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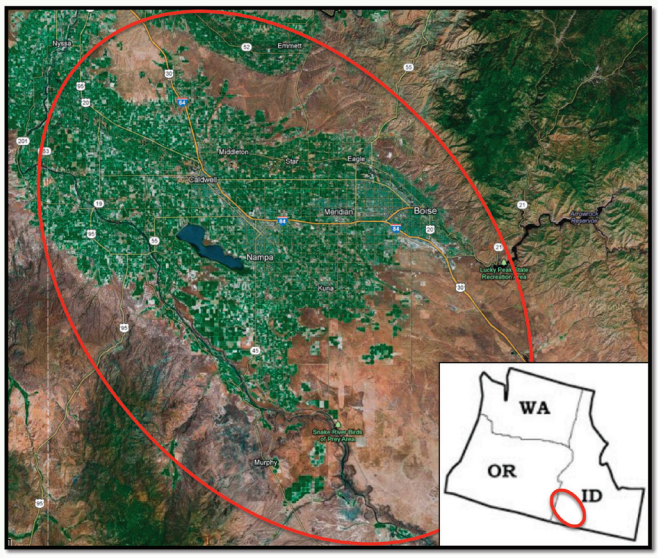
Case Study 7.2-2 Improving nitrogen management and irrigation practices results in efficiency and yield. Irrigated agriculture in southeastern Oregon and southwestern Idaho (Treasure Valley) produces high yields of onion, corn, wheat, sugar beet, potato, bean, relying on significant inputs of water and N fertilizer. Prior to the development of irrigation, agriculture in this region was impossible due to low rainfall during the growing season. Irrigated agriculture became possible with the construction of dams and reservoirs in the early 1900s. Until the 1980s, it was common for farms to routinely apply 170 to 225 kg N/ha in the fall, followed with another 170 to 335 kg N/ha in the spring and summer. Furrow irrigation was the dominant method for water delivery.



Outcomes

An intensive education program was launched to help farmers account for all the N fertilizer applied and removed in harvested crops, expand soil nitrate testing, and include deep-rooted crops in rotation with shallow-rooted crops. Growing crops such as sugar beets and wheat after onions and potatoes allows recovery of residual soil nitrate that the previous crops did not use. Demonstrations on the correct N fertilizer timing, placement, and rate of application have resulted in greater crop quality and productivity with fewer nutrient inputs.

Accounting for all N inputs allowed a better match between nutrient applications and the amount required by the growing crop. To do this, growers are now using soil testing results to guide fertilizer applications. Plant petiole samples are routinely analyzed from potato and sugar beet plants, root samples are measured from onion, and flag leaf samples are tested as needed for wheat.

Fall applications of N are now largely eliminated since it is susceptible to leaching with winter rainfall. In dry winters, the fertilizer salts in the planting beds can interfere with crop seedling establishment. Nitrogen applications now typically start in the spring, with split applications starting in March and ending in July. After the plants reach a prescribed maturity, tissue samples are taken to see if more nutrients are needed for the plants through full crop maturity.

Nitrogen management and irrigation management are closely linked, and trying to manage one without the other is futile. Improving N management also requires improved irrigation practices to avoid nitrate leaching. For example, the first irrigation through furrows has increased potential to leach nitrate below the root zone because of the loose surface soil and dry subsoil, which has a high infiltration rate. Applying N fertilizer after the first irrigation reduces the loss of nitrate and has allowed onion growers to reduce N fertilizer applications by 25% while maintaining yield and quality.

Improvements in irrigation practices have also led to benefits in nutrient management. These include:

- Laser leveling of fields to achieve more uniform water application
- Use of mechanical straw mulching to reduce soil movement and sediment loss
- Gated pipe allows more uniform water distribution and decreased water use by 35%
- Weed screens remove obstructions and allows more uniform water flow
- Addition of polyacrylamide binds soil particles and reduces irrigation-induced erosion
- Sediment basins collect soil leaving the field so it can be recovered and returned to the field
- Adoption of sprinkler irrigation may allow water to be applied more uniformly than furrow irrigation
- Switching to drip irrigation allows more precise water and nutrient management. For example, onions grown with drip irrigation require only 60% as much water as when grown with furrow irrigation with gated pipe
- Soil moisture monitoring devices have been adopted by growers to assist with irrigation scheduling

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Trends in groundwater nitrate for the past 20 years show that nitrate concentrations are slowly declining at a rate of slightly less than 1 ppm/year. A significant decline in the concentration of other agri-chemicals is also occurring.

With the integrated adoption of 4R principles, significant progress has been achieved in improving nutrient use efficiency, boosting productivity, and achieving environmental gains.

Table 1. Improvements in onion yield and N fertilizer use in Malheur County, Oregon from 1980 to 2008.

	Furrow-irrigated			Drip-2007 irrigated
	1980	**1987**	**2008**	**2008**
Yield, t/ha	27	30	44	46
Total N applied, kg N/ha	448	318	288	196

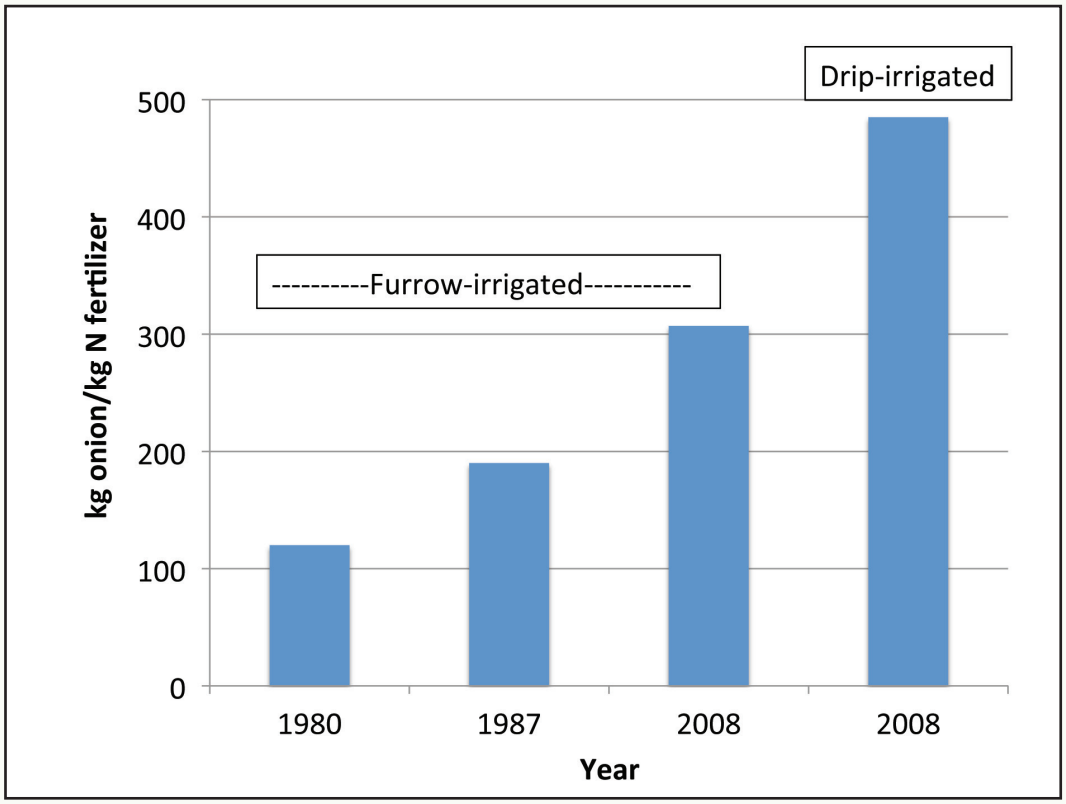

Figure 1. Improvements in nitrogen use efficiency (partial factor productivity) in onion production in Malheur County, Oregon as nutrient and irrigation programs improve nutrient stewardship.

References

Shock, C.C., and C.B. Shock. 2012. J. Integrative Agriculture. 11:14-30

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