March 2015
The WRC operates in terms of the Water Research Act (Act 34 of 1971) and its mandate is to support water research and development as well as the building of a sustainable water research capacity in South Africa.

TECHNICAL BRIEF

Rainwater harvesting

Rainwater harvesting and conservation for cropland and rangeland productivity

A completed Water Research Commission (WRC) study investigated the use of rainwater harvesting and conservation (RWH&C) for improved productivity of cropland and rangelands in communal semi-arid areas of South Africa.

Background

While South Africa as a country is considered self-sufficient in food production, about 14 million people are estimated to be vulnerable to food insecurity. With the majority of the country's poor located in rural areas, agriculture is considered the best tool to address food security challenges, reduce rural poverty and create employment in rural areas.

Less than 15% of the land area in South Africa is arable. This implies that there is very limited scope for conventional food production, both irrigation and dryland. In addition to the limited arable land, South Africa is a semi-arid, water-scarce country.

The low rainfall and limited arable land make it imperative to effectively use natural resources for food and fibre production. Much of South Africa is covered by large areas of rangeland (veld) that is not privately owned by used communally by farmers for grazing domestic livestock and harvesting natural products, such as fuel food.

Most of the communal areas are located in the former homelands in provinces such as Limpopo, Eastern Cape, Free State and KwaZulu-Natal. These rural landscapes are often characterised by abandoned croplands that are infested by weeds and grasses.

Potential of RWH&C for rangelands

Soil erosion is a major threat to water resources and land productivity. Rainwater harvesting and conservation (RWH&C) practices have not only been demonstrated to increase agricultural production but also to be environmentally sustainable.

Rainwater harvesting is based on the principle of deriving (naturally or artificially) part of the land of its share of rainfall and adding it to another part where it can be used beneficially.

WRC study

The WRC has funded research into RWH&H for nearly two decades. The latest study sought to assess RWH&C techniques and practices and related institutional arrangements for improved rangeland and cropland productivity in communal areas through on-station (controlled) and on-farm (participative) research. Research was undertaken

in selected areas in Limpopo, the Eastern Cape and the Free State.

Methodology

In addition to studies into the socio-economic conditions and institutional arrangements of the communal croplands studies, the project also carried out on-station and on-farm field experiments to compare RWH&C techniques for improved crop productivity in communal areas.

Technique selection workshops were held in the Eastern Cape, Limpopo and Free State to identify and select RWH&C techniques to be implemented on the croplands, for both on-station and on-farm sites. The techniques selected were conventional tillage, no-till or minimum tillage, in-field rainwater harvesting, mechanised basins and Daling plough.

The on-station statistical experiments, with maize as the indicator crop, were laid out as randomised block designs with four replications. Standard agronomic practices were used. The parameters used to assess the different RWH&C techniques were climatic conditions, plant-available water, soil water extraction, runoff, evapotranspiration, evaporation from the soil surface, transpiration, grain and biomass yields and rainwater productivity.

Farming systems

The study discovered that villagers found it difficult to make progress with their farming enterprises in their homestead gardens and croplands due to low and erratic rainfall as well marginal soils. Poor service delivery and lack of access to water resources made it impossible for farmers to irrigate their crops during drought periods, often resulting in complete crop failure. It is therefore essential that they use techniques that can utilise the scarce water resources more effectively.

The crop production within all the selected areas was unsatisfying. Most of the farmers and/or villagers produced a variety of vegetables, cash crops and fruit trees, but the yield and quality of the produce was low due to water shortages and poor management practices.

Use of croplands

In Krwakrwa (Eastern Cape) only the Chief and three other villagers cultivated their croplands. In Lambani (Limpopo) farmers and/or villagers were actively involved in their croplands and small patches of land in the mountains were used by the farmers. In Merino (Free State), only one farmer was actively working in his cropland even though farmers from Merino have access to tractors, implements and seeds.

Results of on-station and on-farm research

Variable climatic conditions were experienced at the experimental sites, from extremely dry to abnormally wet seasons. The grain and biomass yields indicated that in-field rainwater harvesting, Daling plough and mechanised basin methods were superior to the other methods tested.

Rangeland study results

The WRC project investigation found that rangelands in general struggled with overgrazing as a result of no camping systems. Bush encroachment was also found to be an issue in Limpopo and the Eastern Cape.

Good results were achieved in the Eastern Cape with the rehabilitation of disturbed rangelands. On the old cultivated croplands re-seeding with grasses, legumes or mixtures and/or cultivated pastures were tested.

It was concluded that climatic variables need to be considered when selecting a single crop of a mixture of grasses and legumes. In areas with less than 650 mm rain per annum the grass species recommended for use in the restoration are ***Digitaria eriantha***, ***Themeda triandra*** and ***Eragrostis curvula***. In areas with annual rainfall above 700 mm it is recommended to introduce a low-cost perennial legume on the abandoned croplands with a minimum or no-till approach.

At Lambani in Limpopo bush thinning by hand and covering the bare patches with the branches resulted in the highest increase in dry matter production of the rangeland (160%) and increased the veld condition score by 66%. The second best treatment was the removal of all ***Helichrysum kraussii*** and covering bare patches with the branches.

Recommendations

Most of the small-scale farmers and/or villagers in all three selected areas were eager to continue with their farming practices. However, there is an urgent need for the government and other stakeholders to play their vital roles.

Further, the research findings clearly indicate that there are many obstacles that impact negatively on the farmers and/or villagers. Even though recommendations have been

made it will be a fruitful exercise if there is no cooperation or any form of positive action between government departments and other stakeholders.

Based on the research findings the following recommendations were made in order to improve production in rural villages:

- **Homestead gardening**: Producing a variety of vegetable crops in the homestead gardens will assist in overcoming food security, poverty and ensuring financial stability. Therefore, awareness raising workshops for farmers and/or villagers should be considered to help assist with producing their own quality food that will decrease the pressure on the government to support them financially, so that more finances can be made available for other essential services, such as health and education. It is further recommend that villagers be made aware, capacitated and supported with the application of IRWH and roof water harvesting in their homesteads.

- **Expansion to croplands and availability of implements**: if farmers and/or villagers want to completely eradicate poverty in their villages they should expand to the croplands. Farmers should not just expand to the croplands but commit themselves to produce quality products that will help in accessing the markets. Most of the croplands are not utilised in the villages. IRWH & C techniques need to be adopted and implemented on the croplands to minimise water losses and secure distribution of water over the land to improve crop production.

- **Land use suitability mapping**: Maps of the natural resources and climate need to be layered in GIS to identify areas suitable for specific management practices and uses. This will enable farmers and villagers to plant suitable crops on the high potential soils and minimise the risk of crop failure. In some cases the croplands and rangelands should be re-planned by making use of these maps. Land registers should also be created for every village which should be used together with the soil maps in order to re-plan villages according to soil potential, with higher potential soils allocated for croplands and the rest for rangelands and planted pastures.

- **Vegetation monitoring system and crop diversity**: The introduction of a rangeland vegetation monitoring system is needed to detect changes in plant species composition induced by poor management practices (overgrazing) and/or natural processes (erosion). Following monitoring in the rangelands, farmers should be encouraged to produce a variety of crops in order to have access to a more balanced nutritional diet.

- **Integrated pest management**: An integrated pest management programme, consisting of mechanical, chemical and biological methods, should be followed to effectively control weeds, insects and diseases. Farmers and/or villagers will have to receive training on the safe and effective use of chemicals.

- **Application of various RWH&C techniques**: Farmers and/or villagers should be informed and encouraged to adopt and implement appropriate RWH&C practices especially in areas where insufficient rainfall is the most limiting factor for crop production. Awareness raising workshops could aid in giving farmers and villagers a broader understanding of RWH&C techniques, e.g. the benefit of combining various techniques.

- **Fencing**: Farmers and villagers have indicated that they would like to expand their production to the croplands but fencing is required to keep animals from destroying the crops as well as the RWH&C structures. Fencing on the rangelands will allow farmers and villagers to implement a rotational grazing system and thereby improve the quality of both their livestock and rangelands.

- **Training**: Farmers and village members are in need of formal and informal training in all aspects of agricultural production, including soils, seedbed preparation, implementation of appropriate RWH&C treatments, planting of various crops, fertilizer application, weed and pest control, harvesting, record keeping and marketing. Moreover, training can be provided by experts from various fields, either from the national and provincial Departments of Agriculture or from the private sector. Considerable attention should also be given to the youth.

- **Rangeland management**: Clashes between livestock and cropland farmers could be avoided by forming a community-based rangeland management institution, which is a body or group that will take on the roles and responsibilities of community-based rangeland management. It is also important that local government representation be included in the initial discussions to ensure that the rangeland management institution selected will be able to gain legal recognition as a local rangeland management body.

- **Service delivery**: For the rural people to develop and continue producing within their croplands they should

be serviced according to their needs. Access to basic services such as healthcare is a right and not a privilege. The clinic have neither doctors nor enough medication; therefore there is an urgent need to build clinics in Lambani and Merino. Failure of the farmers to receive medical attention cripples the agricultural production in their villages and impacts negatively on their nutrition.

Finally, it is recommended that appropriate RWH&C techniques, together with workable institutional arrangements are implemented which will improve production on the croplands and rangelands in communal areas in the semi-arid areas of South Africa. This will only be achieved when the focus is on all three aspects simultaneously, namely appropriate RWH&C techniques on the croplands, on the rangelands and workable institutional arrangements.

Further reading:
To order the reports*, Rainwater harvesting and conservation (RWH&C) for cropland and rangeland productivity in communal semi-arid areas of South Africa* (**Report No. 1775/1/14**) and/or *Guidelines on best management practices for rainwater harvesting and conservation for cropland and rangeland productivity in communal semi-arid areas of South Africa* (**Report No. TT 590/14**) contact Publications at Tel: (012) 330-0340, Email: orders@wrc.org.za or Visit: www.wrc.org.za to download a free copy.