



# Dryland Agriculture



ICRISAT

## What ICRISAT Thinks . . .



*Science with a Human Face*

### Diversity Delivers the Dryland Goods

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## Diversity Delivers the Dryland Goods

The world has grown accustomed to painful images of Africa's drylands. Droughts, famine, utter poverty, fleeing refugees... will it ever end?

The media focuses on disasters, because that grabs attention. But at ICRISAT we know there is another side to the story. The peoples of the drylands want a better future. They want to cultivate their lands in more productive and sustainable ways, and to rehabilitate those lands that are degraded.

We think this dream is achievable, if we think differently—and positively—about the potentials of these lands. The drylands are favored with ample sunshine, fewer pests and diseases, and an easier terrain to cultivate or graze compared to wetter areas. Though dry on the surface, many dryland areas are also blessed with large water resources, either underground or in rivers that pass close to large urban markets.

Yes, drought is an ever-present threat; but if we look outside the box of current farming systems, we can find ways to mitigate drought risk and raise incomes and profitability. With our partners, the national programs across Africa and Ben-Gurion University's International Program for Arid Land Crops (IPALAC), and through support from the CGIAR Members and additional support from Finland, USAID and the World Bank we are developing novel farming systems that we believe offer a new future for dryland Africa. I would like to briefly outline a few of these new options and why we are excited about them.

### Dryland enrichment

There are three main ingredients to a model we call the 'Sahelian Eco-farm', which can multiply dryland farmers' net income by a factor of six while restoring soil health. Because dry areas have less plant vegetation on the surface, their soils tend to be very low in organic matter and depleted of nutrients. We are finding that we can correct these deficiencies by planting hedgerows of special drought-tolerant, nitrogen-fixing trees such as *Acacia colei*. The leaf litter as well as decaying roots add organic matter to the soil and also reduce wind erosion and increase water infiltration. Small amounts of fertilizer



By improving soil fertility and rainfall capture, crops like watermelon can thrive even in the sandy soils of the Sahel.

complement the organic matter, and crop yields are boosted substantially.

Water is the second key ingredient. We construct small bunds, or dikes across the slope, in a way that channels rainwater towards high-value trees such as Pomme du Sahel (*Ziziphus mauritiana*) which yields fruit, firewood and forage. This water-harvesting technique captures water that runs into the field from higher land as well, multiplying the amount of rainfall that effectively reaches the farm; and the healthier root systems of the crops and trees grow deeper and spread wider to capture more of it.

The third crucial ingredient is crop diversity. By adding high-value specialty crops such as fruit trees, vegetables, fibrous grasses, herbs and medicinals to the traditional cereal-based systems of the drylands, farmer's incomes are greatly increased and stabilized. In addition to cash, diversified systems create a more nutritious household diet and provide remunerative labor opportunities as well as valuable byproducts like firewood, fiber and fodder. Naming just a few examples, the seeds of *Acacia coleii* can partially substitute for costly fishmeal in chickenfeed; roselle (*Hibiscus sabdariffa*) has a large export market as a food colorant; *Andropogon gayanus* grass stems are in wide demand for roofing and mats; and local leafy vegetable species add vitamins to the diet as well as cash to the wallet.

Higher incomes can also be wrested from some of our traditional crops through plant breeding. Disease and drought-resistant pigeonpeas yield abundantly and are exported to India, providing farmers with a live-saving backup when droughts wreck their maize crops in eastern and southern Africa. Groundnuts have export potential to Europe when aflatoxin is controlled, as in our Malawi partnership. Cowpeas (which we are studying in partnership with IITA) can earn farmers three times more than millet, and their stems are in high demand to feed hungry livestock across the Sahel.



The Sahelian Eco-farm stays green long after the rains have ended. High-value Pomme du Sahel fruit trees thrive because rainwater channeled to them by the bund system continues to be tapped by their deep roots. Improved cowpeas between the trees grow on residual moisture. Greyish leaves surrounding the field are the soil-building tree *Acacia coleii*.

Diversifying cropping systems is not as simple as just planting new types of seed; the post-harvest processing, transport and marketing systems must also be transformed from an artisanal level into a commercial enterprise. This requires mechanisms for farmer cooperation, new learning and technology, strategic partnerships with the private sector, and enabling policies. We are working on all these aspects in a holistic, systems approach.

### **Bringing drylands back from the dead**

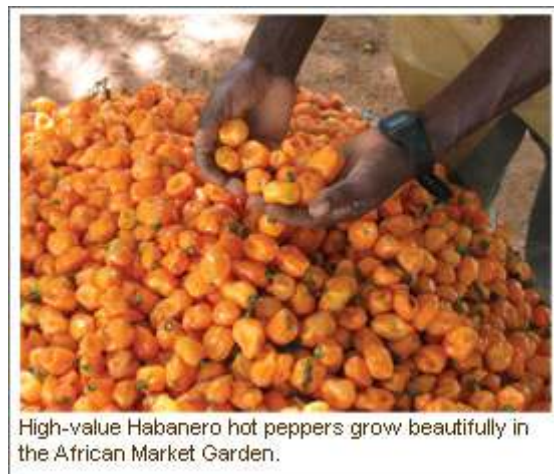
You do not need to look far in dryland Africa to see barren areas that are eroded and capped with crust, or are so nutrient-impoverished that crops are weak from malnutrition, or meager rangelands grazed by stunted, bony cattle. We are finding that some very hardy indigenous trees can grow under such difficult conditions and can restore the soil over time through their root activity, biomass and nitrogen fixation.

But they must be profitable in order to motivate people to plant them. An example is *Acacia senegal*, which produces the commercial product 'gum arabic', which is exported globally. We are selecting high-yielding trees to be grown by communities in plantations that return a good income while renovating ruined lands. Other promising trees being studied include tamarix (*Tamarix aphylla*), mango, jatropha (*Jatropha curcas*), boscia (*Boscia senegalensis*) and more.



### Leveraging water

Most African cities are located near a major water supply, and high-value vegetables are grown nearby by thousands of small-farm entrepreneurs in hand bucket-irrigated 'market gardens.' These gardens are strategic intervention points for development, because irrigation opens many agricultural opportunities, and cities are gateways to regional and international commerce.



We have developed a low-cost system called the 'African Market Garden' that greatly reduces the drudgery of hand-carrying water while increasing the water use efficiency of these gardens through gravity-driven drip irrigation. Combined with improved vegetables interspersed between date palms, the African Market Garden is a real income accelerator. Our studies suggest a seven-fold increase in net income without the date palms, or fifteen-fold when date palms are added to the system.

Vegetables can be extremely profitable when soil fertility and water supplies are improved as in the African Market Garden model. We are selecting varieties of lettuce that will not bolt (flower) too early in the warm tropics; tomatoes that will not drop their

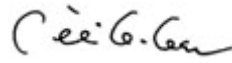
flowers because of high night temperatures during the rainy season, when market prices are highest; and high-value onions and peppers, along with date palms that can thrive in the climate of the Sahel. Many other vegetables can be grown in these warm, sunny climates. This work benefits from close collaboration with the World Vegetable Center (AVDRC) and the Global Horticulture Initiative including a joint staff appointment; and partnership with the University of California at Davis.

### Beyond the box

Basic food grain production will continue to be vital, but farmers can complement it by diversifying parts of their farms to grow their way out of poverty. By thinking beyond the box of the over-simplified agricultural systems that prevail today, we can overcome pessimism and help the peoples of the dryland tropics create what we call a 'grey-to-green revolution', converting a grey hopelessness into a prosperous landscape.

In an effort to keep this letter short, I feel I have barely touched on many ideas that are worth delving into far more deeply. But I hope I have whetted your appetite. I would welcome your comments, feedback and ideas about new systems and crop diversification in the drylands, for there is much yet to learn, and it is a road best travelled together.

Sincerely yours,

A handwritten signature in black ink, appearing to read "W.D. Dar". The signature is written in a cursive style with a large initial "W" and a distinct "D" and "Dar".

William D. Dar  
Director General