FACTSHEET 4
SUSTAINABLE CROP PRODUCTION INTENSIFICATION (SCPI)

To feed a growing world population, we have no option but to intensify crop production. But farmers face unprecedented constraints. In order to grow, agriculture must learn to save.

Water management: technologies that save and grow

Sustainable intensification requires smarter, precision technologies for irrigation and farming practices that use ecosystem approaches to conserve water.

Rainwater harvesting in Africa's Sahel

A wide variety of traditional and innovative rainwater harvesting systems is found in Africa's Sahel zone. In semi-arid areas of Niger, small-scale farmers use planting pits to harvest rainwater and rehabilitate degraded land for cultivation of millet and sorghum. The technology improves infiltration and increases nutrient availability on sandy and loamy soils, leading to significant increases in yields, improved soil cover and reduced downstream flooding.

pearl millet

Planting pits are hand-dug holes 20-30 cm in diameter and 20-25 cm deep, spaced about 1 m apart. Excavated soil is shaped into a small ridge to maximize capture of rainfall and run-off. When available, manure is added to each pit every second year. Seeds are sown directly into the pits at the start of the rainy season, and silt and sand are removed annually. Normally, the highest crop production is during the second year after manure application.

Deficit irrigation for high yield and maximum net profits

The highest crop productivity is achieved using high-yielding varieties with optimal water supply, soil fertility and crop protection. However, crops can also produce well with limited water supply. In deficit irrigation, water supply is less than the crop's full requirements, and mild stress is allowed during growth stages that are less sensitive to moisture deficiency. The expectation is that any yield reduction will be limited, and additional benefits are gained by diverting the saved water to irrigate other crops.

cotton

A six-year study of winter wheat production on the North China Plain showed water savings of 25 percent or more through application of deficit irrigation at various growth stages. In normal years, two irrigations (instead of the usual four) of 60 mm were enough to achieve acceptably high yields and maximize net profits. In Punjab, Pakistan, a study of the long-term impacts of deficit irrigation on wheat and cotton reported yield reductions of up to 15 percent when irrigation was applied to satisfy only 60 percent of total crop evapotranspiration.

The study highlighted the importance of maintaining leaching practices in order to avoid the long-term risk of soil salinization. In studies carried out in India on irrigated groundnuts, production and water productivity were increased by imposing transient soil moisture-deficit stress during the vegetative phase, 20 to 45 days after sowing. Water stress applied during the vegetative growth phase may have had a favourable effect on root growth, contributing to more effective water use from deeper soil horizons.

Higher water savings are possible in fruit trees, compared to herbaceous crops. In Australia, regulated deficit irrigation of fruit trees increased water productivity by approximately 60 percent, with a gain in fruit quality and no loss in yield.

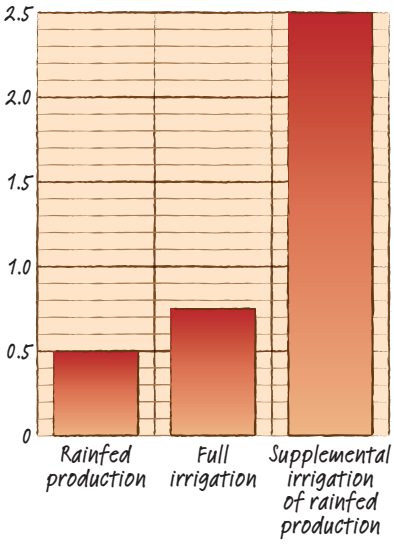
Supplemental irrigation on rainfed dryland

In dry areas, farmers dependent on rainfall for cereal production can increase yields using supplemental irrigation (SI), which entails harvesting rainwater run-off, storing it in ponds, tanks or small dams, and applying it during critical crop growth stages. One of the main benefits of SI is that it permits earlier planting – while the planting date in rainfed agriculture is determined by the onset of rains, supplemental irrigation allows the date to be chosen precisely, which can improve productivity significantly. For example, in Mediterranean countries, a wheat crop sown in November has consistently higher yield and shows better response to water and nitrogen fertilizer than a crop sown in January.

The average water productivity of rain in dry areas of North Africa and West Asia ranges from about 0.35 to 1 kg of wheat grain for every cubic metre of water. ICARDA has found that, applied as supplemental irrigation and along with good management practices, the same amount of water can produce 2.5 kg of grain. The improvement is mainly attributed to the effectiveness of a small amount of water in alleviating severe moisture stress.

In the Syrian Arab Republic, SI helped boost the average grain yield from 1.2 tonnes to 3 tonnes per hectare. In Morocco, applying 50 mm of supplemental irrigation increased average yields of early planted wheat from 4.6 tonnes to 5.8 tonnes, with a 50 percent increase in water productivity. In Iran, a single SI application increased barley yields from 2.2 to 3.4 t/ha. When integrated with improved varieties and good soil and nutrition management, supplemental irrigation can be optimized by deliberately allowing crops to sustain a degree of water deficit.

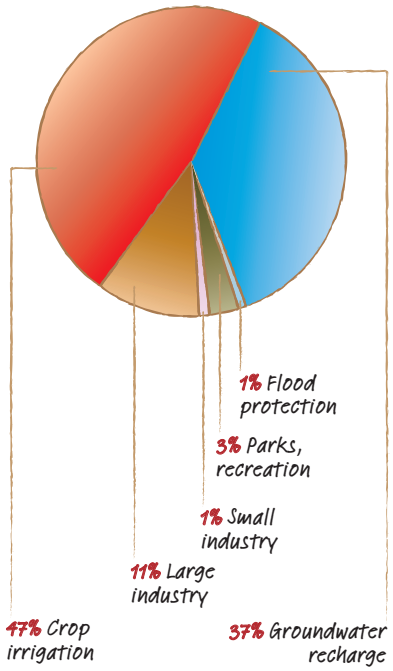
Productivity of water in wheat production
(kg of grain/m³)



Multiple uses of water systems

In addition to water for crop production, irrigation systems and infrastructure can provide multiple services, including supplying water for domestic use, animal production and electricity generation, and channels for transport. Analysis by FAO of 20 irrigation schemes revealed that non-crop water uses and multiple functions of irrigation schemes are more the norm than the exception.

Use of irrigation water, Fenhe district, China
(percent)



For example, in the Fenhe irrigation district of Shaanxi Province, China, values derived from conventional irrigation were found to be lower than those from related services, such as aquaculture, timber plantations and flood protection. In recent years, Shanxi province has suffered increasing drought, flooding and water pollution, and competition for water from industrial and domestic users is growing. Owing to water shortages, surface irrigation is now limited essentially to winter wheat and maize crops. As a result, many farmers have diversified production away from staple crops toward intensive cash crop production using mainly groundwater, and the original command area of 86 000 ha has been reduced by about 50 percent.

Within this smaller area, many more functions are serviced by the district's water allocations from the Yellow River: productive services, such as crop irrigation, aquaculture, hydropower generation, timber plantations and industrial water supply, and amenities, including flood protection, groundwater recharge and forest parkland. In this way, intensification of water use has been accompanied by conservation of environmental services.

Adapted from *Save and grow* (FAO, 2011),
a policymaker's guide to the sustainable intensification
of smallholder crop production
Save and grow can be purchased from:
fao@earthprint.co.uk or through the FAO
online catalogue: www.fao.org/icatalog/inter-e.htm

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