Technical report

Investment note 6.1 - Investing in Supplemental Irrigation

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Supplemental irrigation helps stabilize rainfed agriculture. For the greatest benefit, it must be part of an integrated package of farm cultural practices. Overexploitation of groundwater threatens the sustainability of groundwater-based supplemental irrigation in many areas. Supplemental irrigation that is optimized through on-farm water management policies and timely socioeconomic interventions is essential for the sustainable use of limited water resources.

Production is low and unstable in dry farming, dependent on variable rainfall and subject to droughts and land degradation. One option for boosting and stabilizing crop productivity is supplemental irrigation, whose returns to farmers can be overwhelming. *Supplemental irrigation* (SI) is defined as the application of additional water to otherwise rainfed crops, when rainfall fails to provide essential moisture for normal plant growth, to improve and stabilize productivity. Unlike full irrigation, the timing and amount of SI cannot be determined in advance owing to rainfall stochasticity.

Key questions and issues for successful SI are as follows:

- Determining the most appropriate scheduling for farm conditions
- Selecting crops and cropping patterns for maximum returns
- Determining the socioeconomic feasibility of occasionally supplying extra water to rainfed crops
- Promoting water user associations (WUAs) that manage water use in a sustainable manner
- Setting fixed and efficient water delivery schedules
- Providing incentives for local communities to use water efficiently to improve livelihoods
- Managing the economic and environmental consequences of using water in supplemental irrigation
- Developing policies that foster an enabling environment for the adoption of water-efficient technologies to manage rainfed systems in a sustainable manner

Investment Area

Alleviating soil moisture stress during the critical crop growth stages is key to improved production. Supplemental irrigation is a highly efficient option to achieve this strategic goal because it provides the crop with a limited amount of water at the critical time (box 6.1).

Box 6.1 Supplemental Irrigation in Northern and Western Syrian Arab Republic

Research has shown the following:

- Wheat yields have been increased from 2 tons per hectare to more than 5 tons per hectare by the conjunctive use and timely application of only 100 millimeters to 200 millimeters of irrigation water. Therefore, little water would not support a fully irrigated crop and is only productive as a supplement to rainfall.
- Water productivity under SI is far higher than in conventional full irrigation. Wheat productivity in nonrainfed areas is less than 1 kilogram per cubic meter but up to 2 kilograms per cubic meter under SI. Thus, SI also improves the productivity of limited rainfall.

Extent and economy of implementation:

- The area of wheat under SI in northern and western Syria (where annual rainfall is greater than 300 millimeters) has increased from 74,000 hectares (in 1980) to 418 thousand hectares (in 2000), an increase of 470 percent.
- Estimated mean annual increase in production cost due to SI (including fixed and variable costs) as compared to rainfed equals US$150 per hectare. Estimated mean increase in net profit between rainfed and SI for wheat equals US$300 per hectare. Ratio of increase in estimated annual net profit per hectare to estimated difference in annual costs between rainfed and SI is 200 percent, which is highly significant.

Source: Authors.

Water resources management strategies have become more integrated, and current policies look at the whole set of technical, institutional, managerial, legal, social, and operational aspects needed for development on every scale. Sustainability is a major objective of national policies. Optimizing SI in rainfed areas is based on three basic aspects:

- Water is applied to a rainfed crop that would normally produce some yield without irrigation.
- Since rainfall is the principal source of water for rainfed crops, SI is applied only when rainfall fails to provide enough moisture to improve and stabilize production.
- The amount and timing of SI are scheduled not to provide stress-free moisture conditions throughout the growing season, but to ensure a minimum amount of water during the critical stages of crop growth so as to permit optimal instead of maximum yield (box 6.2).

Box 6.2 Optimizing Supplemental Irrigation

SI led rainwater productivity in northwest Syria to increase from 0.84 kilograms of grain per cubic meter to 1.53 (at one-third SI), 2.14 kilograms per cubic meter (at two-thirds SI), and 1.06 kilograms per cubic meter (at full SI). Similarly, for biomass water productivity, the obtained mean values are 2.37, 2.42, 3.9, and 2.49 kilograms per cubic meter for rainfed, one-third SI, two-thirds SI, and full SI, respectively. The results show more significant improvement in SI water productivity at medium SI application rates than at full SI. Highest water productivity was achieved at rates between one-third and two-thirds of full SI. Water productivity becomes an issue for farmers only if water is the production factor that most constrains yields or if saving water yields immediate benefits.

The association of high water productivity values with high yields has important implications for crop management that aims at efficient use of water resources in water-scarce areas. Raising yields by increasing water productivity is economical only when crop yield gains are not offset by increased costs of other inputs. The curvilinear water productivity-yield relationship makes clear the importance of attaining relatively high yields for efficient use of water. Policies for maximizing yield should be examined from every angle before they are applied under water-scarce conditions. Guidelines for recommending irrigation schedules under normal water availability conditions need to be revised when applied in water-scarce areas.

Source: Oweis and Hachum 2003.