Upscaling "organic by default" agriculture – a hope spot for drylands

In India's arid zones, farms are traditionally managed with no or very low chemical inputs. This "natural" organic production method helps maintain the fragile ecological balance but provides only low yields. The Central Arid Zone Research Institute is supporting the traditional farmers with on-farm research to enhance their productivity by making use of modern agricultural and ecological technologies and know-how.

India's low rainfall areas (<500 mm/year) cover about 45 million hectares, about the area of Sweden. They are mostly found in Rajasthan and small parts of Gujarat, Andhra Pradesh, Haryana and Tamil Nadu. Rainfall is erratically distributed and there are frequent droughts, a condition further aggravated by climate change and causing economic uncertainties for local farmers. Multi-component farming systems which include annuals, perennials and livestock are prevalent. Such systems have very low external inputs and rely heavily on recycling of local resources. This type of production can therefore also be referred to as "organic by default".

During the last 50 years, efforts have been made to improve productivity of these farms by use of synthetic external inputs, e.g. fertilisers, pesticides, weedicides etc. However, success was limited to good rainfall years. Use of organic manure is an effective alternative as it provides at least some produce even under prolonged dry spells thanks to its highly efficient nature in recycling of nutrients. Thus it can result in better food and economic sustainability. During the past six years the Central Arid Zone Research Institute (CAZRI) has successfully attempted to redesign the traditional farming systems by incorporating modern eco-technologies to increase their efficiency and outcome. In the following, some examples from north-western India are presented most of which are applicable to the other low rainfall areas and drylands of the world as well. This approach may also be helpful for ecosystem conservation of default organic areas to preserve flora, fauna and heritage agriculture for future use that is otherwise degrading at a very fast rate through the spread of chemicals-based production systems.

Extent of arid zones in different continents of the world

Continent	Area (million hectares)	Percent of total
Africa	1,175.5	46.1
Asia	903.0	35.5
Australia	303.0	11.9
Europe	11.0	0.4
North America	84.6	3.3
South America	70.2	2.8
Total	**2,547.3**	**100.0**

Why organic?

The low and erratic rainfall areas of northwest India are characterised by extreme temperatures and light soils. The traditional farming systems are based on recycling crop residues to increase the humus content of these light soils. Promoting organic agriculture offers several other advantages in these areas:

Diversified farming systems: Farming systems in the region are highly diversified, with annual and perennial crops, trees, grasses and farm animals. This system is efficient in nutrient recycling and in restoring soil fertility. In these areas 10–30 trees/ha are common, and 2–5 animals are reared per family. This integrated organic (by default) farming system minimises pest incidence and controls desertification.

Efficient use of limited water: Water is the scarcest resource in these regions. The use of synthetic fertilisers both increases water demand by crops and reduces the water-holding capacity of these light soils, whereas manure increases the soil's water-holding capacity. Water use can further be reduced by growing low water-demanding crops such as spices, oilseeds and certain medicinal plants.

Fertiliser use and quick conversion: In rainfed areas, due to the erratic pattern of rainfall, the rate of fertiliser application is very low (36.4 kg/ha as compared to the national average of 76.8 kg/ha) – a good op-

Arun K Sharma
Senior Scientist
Central Arid Zone Research Institute (CAZRI)
Jodhpur, India
arun.k_sharma@yahoo.co.in

portunity to quickly and easily convert to certified organic farming.

Rich traditional know-how: Rich traditional know-how in these areas provides further strong arguments for organic conversion to ensure the restoration of soil fertility and control pests.

Availability of natural inputs: Plants such as *Azadirchata indica* (neem) and *Calotropis procera* (Indian name: Aak) are good sources of bio-pesticides and are abundantly available in these areas. Minerals such as rock phosphate, gypsum and lime are available in large quantities. These soil improvers also provide plant nutrients and regulate the pH of the soils.

Employment opportunities: With cropping limited to the rainy season, the high population density remains underutilised nine months a year. The migration of human resources during drought periods inhibits the development of these areas. Since organic farming is more labour-intensive and inputs are from local resources, it provides more employment opportunities and social protection than conventional farming.

The 'Like and follow organic system' – the hub of capacity building

People or organisations present their profiles and work to others via the social media, a principle that CAZRI is using to promote organic farming. If all the possibilities are displayed and the outcomes can be seen, a famer just needs to 'like' it and prepare himself to 'follow' it. To this end the institute developed a two-hectare model organic farm (MOF) to show farmers organic farming technologies, how they can be integrated and their synergetic effects. This is the like phase. If a farmer decides to follow (adopt) this approach, CAZRI provides the knowledge and, to some extent, financial support (from various national schemes on agriculture) so that the system can be replicated successfully on the farmer's fields. Another meaning of follow is that once farmers have started adoption, CAZRI staff will do follow-up action from time to time to ensure success.

A neem plantation on a field boundary – a good source of bio-pesticides.

The catchment area of the rainwater harvesting pond is also utilised for drying and threshing crops.

Pheromone traps for white grub and legume pod borer.

A biodiversity corridor provides nectar and shelter to beneficial insects.

Photos: A. Sharma

The certified model organic farm (MOF)

The farm is set up around three main branches of sustainability: rainwater, waste utilisation and field education. The following support facilities to research and demonstrate the organic system were installed:

A trench and mound was dug around the plot for *in situ* conservation of rainwater and *Cassia angustifolia* (senna or sanai), a medicinal shrub, was planted on the mounds for round the year availability of flowers for predators and further prevention of spray drift contamination. Two **rainwater harvesting ponds** of 5,000 litres capacity (each) were constructed with a cemented catchment area for maximum collection of rainwater, which is distributed using a gravity drip system that irrigates two low-volume, high-value crops, i.e. cumin and psyllium.

Manual weeding is done regularly, and uprooted weeds are left as mulch that later decomposes and contributes to organic matter (at about 1.5–2.0 tonnes/ha). A variety of **fruit trees** were planted on the farm to ensure an income from diverse sources and to increase biodiversity: *Zizyphus mauritiana* (Ber), *Emblica officinalis* (Aonla), *Cordia mixa* (Gunda), *Lawsonia alba* (Mehndi), and plants for bio-pesticides: *Adhatoda vasica* (Adusa), *Vitex nigundo* (Nrgundi), *Aloe vera* (Guarpatha) and sanai. Besides the fruit trees there are about 30 naturally grown trees of 30 to 35 years of age of *Prosopis cineraria* (Khejri) and two neem trees that can be used to make bio-pesticides. This plantation also ensures a supply of nectar and shelter for beneficial insects.

Six compost pits were dug inside the farm for making quality **compost** from crop residues, manure and cattle urine. **Bio-pesticides** are prepared in a tank in situ in the field from the

leaves of neem, aak and adusa. **Pheromone traps** are also used for the major pests. This technology is simple to use, cost-efficient and effective.

The farm also keeps its **own seeds** for sowing and distributing to the farmers adopting the organic system. The seeds are preserved with a coating of mustard and castor seed oil (mixed at a ratio of 3:1). **Information boards** are placed at various places in the field so that any visitor can read about and understand different aspects of the system.

For scientific purposes, records are maintained on input use, farming practices and produce storage, and auditors from the Rajasthan Organic Certification Agency (an accredited certification body based in Jaipur, India) visited the farms several times to verify the records and for testing of pesticide residues in the soil and produce. The MOF was certified organic in August 2011, after completing a three-year conversion period.

The outcomes

A rotation of four high-value crops including cluster bean, sesame, cumin and psyllium was selected. Five years after establishing the farm, there has been an overall improvement in soil health and agro-diversity that is helping to make the system more resilient to climatic extremes. Achievements include:

Improved soil properties. The use of cattle manure and compost has led to an observable increase in soil water retention (from 8.43 % to 8.92 %) and soil organic carbon content (from 0.23 % to 0.31 %), which has enhanced crop yields. Biological activity, measured in terms of dehydrogenase enzyme activity, has also improved from 1.06 to 2.36 (p Kat g-1), showing that the soil is becoming more alive.

Resilience to climatic variability and better yields. Crop resilience to climatic variability has been enhanced, observed in sustained crop growth, less incidence of pests and diseases and sustained yield during climatic extremes, compared to conventional farms where crops almost always fail in such situations. Legume cultivation contributed to an average 25 to 30 per cent increase in yield in the subsequent crops of cumin and psyllium.

There is a widely held view that organic systems give poor yields. However, the findings show that, while there may be slightly lower yields than in a conventional one during their introduction, once the system is developed after 2–3 years, the yield levels are comparable to those in the conventional (chemical input-based) system as observed in the fifth year (2013) yields of 917.5 kg/ha for sesame, 1,122.2 kg/ha for cluster bean, 830.9 kg/ha for cumin and 856.4 kg/ha for psyllium in organic system. Preparing most of the inputs on-farm reduced the cost of production by 30 to 70 per cent, depending upon the crop.

Higher diversity and density of beneficial insects. Round-the-year availability of water and nectar and not using chemicals led to an increase in the diversity and density of beneficial fauna, which almost tripled in five years (2008–13). Syrphid flies, wasps of different types, honey bees and geocorid bugs are major beneficial insects for *Zizyphus*. The henna crop attracts *Chrysoperla*, *Apis* sp., syrphid flies and *Coccinellid* beetles (Ladybird beetle). Major beneficial insects on pearl millet, cluster bean and weeds include *Digera muricata* (Lolru), and *Amaranthus virdis* (Cholai), and on *Calotropis* there were *Chrysoperla* and the ladybird beetle, *Chilomenes* sp. Besides insects, 13 species of predatory birds that help in controlling insect pests have been seen including crows, prinia, babblers, etc.

Improving farmers' perceptions about organic farming

A total of 1,500 to 2,000 farmers a year come to visit this farm and get hands-on training. Many of them have adopted these technologies because using local resources makes it a cost-effective and affordable system for drought-prone marginal farmers. Yet they often mention questions and doubts about the organic approach which we listen to carefully. For example, farmers are apprehensive about low yields and the availability of organic inputs. These doubts are cleared when farmers see the standing crops and learn how to make and use proper compost and bio-pesticides. In

Availability of organic inputs

As biomass production is generally low in low rainfall areas, the crucial point with organic farming is limited availability of organic inputs, such as crop residues and animal manure. A survey among farmers in four districts has shown that, when added together, all the organic inputs from available sources provide between 4.5 and 5 metric tonnes/ha. This is sufficient for sustainable rain-fed farming in these areas. The availability of nutrients can be enhanced by management practices such as incorporating legumes in crop rotation, proper composting of dung and use of tree leaf litter, animal urine, the bones of dead animals and non-palatable weed biomass.

Supportive government schemes

Several government schemes are providing support for organic farming. They offer capacity building on eco-friendly technologies and subsidies for compost preparation, rainwater harvesting, the purchase of bio-pesticides, and certification. This year, Pramparagat Krishi Vikas Yojna (Traditional Agriculture Development Scheme) has been launched exclusively for the promotion of organic farming. The National Bank for Agriculture and Rural Development (NABARD) is also providing soft loans to self-help groups who work in agribusiness and favours those working with organic farming.

this low rainfall region, every farmer knows the value of applying manure, but adverse conditions (family, social, financial etc.) mean that farmers often do not make good compost. When dry raw cow dung is applied, this creates problems with termites and weeds. A farmer visiting the MOF can receive a customised nutrition management system according to his conditions and resource availability.

Many of the farmers already know about traditional methods of pest control such as using neem and other bio-pesticides and we, at the MOF, just refine these methods to enhance their efficacy.

A question that is asked by almost all farmers is where to sell organic produce and whether they will get a premium. At the MOF, we suggest they go for group certification, and once the farm group is certified it can approach any of the organic buyers or develop its own brand. We provide facts and figures to demonstrate the shortage of organic produce as well as examples of farmers who have successfully developed their own brand and get a premium price in order to encourage farmers to follow this approach.

It is harder to convince groups of farmers who are exploiting groundwater reserves or using water from the Indira Gandhi Canal of the benefits of the organic approach. They use agrochemicals heavily and are afraid to shift to organic methods because they anticipate a drastic reduction in yields. We suggest a more gradual shift to organic to them: i.e. first follow an integrated use of chemicals and organic methods and then gradually replace the chemicals with organic inputs over 3–4 years. Some of them have been convinced and have started to move towards an organic approach.

In a nutshell, farmers are gradually realising the benefits of organic farming in this area with its erratic climate and are ready to adopt organic methods. But they need knowledge backup tailored to their resources and marketing backup.

The future of organic farming in arid regions

An organic approach is highly suited for and applicable in these low rainfall areas with light soils. These regions have a near monopoly on high value crops, such as oilseeds and spices, which are in great demand internationally, especially if produced organically. In this way, organic production in low rainfall areas can not only boost the economy but also sustain the productivity of natural resources. The management system developed at the MOF may also be useful for low rainfall areas in other parts of the world. Further research is needed to economically and ecologically quantify the contribution that this system makes, and a team of devoted trainers is required in order to up-scale (extend) this system to more interested farmers.

For more information, see:
➤ **www.cazri.res.in**

Farmers get hands-on training on organic agriculture.
Photo: A. Sharma

Imprint

Rural 21 –
The International Journal for Rural Development

Published by:
DLG-Verlag GmbH
Frankfurt, Germany

Advisory council:
Felix Fellmann, DEZA
Dr Reinhard Grandke, DLG
Dr Stefan Schmitz, BMZ
Christel Weller-Molongua, GIZ

Editorial committee:
Dr Michael Brüntrup, DIE
Lüder Cammann, GIZ
Dr Christine Chemnitz, Heinrich-Böll-Stiftung
Karl-Martin Lüth, DLG
Prof. Dr Matin Qaim, University of Göttingen
Dr Detlef Virchow, ZEF

Editor in chief:
Silvia Richter, s.richter@dlg.org

Editorial staff:
Olive Bexten, o.bexten@dlg.org
Ines Lechner, i.lechner@dlg.org
Angelika Wilcke, a.wilcke@dlg.org

Editorial office:
DLG-Verlag GmbH
Eschborner Landstraße 122
60489 Frankfurt, Germany

Translated by:
Michael Gardner
Christopher Hay
Tazir International Services

Distribution, advertising:
DLG-Verlag GmbH
Eschborner Landstraße 122
60489 Frankfurt, Germany

FSC www.fsc.org MIX Paper from responsible sources FSC® C051249

Design:
Petra Sarow, Munich, Germany

Design & Layout:
Andrea Trapani, DLG-Verlag

Printed by:
Brühlsche Universitäts-druckerei GmbH & Co KG
35396 Gießen, Germany

Rural 21 is published four times per year. The subscription rate is 33.– Euro (Germany), 37.– Euro (EU countries), 51.– Euro (non-EU countries) and 8.30 Euro per issue, plus postage.