ECONOMIC EFFICIENCY OF DIFFERENT IRRIGATION TECHNIQUES IN ARMENIA

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ABSTRACT

The economic efficiency and rate of return of different irrigation techniques were demonstrated in Armenia under On-Farm Water Management Component of the Water-to-Market Project. The Project goal was to reduce rural poverty from 32% to 26% and boost annual incomes through sustainable increases in the economic performance of the agricultural sector after 5 years. The objective of the Water Management Component was to set up demonstration farms with irrigation improvements for farmers to adopt.

For calculating the economic efficiency, three major impact elements were taken into account: yield increase, water savings and labor savings. Necessary input data were collected from records of demonstration site farmers and questionnaires filled at the beginning and end of vegetation period. The indirect positive impacts of farmers adopting irrigation improvements were appraised as: 1) possibility to irrigate abandoned lands; 2) obtain higher yields; 3) provide opportunity to expand on agricultural activities (double cropping, etc.); and 3) enlarge irrigation system capacity to allow more farmers to share water and regulate its distribution in the peak growing season, and eliminate potential conflicts. In addition, the density of demonstration sites was assessed based on the number of the peasant farms and rural communities, density of farms, and average size of cultivated land, to assure high adoption rate among nearby farmers.

The adoption rate was assessed based on specified categories and density of farms in the third year of the five year project and provided a clear direction for future work.

INTRODUCTION

Background

The Water to Market project is the part of the five-year Compact between Millennium Challenge Corporation and the Government of Armenia. Its main goal is to reduce rural poverty from 32% to 26% and boost the annual incomes through sustainable increases in the economic performance of the agricultural sector. The targeted crops were primarily vegetables, grapes and variety of fruits (yield increase by 15.9, 22.5, and 13% respectively).

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Geography and topography

Armenia is a small landlocked country with a total area of 29,800 km^2. It is located south of the Caucasus Mountains. It is divided into ten marzes (regions). The altitude ranges from 380 to 4,090 m above sea level. More than 90% of the country lies above 1,000 m and 72% above 1,500 m. The landform generally comprises rocky high mountain ranges separated by narrow, irregular-shaped fertile valleys. The broad, flat, and fertile Ararat valley is located on the left bank of the Araks River. Most of the population and cultivated lands are here. The total population is about 3.23 million, of which 36% is rural. The average rural population density is 101 inhabitants / km^2. The average annual precipitation varies from 1,000 mm in the high mountains to 300 mm in the Ararat Valley. About 60 % of the territory receives less than 600 mm of rainfall per year. The total water resources of Armenia amount to 8.2 BCM/year, comprised of renewable surface water resources (7.2 BCM/year) and renewable groundwater resources (1 BCM/year). Armenia's only multi-year water storage is Lake Sevan (33 BCM). Considering these water resources, Armenia has an average of over 3,000 m^3/year water resources per capita. There are spatial and temporal imbalances of Armenia's water resource base. There is a wide fluctuation in the seasonal volume of river flow. About 55% of run-off occurs in the spring months.

Goal and objectives

To achieve the goal of poverty reduction in rural areas, the major activities of the On-Farm Water Management Component consist of introducing new on-farm water management technologies in situ and conducting trainings. The objective of establishing demonstration sites to improve farmers' skills in water management techniques will enhance the efficiency of water and labor use on the farms as well as introduce new more efficient irrigation technology, which would positively affect the yields of highly valuable crops.

By the end of the five year project it would be expected that approximately 38,000 farmers from the approximately 60,000 trained farmers would adopt the innovations demonstrated. As a result, there would be an increase of the net benefit from their farming operations.

METHODOLOGY AND IMPROVEMENTS

To enhance chances for success with the adoption of new and more modern on-farm water management technologies and techniques, it was decided to demonstrate them in a real farm condition, and set them up as much as possible in proximity to each other. This would allow multiple visits during field days of the trainees, so that they would be exposed to several technologies or improvements in one day. The demonstration of the on-farm water management technologies under real farm conditions definitely increases the adoption rate because the trainees receive feedback on the improvement from the demonstration directly from the 'host demo-farmer'.

The demonstrated irrigation improvements were grouped in 4 categories: 1) simple improvements, affordable mainly by small farmers, including siphons and spiles; 2) medium improvements, readily affordable by all farmers, including PVC or metal hydrants, gated pipes, lay-flat pipe, PE ditch; 3) advanced technologies, affordable mainly by big farmers, including drip and micro sprinkler irrigation systems; and, 4) equipment to help in irrigation scheduling: soil moisture meters/sensors, tensiometers and ET gauges. In demonstration sites with simple improvements, siphons or spiles were demonstrated with or without plastic or metal dams, plastic lining for farm ditch, sluice gate and V-notch. All demonstration sites have a minimum of two improvements in irrigation technology, one from first three groups and one from fourth group.

For calculating the economic efficiency, three major elements of impact were taken into account: yield increase, water savings and labor savings. The necessary input data were collected from records of demonstration site farmers (initial investment of the demonstrated improvement, maintenance, water and labor usage, weed control etc.) and filled in questionnaires at the beginning and end of the vegetation periods (for comparison of data before improvement and after the improvement). The questionnaires contain information on basic farmer's data – such as water source, irrigation method, irrigation practice, irrigation scheduling, yield, market prices for fruits and vegetables, labor cost and cost of irrigation, and water and labor usage.

Analysis of 60 demonstration sites on cost return of the improvement

From the existing 60 demonstration sites established in the course of the third year, the records were analyzed. All calculations were done for 1 ha of land. Because the impacts vary, depending on a crop type and variety, farmer's capacity, agricultural zone, water quality, soil texture, field topography, fertilizer quality, etc., summary was prepared for a range of possible impact for each improvement without taking into consideration the crop variety, agronomical practice, etc. Table 1 provides the summary.

Table 1. Cost Return of the Improvement

Irrigation Improvement	Initial expenditure divided by operation years (20), $	Annual maintenance estimated per ha , $	Increase of yield, %	Water savings, %	Labor savings, %	Fertilizer savings, $	Average savings for one season estimated per ha, $	Investment return year
Simple improvement	5-16	0-11	1-10	1-15	10-50	n/a	476	<1-2
Medium improvement	12-150	11-20	1-10	10-30	20-60	n/a	519	2-3.5
Advanced technology	200-250	45	20-50	30-60	90-95	33-50	3,295	1-3
Irrigation scheduling method	34-68 (for 5 yrs)	11	10-20	5-15	5-15	n/a	1,125	<1

Indirect impacts of improvements

The indirect impacts of implemented on-farm water management improvements were also estimated, and these are: 1) possibility to irrigate abandoned lands; 2) obtaining higher yield; 3) opportunity for farmers to expand their agricultural activities, such as double or triple cropping; and 4) enlargement of irrigation system capacity to allow more farmers to share the water source and regulate water distribution in the peak of the growing season, as well as eliminate conflicts (farmers waiting for irrigation, quarrels for water, etc.).

Importance of density of demonstration sites

For the effectiveness of the project demonstration sites, the important consideration was an assessment of the density of demonstration sites. In the Ararat Valley 10 (ten) demonstration sites with new technology - drip irrigation - was taken for recording direct adoptees, who adopted it after visiting at least one of the demonstration sites. The number of adoptees was 80. There were 5(five) adoptees who visited two demonstration sites; one of those sites was giving an opportunity to observe directly proper installation of the drip irrigation system.

The influence area of a demonstration site was studied. As illustrated in the figure below, the adoption rate is high when distance between a demonstration site and a place of an adoption is less than 10 km (66 adoptions), especially when the density of farms and communities is high.

To analyze the density of demonstration sites, three categories of demonstration sites according to distances between them were designated: 1) demonstration sites with distances less than 10 km, 2) demonstration sites with distances amongst them from 15 to 20 km, 3) demonstration sites with distances over 25 km. In case of possible inclusion of the same demonstration site into two groups, it was considered to divide the adoptees from that site into two halves.

The results show that adoption rate for first group is 20% higher than in second group and adoption rate of the second group is 50% higher than in third group.

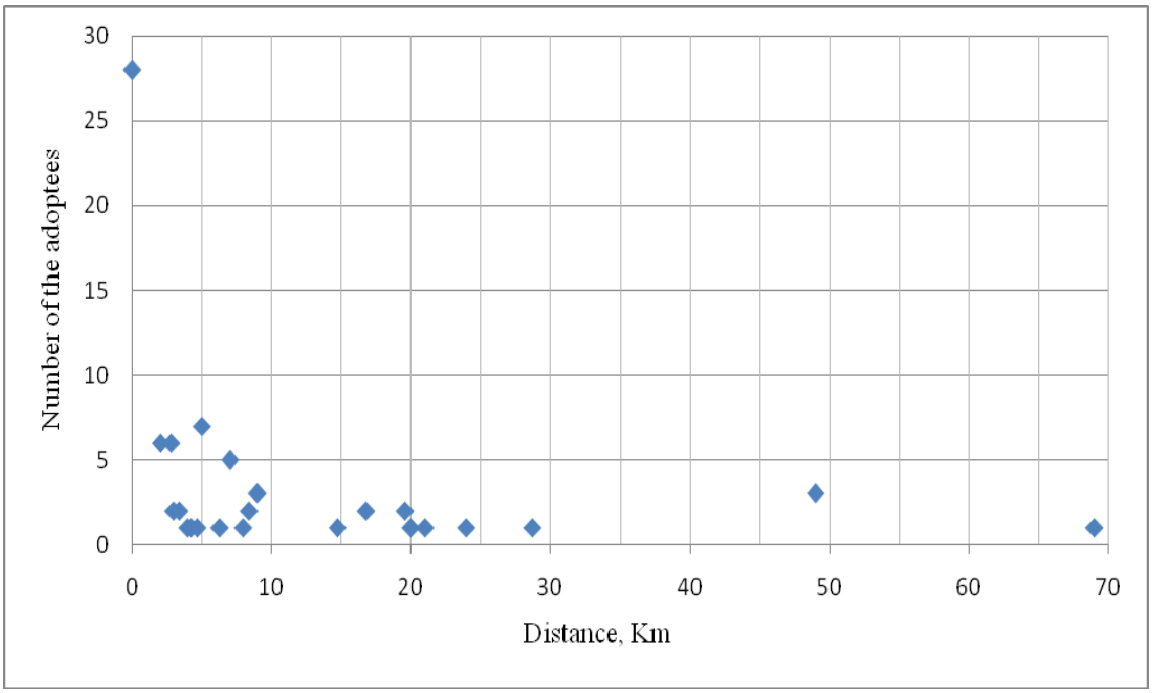

Figure 1. Relationship between Adoption Rate and Distance

CONCLUSION

Based on the assessment of the density of the existing demonstration sites, the number of the peasant farms, number of the rural communities, density of farms, and average size of cultivated land, it is recommended to establish demonstration sites for improvement of farmers' skills in the on-farm water management techniques and technologies in Armenia within a radius of less than 25km from each other.

Statistical data related to number of farms and communities in Armenia are in Table 2:

Table 2. Statistical Data Related to Number of Farms and Communities in Armenia

Marz /Region/	Number of peasant farms	Rural Communities	Calculated Density of farms	Land per farm(ha)
Aragatsotn	37119	111	334	1.5
Ararat	52902	93	569	0.63
Armavir	50332	94	535	0.99
Gegharkunik	48220	87	554	1.97
Lori	32542	105	310	1.42
Kotayk	37611	60	627	1.18
Shirak	28251	116	244	2.83
Syunik	12945	102	127	3.58
Vayots dzor	12828	41	313	1.74
Tavush	21938	57	385	1.45
Total in Armenia	334688	866	-	-

Resulting from the assessment of the economic efficiency and the rate of return of investing into different irrigation techniques and technologies, the number of demonstration sites for every marz was determined. This is basically supported by the data and survey information from the National Statistical Service of the Republic of Armenia. Within the Water-to-Market Project, it relates to the density of the demonstration sites, respectively the number of sites for every marz with representative irrigation improvements and their location – in the most suitable communities to insure high adoption rate among nearby farmers. The numbers of demonstration sites by marzes are shown in Table 3 below.

Table 3. Established and Planned Demonstration Sites by Marzes

Demo sites / Marzes	Established		Planned	
	Simple & medium improvements	Trickle irrigation	Simple & medium improvements	Trickle irrigation
Armavir	11	13	0	1
Ararat	7	13	0	2
Vayots Dzor	2	4	0	2
Aragatsotn	2	1	1	6
Gegharqunik	2	1	1	6
Kotayk	2	2	0	5
Tavush	3	3	0	3
Syunik	2	0	2	4
Shirak	1	1	2	5
Lori	1	1	3	5
Total	33	39	9	39
	72		48	

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