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Improving Food Security in Armenia through Sustainable Water Management

Demand for fresh water exceeds supply in Armenia. Water scarcity is defined as a “situation of imbalance between supply and demand of freshwater ... resulting from a high rate of demand compared with available supply” (FAO European Commission on Agriculture 1). The water supply and demand imbalance in Armenia stems from deficiencies within the storage, transportation, and usage of water for agricultural purposes. As climate change progresses, sources for water and irrigation will decrease. Loss of fresh water will have an immediate and pronounced effect on the Armenian economy. In order to combat current and future water scarcity in Armenia, the installed water capacity needs to be expanded, irrigation systems refurbished, and farmers educated on sustainable water usage. In order for Armenia to derive the greatest benefit from these changes, an inclusive partnership that draws on the knowledge from non-governmental organizations, government, and local farmers is required.

Armenia is a country of mountains, bounded by Azerbaijan in the east, Georgia in the north, Turkey to the west, and Iran in the south. It has an area of 29,800 km² and a population of 3.3 million. Located on the eastern part of the Armenian Plateau, Armenia has an average elevation of 1,800 metres making this country the most mountainous in Transcaucasia. In addition to mountains, Armenia is home to the largest lake in Transcaucasia, Lake Sevan, which is 940 square kilometers (km²) and lies in Eastern Armenia. In the twilight of the Soviet Union, the Armenian Soviet Socialist Republic declared its independence on August 23, 1990 and formed the Republic of Armenia. In 1991, the Republic was internationally recognized.

Agriculture is a vital industry. It contributes twenty percent to Armenia’s gross domestic product (GDP) and employs forty-five percent of the labor force (FAO Food Security and Agriculture Highlights). Due to Armenia’s mountainous geography, less than half (47%) of the country’s area is fit for farming. Of the 1,392,000 hectares (ha) suitable for agriculture; 520,000 ha (37%) is arable land for growing crops; around 40,000 ha (2.9%) are in plantations; 143,000 ha (10.3%) are grassland; and 689,000 ha (49.5%) are pasture (Haykazyan and Pretty 4-5). Armenia has many climatic zones as a result of the mountainous terrain. Gevorg Emin, an Armenian poet, once wrote, “A mountain stream flowing from the thawing snows on the slopes of Mt. Aragats will cross all four seasons of the year in the same day on its way to Mother Araks River – winter, spring, summer, autumn.” Because of the differing climates, a wide variety of fruits and vegetables like tomatoes, cauliflower, melons, peas, and basil can be grown. Winter wheat and spring barely are the main cereals grown; but limited production of rye and oats occur in mountainous areas. Maize is grown mainly as a feed crop; as are alfalfa, sainfoin, clover, and amaranth. In addition to cereals, fruits, and vegetables; Armenia also has well-established livestock industries centered on cattle, pigs, poultry, and sheep husbandry (Haykazyan and Pretty 7).

During the land privatization programs of 1991-1992, the 869 large collectives were broken into 338,000 small farms. Eighty-eight percent of farms today are less than two hectares (ha), with an average farm size of 1.37 ha. Actual farm size depends greatly on where the farm is located. Farms in the Ararat Valley average .61 ha, whereas farms in the pre-mountain and mountain areas average around three hectares. Though farms are small, improved agricultural practices allow farms to supply the subsistence needs of the farm family and provide a small surplus for market. Farms are generally broken into three parcels, one irrigated and two not irrigated (Haykazyan and Pretty 6-7). Around half of the arable land in Armenia is irrigated (Ministry of Nature Protection of the Republic of Armenia, Climate Change

Information Center 13). To irrigate their land, 90.5 percent of Armenia's farmers use surface irrigation, 9.1 percent use sprinklers, and .4 percent use localized irrigation (FAO Land and Water Division 137).

Armenians generally have medium-sized families with an average size of 3.6 people. Around nineteen percent are children under fifteen, while seventeen percent are over sixty (National Statistical Service, Ministry of Health, and ICF International 2). The average Armenian diet is rich in carbohydrates, cereals and starchy roots like potatoes, which supply over two thirds of the dietary energy. Most Armenians consume little meat. However, many consume milk, eggs, fruits, and vegetables (Food and Agriculture Organization of the United Nations 15).

In the period since independence, Armenia has made large strides in improving access to education. For example, in 2006, compulsory education was increased to nine years of education and the Ministry of Education instituted new teacher-training programs. However, the country's net enrollment ratio (NER) for primary and secondary education is seventy-nine percent and eighty-four percent respectfully. In addition, the salary of schoolteachers is seventy percent of the national average wage, making it hard for the state to retain experienced teachers (UNICEF 2).

With a once centralized healthcare system, Armenia's healthcare sector has fragmented. The current healthcare sector in Armenia is primarily focused on expensive hospital interventions that make up fifty percent of the national health budget (World Health Organization 1). As a result of fragmented and expensive healthcare, the system fails to provide adequate care to rural farmers and local communities. In recent years, many reforms have been made by the government to enlarge the healthcare system and improve access. Although progress has been made, Armenia still requires significant improvements in access to healthcare for rural communities.

Constraints

Like many developing countries, Armenia faces many constraints to improving agricultural yields and efficiency. Among the constraints are land scarcity, poor education in agricultural practices, and inefficient irrigation systems. Armenia is a land-poor country, and the small farm size reduces the amount of crops a farmer can grow. The majority of farms produce just enough food to be self-sufficient and to sell a small surplus in the market.

While under Soviet administration, 869 large collective and state farms were created (Haykazyan and Pretty 6). The Soviets managed these farms through specialization of labor. A person was responsible for one part of production and only that part. As a result, few Armenians understood the entire process of crop production. In this system, there was no incentive to share knowledge. In fact, knowledge was highly guarded and often used for personal gain. When the collectives were broken into family farms, the farmers were without experience or education in many aspects of crop production (Haykazyan and Pretty 6-7). This inexperience has resulted in water mismanagement, poor yields, and lower productivity.

Although land and agricultural education are very important issues for Armenia, irrigation is probably the most vital. Just under half of the arable land is irrigated (Ministry of Nature Protection of the Republic of Armenia, Climate Change Information Center 3), which generates eighty percent of gross crop production (Avetisyan 27). Though irrigation is widespread, problems with the current system prevent many of the benefits from arising. One major problem with the irrigation system is the dilapidated infrastructure, which is extremely inefficient and poorly maintained (Millennium Challenge Corporation (9/28/11) 2). To illustrate, over fifty percent of water is lost through poor infrastructure (FAO Land and Water Division 139). As a result of the decrepit system, farmers take water management into their own hands, improvising with debris and old vehicles to manage the water's flow (Millennium Challenge Corporation (9/28/11) 2). Through a compact with the Millennium Challenge Corporation (MCC), an independent United States' foreign aid agency, much progress has been made toward repairing the irrigation system

(Millennium Challenge Corporation (9/20/11)). Yet, many farmers in the fertile Ararat Valley remain without efficient irrigation (European Bank for Reconstruction and Development 136).

Water Scarcity

Despite low precipitation, Armenia is blessed with many important rivers and lakes. As a result, water scarcity is not a natural phenomenon in this country. However, due to inefficient irrigation and expensive pumping stations, water scarcity is a real threat facing many Armenian farm families.

Though irrigation is widespread, there are many deficiencies with the current system that reduce agricultural productivity and prevent improvements in the standard of living for many farmers. A stark representation of the failings of the system can be shown through the amount of land irrigated. In Armenia, 228,000 hectares (ha) of land are equipped for irrigation. However, only half are actually irrigated. Water loss and costly pump stations are two reasons that can explain this reduction in irrigated farmland. Water loss is not a critical issue with primary canals. However, secondary and tertiary canals are reported to lose between forty and fifty percent of water flow. The losses reduce irrigated farmland by preventing additional water supplies from reaching the fields. Another problem is the pumping stations, which are expensive to use and waste a lot of electricity making it economically unviable for farmers to use the stations (FAO Land and Water Division 138).

Water scarcity and the resulting inability to irrigate fields reduces the farmers overall potential productivity, income, and available land to farm. Irrigation can increase yields and income for the farmer. It is estimated that irrigation adds nine hundred dollars of productivity to farmland per hectare (FAO Land and Water Division 137). However, if farmers cannot irrigate the land, the potential benefits will not occur and production will stay the same. If production stays the same, the family will not have enough food to sell in the market and their income stagnates. Due to the debilitating effects of inflation, the family's income in real terms decreases. In addition to preventing improvement in the farmer's situation, water scarcity can reduce the overall land that can be farmed. Around a third of Armenian farmers cannot cultivate all their land because of poor quality, distance, or lack of water. Due to the degrading effects that time has on infrastructure, water scarcity will eventually worsen unless steps are made to refurbish the systems. Due to a semi-arid climate with little precipitation, climate change is projected to greatly influence water scarcity in the future.

Climate Change

Water scarcity is a variable problem affected by many external factors and issues. Climate change is a future issue that Armenia must manage with respect to water scarcity. The effects climate change will have on Armenia's water resources have the potential to decrease the sources of irrigation water and precipitation. These changes will have an immediate and pronounced effect on Armenia's agricultural sector.

With over half of all arable lands in Armenia under irrigation, water is critically important to Armenian agriculture (Ministry of Nature Protection of the Republic of Armenia, Climate Change Information Center 3). In turn, irrigation water is highly dependent on river flow and lake volumes. Climate change has the potential to reduce these key sources for irrigation water. It is estimated that river flow will drop by seven percent by 2030 and by twenty-four percent by 2100 (Ministry of Nature Protection of the Republic of Armenia, Climate Change Information Center 10). Agricultural production will drop in concert with river flow. A twenty-five percent reduction in flow will cause a fifteen to thirty-four percent reduction in output, bringing losses to the agricultural sector of 180 – 405 million U.S. dollars. Consequently, GDP will fall by three percent (Ministry of Nature Protection of the Republic of Armenia, Climate Change Information Center 14).

In addition to a reduction in water supply for irrigation, precipitation will fall as well, harming rain-fed agriculture. Armenia is already semi-arid, with an average annual precipitation of about 590 mm (Ministry of Nature Protection of the Republic of Armenia, Climate Change Information Center 10). This lack of precipitation makes rain-fed farming already difficult. Climate change will make farming even more challenging. Various estimations have shown that soil humidity will fall by ten to thirty percent, moisture reserves in crops will decline by seven to thirteen percent, and the water deficit will increase by twenty-five to thirty percent (Sargsyan 6). To combat these reductions in water supply, irrigated land will need to be increased, putting more strain on already overused rivers and lakes.

Recommendations

To combat current and future effects of water scarcity, I propose alleviating deficiencies in the water storage, transportation, and usage in Armenia.

Armenia must substantially expand water storage capacity. The current installed water storage capacity is inadequate to ensure water for Armenia's many smallholders in a drying country. In 2004, around 1,399 million cubic feet of water was stored in eighty-three reservoirs (FAO Land and Water Division 133). As more hectares of arable land require irrigation, having a steady supply of water will be crucial for Armenia's economy. The current storage capacity is not enough. In order to provide irrigation water to the Armenian farmers in the coming decades, Armenia needs to invest in large-scale infrastructure projects that will increase storage capacity by 1 – 2 billion cubic metres (Ministry of Nature Protection of the Republic of Armenia, Climate Change Information Center 14).

Armenia needs to rehabilitate and upgrade its network of tertiary canals that supply smallholder farmers. Though increased capacity is nice, without an efficient irrigation system much of the stored water will be lost in transit to the farmers. Mainly comprised of old and decaying canals and pipes, the current irrigation system transports water at a fifty percent loss (FAO Land and Water Division 139). Between the years 2006 – 2011, the MCC implemented a 122 million dollar project to rehabilitate vital irrigation infrastructure. All told, the Irrigation Infrastructure Activity rehabilitated seventeen pumping stations, constructed five gravity-fed irrigation systems, refurbished over forty kilometers of canal lining, installed over 260 water structures on six main canals, improved and rehabilitated around 220 kilometers of tertiary canals, and improved the Ararat Valley drainage system through cleaning of 470 kilometers of canals. Though the MCC compact boosted the lives of over 420 thousand Armenians (Millennium Challenge Corporation (9/20/11) 1-2), that is just a third of the estimated 1.338 million people employed in agriculture (FAO). The MCC compact has done an excellent job of rehabilitating the primary and secondary components of the system. However, to really affect the standard Armenian smallholder and solve water scarcity, the 15,000 km long network of tertiary canals need to be rehabilitated and upgraded. The country needs an MCC project on a much broader scale.

Armenia needs to educate irrigation system consumers and users on sustainable water practices. Assuming Armenia adds storage capacity and rehabilitates the entire irrigation system; all that effort will go to waste unless the consumers and users are educated on sustainable water practices. The old Soviet collective farm system did not encourage the sharing of information. As a result, many farmers lack knowledge of irrigation fundamentals (Heaton, Barnhill and Hill 2). In order to gain the best benefit from infrastructure improvements, the farmers need to know how to maximize crop yields and minimize water usage. To educate farmers, the ten Armenian marzer (similar to United States' state) should implement irrigation focused outreach programs to villages under their administration.

Organizations and Communities

In order to effectively implement mass programs in water storage, irrigation, and agriculture education, a top-down approach will be necessary. However, the involvement of smallholder farmers in Armenia will be very important to the effectiveness of these programs.

Massive amounts of capital are needed to improve water storage and irrigation infrastructure; capital that rural farmers do not, by themselves, have access to. However, development banks and large non-governmental organizations (NGOs) do have access to the capital that is needed. Though having access to massive capital, banks and organizations may not have the expertise and familiarity that the farmers have with the land. In the spirit of specialization of labor, I propose the farmers and banks work together on implementing projects. What I envision is that the banks and NGOs provide the monetary, industrial, and intellectual capital needed to sustain long-term infrastructure projects. The farmers in Armenia would identify the best places for water storage and requirements for the irrigation canals. When the planning and organizing phase is completed, the farmers and organizations would come together and build or refurbish the needed infrastructure with the farmers providing input and insight while the organizations provide supplies.

As with infrastructure, an education effort needs to be well structured. To best educate farmers, a local system of education facilities mixed with mobile education extension groups should be set up in each marz (similar to a United States' state). The fixed facilities would service large farming communities, while the mobile units would service the rural and isolated population. Given the extreme variety of climates, I believe the programs would be best served by having each marz tailor their programs to the climates of their region. Similar to the partnership between banks and farmers with infrastructure, a partnership between the farmers, NGOs, and the marzer will be required. The marzer would provide the facilities and physical capital needed. The NGOs would provide the intellectual "know-how" on sustainable agriculture and provide teachers. The farmers themselves will play the most crucial role in the program, participation. If there are no participants, there will be no program. Eventually, I envision participants spreading knowledge on sustainable water use to other farmers, who will then spread the word to others, and on and on, until most Armenian farmers know how to implement irrigation effectively.

Sustainable Water Management to Improve Livelihoods and Rural Communities

As an arid country with little precipitation, Armenia has always relied on its extensive network of rivers and lakes for water. In future years, these water sources will become increasingly important as climate change decreases its already low precipitation. However, this crucial resource faces major threats from huge deficiencies in the current irrigation infrastructure. Over fifty percent of water is lost in transportation. Of the water that reaches the farms, fifty percent is wasted through poor irrigation techniques (Haykazyan and Pretty 10). In addition, irrigation can be out of reach for many farmers due to inefficient pumping stations that drive up water prices. As a result of these manmade problems, Armenia is facing water shortages when it should not. Since agriculture makes up twenty percent of GDP and employs forty-five percent of the population (FAO), it is imperative that Armenia solve the water scarcity. To solve the problem, Armenia needs to implement a multifaceted program that focuses on storage, transportation, and consumption. To combat increased emergence of drought and scarcity, Armenia's reservoir capacity needs to be expanded. Increase storage capacity would provide farmers with a water "safety-net" that would help in mitigating effects of droughts. To improve the farmer's access to irrigation water in Armenia, the current dilapidated system must be refurbished to prevent water loss and waste. Though infrastructure is important, teaching the rural farmers about sustainable irrigation techniques is paramount. These recommendations should be implemented through an inclusive partnership that draws on the knowledge and expertise of the government, non-governmental organizations, and the farmers. The path toward reliable and efficient water use in Armenia will be long and expensive. However, the country will reap the reward of implementing sustainable water management practices and systems long into the future and there will be far-reaching benefits and improve the lives of small farmers and rural community.

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