to land degradation by soil erosion (water, wind).

Water harvesting technology provides opportunity for making water more available to the plants in drier environments.

Through controlled concentration of runoff into target areas, water harvesting increases water availability to plants controls soil erosion, reduces the impact of drought and increase rainwater productivity.

Main activities carried out are:

- Site selection: two sites were selected, one in Mohareb and the other in Mafraq Governorate / Sabha Station.
- Downloading contour lines for the two sites for an area estimated to 10 hectares using survey instruments (Level Instrument).

Downloading Contour Lines

Implementing contour ridges for the same area mentioned above with contour interval ranging between 8-10m.

Implementing Contour Ridges

- Planting range plants (Atriplex) with spacing 2m between plants (4000 seedlings).

Planting Atriplex

- Construct and rehabilitate 5 collecting wells used for animal watering and domestic uses in addition to supplementary irrigation purposes. New 4 cisterns were constructed at Mohareb site ,which is important for the local community as the first priority .

Maintaining collecting wells

- Replanting the two sites after one month of planting date, where about 25% of plants were due to drought periods and frost effects.

Replanting the sites

- The two sites were supplementary irrigated.

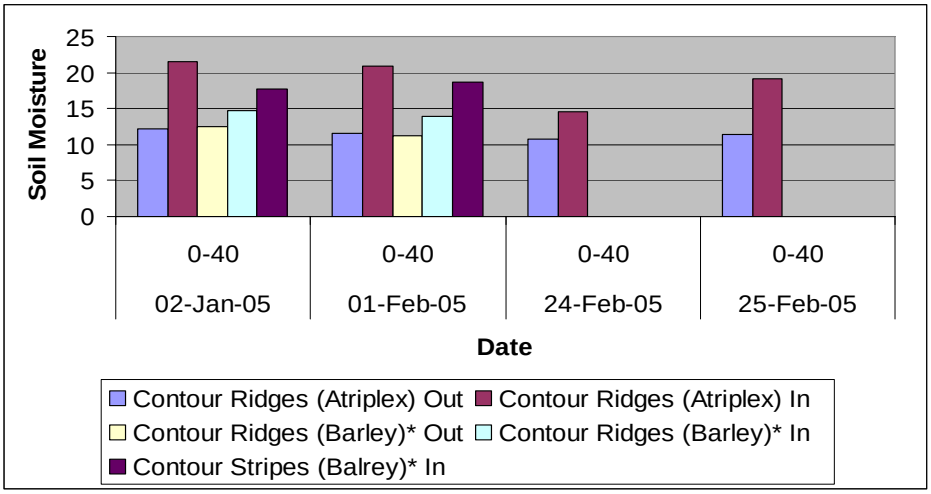
Supplementary Irrigation

- A training field day was held for local community (10-15 persons) to explain the methodology of implementing WH techniques on farm level.

At the beginning of March 2005, and as a result of public awareness that carried out by the project through field days held for stakeholders and farmers, project's activities were expanded to the neighboring farmers and communities. The project is highly appreciated by the farmers as it contributes in solving their problems especially

water scarcity, developing their lands and improving the productivity which finally affects positively the livelihood and life level of farmers.

The following figure shows the collected soil moisture in the contour ridges and out during the rainy season (2004-2005),however the correlation between the moisture content and biophysical yield wasn't achieved yet because it was the first growing season without significant yield ,so it was as a demonstration to encourage the local farmers to adopt the water harvesting techniques and to participate effectively in implementing of project's activities .The useful minutes and comments raised by Mr Ahktar will be taken into consideration in the next season .



Soil Moisture Content (Pw%) Under Different Water Harvesting Techniques

Conclusions and Impact

- Techniques for providing sustainable supplies of water from rainfall runoff for economic production of rangeland and methodologies for designing and implementing such techniques at the field and watershed levels.
- Increasing rainwater efficiency by using water harvesting techniques which were implemented in two sites which are contour ridges and collecting wells.
- Farmer's adoption of water harvesting techniques to improve land productivity that leads to increase in the fodder production.
- Developing knowledge and experience of technical staff through information exchange among experts and researches of project's partners.
- Farmers' adoption of new successful experience presented at other farms.
- Conserving natural resources, combat desertification and improving land cover.

- Analysis of potential economic and institutional constraints and recommended policy measures to support the integration of water harvesting in agricultural systems.
- Jordan suffers from scarcity of water, so it is a national task for all to adopt any suitable water harvesting technique to collect water for survive .
- Improving livelihood of poor people in rangelands through providing the means for more sustainable farming system will help to reduce their out migration.

Experience with water harvesting technologies has indicated that collecting rainwater in dry areas with low and erratic rainfall can lead to sustainable production systems.

Providing employment opportunities for the local community by adoption of sustainable agricultural systems.

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دور الحصاد المائي في تأهيل الأراضي الرعوية في المناطق الجافة في الأردن

عـــادل الشـــوبكـــي

المركز الوطني للبحوث الزراعية ونقـــل التكنولوجي – عمـــان – الأردن

تصنف أكثر من 90% من مساحة المملكة كمناطق جافة و5% فقط أراضي زراعية, حيـــث تقـــدر المساحة الكلية للمملكة 89,296 كم مربع.وتتصف الأمطار في المناطق الرعوية بالندرة والتذبذب وسوء التوزيـــع والشدة.وعليه فان معظم الأمطار الهاطلة على هذه المناطق تفقد بعملية التبخر أو على شكل فيا ضانات وجريـــان سطحي دون فائدة بسبب مواصفات سطح التربة قليل النفاذية وضعف الغطاء النباتي.إن تدهور المناطق الرعويـــة يعود إلي توالي مواسم الجفاف المتعاقبة ونشاط الرعي الجائر مما يؤدي إلي تسارع عملية التصحر.لهذا يعتبر تطبيـــق تقنات الحصاد المائي خيارا ملائما وضروريا لإدارة مياه الأمطار وتنمية الغطاء النباتي في المناطق الجافة وشبه الجافة.

ومن أهم المشاكل البيئية التي تواجه التطور الزراعي في الأراضي الجافة هي : انجراف التربـــة ,تـــدهور الغطاء النباتي,مخاطر عدم استدامة الإنتاج الزراعي وتدني إنتاجية الأراضي مما يؤثر سلبا علـــى التوزيـــع الـــسكاني وتشجيع الهجرة إلي المدن وزيادة لفقر.ويعمل معظم أفراد المجتمع المحلي في تربية الماشية في نظام زراعـــي رعـــوي يتطلعون إلي توفر المياه وإعادة تأهيل المراعي لتلبية الاحتياجات العلفية وتحسين مستوى الدخل لدى الأسر.

من خلال الدراسة تم اختيار موقعين في البادية الأردنية (منطقة محارب و صبحا) حيث لا يزيد المعـــدل المطري السنوي عن 200 ملم.وكجزء من نشاطات مشروع إدارة المساقط المائية في المناطق الجافة فقد تم تنزيـــل الخطوط الكنتورية وزراعتها بنبات القطف بمشاركة المجتمعات المحلية ,بالإضافة إلي حفر وإعادة تأهيل عـــدد مـــن الآبار التجميعية على مستوى المزرعة بسعة تخزينية 50 م^3 . إن أولوية استعمالات المياه المحـــصودة هـــي لغايـــات الاستهلاك المنزلي والشرب وسقاية الحيوانات لتحسين العائد من إنتاج الثروة الحيوانية مما يـــنعكس ايجابيـــا علـــى المستوى المعيشي لسكان المنطقة.

وتتراوح المسافة الملائمة بين الخطوط الكنتورية من 8 إلي 10م وميل 8-12% كما أوصت الدراسات السابقة مما قد يضاعف المحتوى الرطوبي للتربة بالمقارنة مع الشاهد . تم جمع البيانات المتعلقة برطوبة التربة وكميات الأمطار وأطوال النباتات ,كما تم عقد أيام حقلية وورشات عمل تدريبية للمزارعين كنشاط نقـــل تكنولولوجيـــا وتحقيق أهداف الدراسة . لم يتم إجراء ربط العلاقة بين المحتوى الرطوبي والإنتاج حتى الآن حيث أن هذا الموســـم هو الأول بدون إنتاج معنوي,لذا تعتبر الدراسة كمشاهدة لتشجيع المزارعين على تبني تقنـــات الحـــصاد المـــائي والمشاركة الفاعلة في تنفيذ نشاطات المشروع.