

# 5.0 MONITORING AND EVALUATION

The image displays three overlapping copies of a 'TRACTOR SURVEY RESPONSE FORM'. The leftmost form is titled 'Revenue Part II' and contains questions such as 'What other farm machinery do you own?' and 'Do you sell the service of any of these machines to others?'. The middle form is titled 'Primary Crops:' and features a list of crops including Wheat, Barley, Rice, Maize, Summer Vegetables, Chickpeas, Sunflower, Orchards, Tomato, Winter Vegetables, Lentils, Cotton, and Other 1/2. The rightmost form is titled 'Satisfaction:' and includes questions about tractor repairs and performance, with fields for 'Survey\_Takers\_Name' (Admin), 'Date\_Of\_Survey' (04/05/2006), and 'Date\_Tractor\_Returned' (04/05/2006). It also has checkboxes for 'Yes' and 'No' for various satisfaction levels.

ARDI designed and implemented a Monitoring and Evaluation system to inform managers of the success of project investments and to collect data that would satisfy contractual reporting requirements. Nine specific contract objectives (the C 5 Results) were tracked. Data was collected and analyzed, with the impacts reported in this chapter.

The Monitoring and Evaluation Team designed surveys to gather data that would add to the information collected during project implementation. Samples were distributed to the three regions—the Kurdistan Regional Government (KRG), Ninewa governorate, and the Central/South governorates, matching as closely as possible the distribution of project activities among those three areas. Sample sizes were set between the minimum number necessary for meaningful analysis and the maximum number considered manageable, given time and financial constraints. In most cases, the range of variability of the data was unknown at

the time of sample selection. Beneficiaries were selected at random. Project scope, sample sizes, and the number of surveys completed are listed in the following table.

**TABLE 99 IMPACT SURVEYS IN MAJOR ARDI PROGRAMS**

Program	Total Scope of Program	Target Sample Size	Surveys Completed	Percent Surveyed
Tractors	4600 tractors	600	300	6.50%
Irrigation	74 projects	10	7	9.50%
Seed Cleaning	7400 farmers	140	138	2%
"Neighbor" farmers	n/a	140	138	n/a
Vet Clinics	69 clinics	20	14	20%
Breeders	n/a	200	123	n/a
Honey Producers	368	50	35	9.50%
Mechanics	174	28	28	16%

Security concerns in Ninewa and the Central/South regions seriously hampered data collection, while surveys in the relatively secure KRG were completed almost in full. This uneven collection of data likely skews averages toward results recorded in the northern part of the country.

Given the security situation, it was necessary to assemble and train teams of enumerators with the necessary local knowledge to travel safely in each of the different areas of the country. ARDI issued contracts to NGOs in the KRG and Ninewa, and hired 9 independent enumerators to complete surveys in the Central/South areas of the country. Although enumerators were hired based on previous experience, they also received a three-day training course covering the projects to be surveyed, survey methodology, and data entry. Surveys in the north were taken from June through August of 2006, and surveys in the south were completed primarily in August, 2006.

Once data collection was completed, survey data were entered into a common database for analysis. Data entry was performed partially by the contracted survey enumerators and partially by ARDI staff. The ARDI Monitoring and Evaluation Team provided oversight to assure quality control for all data entry. Surveys were analyzed, cross-checked, and summarized by ARDI staff.

The nine C 5 Contract Results are reported below.

**OBJECTIVE A:  
\$230 MILLION VALUE ADDED TO THE IRAQ AGRICULTURE ECONOMY DUE TO ARDI PROGRAMS.**

The first C 5 objective calls for the monetization of ARDI project benefits as a contribution to Iraq's agricultural economy. Of the more than 100 ARDI initiatives, the four largest investments have been examined in depth: wheat seed (from wheat seed cleaners), tractor rehabilitation, veterinary clinic reconstruction, and irrigation and drainage infrastructure rehabilitation. Using conventional assumptions to monetize benefit streams, and discounting to obtain "present value," these four projects accounted for \$400 million in value added to Iraq's agriculture economy, comfortably surpassing the contract requirement.

**TABLE 100 MONETIZED PRESENT VALUE OF ARDI BENEFITS IN FOUR PROGRAMS**

Program	First year Benefits	Project Total (Present Value)	Time Line
Seed Cleaners	\$19,000,000	\$66,000,000	5 Years
Tractor Rehabilitation	\$16,000,000	\$120,000,000	10 Years
Veterinary Clinic Reconstruction	\$9,092,141	\$61,000,000	10 Years
Irrigation and Drainage Infrastructure	\$50,392,162	\$153,000,000	5 Years
		Total	\$400,000,000

**MONETIZATION METHODOLOGY**

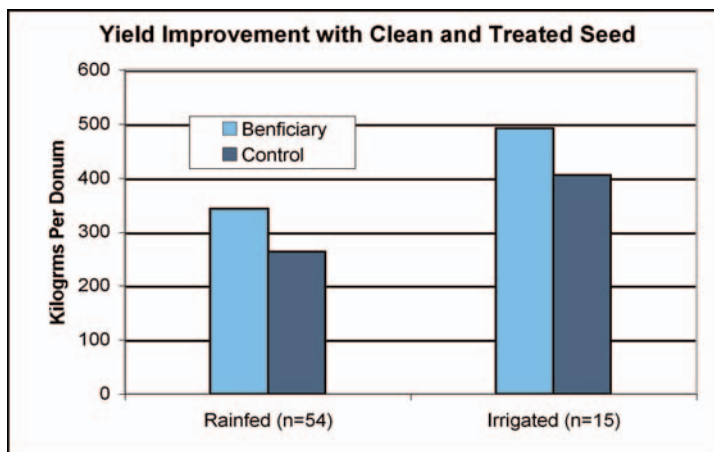
The economic models that are used to monetize project benefits were developed prior to survey design or data collection. Each of the monetization models is specific to the project for which it was designed. There is, however, a common approach and methodology that forms the basis for all models. The elements of it are:

1. ARDI project benefits are calculated using a “with-project scenario” and a “without-project scenario.” The “value introduced” is the with-project benefits minus the without-project benefits. Whenever possible the without-project scenario will be calculated for the same year as the with-project scenario. A comparison of year 1 to year 2 will be used as the alternative.
2. The future benefit stream from ARDI projects is converted to present value to take into account the time value of money. A dollar received today is worth more than a dollar received five years from now, because money in hand today can be invested and grow in value. The future benefits from ARDI projects are discounted at an annual rate of 10%.<sup>1</sup>
3. A ten-year benefit stream forecast is used for tractor rehabilitation and veterinary clinic reconstruction. The benefit stream from irrigation and drainage infrastructure rehabilitation and wheat seed cleaners is calculated for five years.
4. Monetization models are based on data from a number of sources, including prior field surveys, technical reports, or statistics gathered from public or private sources (e.g., FAO, UNWFP, Government of Iraq). ARDI conducted extensive surveys to evaluate the four targeted programs. Whenever the survey results were incomplete or inconclusive, due to security constraints on traveling or obtaining sufficient interviews, the assumptions used in developing the models are made explicit.
5. Monetized benefits can be calculated at various stages along the value chain. For example, the value added to the economy from newly introduced varieties of wheat could be valued at the farm-gate level, or that of the wholesale market, flourmill, or bakery. The monetized benefits in this report are calculated at the farm-gate or wholesale level.

<sup>1</sup> This rate may undervalue ARDI monetized benefits. There are few investments readily available to the general public that would yield such a return in Iraq. For domestic cost-benefit analysis the US Office of Management and Budget (OMB) currently mandates the use of a 2.8% real discount rate for 10-year forecasts.

**CASE I: WHEAT SEED CLEANERS**

There has been no government-supported distribution of certified wheat seed grown in Iraq since 2002. In 2004, the MOA, ARDI and the US military combined to import 16,000 mt of certified wheat seed that satisfied a small portion of domestic demand. Most farmers rely on farmer-saved seed for planting the next season, seed that often contains a large percentage of foreign seeds, including mustard, barley, and other volunteers. In 2005, ARDI implemented a program to procure 169 wheat seed cleaners for distribution throughout Iraq (see Section 2.1 for project details) to improve the quality of farmer-saved wheat seed. The result was higher wheat grain yield, with better quality as graded at the purchasing silo.<sup>2</sup> Cleaned seed commands a premium price on the open market. Seed cleaners add additional value by treating seed with a fungicide, which significantly reduces “smut,” a major wheat disease.<sup>3</sup> Cleaned and treated seed can sell for 30% more than untreated wheat grain. However, the most significant benefits from clean and treated seed are realized with the subsequent year’s harvest. Surveys showed that under rainfed conditions farmers who planted seed cleaned with ARDI machines harvested 30% more wheat than their neighbors, who did not use the machines. Under irrigation the increase in yield was over 20%.



The key variables of the monetization model include how the seed cleaner output is used, and the increased yield from cleaned seed. The increase in yield was determined by interviewing beneficiary farmers and the nearest neighbor who did not have cleaned seed. The survey also revealed that more than 75% of the wheat was treated with fungicide, which renders it unfit for human or animal consumption. Since this wheat seed has value, and the farmer has paid the cost of transportation to and from the seed cleaner location, we can safely assume that treated seed was saved for planting the next season, or sold to

<sup>2</sup>The Ministry of Trade grades wheat only on content of brokens, foreign matter, and smut. Thus a clean wheat field qualifies as Grade 1, receiving the highest price at the silo.

<sup>3</sup>The use of fungicide applied by the seed cleaners also contributed to the increased yields that were seen last year. However, the 2005/2006 growing season was not a year of a major smut infestation. Outbreaks of smut are generally contingent on meteorological and soil conditions, in addition to the extent of fungicide use. During a year when smut infestation is prevalent, much of the harvest not treated with fungicide in a given region will be affected with smut and will be unsuitable for human consumption. Consequently, farmers receive much lower prices for their harvest. Such an infestation of smut affected northern Iraq as recently as three years ago. The benefits from seed cleaners during such a year would be much greater than those seen in 2005/2006 and used in the monetization model.

someone else for planting.<sup>4</sup>

The monetization model is shown below. Seed cleaner records show that the cleaners input over 35 million kilograms of grain and delivered 31.76 million kilograms of clean seed. 57% of the wheat seed is assumed to be planted in rainfed land and 43% planted in irrigated land.<sup>5</sup> The sowing rate is the average value based on the estimated need for broadcast seeding. Yields under conditions “with” cleaning and treatment and “without” are captured by the beneficiary and neighbor surveys. The wheat silo prices for 2006 were used to calculate the monetization of seed cleaner benefits. Grade 1 wheat is purchased at 450 ID/kg, grade 2 at 375 ID/kg, and grade 3 at 250 ID/kg. These prices are established annually and paid by the Government of Iraq at Ministry of Trade silos.<sup>6</sup>

**TABLE 101 ARDI SEED CLEANERS REVISED MONETIZED BENEFIT CALCULATION**

Output Kgs wheat seed	31,764,633				
75% seed planted (Kgs)	23,823,475				
130 Kgs seed per ha					
		<u>Yield with</u>	<u>Yield with total</u>	<u>Yield without</u>	<u>Yield without total</u>
57% rainfed planted (ha)	104,457	1370 kgs per ha	143,105,780	1050 kgs per ha	109,679,613
43% irrigated planted (ha)	78,801	1966 kgs per ha	154,922,224	1619 kgs per ha	127,578,372
Next year's harvest	Grade 1		25.00%		0.00%
	Grade 2		75.00%		100.00%
Prices US\$	Grade 1		\$0.30		
Prices US\$	Grade 2		\$0.25		\$0.25
Value with rainfed			\$37,565,267		
Value with irrigated			\$40,667,084		
Total			\$78,232,351		
Value without rainfed					\$27,419,903
Value without irrigated					\$31,894,593
<b>Total</b>					<b>\$59,314,496</b>
<b>Net increase with Project (Year 1)</b>			<b>\$18,917,855</b>		
	<b>Year 1</b>	<b>Year 2</b>	<b>Year 3</b>	<b>Year 4</b>	<b>Year 5</b>
Survival Discount (10%)	\$18,917,855	\$17,026,069	\$15,323,462	\$13,791,116	\$12,412,005
					<b>\$65,899,154</b>

NPV @ 10% discount rate

=NPV(.1, benefit steam years 2,3,4,5)+benefit stream year 1

<sup>4</sup> The fungicide Raxil was to be provided by the government at seed cleaning sites and purchased by local farmers. In some locations the Raxil was not made available. In others, farmer associations or chambers of commerce purchased the Raxil and provided it at the sites. Thus, there is reason to believe that more cleaned seed will be planted each year than was treated by the seed cleaning machines.

<sup>5</sup> This assumption is based on Agro-Ecological Zone GIS analysis derived from remote sensing data.

<sup>6</sup> Wheat prices paid to farmers at the Ministry of Trade silos are administratively determined. Since 2003, the annual prices paid for Grade 1 wheat per metric ton have been \$180, \$200, \$260, and \$300. The 2006 figures (including Grades 2 and 3) most closely approximate the landed cost of wheat in Baghdad, estimated to be \$275-\$280 per mt.

**CASE 2: TRACTOR REHABILITATION**

As part of the Agriculture Mechanization Rehabilitation project (see Section 2.2), ARDI repaired 4,633 tractors across Iraq, approximately 9% of the national fleet, and provided training and basic tools to 216 mechanics, establishing the base for continued maintenance of the repaired tractors. The repairs ranged from engine and transmission overhauls to the replacement of starter motors and brakes. The program targeted tractors with the highest cost/benefit returns. Affordable costs were weighed against increasing tractor efficiency, and productive lifespan of the machine. Increased tractor efficiency and lifespan are particularly vital to Iraq's agricultural economy, given the age composition of the national fleet. FAO has reported that in 1995, 80% of the tractors in the center and south were more than 10 years old and 53% of total tractors were more than 15 years old. The "FAO Rural Socioeconomic Survey for 2002" reported that 97% of the tractors in the north were over 10 years old, 78.5% of the total were over 16 years old, and 35% of the total were over 21 years old.

Through the use of the monetization model described below, it is estimated that the present value added to the agriculture sector economy from tractor rehabilitation totals approximately \$116,000,000 over a period of 10 years.

A year 1/year 2 approach is used to measure the change in tractor-related activity before and after the repairs. From approximately 300 sampled beneficiary tractor owners, 256 surveys contained responses considered valid for use in the monetization model.

The benefits from tractor rehabilitation are derived from the additional area brought into cultivation/kept in cultivation from more efficient and more reliable tractors; the additional revenue from tractor-related services; and the savings to farmer-owners from reduced purchase of imported tractor parts and equipment. The timing of tractor repairs eliminated most contract plowing and seeding for the 2006-2007 winter crops. Those benefits are estimated from the tractor's increased capacity after it has been repaired and returned. The timing of the tractor repairs, the agricultural season, and surveys did not allow a complete calculation of the value added to the agriculture economy from this project. More than anything else, benefits are contingent on the area plowed in the fall and early winter in preparation for the planting of wheat, barley, and other crops grown in the winter. For most of Iraq, plowing for the winter season begins around early October; is most intense during the month of December; and continues as late as January. Many of the tractors were undergoing repairs during this important period, as the table below shows. Surveying began in June and was completed in late August.

The surveys did reveal strong positive results in additional area cultivated and revenue from tractor-related services, in spite of the limitations presented by the timing of the project and surveys. The average area cultivated per farmer is estimated by taking the area plowed for the two primary winter crops and applying a multiplier that accounts for the other crops grown.<sup>8</sup> These values are derived from survey data. During the 2004/2005 season (prior to tractor repairs) an average of 26.2 ha was cultivated by the farmers participating in the

<sup>8</sup> There are multiple ways to calculate area cultivated from the survey data. The multiplier was determined from previous data showing the average amount of land cultivated in grain crops against the amount of land cultivated in all crops.

**TABLE 102 DATE REPAIRED TRACTORS RETURNED TO THEIR OWNERS**

Month Returned	Percent
November-05	22%
December-05	31%
January-06	34%
February-06	3%
After Feb-06	10%

tractor repair program. The area increased by 10% to 28.8 ha during the 2005/2006 season (after repairs). Tractor-related services captured by the surveys include the transportation of fodder, water, construction materials and, if the timing had included harvest, would have included the movement of the grain and straw from the fields to warehouses. The survey data showed that the revenue from tractor-related services (not including tractor custom plowing, seeding, and cultivation) increased by 24% after rehabilitation, to an annual total of \$1,054 per tractor. This sizable increase points to the increase in tractor power, reliability, and efficiency.

The surveys included questions related to contracted agricultural services such as plowing, seeding, spreading fertilizer, and spraying for pests. According to the FAO, 96% of farmers in Iraq rely on renting a tractor or tractor services for all or part of their operations; clearly these services play an important role in agricultural production. Because of the timing of tractor repairs, the survey did not show an increase in the revenue from these services. However, with the average repaired tractor cultivating only 28 ha, there is sufficient capacity to undertake contract cultivation services in the next calendar year after repair. These benefits, calculated to approximate the 24% increase in noncultivation tractor rental services, have been included in the benefit stream.

The survey also obtained before and after tractor rehabilitation repair costs to the farmer-owners. This very substantial benefit was estimated by the repair facilities to consist of 50% cost of imported parts and equipment. This benefit to the agricultural economy has been captured in the monetization of benefits below.

### **THE MONETIZATION MODEL**

The additional area cultivated and service revenue made possible from better power and reliability are calculated from survey data with extrapolations from the survey for custom tractor services. Estimates of future performance are based on efficiency and useful life, the two main contributing elements of future tractor performance used in the monetization model.

Efficiency is the amount of work that a fully operational tractor can perform. Repairs were intended to return tractors to new specification conditions. If repaired tractors delivered 75% of new efficiency, and estimating the prerepair status at 25% of new efficiency, the repaired tractors should show a 50% increase in performance. The increased area under production documented by the survey data provides the "with" and "without" efficiency factors for owner-cultivated land in year 1. The increase in nonfarm tractor leasing services provides a second efficiency measure, and the projection for a similar increase in farm-based custom tractor services completes the efficiency calculation.

The "survival rate" is defined as the percentage of the original set of tractors that is operational over time. Under the "with project" scenario, there is little likelihood of the repaired tractors failing for the first few years. The rehabilitation project focused on the repairs that would be most likely to ensure maximum tractor functionality (e.g. engine or transmission overhauls, or clutch repairs). Any necessary additional repairs over the short term would likely be minor, and could be completed at minimal cost to the farmer. A flat survival rate of 100% is used for the first 4 years after tractor repairs, followed by a decelerating

**TABLE 103 ARDI TRACTOR REPAIR  
REVISED MONETIZED CALCULATION**

Total number of tractors repaired	4633	
Average area in cultivation 2006 ha	28.5	
Average yield per ha wheat 2006 kgs/ha	1050	
Price of grade 2 wheat kg	\$0.25	
<b>MONETIZED BENEFIT: LAND UNDER CULTIVATION</b>		
<b>With Tractor Repair</b>		
Value of the wheat crop cultivated by tractors	\$34,660,631	
Benefit stream:5% annual efficiency decline after 4 years	<b>\$34,660,631</b>	<b>\$34,660,631</b>
<b>Without Tractor Repair</b>		
Value of the wheat crop cultivated by tractors	\$31,194,568	
Benefit stream with 5% efficiency decline each year	\$31,194,568	\$29,634,840
Net Benefits from tractor repair	<b>\$3,466,063</b>	<b>\$5,025,792</b>
Net Present Value discounted at 10% =		<b>\$41,395,028.85</b>
<b>MONETIZED BENEFITS: FARM TRACTOR SERVICES</b>		
Annual income before repairs	\$1,752.54	
Annual income after repairs	\$2,173.15	
Net Benefit for all tractors	\$1,948,684	
<b>With Tractor Repair</b>		
Benefit stream with 5% efficiency decline after 4 years	\$10,068,202	\$10,068,202
<b>Without Tractor Repair</b>		
Benefit stream with 5% efficiency decline each year	\$8,119,518	\$7,713,542
Net Benefits from tractor repair	<b>\$1,948,684</b>	<b>\$2,354,660</b>
Net Present Value discounted at 10% =		<b>\$17,337,004</b>
<b>MONETIZED BENEFITS: NON-FARM TRACTOR SERVICES</b>		
Annual income before repairs	\$849.94	
Annual income after repairs	\$1,053.63	
Net Benefit for all tractors	\$943,696	
<b>With Tractor Repair</b>		
Benefit stream with 5% efficiency decline after 4 years	\$4,881,468	\$4,881,468
<b>Without Tractor Repair</b>		
Benefit stream with 5% efficiency decline each year	\$3,937,772	\$3,740,883
Net Benefits from tractor repair	<b>\$943,696</b>	<b>\$1,140,584</b>
Net Present Value discounted at 10% =		<b>\$8,399,444</b>
<b>MONETIZED BENEFITS: REPAIR COSTS</b>		
Annual costs before repair	\$4,584.00	
Annual costs after repair	\$564.00	
Percentage repairs cost of imported parts	\$0.50	
Annual benefits to farmers of repairs in cost savings	\$2,010.00	
Total benefits to tractor owners in repair cost savings	\$9,312,330	
Benefit stream with 5% loss per year	<b>\$9,312,330</b>	<b>\$8,846,714</b>
Net Present Value discounted at 10%		<b>\$52,526,327.12</b>
<b>Total Net Present Value</b>	<b>\$119,657,804</b>	
Total first year	\$15,670,773	



	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
	\$34,660,631	\$34,660,631	\$32,927,600	\$31,281,220	\$29,717,159	\$28,231,301	\$26,819,736	\$25,478,749
	\$28,153,098	\$26,745,443	\$25,408,171	\$24,137,762	\$22,930,874	\$21,784,330	\$20,695,114	\$19,660,358
	\$6,507,534	\$7,915,188	\$7,519,429	\$7,143,458	\$6,786,285	\$6,446,970	\$6,124,622	\$5,818,391
	\$10,068,202	\$10,068,202	\$9,564,792	\$9,086,552	\$8,632,225	\$8,200,614	\$7,790,583	\$7,401,054
	\$7,327,865	\$6,961,472	\$6,613,398	\$6,282,728	\$5,968,592	\$5,670,162	\$5,386,654	\$5,117,321
	\$2,740,337	\$3,106,731	\$2,951,394	\$2,803,824	\$2,663,633	\$2,530,451	\$2,403,929	\$2,283,732
	\$4,881,468	\$4,881,468	\$4,637,394	\$4,405,525	\$4,185,248	\$3,975,986	\$3,777,187	\$3,588,327
	\$3,553,839	\$3,376,147	\$3,207,340	\$3,046,973	\$2,894,624	\$2,749,893	\$2,612,398	\$2,481,778
	\$1,327,629	\$1,505,321	\$1,430,054	\$1,358,552	\$1,290,624	\$1,226,093	\$1,164,788	\$1,106,549
	\$8,404,378	\$7,984,159	\$7,584,951	\$7,205,703	\$6,845,418	\$6,503,147	\$6,177,990	\$5,869,090

survival rate similar to the calculated loss in efficiency by both repair and unrepaired tractors.

The value of the additional area in cultivation is measured in terms of wheat production. This crop is used both because wheat is the major crop grown by tractor owners, and also to ensure a simple monetization model that provides conservative estimates of project benefits. An average yield of 1050 kgs per hectare, and a silo price of \$250 per metric ton (grade 2) complete the monetization of the additional area cultivated as a result of tractor rehabilitation. Taking the tractor rehabilitation project as a whole, the difference between the “with” and “without” project scenarios for the additional area cultivated in wheat totals over \$41,000,000.

The net total value of benefits from nonfarm and farm tractor-related services, calculated over a ten-year period, exceed \$25,000,000. Calculating the savings in imported parts and equipment repair costs increases the contribution of the tractor program by more than \$52,000,000.

The total value in benefits from ARDI's tractor rehabilitation program, increasing tractor efficiency by 50%, is approximately \$120,000,000 taken over the 10-year life of the tractor repairs.

### **CASE 3: VETERINARY CLINIC REHABILITATION**

ARDI completed the rehabilitation of 68 Ministry of Agriculture (MOA) veterinary clinics in 17 governorates. According to Government of Iraq records, the rehabilitated clinics serve over 135,000 livestock breeders. The clinics suffered from years of neglect during the previous regime, and extensive looting after the 2003 invasion. MOA clinics provide a critical source of veterinary services for mass vaccination campaigns as well as for the small-scale breeders that can't afford private services. Since many diseases that most afflict animals can also be transferred to humans who live in close proximity with their animals, the clinics also serve an important role in public health. Iraqi breeders suffered increasing losses to herd numbers and household income as MOA clinic services declined, and cases of animal-transmitted diseases to humans, especially brucellosis, were at unacceptable levels in some governorates of the country. In terms of animal health alone, however, the estimated benefits from rehabilitation of the MOA veterinary clinics total more than \$61,400,000 over a 10-year period.

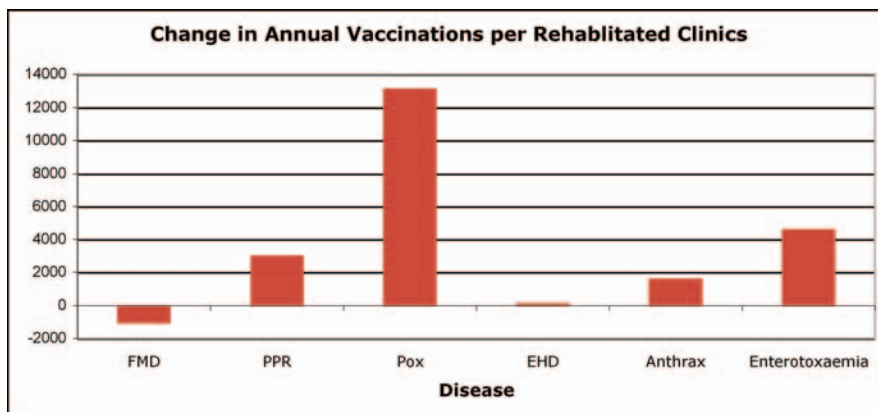
The value added to the agriculture economy is derived primarily from the animals saved through the rehabilitated veterinary clinics, either through treatments or vaccinations. Two separate studies were conducted in order to capture these benefits. First, a total of 14 rehabilitated clinics were chosen to compare services delivered both before and after rehabilitation. Second, a total of 73 valid surveys of livestock breeders who utilized the services of the clinics verified service delivery from the perspective of both service providers and users.

The surveys showed that, by far, the greatest benefits from the rehabilitated clinics were derived from significant increases in the number of vaccinations. This is an expected result, since the clinics serve as a vital component of the vaccination campaigns, and without a functioning clinic it is difficult to reach large numbers of animals. A functioning clinic is able to provide facilities for proper vaccine storage, as well as a satisfactory base of operations so that more staff

can reach more animals.

Perhaps surprisingly, the number of treatments for specific problems did not show a notable increase. This may be because farmers consult with the veterinarians about general problems during the course of on-farm visits for vaccination campaigns, while the long distance between farmer and clinic discourages consultations for treating a single animal, because of transportation difficulties for both veterinarian and farmer.

As government employees, clinic veterinarians keep complete records of all activities, including numbers of vaccinations for each disease. The clinic managers opened their records for ARDI surveyors, who noted figures for the years proceeding and following rehabilitation. The chart below shows the average change in number of vaccinations per clinic, after rehabilitation, for all of the vaccinations listed by the surveyed clinic managers. All of the vaccination types showed increases except for foot and mouth disease (FMD). Goat pox alone showed an average increase of around 13,000 vaccinated animals per clinic.



Expected morbidity and mortality rates of these diseases, both with and without vaccination, permit a determination of the monetized value of additional vaccinations. These variables are shown in the monetization model, below. Morbidity, mortality, and vaccine effectiveness values are provided by Iraqi State Veterinarians, the World Organization for Animal Health, or USDA-APHIS for every disease except peste des petits (PPR) and anthrax. Whenever possible, the values are specific to Iraq. Otherwise, the values are based on regional or global estimates. The epidemiology of PPR is somewhat similar to FMD; therefore FMD values are used for PPR. The anthrax estimate is based on values provided by the experience of local veterinarians.

The number of animals saved per year by each clinic is estimated by multiplying the number of additional vaccinations, morbidity, mortality, and vaccine effectiveness. It is assumed that the breeds of the animals saved are proportional to average herd composition determined by the breeder surveys (see the figure on the following pages). The value of each animal saved (whether adult or immature) is based on the average cost of the animal at market, as verified by the breeder surveys.

The percentage of adult animals by sex is captured by the breeder surveys. Local veterinarians estimate that on average 80% of the herd is over one year of age, or "adult." The total number of animals less than one year old is assumed

**TABLE 104 MONETIZED BENEFITS - VACCINATION CAMPAIGNS**

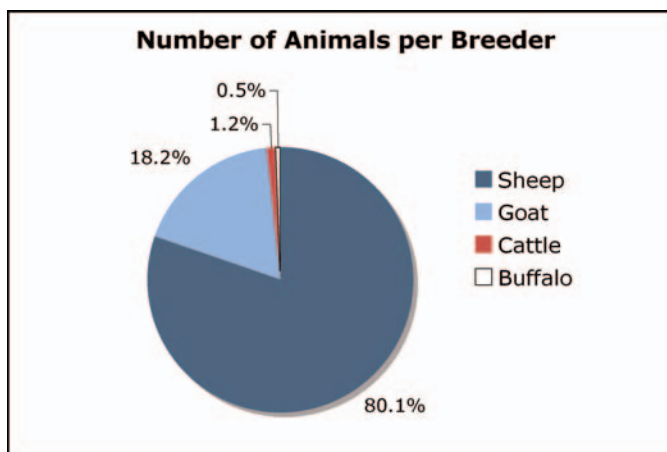
<b>Vaccination Campaigns</b>					
<b>Disease</b>	<b>FMD</b>	<b>PPR</b>	<b>Pox</b>	<b>EHD</b>	
Vac/Year/Clinic Difference	-1094	3009	13138	136	
Morbidity X Mortality X					
Vac. Effectiveness	1.10%	5.40%	5.40%	2.30%	4.30%
Animals Saved/Clinic	-12	162	709	3	
<b>Total Animals Saved/Year</b>	<b>1447</b>				
Clinics Rehabilitated	68				
Sheep Saved per Year	78882				
Goats Saved per Year	17925				
Cattle Saved per Year	1154				
Buffalo Saved per Year	466				
Percent Female	58%				
<b>Vaccination Campaigns</b>					
	<b>Total</b>	<b>Male</b>	<b>Female</b>		
Percent Juvenile	20%	10%	10%		
Percent Adult	80%	34%	46%		
<b>Average Price</b>					
	<b>Female</b>		<b>Male</b>		
	<b>Price for Juvenile</b>	<b>Price for Adult</b>	<b>Price for Juvenile</b>	<b>Price for Adult</b>	
Sheep	\$51	\$77	\$60	\$120	
Goats	\$43	\$74	\$46	\$78	
Cattle	\$224	\$456	\$371	\$624	
Buffalo	\$133	\$933	\$425	\$1,005	
<b>Vaccination Campaigns</b>					
	<b>Sheep</b>	<b>Goats</b>	<b>Cattle</b>	<b>Buffalo</b>	
Male Juvenile	\$474,741	\$83,249	\$42,799	\$19,807	
Female Juvenile	\$401,792	\$77,673	\$25,812	\$6,214	
Adult Male	\$3,201,820	\$472,652	\$242,537	\$157,743	
Adult Female	\$2,828,318	\$611,626	\$243,913	\$201,445	
<b>Vaccination</b>					<b>\$9,092,141</b>
<b>Increased Vaccination Benefits Over Time</b>					
	<b>Year 1</b>	<b>Year 2</b>	<b>Year 3</b>	<b>Year 4</b>	<b>Year 5</b>
Annual Benefit of Increased Vaccination	\$9,092,141	\$9,092,141	\$9,092,141	\$9,092,141	\$9,092,141
NPV Multiplier	1	0.91	0.83	0.75	
NPV Including Vaccination	<b>\$9,092,141</b>	<b>\$8,265,583</b>	<b>\$7,514,166</b>	<b>\$6,831,060</b>	
<b>Total NPV Including Vaccination</b>	<b>\$61,454,000</b>				

	<b>Anthrax</b>	<b>Enterotoxaemia</b>
	1597	4591
2.30%	4.30%	11.30%
	68	516

**Buffalo**

**\$9,092,141**

<b>Year 4</b>	<b>Year 5</b>	<b>Year 6</b>	<b>Year 7</b>	<b>Year 8</b>	<b>Year 9</b>	<b>Year 10</b>
\$9,092,141	\$9,092,141	\$9,092,141	\$9,092,141	\$9,092,141	\$9,092,141	\$9,092,141
	0.68	0.62	0.56	0.51	0.47	0.42
	<b>\$6,210,055</b>	<b>\$5,645,504</b>	<b>\$5,132,277</b>	<b>\$4,665,706</b>	<b>\$4,241,551</b>	<b>\$3,855,955</b>



to be 50% male and 50% female, an approximation since the animals are culled by sex sometime between 6 months and one year. The annual benefits from increased vaccinations are monetized for both adult and immature animals, using value per animal based on market prices and verified by the breeder surveys. The annual benefits from increased vaccinations are estimated at \$9,092,141 for all 68 rehabilitated clinics. At an annual discounted rate of 10%, the value in current dollars of the increased numbers of vaccinations totals \$61,454,000 projected over a 10-year period.

#### **CASE 4: IRRIGATION AND DRAINAGE IMPROVEMENT PROJECTS**

In the center and southern areas of Iraq, all agriculture is dependent on irrigation. In the northern areas, irrigation systems supplement rainfall. The country has existing and extensive irrigation infrastructure, however, irrigation systems require regular maintenance and repair, and the Iraqi systems suffered from years of disrepair and neglect. ARDI determined that agricultural production could increase dramatically through the rehabilitation of existing irrigation systems, producing rapid results for relatively modest investments. Projects with the highest potential impact were identified and implemented, yielding impressive benefits for large numbers of farmers. The annual estimated benefits from irrigation and drainage infrastructure rehabilitation projects total over \$50,000,000. The net present value over five years is more than \$153,000,000.

For the purposes of data collection and monetization, the irrigation and drainage infrastructure projects are broken down into three categories. **Drainage** projects allow proper drainage (e.g. pumping stations), a critical function to maintain soil tilth and prevent salinization. **Regulator** projects are aimed at structures (e.g., head regulators, cross regulators, and gates) that permit efficient distribution and management of irrigation water. **Other irrigation infrastructure** projects both conserve water, and facilitate the regular flow of water to agricultural lands (e.g. canal cleaning, canal lining, pipe flumes).

For individual irrigation projects, surveys were conducted with randomly selected farmers at the beginning, middle, and "tail" of the irrigation system. This protects against unequal distribution of irrigation water between the time it leaves the main canal and arrives at the farmers' lands furthest from the headworks. Surveys were completed on one drainage project, two regulator projects, and three other irrigation infrastructure projects. These projects were selected to be representative in terms of scale and potential impact. Security considerations

affected the locations where surveys could and could not be conducted. Three projects in Muthanna were surveyed, along with one each from Wassit, Thi-Qar, and Sulaymaniyah.

**TABLE 105 SURVEYED IRRIGATION AND DRAINAGE PROJECTS**

Project	Governorate	Sample
<b>Drainage</b>		
Um Al-Agaf Pump Station	Muthana	15
<b>Regulator</b>		
Irrigation Regulator at Al Mhaddad Pumping Station	Muthana	21
Al-Bassrokiyah Cross Regulator	Wassit	15
<b>Other Irrigation Infrastructure</b>		
Cleaning Canals in Sayed Dekhee	Thi-Qar	6
Cleaning Canals in Al-Warka'a	Muthana	24
Cleaning Khormal Irrigation Canal	Sulaymaniyah	20

The monetized benefits from irrigation infrastructure projects are determined by the increase in revenue of farm families as a result of ARDI-funded improvements in irrigation systems.<sup>1</sup> The additional area cultivated, crop selection, and increased yields from improved irrigation all contribute to the increase in revenue. Of the three kinds of projects evaluated, the average increase in farmer revenue from drainage projects was 27 percent. This increase is lower than found with regulator projects, which tend to produce immediate benefits as opposed to the longer-term benefits obtained from proper drainage systems. However, the repair of drainage systems will, over time, return large areas of agricultural lands affected by salinization back to full production. By far the highest short-term impact came from regulator projects, which increased farmer revenues by 196 percent. The average increase in revenue for other irrigation projects (mainly canal cleaning) was 21%. Overall there was an average farmer revenue increase of 54% from ARDI's irrigation and drainage infrastructure projects.

The commodity prices used to determine revenue are shown together with the monetization model below. Most commodity prices were derived from ARDI's Wholesale Market Price Monitoring Program. The irrigation survey farm-gate price is used when a product was not reported by the Price Monitoring Program. Prices are normalized to September 2006.

Surveys of irrigation and drainage projects provided data at the level of the farm family. Estimates are averaged, and multiplied by the total number of beneficiary families to determine the impact of each of ARDI's main types of irrigation improvement projects. The data for the area covered, and number of families for each project (the command area) are provided by Ministry of Water Resources.

The estimated annual benefits from irrigation and drainage projects total **\$50,392,162**. The net present value over five years is **\$153,074,668**.<sup>2</sup>

<sup>1</sup> One example of a particularly successful project was the Al-Warkaa canal cleaning project. None of the 24 farmers surveyed for the project was able to grow rice prior to the cleaning, because the canal was blocked with weeds and debris. After the project was completed, all farmers were able to grow rice; on average, each farmer cultivated 13.1 donums of rice and harvested 13 metric tons of rice in the "with" situation. However, the large increase in revenue from rice found in Al-Warkaa is not representative of production possibilities in most of irrigated Iraq, and thus not included in the monetization model.

<sup>2</sup> These substantial benefits should be examined with the knowledge that they are based on a small sample size. Five out of 76 projects were surveyed, but only 77 beneficiary families were surveyed out of 85,145 impacted. The high-return canal cleaning project that allowed rice production, Al Warkaa, is not included, as mentioned above.

**TABLE 106 PROJECT SCALE AND COMMODITY PRICES**

Type of Project	Hectares	Percent	Families	Percent
Drainage and Pumping	108,345	38%	47,435	56%
Regulators	85,473	30%	14,334	17%
Other Irrigation Infrastructure	88,596	31%	23,526	28%
Total	282,413	100%	85,295	100%

**TABLE 107 COMMODITY PRICES**

Prices				
	Price (IDN/kg)	Price (US\$/kg)	Note	
Wheat	340	\$0.23	Hard Grade One	
Barley	255	\$0.17	Black Grade One	
Rice	1,000	\$0.67	Anbar Grade One	
Maize	280	\$0.19		
Sunflower	189	\$0.13	From 2006 Irrigation Survey	
Tomato	300	\$0.20		
Melon	325	\$0.22		
Okra	625	\$0.42		
Cucumber	350	\$0.23		
Alfalfa	402	\$0.27	From 2006 Irrigation Survey	
Eggplant	325	\$0.22		
Black cumin	169	\$0.11	From 2006 Irrigation Survey	
Broad - bean	600	\$0.40	Anbar Wholesale Market	
Onion	260	\$0.17	White Variety	
Sesame	185	\$0.12	From 2006 Irrigation Survey	
Chickpea	1,063	\$0.71	Erbil Wholesale Market	
Millet	340	\$0.23	Wheat Price is Used as Sub.	
Water Melon	275	\$0.18		
Cotton	231	\$0.15	From 2006 Irrigation Survey	
Field Pistachio	162	\$0.11	From 2006 Irrigation Survey	
Pomegranate	500	\$0.33		
Fig	550	\$0.37		
Apricot	500	\$0.33	Diyala Wholesale Market	

Note: Unless noted, prices taken from Baghdad wholesale market first week in September.

**TABLE 108 ANNUAL BENEFITS FROM DRAINAGE AND PUMPING PROJECTS**

Field Crops	2005 Harvest (kg)	2006 Harvest (kg)	Difference	Prices	Revenue
Wheat	525	689	164	\$0.23	\$37.27
Barley	2,020	2,720	700	\$0.17	\$119.00
Rice	833	933	100	\$0.67	\$66.67
Maize	468	479	11	\$0.19	\$2.00
Okra	167	200	33	\$0.42	\$13.89
Cucumber	407	693	287	\$0.23	\$66.89
Eggplant	0	200	200	\$0.22	\$43.33
<b>Average Revenue Increase</b>		<b>\$349.05</b>			
<b>Annual Project Benefits</b>		<b>\$16,557,153</b>			



TABLE 109 ANNUAL BENEFITS FROM REGULATOR PROJECTS

Field Crops	2005 Harvest (kg)	2006 Harvest (kg)	Difference	Prices	Revenue
Wheat	535	1,503	968	\$0.23	\$219.43
Barley	111	883	772	\$0.17	\$131.28
Melon	139	139	0	\$0.42	\$-
Cucumber	0	139	139	\$0.27	\$37.23
Apricot			0	\$0.33	\$-
<b>Average Revenue Increase</b>		<b>\$387.93</b>			
<b>Annual Project Benefits</b>		<b>\$5,560,598</b>			

TABLE 110 ANNUAL BENEFITS FROM OTHER IRRIGATION INFRASTRUCTURE PROJECTS

Field Crops	2005 Harvest (kg)	2006 Harvest (kg)	Difference	Prices	Revenue
Wheat	4,501	5,512	1,011	\$0.23	\$229.14
Barley	20,681	21,949	1,268	\$0.17	\$215.61
Rice	38	58	19	\$0.67	\$12.82
Maize	0	0	0	\$0.19	\$-
Sunflower	373	2,160	1,787	\$0.13	\$225.38
Tomato	277	483	206	\$0.20	\$41.15
Melon	198	654	456	\$0.22	\$98.75
Okra	46	19	-27	\$0.42	(\$11.22)
Cucumber	269	304	35	\$0.23	\$8.08
Black cumin	813	754	-59	\$0.11	(\$6.68)
Broad - bean	81	98	17	\$0.40	\$6.92
Onion	0	34	34	\$0.17	\$5.93
Sesame	226	171	-55	\$0.12	(\$6.81)
Chickpea	317	256	-60	\$0.71	(\$42.76)
Millet	178	88	-90	\$0.23	(\$20.40)
Water Melon	81	190	109	\$0.18	\$20.04
Cotton	0	202	202	\$0.15	\$31.14
Field Pistachio	32	182	150	\$0.11	\$16.15
Pomegranate	19	231	212	\$0.33	\$70.51
Fig	1,217	2,075	858	\$0.37	\$314.49
Apricot	19	0	-19	\$0.33	(\$6.41)
<b>Average Revenue Increase</b>		<b>\$1,201.84</b>			
<b>Annual Project Benefits</b>		<b>\$28,274,410</b>			

TABLE 111 SUMMARY

Annual Benefits from Drainage Projects	\$16,557,153				
Annual Benefits from Regulator Projects	\$5,560,598				
Annual Benefits from Irrigation Projects	\$28,274,410				
<b>Annual Water Project Benefits</b>	<b>\$50,392,162</b>				
	<b>Year 1</b>	<b>Year 2</b>	<b>Year 3</b>	<b>Year 4</b>	<b>Year 5</b>
<b>Project Benefits</b>	\$50,392,162	\$50,392,162	\$50,392,162	\$50,392,162	\$50,392,162
<b>Failure Rate</b>	1	0.85	0.7	0.55	0.4
<b>NPV Multiplier</b>	1	0.91	0.83	0.75	0.68
	<b>\$50,392,162</b>	<b>\$38,939,398</b>	<b>\$29,152,491</b>	<b>\$20,823,208</b>	<b>\$13,767,410</b>
<b>Total Benefits</b>	<b>\$153,074,668</b>				

**IRRIGATION INFRASTRUCTURE MONETIZATION****SUMMARY: OBJECTIVE A**

During three years of operation in Iraq, ARDI was involved in hundreds of individual projects aimed at the development of the agriculture sector, spread over six program areas. All contributed to the development of the agriculture sector, whether through education and training, organizational and business development, institutional renovation or infrastructure reconstruction. Many of the projects (such as training programs and organizational development) are extremely difficult to monetize because the benefits are realized over the long term, and may be diffuse in their effects. The material benefits of "production projects" are much easier to quantify, because their effects are more immediate and demonstrable. This report concentrates on only four project initiatives, which are explained in detail above. The results of this partial list of activities, totaling more than \$400 million, demonstrate that ARDI surpassed the stated goal of this objective by a wide margin.

**OBJECTIVE B:****CONDUCTED FIVE TARGETED ASSESSMENTS ON MAJOR COMMODITY SUBSECTORS TO GUIDE PROGRAM INVESTMENTS.**

ARDI has far exceeded the number of studies required by this C 5 objective. The following is a list of the titles of 26 targeted assessments that played an integral part in guiding program activities and investments. These assessment reports have been delivered to USAID and are available from Clearinghouse.

**TABLE I 12 ASSESSMENT REPORTS PRODUCED BY ARDI****REPORT TITLE**

*Iraqi Date Industry - Marketing and Post-harvest Issues*  
*Date Palm Restoration Program*  
*Sheep Production Improvement Program*  
*Beekeeping Input Final Report*  
*Poultry Industry Study*  
*Baghdad Poultry Farm Survey Summary Report, 2005*  
*Poultry Survey Summary Report- Erbil, Dahuk and Sulaymaniyah, 2005*  
*Seed Technology Study*  
*Grape Benchmarking Study*  
*Wheat Production Program*  
*Mesopotamia Seed Company Report*  
*Grain Silos Report*  
*Rangelands Assessment- Preliminary Report*  
*Erbil Winter Crop Survey 2004 – 2005*  
*Dahuk Winter Crop Survey 2004 – 2005*  
*2005 Livestock Inventory and Dairy Production Survey in Sulaymaniyah*  
*2005 Summer Crop Production Survey in Sulaymaniyah*  
*Major Issues in Markets for Farm Products and Agricultural Inputs*  
*Market Research in Rural Areas- Basrah Region*

Rural Liquidity for Agriculture and Agribusiness  
 Agriculture Credit Bank  
 Irrigation Water Management Assessment and Priorities for Iraq  
 Irrigation Fees Study in Iraq  
 Rehabilitation Of Irrigation And Drainage Infrastructures And Soil-Water  
 On-Farm Management  
 Inception Report- Strategy for Water and Land Resources in Iraq

#### OBJECTIVE C:

#### **PRODUCTION OF WHEAT, MAIZE, RICE, SORGHUM, AND TARGETED VEGETABLES IN PROGRAM-ASSISTED AREAS INCREASED BY 30% OVER THE LIFE OF THE PROGRAM.**

ARDI's multiplication, production, and demonstration programs surpassed the target set for this objective. Production increased by an average of 70%, using weighted average (by area) of the selected crops. The specific production results for wheat, maize, rice, sorghum, and tomatoes are shown in the tables below.

In some instances, accurate production or baseline data (dating from the start of the ARDI project in 2003) did not exist. In these cases reasonable and conservative assumptions or substitutes are made, based on the best information available. Results from the appropriate ARDI Winter Crop Survey are used when a control production plot was not established to compare a project plot's improvement over traditional yields at a given location. The one exception is the 2005/2006 wheat demonstration in Qadissiya, Muthanna, Thi-Qar, and Baghdad. In that case, there was no productive agriculture on the land to allow comparison, so the results have been shown in the table below as a 200% increase in yield. Complete results are not available for the 2004/2005 wheat production program in Ninewa. The 2005/2006 results for the same variety (Cham 5) are used as a substitute. Complete results were also not available for the 2005 maize production program in Kirkuk, Babylon, Wasit, Diyala, Qadissiya, Missan, and Kerbala. Only results from Missan are complete, so those figures are used for all governorates.

**TABLE 112 WHEAT - SEED MULTIPLICATION PROGRAMS**

Season	Governorate	Participating Farmers	Impacted Area (Hectares)	Improved Yield (kg/ha)	Traditional Yield (kg/ha)*	% Increase Production
2004-2005	Dahuk	5	200	1,700	752	126%
2005-2006	Dahuk, Erbil (Cham 5)	55	3,959	1,888	1,196	58%
2005-2006	Dahuk, Erbil (Acsad-65)	69	5,821	1,808	1,196	51%
2005-2006	Qadissiya, Muthanna, Thi-Qar, Baghdad	17	100	2,100	1050	200%

**TABLE 113 WHEAT - PRODUCTION PROGRAMS**

Season	Governorate	Participating Farmers	Impacted Area (Hectares)	Improved Yield (kg/ha)	Traditional Yield (kg/ha)*	% Increase Production
2004-2005	Ninewa	<i>no data</i>	30,770	1,888	1,196	58%
2005-2006	Sulaymaniyah	10	594	1,290	1,139	13%

TABLE I 14 MAIZE - PRODUCTION PROGRAMS

Season	Governorate	Participating Farmers	Impacted Area (ha)	Improved Yield (kg/ha)	Traditional Yield (kg/ha)	% Increase Production
2005	Kirkuk, Babylon, Wassit, Diyala, Qadissiya, Missan, Kerbala	1,844	1,743	4,700	1,250	276%
2006	Anbar	100	1,250	8,500	2,950	188%

TABLE I 15 MAIZE - DEMONSTRATION PROGRAMS

Season	Governorate	Farmers Attending Field Days	Demonstration Area-- Improved and Traditional (ha)	Improved Yield (kg/ha)	Traditional Yield (kg/ha)*	% Increase Production
2006	Missan, Thi-Qar, Basrah (Marshlands)	n/a	12	4800	2950	63%

TABLE I 16 RICE - DEMONSTRATION PROGRAMS

Season	Governorate	Farmers Attending Field Days	Demonstration Area-- Improved and Traditional (ha)	Improved Yield (kg/ha)	Traditional Yield (kg/ha)*	% Increase Production
2004	Najaf, Qadissiya, Diyala	344	13	5,160	3,753	37%
2005	Najaf, Qadissiya, Muthanna, Wassit, Diyala, Babylon, Erbil	1,450	40	3,613	2,767	31%

TABLE I 17 SORGHUM - DEMONSTRATION PROGRAMS

Season	Governorate	Farmers Attending Field Days	Demonstration Area-- Improved and Traditional (ha)	Improved Yield (kg/ha)	Traditional Yield (kg/ha)*	% Increase Production
2005	Baghdad, Babylon, Kirkuk, Thi-Qar, Sulaymaniyah, Basrah, Muthanna, Qadissiya, Wassit	n/a	1	5,191	4,754	9%
2006	Missan, Basrah, Thi-Qar	n/a	12	2,590	1,000	159%

TABLE I 18 TOMATOES - DEMONSTRATION PROGRAMS

Season	Governorate	Farmers Attending Field Days	Demonstration Area-- Improved and Traditional (ha)	Improved Yield (kg/ha)	Traditional Yield (kg/ha)*	% Increase Production
2005	Muthanna, Kerbala, Najaf, Basrah	235	40	50,700	4,000	1168%
2006	Dahuk					

\* Traditional yield taken from the Winter Crop Surveys

TABLE 119 SUMMARY

	Total Area (Hectares)	Average Yield*	% Increase in Production*
Wheat	41,444	1,868	56%
Maize	3,005	6281	239%
Rice	53	3,992	32%
Sorghum	13	2790	147%
Tomatoes	40	50,700	1168%
<b>Total</b>	<b>44,555</b>	<b>-</b>	<b>70%</b>

\* Weighted averages, based on area cultivated

#### OBJECTIVE D:

##### **ESTABLISH INFRASTRUCTURE TO SUPPLY 410,000 DATE PALM SEEDLINGS, OR OTHER HIGH-VALUE CROP TRANSPLANTS PER YEAR.**

ARDI established infrastructure to increase supplies of improved varieties of date palm seedlings, grape seedlings, and ornamentals. The combined annual output from this infrastructure will total over 1,000,000 plants per year:

In collaboration with the MOA, ARDI established 21 date palm mother orchards in 13 governorates of Iraq where dates are an economically important crop. In addition to supplying over 80,000 mother trees of commercially desirable varieties, ARDI made considerable improvements to orchard infrastructure, including efficient drip irrigation systems, water reservoirs, generators, and pump houses. These orchards will produce a minimum of 240,000 new date offshoots (seedlings) per year, to replenish aging orchards and establish new orchards. This figure allows for an average of 3 offshoots per year per mother tree, although experts in date nursery production state that more than 8 offshoots per year of some varieties are possible under the conditions provided by these improved mother orchards. The offshoots from the mother orchards also feed a network of 16 date palm nurseries that ARDI established in the same 13 governorates. The date offshoots remain in the nurseries for one year in order to grow to a size ideal for transplanting, although offshoots can also be planted directly from the mother orchards to the farmers' lands, with a high survival rate. Nursery production will total 170,000 date palms per year. Within three years, total annual production of young date palms will peak at around 240,000 plants, including the 170,000 transplants from nurseries and 70,000 additional offshoots for direct planting from mother orchards. This number of new palm trees is valued at nearly \$2,500,000 per year, and will replenish 6% of Iraq's aging and nonproductive trees each year. The increase in date production as a result of the new stock will equal approximately 15,288 tons per year, for a total of \$8,179,000 in added income to date farmers each year.

Grapes are a major fruit crop, and have a high potential for profit for small to medium farmers, especially in northern Iraq, although varieties of grapes can be grown throughout the country. The vines are also one of the few crops that can be grown on the steep and rocky hillsides in the northern part of the country, where vineyards offer erosion control and convert otherwise fallow land to profitable use. ARDI provided farmers with the opportunity to greatly increase their benefits from grape production through the establishment of three privately owned and operated nurseries. These nurseries will provide farmers with new vine stock of the most commercially desirable varieties, and guarantee

the provenance of genetic lines. The privately owned nurseries offer the seedlings at a low price, and sales of stock will enable the nurseries to continue replacing seedlings from approved "mother plants." In return for matching funds from nursery operators, ARDI provided each nursery with drip-irrigation facilities and an initial stock of 400,000 grape cuttings taken from the best vines found in the country. Each of the nurseries produced approximately 300,000 new plants of commercial quality during the first year. The nursery owners will have access to the same registered "mother stocks" to replenish their nurseries, although they will also establish their own "mother blocks" which will allow them to become completely self-sufficient within four years. Maintaining the current rates of production, the three nurseries will be able to furnish at least 750,000 new plants each year, with a gross retail value exceeding \$200,000. The grape growers, especially in the northern region, will be able to replenish or expand their vineyards with proven stock of high commercial value.

**TABLE 120 PRIMARY SOURCES - MOA  
DATE MOTHER ORCHARDS**

<b>Governorate</b>	<b>Mother Orchards</b>	<b>Mother Plants</b>	<b>Offshoots per Year</b>
Baghdad	3	8,000	24,000
Anbar	1	4,000	12,000
Salah al-Din	1	4,000	12,000
Diyala	1	4,000	12,000
Wassit	1	6,000	18,000
Missan	1	6,000	18,000
Basrah	4	12,000	36,000
Thi-Qar	1	6,000	18,000
Muthana	1	6,000	18,000
Qadisiya	3	6,000	18,000
Najaf	1	6,000	18,000
Karbala	2	6,000	18,000
Babylon	1	6,000	18,000
<b>Total</b>	<b>21</b>	<b>80,000</b>	<b>240,000</b>
<b>Offshoots moved to nurseries</b>			<b>170</b>
<b>Offshoots for direct transplant</b>			<b>70,000</b>

Supported by:

LOA-033: National Program for the Improvement and Propagation of Date Palms  
- Mother Orchard Infrastructure Support

Notes:

Assuming 3.0 offshoots per plant per year

**TABLE I21 PRIMARY SOURCES - MOA DATE NURSERIES**

Governorate	Plants per Year
Anbar	15,000
Babil	10,000
Baghdad	12,000
Baghdad	2,000
Basrah	5,000
Basrah	10,000
Basrah	10,000
Qadissiya	11,000
Diyala	10,000
Karbala	12,000
Missan	10,000
Muthanna	18,000
Najaf	10,000
Salah al Din	10,000
Thi Qar	15,000
Wassit	10,000
<b>Total</b>	<b>170,000</b>

Supported by:

- LOA-004: Establishment of Date Palms Mother Orchards (2004)

- LOA-026: Establishment of date palms mother orchards Phase II

- LOA-028: National Program for the Improvement and Propagation of Date Palms - Nursery Infrastructure Support

- LOA-033: National Program for the Improvement and Propagation of Date Palms - Mother Orchard Infrastructure Support

Notes: Date offshoots remain in the nurseries for 1 year before they are distributed

**TABLE I22 PRIMARY SOURCES GRAPE NURSERIES**

Governorate	Grant #	Plants produced per Year
Dahuk	G-3834-001-0221	250,000
Sulaymaniyah	G-3834-001-0223	250,000
Erbil	G-3834-001-0224	250,000
<b>Total</b>		<b>750,000</b>

**TABLE I23 SUMMARY**

Type	Plants per Year
Date Nurseries	170,000
Date Mother Orchards	70,000
Grape Nurseries	750,000
<b>Total</b>	<b>990,000</b>

**OBJECTIVE E:**

**AVERAGE PRODUCTIVITY OF APPROXIMATELY 250,000 FARM FAMILIES INCREASED BY 20% IN PROGRAM-ASSISTED AREAS THROUGH THE USE OF ONE OR MORE OF THE FOLLOWING: IMPROVED TECHNOLOGY AND BEST PRACTICES, IMPROVED INFRASTRUCTURE, AND ACCESS TO PROFITABLE MARKETS.**

The data presented in this and other sections strongly indicate that this objective was met, with nearly 300,000 farm families receiving increases in productivity of greater than 30%. For the purposes of this analysis, productivity is measured in terms of either increased harvest or income from agriculture.

- A. Irrigation and drainage infrastructure rehabilitation projects have increased the productivity of 85,295 farm families by an average of 54%. These results are based on the data from the irrigation surveys and have been previously discussed.
- B. The rehabilitation of veterinary clinics significantly increased the productivity of many breeders across Iraq. This is especially true in the center and south of the country, where the clinics and related infrastructure suffered most from disrepair, neglect, and destructive looting in 2003. The gain in value through vaccination services was calculated at \$61 million. Given improved security conditions, the majority of breeders in the south will realize productivity increases greater than 20% from an efficient public veterinary service. However, for the purposes of this objective, we used the more conservative assumption that half the breeders (approximately 68,000) served by the clinics will increase their productivity by 20% over the course of the animal breeding cycle.
- C. ARDI's projects related to wheat production have clearer results regarding productivity gains. An estimated 48,828 farmers or farm families increased their productivity by 27% through ARDI's seed cleaner program. The productivity increase is from survey results, and the number of farmers is based on an assumed seeding rate of 130/kg/hectare, 5 hectares per farmer. Precise results for productivity increases are not available for the 4,000 metric tons of certified seed supplied by ARDI. However, approximately 71,000 families increased their yield by at least 20%, if the certified grade I imported (and treated) seed performed at expected minimum levels. Finally, the Certified+ I wheat multiplication program managed by ARDI will increase the productivity of 25,000 farmers by 20%.

**TABLE 124 PROGRAM SPECIFIC RESULTS  
IRRIGATION REHABILITATION**

	<b>Farm Families</b>	<b>% Increase</b>
Drainage Projects	47,435	27%
Regulator Projects	14,334	196%
Other Irrigation Projects	23,526	21%
Average Productivity Increase	85,295	54%



**TABLE 124 PROGRAM SPECIFIC RESULTS  
VET CLINIC REHABILITATION**

	Clinics	Families (2000/clinic)	Productivity Increase
Project Scope	68	136,000	-
Estimated Impact	68	68,000	20%

**TABLE 125 PROGRAM SPECIFIC RESULTS - SEED CLEANING**

	Farmers Participating	Clean Seed (mt)	Farmers Benefiting	Productivity Increase
Rainfed (65%)	4,800	20,630	31,738	30%
Irrigated (35%)	2,600	11,108	17,090	21%
Total	7,400	31,738	48,828	27%

**TABLE 126 PROGRAM SPECIFIC RESULTS  
PROCUREMENT OF CERTIFIED SEED**

Year 1	
Certified Cham 6 Imported by ARDI (MT)	4,000
Area Planted (Ha) @ 130 Kg/MT	30,769
Number of Families Benefiting (5 ha per farmer)	6,152
Year 2	
Resulting Harvest (Kg) @ 1,500 Kg/Ha	46,153,846
Area Planted with Certified+I (Ha)	355,030
Number of Families Benefiting (5 ha per farmer)	71,006

**TABLE 127 PROGRAM SPECIFIC RESULTS  
SUMMARY**

Seed Procured	Farmers Benefiting	Productivity Increase*
4,000 mt	77,158	> 20%

Multiplication of Certified+I seed

**TABLE 128 PROGRAM SPECIFIC RESULTS - CERTIFIED SEED**

Season	Variety	Participating Farmers	% Increase Production	Total Harvest (mt)	Farmers Benefiting
2004-2005	Cham 6	5	126%	305	470
2005-2006	Cham 5	55	58%	1,118	1,720
2005-2006	Acsad-65	69	51%	1,816	2,794
2005-2006	Salt-tolerant varieties	17	200%	97	150
Total		146	74%	3,336	25,662

**TABLE 129 PROGRAM SPECIFIC RESULTS**

Projects	Number of Farm Families	Productivity Increase (%)
Irrigation and Drainage Infrastructure	85,295	54%
Vet Clinic Rehabilitation	68,000	20%
Seed Cleaning	48,828	27%
Certified Wheat Seed	71,158	20%
Certified+I	25,662	20%
<b>Total</b>	<b>298,943</b>	<b>31%</b>

**OBJECTIVE F:**

**50% INCREASE IN REVENUE FOR APPROXIMATELY 6,000 AGRIBUSINESSES IMPACTED BY ARDI PROGRAMS**

When ARDI was conceived, direct support to agribusinesses was an important objective. The agricultural sector in 2003 had been nearly destroyed, and the project made major contributions in rebuilding the capital and infrastructure. Only in the later part of 2004 did attention turn again to agribusiness development.

In the context of Iraq, we have accepted as an agribusiness all enterprises or individuals not producing primary agricultural products—farmers in their usual role growing wheat are not agribusinesses. However, tractor owners who sell tractor services to others are agribusinesses, as are honey producers, private veterinarians, wheat seed multipliers, nurseries, etc. Using these definitions, targeted ARDI programs have produced at least a 50% increase in income for a minimum of 3,000 agribusinesses, reaching half the objective.

**Honey Producers:** Beekeepers represent a well-documented instance of the success of an ARDI-assisted agribusiness program. The project helped honey producers increase their revenue directly through honey production programs, and indirectly through the formation of honey producers associations. The honey production programs established new honey producing businesses and introduced modern technologies to those that were already established. As indicated in the figure below, the results are striking. ARDI honey production programs assisted 368 honey producers to far exceed the 50% revenue increase target of this objective.

ARDI trained leaders and representatives from the Erbil, Dahuk, Sulaymaniyah, Kirkuk, and Ninewa beekeepers associations, and was directly responsible for the formation of the Dahuk and Kirkuk beekeeper associations. These interventions led to an increase in the productivity of beekeepers involved with these organizations. One of the most significant changes has been in marketing practices. Profits can climb 50% from changing the packaging of honey products to compare in consumer appeal with foreign imported products. A survey of association presidents from Erbil, Dahuk, Kirkuk, and Ninewa was taken to determine the number of beekeepers who have changed their packaging as a result of ARDI interventions. The survey showed that 1,930 beekeepers increased their income in honey sales by more than 50% through improved marketing and packaging practices.

**TABLE 130 PRIMARY SOURCES HONEY PRODUCTION - DIRECT**

Honey Producers	Income Increase	Grant #
32	1,400%	28
50	1,400%	29
183	1,400%	131
51	1,400%	161
52	1,400%	242
<b>Agribusiness that qualify under Honey Production Grants = 368</b>		

Income increase is taken from the honey production survey.

**TABLE 131 PRIMARY SOURCES  
HONEY PRODUCTION - INDIRECT**

Association	Percent Of Members w/ Improved Marketing	Number of Members
Baghdad	0%	700
Diyala	0%	300
Dahuk	60%	711
Erbil	65%	870
Sulaymaniyah	55%	1,705
<b>Total</b>	<b>28%</b>	<b>6,940</b>
<b>Total Associated Members Qualifying = 1930</b>		

**TABLE 132 PRIMARY SOURCES - FEEDLOTS**

Feedlot Business	Grant #	Governorate	Business Owners
I	276	Ninewa	31
I	238	Ninewa	35
I	237	Tameem	35
<b>Agribusiness that qualify under Feedlot Grants = 3</b>			

Note: Feedlots were not operating before ARDI intervention.

**TABLE 133 PRIMARY SOURCES - NURSERIES**

Nursery	Type of Nursery	Grant #	Location
I	Tomato	205	Dahuk
I	Flower	117	Dahuk
I	Grape	221	Dahuk
I	Grape	224	Erbil
I	Grape	223	Sulaymaniyah
<b>Agribusiness that qualify under Nursery Grants = 5</b>			

Nurseries were not operating before ARDI intervention

**TABLE 134 PRIMARY SOURCES - CARPENTERS**

Businesses	Grant #	Governorate	Business Owners
9	127	Dahuk, Erbil, Sulaymaniyah, Ninewa, Tameem	13
<b>Agribusiness that qualify under Carpenter Grants = 9</b>			

Carpenters were not producing bee hives previous to ARDI intervention.

**TABLE 135 PRIMARY SOURCES - AGRICULTURAL MACHINERY MECHANICS AND TECHNICIANS**

Businesses	Income Increase	Grant #	Governorate
13	56%	230	Sulaymaniyah
23	56%	232	Dahuk
29	56%	248	Tameem
8	56%	231	Sulaymaniyah
14	56%	135	Erbil
<b>Agribusiness that qualify under Grants = 87</b>			

Income increase established through the survey results.

**TABLE 136 PRIMARY SOURCES - PESTICIDE DEALERS**

Businesses	Income Increase	Governorate
119	24%	Nationwide
<b>Agribusiness that qualify under Pesticide Dealer Training Grants = 0</b>		

Income increase established through the survey results.

**TABLE 137 PRIMARY SOURCES WHEAT SEED PRODUCERS**

	Businesses
2005	5
2006	141

Total of farmers participating in Certified+I seed production

**TABLE 138 PRIMARY SOURCES CONTRACT TRACTOR SERVICES**

Tractor owners selling farm contract services:17% of survey sample	787 tractor owners
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**TABLE 139 SUMMARY**

Type	Agribusinesses	# Who Qualify
Honey Production - Direct	368	368
Honey Production - Indirect	3,516	1930
Feedlots	3	2
Nurseries	5	5
Carpenters	9	9
Mechanics	87	87
Pesticide Dealers	119	0
Tractor Owners	787	787
<b>Total</b>	<b>4,894</b>	<b>3,188</b>

**OBJECTIVE I:****30% OF MARSH DWELLERS WILL INCREASE FAMILY INCOME BY 50% FROM PROJECT INTERVENTIONS**

Security restrictions on staff movement, and the lack of baseline data, made the measurement of ARDI's progress against this objective difficult. ARDI's activities in the Marshlands represent investments that will result in increased family income of a significant portion of the marsh dweller population. The potential impact of marshland projects can be demonstrated by examining several key projects. The analysis below focuses on the potential impact of fish restocking and the rehabilitation of irrigation infrastructure. Other projects are briefly discussed. A full description of ARDI's marshland activities can be found in Section 4.

ARDI's programs that directly affect the marsh dweller population include wheat seed cleaners, crop demonstrations, family drip irrigation kits, tractor rehabilitation, date palm mother orchards, date palm nurseries, buffalo nutrition, irrigation infrastructure, marshland monitoring, fish restocking, and veterinary clinic rehabilitation. The existence of ARDI's Basrah and Samawa offices made these projects possible. Those offices bordered the marshlands and played a vital role in the implementation of ARDI projects there. Some initiatives, such as date palm mother orchards, and fish restocking, have longer-term impact, with the benefits increasing over time. Other projects, such as family drip irrigation and crop demonstrations, have a strong "replicator effect" with a high potential for persuading neighboring farmers to adopt the new technologies.

The figure below shows baseline data and the details of the fish restocking program and irrigation infrastructure projects in and around the marshlands. For the purposes of this analysis the marsh dweller population is set at 85,000, a figure which was established by the USAID-funded Iraq Marshland Restoration Project (IMRP). This figure includes the indigenous marsh dwelling population, as well as other Iraqis who have settled in the area. A median household size of 8.2 in marshland districts was estimated by the United Nations World Food Program. These numbers provided an estimate of 10,366 households in marshland areas.

**TABLE 140 MARSHLAND BASELINE**

Marsh dwellers population (IMRP/USAID)	85,000
Median regional (selected districts) household size (WFP)	8.2
<b>Marsh Dweller Households</b>	<b>10,366</b>

**TABLE 141 SAMPLE PROJECTS  
MARSHLAND FISH RESTOCKING**

Total 2000 Iraq employment in fish production (FAO)	20,000
Total 2000 Employment in fish marketing (FAO)	4,500
<b>Fisheries Employment Multiplier</b>	<b>1.23</b>
Square km of water May 14, 2006 (UNEP)	1,379
Fishermen per square km (IMRP)	2.3
<b>Current Marshlands Fisherman</b>	<b>3,172</b>
<b>Marsh Dwellers Fisheries Employment</b>	<b>3,885</b>
Estimated current catch weight/predrainage catch weight (IMRP)	10%

**TABLE 142 SAMPLE PROJECTS  
IRRIGATION**

Project ID	Donums	Farmers	Employees
G-3834-001-0219	7,800	260	161
G-3834-001-0266	8,000	200	163
G-3834-001-0240	11,500	550	68

<b>Percentage of Families</b>	10%
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In 2006, ARDI's fish restocking program successfully released nearly 1,000,000 indigenous fingerlings into the marshlands at four locations. These fish will replenish the breeding stock and will also, upon maturity, provide income for fishing families. ARDI focused on raising and releasing indigenous species that are significant both in terms of commercial value and of their importance to ecosystem restoration. The restocking has special importance, given the central role that fishing plays in marsh family income and nutrition.

While fish are an integral part of the diet of all marsh families, the number who depend on fishing as a primary source of income is less clear. According to the UNEP, as of May 14, 2006 there were 1,379 square kilometers of water in the marshlands. Using a fisherman density of 2.3 fishermen per square kilometer, there are currently 3,172 fishermen in the marshlands. This equates to 3,885 marsh dweller families that depend on the fishing industry, assuming .23 related jobs for every fishermen. Therefore, ARDI's restocking activities directly impact 38% of marshland families who rely on fishing (or related employment) as a primary source of income.

It is too soon to determine the extent to which ARDI's restocking program will increase catch rates in the shorter term. Monitoring of the fingerling survival rate was under way at the time of ARDI's closedown, but more time is necessary to assess the success of this project intervention. According to the local fishing hatchery operators, the restocking efforts have a high probability of increasing the catch by more than 50% for many fishermen, as the marshlands ecosystem recovers and the newly introduced fingerlings reproduce.

In contrast to the restocking program, the irrigation projects in and around the marshlands have a clearer and more immediate impact on family income. There are three irrigation projects that benefit a large number of marshland families:

- Irrigation Canal Cleaning of Hamdan and Muhagran, Basra
- Irrigation Canal Cleaning in Sayed Dekheel, Nassriya, Thi-Qar
- Irrigation Canal Cleaning in Abu Al-Khaseeb, Basrah.

The irrigation surveys conducted as part of the overall M&E effort show that the average income of families benefiting from irrigation projects increase by more than 50%. A total of 1,010 families, or maximum of 10% of the marshland families, benefited from ARDI's irrigation projects, and are expected to increase their income from agriculture by an average of 50 percent.

**OBJECTIVE G:****REHABILITATE, INTENSIFY, OR EXPAND 250,000 HECTARES OF EXISTING IRRIGATED AREA.**

ARDI awarded a total of 68 grants and 5 direct subcontracts to rehabilitate irrigation systems in Iraq. As explained elsewhere, these projects ranged from repair or complete renovation of damaged infrastructure (drains, gates, regulators, flumes, etc.), to upgrading existing water resources (community water storage facilities), to reclaiming inefficient existing resources (canal cleaning projects). The following table is a list of all the projects completed by ARDI devoted to renovation of irrigation and drainage systems. ARDI surpassed the objective set for these activities, with total land area restored of 282,038 hectares.

**TABLE 143 IRRIGATION AND DRAINAGE PROJECTS**

Name of Project	Grant/LOA	Governorate	Hectares	Families
<b>Drainage Projects</b>				
Constructing Al Bashiyah Pipe Culvert on Al Salamiyah Drain	G-3834-001-0222	Kerbala	750	200
Raising the Canal Banks for transporting Drainage Water	ARDIBAG-FP-0048	Kerbala	17,500	10,000
Re-construction of the Al Thail Regulator	G-3834-001-0191	Muthanna	750	1,500
Cleaning and Rehabilitation of drainage canal in Al Hindia District	G-3834-001-0196	Kerbala	413	480
Al Kufa Drain Rehabilitation	ARDIBAG-FP-0051	Najaf	7,500	5,000
Improving the Drainage Conditions of a waterlogged area in Al-Muthanna	G-3834-001-0241	Muthanna	520	55
Main Baquba Drain Cleaning	G-3834-001-0251	Diyala	9,961	12,000
Shomaly Pumping Station Emergency Regulator	ARDIBAG-FP-0053	Babylon	60,000	16,000
<b>Irrigation Projects</b>				
Cleaning Balula Irrigation Canal	G-3834-001-0098	Diyala	1,250	200
Rehabilitation of Tertiary Canal System in Al Nasiriyah Reclamation Project	G-3834-001-0118	Babylon	2,500	1,700
Rehabilitation of Al Haminiyah Culvert	G-3834-001-0168	Babylon	625	150
Rehabilitation of Al Tajyah Culvert	G-3834-001-0169	Babylon	625	100
Rehabilitation of Tertiary Canal System AT Hillah-Kifil Reclamation Project Phase 1	G-3834-001-0121	Babylon	0	0
Rehabilitation of Tertiary Canal System AT Hillah-Kifil Reclamation Project Phase 2	G-3834-001-0122	Babylon	1,250	850
Rehabilitation of the Moka Irrigation Project	G-3834-001-0136	Erbil	28	100
Reconstruction of Al Mhaddad Regulator	G-3834-001-0192	Muthanna	15,000	1,500
Al Behta Pipe Flume	G-3834-001-0173	Kerbala	75	30
Al E'aywig Pipe flume Grant	G-3834-001-0174	Kerbala	750	400
Rehabilitation of Baskadere Irrigation Project	G-3834-001-0159	Dahuk	40	80
Reconstruction of Al Bassrokiyah Discharge Regulator	G-3834-001-0187	Wassit	5,000	500
Reconstruction of Al Khashaniyah Head Regulator	G-3834-001-0172	Qadissiya	1,000	500
Rehabilitation of Zamaqy Sarw Kareze	G-3834-001-0153	Sulaymaniyah	39	26
Repairing the Um Al Agaf Pumping Station	G-3834-001-0190	Muthanna	7,500	1,000
Re-construction of A'al Awad A'al Majid Head Regulators	G-3834-001-0185	Najaf	275	180
Reconstruction of Al Ghallal-Al Gowah Head Regulators	G-3834-001-0170	Najaf	325	240
Reconstruction of Al Ghazali-A'al Habib Head Regulators	G-3834-001-0184	Najaf	275	180
Rehabilitation of Abu Gressah-Al Kothary Head Regulators	G-3834-001-0183	Najaf	500	500
Rehabilitation of Abu Jagi Head Regulator	G-3834-001-0186	Najaf	250	100
Cleaning Irrigation Canals in Bewre	G-3834-001-0143	Sulaymaniyah	210	322

TABLE I43 IRRIGATION AND DRAINAGE PROJECTS - CONTINUED

Name of Project	Grant/LOA	Governorate	Hectares	Families
<b>Drainage Projects</b>				
Irrigation Canal Cleaning, Eastern Drainage Canals	G-3834-001-0150	Muthanna	1,706	800
Irrigation Canal Cleaning, Al Dokhan Village Project	G-3834-001-0151	Muthanna	1,219	700
Irrigation Canal Cleaning, Small Irrigation Canals Project	G-3834-001-0152	Muthanna	1,950	500
Cleaning Bnkura Irrigation Canal	G-3834-001-0129	Diyala	2,750	716
Cleaning Irrigation Canals in Fayda-Ninewa	G-3834-001-0128	Ninewa	644	97
Cleaning Irrigation Canals in Dasnee, Bechoporshik, Zheen and Zhoyhel Villages	G-3834-001-0124	Erbil	625	200
Cleaning Irrigation Canals in Mjesar, Shiwan, Kazhad, Qalatan	G-3834-001-0147	Erbil	738	395
Cleaning canals in 6 Villages of Rawandooz	G-3834-001-0145	Erbil	1,675	251
Cleaning Canals in 4 Villages in Salahadin Subdistrict	G-3834-001-0149	Erbil	1,000	600
Cleaning Khormal Irrigation Canal in Sulaymaniyah	G-3834-001-0160	Sulaymaniyah	6,175	1,938
Irrigation Canals Cleaning in Al Warka'a District	G-3834-001-0182	Muthanna	4,003	491
Installation of Center Pivot Irrigation Systems in Tameem Governorate	G-3834-001-0197	Tameem	450	360
Installation of Center Pivot Irrigation Systems in Tameem Governorate, Phase II	G-3834-001-0247	Tameem	180	15
Irrigation Canals Cleaning in Al Mahnawiyah Sub-District	G-3834-001-0229	Qadissiya	2,000	750
Irrigation Canal Cleaning in Abu Alkhaseeb	G-3834-001-0219	Basrah	1,950	260
Cleaning Al - Dujeel Irrigation Canals	G-3834-001-0216	Salah al-Din	1,838	600
Cleaning Jalwa Irrigation Canal	G-3834-001-0253	Diyala	1,383	545
Cleaning Shekhan Irrigation Canal	G-3834-001-0215	Ninewa	2,277	250
Rehabilitation of Retaining Walls and Pipe Flume in Al-Adja'a River	G-3834-001-0213	Kerbala	1,150	1,000
Construction of a Head Regulator and Retaining Walls for Eshan Graed Canal	G-3834-001-0260	Babylon	1,373	1,800
Reconstruction of Al Mishkab Head Regulator	G-3834-001-0245	Najaf	12,500	2,000
Reconstruction of the Munaither Pumping Station between Hillah-Kifil Canal and the Euphrates River (Monaither)	ARDIBAG-FP-0058	Babylon	3,451	1,200
Irrigation canals cleaning in Sayed Dekheel, Nasseriya.	G-3834-001-0240	Thi Qar	1,688	280
Gordara Irrigation Canal Cleaning in Taza District	G-3834-001-0209	Tameem	1,250	700
Rehabilitation of Shleet Regulator in Abu-Zaraa Canal	G-3834-001-0255	Kerbala	2,350	900
Reconstruction of Hanoon Cross Regulator	LOA-X17	Wassit	45,000	3,000
Renovation of Sidakan Irrigation Channel	G-3834-001-0125	Erbil	1,125	200
Irrigation Canal Cleaning Project in Al Hilal	G-3834-001-0261	Muthanna	5,713	2,434
Construction of Abu Kohuf Regulator	G-3834-001-0250	Muthanna	1,250	2,134
Construction of Al Khdirawy canal regulator	G-3834-001-0252	Muthanna	375	800
Irrigation Canal Cleaning in 45 villages in Dinarta	G-3834-001-0249	Ninewa	4,091	2,500
Irrigation Canal Cleaning in 15 Villages in Sidakan Subdistrict	G-3834-001-0258	Erbil	2,963	200
Irrigation Canal Cleaning in 15 Villages in Soran district	G-3834-001-0259	Erbil	3,125	210
Rejuvenate and Expand Water Spring and Cleaning an Irrigation Canal	G-3834-001-0267	Erbil	5,500	600
Irrigation Canals Cleaning of Hamdan and Muhagran	G-3834-001-0266	Basrah	2,000	200



TABLE 143 IRRIGATION AND DRAINAGE PROJECTS - CONTINUED

Name of Project	Grant/LOA	Governorate	Hectares	Families
<b>Drainage Projects</b>				
<b>Irrigation/Drainage Projects</b>				
Cleaning Canals and Drains in Al Buhwaichma and surrounded villages	G-3834-001-0181	Muthanna	5,330	450
<b>Village Water Supply Projects</b>				
Village Water Storage Facilities	G-3834-001-0104	Dahuk	55	81
Village Water Storage Facilities in Akre District	G-3834-001-0141	Ninewa	39	61
Village Water Storage Facilities Shekhan District	G-3834-001-0142	Ninewa	46	77
Water Storage Facilities in Qadesh Village	G-3834-001-0158	Dahuk	38	100
Water Storage Facilities at 5 villages in Rawanduz Subdistrict	G-3834-001-0178	Erbil	113	190
<b>Total</b>			<b>282,038</b>	<b>85,145</b>

**Summary**

Type of Project	Area		Families	
	Hectares	Percent	Families	Percent
Drainage	97,394	35%	45,235	53%
Irrigation	184,645	65%	39,910	47%
<b>Total</b>	<b>282,038</b>	<b>100%</b>	<b>85,145</b>	<b>100%</b>

**OBJECTIVE H:****PROVIDE THE GOI WITH THE TOOLS NEEDED FOR MORE ACCURATE DETERMINATION OF THE VOLUME OF WATER, OVER TIME THAT COULD BE ALLOCATED TO THE MARSHLANDS AND AGRICULTURE USES**

The program and activities for a water strategy for Iraq, to meet the requirements stated in this objective, are found in Annex I – *Strategy for Water and Land Resources in Iraq Final Report*.

In close coordination with GOI ministries (in particular, the Ministry of Water Resources – MOWR), ARDI developed the Strategy for Water and Land Resources in Iraq, which would occur in two phases. Phase I was completed over a 14-month timeframe, and equipped GOI with the resources necessary to continue to work independently on a constantly evolving plan to determine water resources and distribution strategies. The collaboration between ARDI and the participating ministries, including the MOWR and SWLRI Steering Committee, focused on collecting relevant data from all ministries and creating a framework for management and development of Iraq's water and land resources over the next few decades. Activities completed under Phase I included:

- Data collection across all ministries to compile data sets of current information, needs in the water sector, and future opportunities (project and program development);
- Development of models and tools to inform the planning process, with a schedule to demonstrate the planning process by running all the models;
- Training and capacity building within the Government to ensure that staff have the necessary capability to proceed with implementation of the SWLRI in Phase 2.

Phase 2 of the SWLRI project will be led by the MOWR and will involve selection of appropriate interventions and identification of priorities in the water and land sectors, using the data sets, tools, and models developed during Phase I. This phase will also initiate the development of a “rolling” master plan that can be updated periodically upon receipt of new data and/or policy changes.

To facilitate its leadership role in the development of the SWLRI, the MOWR established a special SLWRI unit with dedicated staffing resources, including two senior chief engineers, an expert agronomist, two irrigation engineers, and two IT engineers. ARDI provided funds for the establishment of the unit, including equipment for the offices and filled some of the initial staff positions.