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## EVALUATION

## UNITED STATES ASSISTANCE TO BALOCHISTAN BORDER AREAS

## EVALUATION REPORT: ANNEX A - IMPACT ASSESSMENT

January 3, 2012

This publication was produced for review by the United States Agency for International Development (USAID). It was prepared by Management Systems International (MSI) under the Independent Monitoring and Evaluation Contract (IMEC).



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## EVALUATION REPORT - ANNEX IMPACT ASSESSMENT



600 Water Street, SW, Washington, DC 20024, USA  
Tel: +1.202.484.7170 | Fax: +1.202.488.0754  
[www.msiworldwide.com](http://www.msiworldwide.com)

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## ACRONYMS

AZRI	Arid Zone Research Institute
B:C	Benefit Cost Ratio
CO	Community Organization
DWSS	Drinking Water Supply Scheme
GoP	Government of Pakistan
ICARDA	International Center for Agricultural Research in the Dry Areas
IRR	Internal Rate of Return
kg	Kilogram
mdy	Man Day
MTE	Mid-Term Evaluation
NPV	Net Present Value
PV	Present Value
RAHA	Refugee Affected Hosting Areas
Rs.	Rupee

## EXECUTIVE SUMMARY

The project is a direct follow-up to the “Food Security/Poverty Alleviation in Arid Agriculture Balochistan - Pilot Project Phase”, which began activities in 2004 and was completed by December 2008. The current project used the same overall approach as the original project in five districts instead of the three districts included in its precursor project. The current project examined the districts of Killa Saifullah, Loralai, Zhob, Quetta and Mastung. It aims at directly contributing to the Government of Pakistan’s (GoP) Poverty Reduction Strategy by reducing poverty in the border areas and contributing directly to the GoP’s ongoing National Food Security Program. At a more general level, it supports the ongoing government efforts to foster economic growth and stability in the border areas.

The overall development objective of the project is to increase the incomes of poor rural men and women in the 5 districts in the border areas of Balochistan. The immediate project objectives are:

- Build the capacity of poor men and women to raise beneficiary income from increased crop area, made possible by increased water availabilities, increased crop productivity through improved seeds, better technical know-how and increased area under high value fruit plants;
- Raise crop and livestock productivity and increase the scale of crop production by bringing additional area under cultivation by land leveling;
- Build sustainable outcomes through effective impact assessment and strong and durable partnerships with public and private sector actors.

## Project Interventions

The project’s interventions fall into four categories: 1) water, 2) crops, 3) livestock and 4) marketing. Water interventions included rehabilitating karez systems (21), piping or lining water channels (17) and lining water storage reservoirs (23). Crop related interventions included distributing improved wheat seeds (13,514 acres), land leveling (2,059 acres), distribution of fodder and pea seed on a limited scale and supplying sprayers and silos. The project also established plots for wheat and barley to demonstrate the effects of improved seeds and crop husbandry techniques. Livestock interventions included providing balanced feed rations to increase milk production (126.8 tons), treating animals for disease and parasites, supplying 8,143 poultry birds to women, and organizing livestock markets to attract buyers and garner higher prices for sellers.

## Project Impact

**Water Enhancement/Availability:** Out of a total of 72 interventions, 61 were related to increasing the supply of irrigation water by increased conveyance efficiency as a result of channel improvement, reducing seepage and optimizing use by storing in reservoirs. By making more water available for agriculture, these interventions allowed farmers to irrigate more land and increase yields on existing irrigated land. Two demonstration Micro Catchment Water Harvesting (MCWH) structures failed to create any impact due to drought and the small scale of the intervention. Water interventions increased wheat yields slightly (877 kg per acre) over the baseline yield of 861 kg per acre, but still substantially higher than the “without project” scenario. Apple and apricot yields increased by 40 percent and 12 percent respectively over the baseline and almond yields increased by 53 percent. The yield increase over the “without project” scenario was 22 percent for apple and 26 percent for almond.

When farmers obtain access to additional water, their first priority is to plant fruit orchards due to their high returns and long-term income sustainability. Area under fruit trees increased to 47.1 percent due to project

interventions compared with 20.2 percent in the ‘without project’ situation and 37.7 percent prior to the start of the current phase of the project. The cropping intensity increased by 13 percent for karez, 11 percent for water storage reservoir and 5 percent for pipe lining over the baseline figures.

**TABLE I: INCREASE IN CROPPING INTENSITY**

Type of intervention	Before project	After project	Without project
Karez Rehabilitation	122%	135%	118%
Water reservoirs	115%	126%	118%
Pipeline	177%	181%	124%
Average	138%	147%	120%

Source: MSI field survey, 2011. USABBA baseline survey, 2010

**Crop Inputs:** The project procures wheat seed from Punjab, generally of the “Bhakkar” variety. The supply of improved seeds has led to increased yields and higher production. The yield of wheat increased to 822 kg/acre compared with an average yield of 651 kg/acre for the traditional seed (25 percent increase). The yield of pea planted with project seed was much higher compared to the traditional seed, almost double, attributed to poor quality of local seeds. There was however, no change in yield of alfalfa seed supplied by the project compared with the traditional seeds. The beneficiary farmers are eager to have good quality wheat seed which is not available in the province. In view of non-availability of specific wheat seed recommended for irrigated and un-irrigated areas, the farmers plant whatever seed is available to them – from the project or the market. Farmers are not able to buy the seed themselves because the limited demand has not produced a private supply network.

**Land Leveling:** There is abundant land available in the foothills of mountains in all of the project districts. The project helps farmers build structures to divert seasonal rainwater onto land and hold it there so it soaks into the soil for later use by crops. It also levels the land so prepared so it makes better and more consistent use of the rainwater. In all, 2,059 acres of land has been leveled in project districts wherein the farmer contributed 50 percent of the cost. Seventy percent of leveled land is planted with wheat with an average yield of 687 kg/acre. Almond, a low water requirement plant, is planted over 3 percent of the leveled land. These plants are not yet at fruiting stage but the farmers expect that the yield will be 560 kg per acre on account of high quality plants supplied by the project. Seeing the benefits of crop production from such neglected lands, some financially well-off farmers have installed tubewells and are raising vegetables on these lands.

**Sprayers/Silos:** The timely availability of sprayers is a constraint, especially for orchards that are sprayed 3-4 times a year. Realizing this constraint, the project provided 130 power sprayers to the community organizations (COs) on a 50 percent cost-share. Farmers who use the sprayers pay for fuel and pesticide/insecticide. On average, interviewed communities sprayed 45 acres per year with a cost saving of Rs. 271 per acre relative to the cost of purchasing spraying services. Aggregate benefits of power sprayers are thus Rs. 12,195 per sprayer. Knapsack sprayers are used for short statured crops and benefits are Rs 908 per year per sprayer. The provision of silos for storing grains has led to savings from insect pests. However, the small scale of the intervention and small silos produced negligible benefits.

**Livestock/Poultry:** The project supplied 2,056 bags of balanced feed to livestock farmers, at 50 percent subsidized cost. Average consumption feed is 1.5 kg per day for large cows and 0.29 kg per day for sheep and goats. The increase in milk yield is 1.02 kg per day for cows and 0.15 kg for sheep and goats. The benefit cost ratio (B:C) is 1.2 for the use of feed. However, despite the proven benefits, the farmers are not motivated to purchase the feed by themselves.

**Poultry:** The project supplied 8,143 poultry birds to women COs in Quetta (3,969 birds), Mastung (3,324) and Killa Saifullah (850). It also provided four incubators in Quetta at a subsidized cost of 25 percent. The interventions were aimed at field testing the incubator designs and increasing women's incomes. Unfortunately most of the birds supplied in Killa Saifullah died due to bad weather. However, farmers reported that the chickens provided on average nine more eggs per year than the local birds. The gain is estimated at Rs 135 per bird. The project arranged seven livestock markets (3 in 2009 and 4 in 2010) to enable livestock farmers to market their animals for Eid. The markets are infrequent and do not appear to produce significant benefits.

**Employment Generation:** The interventions made by the project have increased employment in the project areas. The increased employment has been in farm related activities, particularly in preparing agricultural land and in harvesting the greater quantities produced. Employment increased by 61.6 thousand man days per year – 64 percent in leveling land and 22 percent in harvesting (due to increased yields and new orchards).

**Monetary Impact:** The project generated an estimated Rs. 224.8 million in direct monetary impact to beneficiary households during its three-year life. Of this total, crop interventions accounted for 96 percent of benefits, water interventions for 7 percent and livestock interventions for less than 1 percent.

**Returns on Investment:** Project costs since inception total \$7.181 million (Rs. 834 million at constant 2011 prices). The project spent 34 percent of this total in 2009, 38 percent in 2010 and 28 percent in 2011. Estimated total monetary benefits projected for 15 years from the start of the project total \$51.4 million in nominal terms with a present value of \$20.3 million. These values yield a net present value (NPV) of the investment of \$8.5 million, a benefit cost ratio of 1.72, and an internal rate of return (IRR) of 13 percent. Values are higher (i.e., NPV of \$13.3 million, benefit cost ratio of 2.89, and IRR of 14%) if future privately incurred maintenance costs are not considered.

**Project Beneficiaries:** The project has directly benefitted 6,400 households by increasing the supply of inputs and improving crop husbandry, more than 1,000 households by increasing water supply and about 3,000 households by increasing livestock feed and distributing poultry for a total of about 10,400 households (equivalent to 83,000 individuals). In addition a number of households benefitted indirectly through increased employment generation or by adopting improved seed varieties or other agricultural technologies and practices introduced by the project.

## PURPOSE OF THE IMPACT ASSESSMENT

The impact assessment is one component of a comprehensive evaluation of the USABBA project. USAID/Pakistan requested the impact evaluation in part to validate economic impact estimates reported by the project. Evaluation results will help USAID/Pakistan decide whether or not to extend the project.

## IMPACT ASSESSMENT METHODOLOGY

A four-person team conducted the impact assessment during three weeks in October, 2011. The team leader met with project staff, visited nine project-assisted communities in Killa Saifullah, developed survey instruments, trained and managed three enumerators, analyzed survey data and wrote the impact assessment report. Three enumerators conducted the bulk of the field survey work in Killa Saifullah, Loralai and Zhob, visiting 97 separate communities to observe project activities and interview participants. The remainder of this section describes the data sources and analyses used to conduct the impact assessment.

## Data Sources

The impact assessment drew primarily from four sources of data: the USABBA project’s 2010 baseline survey, a field survey conducted by the impact assessment team, key informant interviews, and project records.

### USABBA Baseline Survey

The USABBA project conducted a baseline survey in 2010. The survey collected data from a random sample of 441 project-assisted households proportionally distributed across the five project districts – Killa Saifullah, Loralai, Mastung, Quetta and Zhob. The sample of 310 households drawn from male community organizations (COs) was sufficient to estimate population parameters with a five percent margin of error at the 95 percent confidence level. The sample of 131 households drawn from women’s COs produced parameter estimates with an 8 percent margin of error at the 95 percent confidence level. The impact assessment used the USABBA baseline survey results to estimate pre-project cultivated areas by crop. The estimates from the USABBA baseline survey represent the “before” project scenario for some activities.

### MSI Field Survey

The MSI impact assessment team visited communities in three of the five project districts – Killa Saifullah, Loralai, and Zhob<sup>1</sup> – to collect information about project activities. From a cross tabulation of project communities with interventions, the team selected a sample of communities where it could observe a variety of project interventions. In consultation with district level project staff, the team slightly adjusted the list to optimize travel requirements. In addition to project-assisted communities, the evaluation team also conducted interviews in non-project communities close to project communities to validate selected “without project” conditions. Table 2 summarizes characteristics of the community sample.

**TABLE 2 : COMMUNITY SAMPLE**

	<b>Killa Saifullah</b>	<b>Loralai</b>	<b>Zhob</b>
<b>Project communities</b>	22	38	17
<b>Non-project communities</b>	3	14	3

Within each community, the evaluation team selected a sample of individuals from a list provided by project staff who had participated in each project intervention that had occurred in the community. The final sample of individuals included 286 project beneficiaries participating in 17 project interventions and 59 non-beneficiaries. The sample of 286 project beneficiaries represents 4.6 percent of the direct project participants in the three districts included in the sample. Table 3 summarizes the sample distribution over districts and project interventions.

During visits to the project communities, enumerators and evaluation team members observed project interventions to gain an understanding of the nature of the project. They also used structured interviews to quantitatively document project impacts on beneficiaries and validate parameters of the project’s quantitative impact model. Enumerators also noted beneficiaries’ qualitative perceptions of the project.

Prior to the field work, the impact assessment team developed draft data collection instruments tailored to each intervention. With the help of the local field enumerators, who conducted most of the actual interviews, the team revised the instruments to reflect local norms and then pre-tested the instruments in the field. Annex 1 contains the final data collection instruments.

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<sup>1</sup> The tenuous security situation in the Baloch dominated districts of Quetta and Mastung prevented field work in these districts.

Enumerators conducted the field data collection during a 12-day period between October 1 and October 12, 2011. Project staff members accompanied the field enumerators during visits to project communities but, to reduce the risk of biasing responses, did not attend interviews. The impact assessment team leader entered survey data, conducted post-entry quality checks, and validated or corrected ambiguous data with the help of the relevant field enumerators.

**TABLE 3: RESPONDENT SAMPLE BY ACTIVITY**

Activity	Number of respondents			
	Killa Saifullah	Zhob	Loralai	Total
Karez rehabilitation	7		2	9
Lining/piping water channels	13			13
Water storage reservoirs	4	9	11	24
Knapsack sprayers		15	2	17
Power sprayers	4	17		21
Silos	3	3	3	9
Wheat seed distribution	15	15	14	44
Peas seed distribution			14	14
Alfalfa seed distribution	5		10	15
Livestock feed distribution	15	15	14	44
Poultry/ incubators				0
Fruit plants distribution	6	5	12	23
Land leveling	16	15	15	46
Sailaba	9	7	10	26
Micro-catchment water harvesting	1		1	2
Drinking water supply	3			3
Greenhouses	1		1	2
No piped/lined channels	2			2
No water storage reservoirs	7	10	14	31
<b>Total</b>	<b>111</b>	<b>111</b>	<b>123</b>	<b>345</b>

### Key Informant Interviews

Impact assessment evaluation team members also interviewed key informants including officials from the Arid Zone Research Institute (AZRI), the International Center for Agricultural Research in the Dry Areas (ICARDA), and provincial Agriculture Department officers at Quetta.

Annex 2 provides a list of the key informants the evaluation team interviewed.

### Project Records

Project records provided data on the number and sizes of project interventions as well as lists of project-assisted communities and individual participants to facilitate sampling.

## Impact Assessment and Cost Benefit Analysis

The impact assessment relies on quantitative data from the project's 2010 baseline and from the MSI field survey to estimate differences in agricultural and livestock production practices attributable to project interventions and the impact of these changes on farmers' incomes. To attribute changes to project interventions, the analysis compares the situation "with" project interventions to the situation "without" the interventions for some activities and compares the situation "before" project interventions to the situation "after" interventions for other activities. These four data points were determined as follows.

- **With/after project situation** – the MSI field survey of project-assisted households conducted by the evaluation team collected data on the situation "with" or "after" project interventions.
- **Before project situation** – the MSI field survey of participating households collected retrospective information from project-assisted households to reflect the "before" situation for most activities. Data from the project's 2010 baseline survey of project-assisted households represents the "before" situation with respect key agricultural production parameters (i.e., cropping patterns, yields, and cultivated area).
- **Without project situation** – the team surveyed non-participating households near project-assisted communities to establish the "without" situation for some interventions (i.e., karez rehabilitation, lined/piped water channels and lined water storage reservoirs).

The analysis subtracts the net (of production costs) value of agricultural and livestock production "before" the project from the value "after" the project (or the "with" values from the "without" values, as appropriate) to estimate the net increase in incomes attributable to the project.

The general approach to impact assessment thus involved the following steps.

1. Collecting information on the size of each intervention by year and by district and the level of community cost-share for each intervention from project records.
2. Collecting information on agricultural and livestock production parameters (e.g., cropped area, cropping patterns, yields, cropping intensities, animal weights) from field surveys of beneficiary households and non-beneficiary households and from the project's 2010 baseline.
3. Collecting information on the economic benefits associated with each type of intervention from the field survey of beneficiary and non-beneficiary households.
4. Calculating crop production costs and gross margins using the input/output coefficients derived from the field survey.
5. Deriving average financial gains for various activities based on the average figures of selected beneficiary and non-beneficiary households.
6. Extrapolating the benefits associated with each type of intervention to the project level by multiplying per intervention benefits by the total number of interventions implemented of a particular type, accounting for the size of interventions implemented in a particular year and the number of incomplete interventions.
7. Accounting for the fact that fruit trees do not begin bearing fruit until about six years after planting;
8. Accounting for increased fruit yields resulting from improved irrigation scheduling attributable to increased supply of irrigation water.
9. Calculating returns separately for crops, water and livestock/poultry related interventions and finally aggregating to calculate overall returns.

10. Comparing returns to project-assisted households to those of non-participating households (with and without comparison) or to returns of project-assisted households before the project began (before and after analysis), as applicable.

The analysis does not include the value of family labor as a cost of production because family members who work in agriculture and livestock often have few other employment opportunities. Most agriculture-dependent households work on their own farms and hire labor only as needed during harvest.

While the sample sizes from both the project's baseline and the MSI field survey are too small to generate activity-specific benefit estimates at the standard 5 percent margin of error and 95 percent confidence level, they are accurate enough to triangulate the estimates obtained through another methodology and reported by the project.

## Data Limitations

The data used for the impact assessment suffered from several limitations. These include:

- i) It is difficult to construct good counterfactuals ex-post. The analysis developed two alternative measures of the counterfactual – the “before” and “without” project scenarios. The former uses retrospective interviews with project participants and data from the project's 2010 baseline report to determine farmers' situations before the project interventions. However, some surveyed households had participated in the five-year pilot phase of the project and had therefore already experienced some benefit from the project. The latter measure used data collected from communities near the sampled project-assisted communities to represent farmers' situations had the project (including the pilot phase) not occurred for selected interventions (karez rehabilitation, lined/piped water channels, lined reservoirs). This measure suffers from potential selection bias since the project chose to work with specific types of communities. In spite of these deficiencies – which were largely beyond the limited scope of the evaluation to resolve – the estimates serve to triangulate estimates from the project's own impact assessment model.
- ii) Time limitations limited pre-testing of data collection instruments. The evaluation team did pretest the instruments but not as thoroughly as it would have with more time.
- iii) A few project records were poorly organized, incomplete, and inconsistent. For example, the information on fruit plants did not always specify their type and some activity records lacked start or completion dates. The project had not followed up on activities like use of livestock feed or benefit of poultry to monitor any increase in weight or egg production. The project had no records for livestock shows regarding the costs of the activity or the benefits in the form of increased price to sale participants. These limitations related to minor activities and did not significantly affect impact estimates.
- iv) The tenuous security situation prevented data collection in Quetta and Mastung. The evaluation team does not know how well survey results from the three districts in which the team collected survey data represent results in the other two districts.
- v) Enumerators (all male) could not directly interview female respondents so male family members provided responses for interventions targeting women. Given the limited number and scope of women's activities relative to those targeting men, it was not feasible to engage female enumerators.
- vi) The team could not collect data on some interventions. The season was over for wheat and barley demonstration plots and all project-supported greenhouses were under construction.

- vii) Some interventions (i.e., two MCWH structure and 12 silos) were too small to reliably estimate impacts. The two activities were very small however, and had a negligible effect on total benefits.
- viii) Farmers could not provide precise estimates of field sizes. However, they were more accurate in their estimates of seed inputs and harvested quantities. Therefore, the impact assessment estimated yields indirectly based on the seed quantity used and the resulting produce. In the case of orchards, farmer reported the number of crates (fixed weight) per tree and the row and plant spacing. The analysis estimated the number of trees per acre from the spacing data and yield per acre from the estimated number of trees and reported number and weight of crates per tree.
- ix) The remoteness of the project communities made communication between the field teams, Quetta-based project staff, and Lahore-based data entry staff difficult. Consequently, it was difficult to continuously monitor the data collection process and communicate changing tabulation requirements. The team also had to collect completed instruments in the middle of data collection and transport them to Lahore to facilitate timely data processing.

## IMPACT ASSESSMENT

The impact assessment approach estimates the total benefits associated with a particular activity by multiplying the per unit net benefit by the size of the intervention (in the relevant units). This section first documents the project-reported size of each intervention (Table 4). It then presents estimates of changes in production parameters (i.e., cultivated area, cropping patterns, yields and production costs) derived from the 2010 baseline and the MSI field survey. The main body of the section presents estimates of the economic impact associated with each of 17 project interventions included in the impact assessment.

The USABBA project requires communities to share the cost of its activities. The community cost-share is 50 percent for developmental activities (e.g., seed supply, sprayers, land leveling, fruit plants, irrigation water). The project pays the entire cost of wheat and barley demonstration plots including seed and fertilizers as motivational activities. The project also contributes 50 percent of the cost of livestock feed and animal health interventions. For activities that directly benefit women (i.e., drinking water systems, poultry distribution) the project covers 75 percent of the cost. Communities may cover their share of costs in cash or in-kind (e.g., providing labor or other inputs). Table 5 summarizes the project's portion of costs by activity.

### Crop Production

This section describes how the analysis estimated changes in key agricultural production parameters attributable to the project interventions. Production parameters include cultivated/cropped area, cropping patterns, yield, and production costs.

#### Changes in Cultivated Area

Cultivated area is the area of land that households plant to crops in the course of a year (two seasons). Average cultivated area varies substantially by district but in all districts, farmers cultivate more rainfed than irrigated land – 11.2 acres of rainfed land and 7.2 acres of irrigated land on average<sup>2</sup>. This result reflects the wide availability of land but the shortage of water. Respondents to the MSI field survey reported cultivating between 2.0 acres and 8.0 acres in Killa Saifullah, between 3.0 acres and 15.6 acres in Loralai, and between 11.3 acres and 13.6 acres in Zhob.

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<sup>2</sup> USABBA baseline survey report, 2010.

Comparisons of irrigated area between project-assisted communities and similar communities without interventions suggest that the project's water interventions (i.e., karez rehabilitation, water reservoirs, and piped irrigation channels) have generally increased the irrigated acreage cultivated by project-assisted households. Farmers reported that they use additional irrigation water first to expand irrigated area and then to increase irrigation scheduling (i.e., use the appropriate amount of water) on irrigated land. Piping and lining irrigation water channels produced the greatest percentage increase in irrigated acreage followed by karez rehabilitation, and then water reservoirs.

Table 6 summarizes results.

## Changes in Cropping Pattern

USABBA crop- and water-related interventions affected farmers' cropping patterns on both irrigated and rainfed land. Wheat remains the single most prevalent crop under irrigated and rainfed conditions. On irrigated land, farmers plant wheat under immature orchards when the trees are young and the canopy is thin. Other important crops on irrigated land include orchards (apple, apricot, almonds and pomegranate) and vegetables such as onion, carrot, chilies and pea. Wheat is the dominant crop on rainfed land and accounts for 75 percent of the total rainfed area.

**TABLE 4: SIZE OF INTERVENTIONS**

Activity	Unit	Killa Saifullah	Loralai	Mastung	Quetta	Zhob	All districts
<b>Water interventions</b>							
Karez Rehabilitation	No	19	1	0	1	0	21
Pipe Lining	No	7	0	8	2	0	17
Water Storage Reservoir	No	7	9	1	0	6	23
MCWH	No	1	1	0	0	0	2
Drinking Water	No	5	2	1	0	2	10
<b>Crop interventions</b>							
Wheat Seed	Acre	3,738	6,061	247	358	3,110	13,514
Alfalfa Seed	Acre	4	2		6		12
Pea Seed	Acre		37		0		37
Wheat Demo plots	Acre	24	26	10	26	26	112
Barley Demo Plots	Acre	4	3			3	10
Land leveling	Acre	522	563	754	40	180	2,059
Knapsack Sprayers	No	4	5	2	37	4	52
Power Sprayers	No	18	20	28	44	20	130
Silos distribution	No	3	3	3		3	12
Fruit plants	Acre	649	523	598	80	592	2,442
<b>Livestock interventions</b>							
Rural poultry production	No	850		3,324	3,969		8,143
Vet. treatment/ Vet Kits	No	9	9	9	9	9	45
Livestock shows	No	2	2	2		1	7
Feed Distributed	Bags	875		1,160		501	2,536
Incubators provided	No				4		4

Source: USABBA project records.

**TABLE 5: PROJECT COST-SHARE BY ACTIVITY**

Activity	Project share of cost (% of total cost)
Seeds	50
Demonstration plots	100

Sprayers	50
Silos (Demonstration)	100
Land leveling	50
Fruit plants	50
Water schemes	50
Greenhouses (Demonstration)	100
Drinking Water supply	75
Livestock feed	50
Poultry birds	75

Source: USABBA project documents.

Comparison of cropping patterns in the “with” or “after” the project scenarios with the “before” or “without” scenarios, as appropriate, suggests that farmers have changed cropping patterns as a result of project interventions that made more water available for agriculture. In general, farmers shifted away from wheat on irrigated land and towards higher value crops. Table 7 summarizes data on changes in cropping patterns. Changes of particular importance include:

- Farmers reduced the area planted to wheat and planted additional area to orchards and vegetables. The share of wheat on irrigated land fell to 25.8 percent with or after the project from 65.5 percent without the project and 40.2 percent before the project.
- The aggregate area under vegetables remained virtually unchanged although the area in vegetable crops with lower water requirements (e.g., potatoes and pea) increased.
- The area planted to orchards increased to 47.1 percent relative to 37.7 percent before the project and 20.2 percent in the without project scenario.
- Tubewells are changing the cropping pattern in leveled lands relative to normal sailaba or khushaba land, especially in Killa Saifullah district. Farmers plant predominantly wheat on leveled land (70 percent of the area) followed by tomato (9 percent) and onion (5 percent). Almond – a low water requirement crop – is the only fruit that farmers plant in any quantity on leveled land and accounts for just over three percent of area.

**TABLE 6: CHANGE IN IRRIGATED AREA ATTRIBUTABLE TO WATER INTERVENTIONS**

Type of scheme	Average area per farm (acres)			
	Killa Saifullah	Loralai	Zhob	Average
Before karez rehabilitation (acres)	2.14	3.00		2.57
After karez rehabilitation (acres)	4.21	4.00		4.11
<b>Change attributable to project (acres)</b>	<b>2.07</b>	<b>1.00</b>		<b>1.54</b>
<b>Change attributable to project (%)</b>	<b>96.7%</b>	<b>33.3%</b>		<b>59.9%</b>
Without water reservoir (acres)	6.86	9.43	13.60	9.96
With water reservoir (acres)	8.00	15.64	11.78	11.80
<b>Change attributable to project (acres)</b>	<b>1.14</b>	<b>6.21</b>	<b>-1.82</b>	<b>1.84</b>
<b>Change attributable to project (%)</b>	<b>16.6%</b>	<b>65.9%</b>	<b>-13.4%<sup>a</sup></b>	<b>18.5%</b>
Before pipeline (acres)	1.73			1.73
After pipeline (acres)	5.04			5.04
<b>Change attributable to project (acres)</b>	<b>3.31</b>			<b>3.31</b>
<b>Change attributable to project (%)</b>	<b>191.3%</b>			<b>191.3%</b>

Source: MSI field survey, 2011.

- a. It is very unlikely that water reservoirs actually caused a decrease in cultivated area. This finding is more likely a result of an inappropriate comparison group of non-participating communities and a small sample.

**TABLE 7: CROPPING PATTERNS UNDER DIFFERENT FARMING CONDITIONS (% OF CROPPED AREA)**

Crop	Karez			Water storage reservoir			Pipeline			Average			Sailaba/ Khushkaba	
	Before	With/ After	Without	Before	With/ After	Without	Before	With/ After	Without	Before	With/ After	Without	Sailaba/ Khushkaba	Levelled land
Wheat	69.1	40.8	63.8	51.4	36.7	63.8	0.0	0.0	69.0	40.2	25.8	65.5	77.8	70.1
Barley		0.9		5.6	1.8	0.0	11.6	9.7	0.0	5.7	4.1	0.0	1.8	1.8
Mash				0.0	0.6	1.4				0.0	0.2	0.5	8.2	5.1
Maize				0.0	5.2	2.9	0.0	0.0	0.0	0.0	1.7	1.0	10.5	1.2
Millet		3.7	4.3							0.0	1.2	1.4		
Tomato	4.6	8.3	4.8	7.6	9.9	4.8	0.0	2.4	0.0	4.1	6.9	3.2	0.0	9.0
Onion		1.9	4.0	9.7	7.6	4.0				3.2	3.2	2.7	0.0	5.1
Carrot				5.6	2.1	0.0				1.9	0.7	0.0	1.8	0.5
Chillies				5.6	2.3	0.5				1.9	0.8	0.2	0.0	1.4
Pea				0.0	3.7	2.4	0.0	0.0	0.0	0.0	1.2	0.8		
Potato		7.1	2.9							0.0	2.4	1.0		
Alfalfa/ Maize	4.6	2.8	1.9	0.0	4.7	1.9	11.6	6.7	6.9	5.4	4.7	3.6	0.0	1.9
Apple	9.2	10.8	2.6	9.0	9.7	2.6	57.6	55.2	0.0	25.3	25.2	1.7		
Apricot	12.4	14.5	2.4	0.0	2.4	0.0	19.2	25.5	0.0	10.5	14.1	0.8	0.0	0.9
Almond		9.3	13.3	5.6	8.2	13.3	0.0	0.5	24.1	1.9	6.0	16.9	0.0	3.0
Grapes				0.0	5.3	2.4				0.0	1.8	0.8		
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>

Source: MSI field survey, 2011.

## Crop Yields

Data from the MSI field survey suggest that project water interventions have increased yields of most crops under most conditions (Table 8). Furthermore, higher yielding varieties of wheat distributed by the project have substantially increased wheat yields. Although the field survey could not quantify the extent of the outcome, many non-participating farmers are also adopting the improved wheat varieties and experiencing improved yields as a result.

Estimating the yield of fruit was particularly challenging. Since fruit plants (apple, apricot) supplied by the project have not yet reached bearing age, it is not possible to directly measure yields. Furthermore, farmers rarely know the area of their fields. The analysis estimated yields per acre (Table 8) by estimating the average number of plants per acre based on observed plant spacing and then multiplying the number of plants by estimates of yield per plant measured from mature orchards planted with similar varieties during the project's pilot phase. The basic data for these calculations are:

- Farmers plant about 100 trees per acre for apple and apricot, 67 plants per acre for almond and 400 plants per acre for grape.
- Almond yields vary substantially by variety and range from 5 kg/plant to 30 kg/plant – or 335 to 2,010 kg per acre.
- Apple yields average 6,767 kg per acre in the “with” or “after” project scenario, 4,833 kg per acre in the “before” scenario and 5,541 kg per acre in the “without” scenario.
- Average wheat yield on leveled land is 687 kg/acre and 447 kg/acre on sailaba land.
- Tomatoes and carrots, both planted extensively on leveled land, yield an average of 8,585 kg per acre and 6,000 kg per acre, respectively.

## Crop Production Costs

Table 32 in Annex 3 presents production costs and net returns for all crops based on data from the MSI field survey. Table 9 summarizes production costs and net income for selected crops for which a comparison between the 2010 USABBA baseline (the “before” scenario) and the MSI survey (the “with” or “after” scenario) is possible. The differences between baseline and MSI survey values are due to variation in planting conditions, farming practices, and variability inherent in data from small samples.

Some of the values the project uses appear incorrect. In particular, returns to apple reported in the baseline are unrealistically low, even less than for vegetables. The project's impact assessment model also assumes that the weight of wheat straw is 200 percent of the weight of the grain under irrigated conditions and 372 percent under rainfed conditions. It also assumes that the weight of barley straw under rainfed conditions is 400 percent of the grain weight. According to experts in Pakistan agriculture, these figures are unrealistically high. The impact assessment conservatively assumed that the weight of wheat and barley straw is equal to the weight of the grain.

The project's baseline survey also found that farmers used more fertilizer when growing cereals on irrigated land than on rainfed land. The cost of production for cereals is thus higher on irrigated land than on rainfed land. Higher yields outweigh higher costs, however, producing higher returns on irrigated lands. Although the data are thin, it also appears that the greater yield on irrigated land requires more labor during harvest.

**TABLE 8: CROP YIELD UNDER DIFFERENT FARMING CONDITIONS (KG/CROPPED ACRE)**

Crop	Karez rehabilitation			Water storage reservoir			Pipeline			Average yield (kg/acre)			Sailaba and Khushkaba	
	Before	With/ After	Without	Before	With/ After	Without	Before	With/ After	Without	Before	With/ After	Without	Sailaba/ Khushkaba	Levelled land
Wheat	720	789	676	1,002	965	676	-	-	376	861	877	576	447	687
Barley	-	640	-	1,210	870	-	480	600	-	845	703	-	267	450
Mash				-	677	173				-	677	173	170	193
Maize				662	519	667	-	-	-	662	519	667	227	464
Millet	-	480	173							-	480	173		
Tomato	4,000	9,422	7,260	6,160	4,698	7,260	-	8,000	-	5,080	7,373	7,260	-	8,585
Onion	-	8,800	6,664	7,629	5,636	6,664				7,629	7,218	6,664	-	7,509
Carrot				8,801	7,556	-				8,801	7,556	-	3,333	6,000
Chillies				1,940	3,800	2,400				1,940	3,800	2,400	-	2,400
Pea				-	4,300	2,360	-	-	-	-	4,300	2,360		
Potato	-	6,737	-							-	6,737	-		
Alfalfa	4,000	6,133	8,750	-	9,698	8,750	7,000	10,909	8,000	5,500	8,913	8,500	-	10,000
Apple	4,500	6,300	5,541	4,470	6,258	5,541	5,530	7,742	-	4,833	6,767	5,541		
Apricot	4,096	4,916	-	-	4,308	-	4,667	5,600	-	4,381	4,941	-	-	4,308
Almond	-	560	295	365	560	295	-	-	153	365	560	248	-	560
Grapes				-	1,070	764				-	1,070	764		

Source: MSI field survey, 2011.

**TABLE 9: COMPARISON OF PRODUCTION COSTS AND NET RETURNS**

Crop	Production cost			Net income (Rs./acre)	
	USABBA baseline		MSI survey - all areas	Baseline	Survey
	Irrigated	Rainfed			
Wheat	10,824	9,254	12,215	11,992	14,879
Maize	7,071	3,759	5,720	4,089	5,720
Tomato	35,346	-	25,680	40,945	58,320
Onion	21,675	-	33,220	44,997	59,180
Chillies	16,849	-	19,020	61,168	64,980
Carrot	32,095	-	25,865	63,982	61,135
Apple	44,837	-	64,450	22,684	157,880
Almond	8,315	2,500		8,685	

Source: MSI field survey, 2011.

## Economic Returns by Activity

USABBA interventions fall into three general categories - water, crops and livestock. This section describes how the evaluation estimated the economic impact of specific project interventions grouped under these three broad headings.

### Water Interventions

The project's water interventions focus on making more water available for agriculture (either by increasing water supplies or making more efficient use of existing supplies), providing drinking water to communities, and constructing rainwater harvesting infrastructure. Specific interventions include:

- **Karez rehabilitation** – Many karez systems – natural water sources developed by communities to provide water for agricultural and household use – have fallen into disrepair. The project provides technical assistance and cost-sharing support to rehabilitate karez systems. Rehabilitation increases the flow of water and makes more water available for agricultural and household use.
- **Piping or lining irrigation channels** – When water is transported in open channels, a great deal is lost to evaporation and seepage into the ground. By lining channels with water-impervious materials (e.g., concrete) or converting the channel to pipe, this project intervention reduces water loss.
- **Lining water reservoirs** – Some communities use earthen reservoirs to store water from karez systems, pipelines or tubewells. Reservoirs allow communities to better manage water use by storing it when it is available and using it when needed. Earthen reservoirs, however, lose a lot of water to seepage. By lining reservoirs with concrete, the project reduces water loss.
- **Drinking water supply** – Many communities do not have easy access to a source of clean drinking water. When sources are far from the community, it often takes a great deal of time for households to collect water each day – a task that usually falls to women, girls, and young boys. By developing drinking water supplies, the project saves time and effort and increases the quality of drinking water available to a community.
- **Micro Catchment Water Harvesting (MCWH)** – Micro catchment water harvesting structures are contoured ditches on a hillside that capture rainwater flowing off the hillside, allowing it to seep into

the ground to nourish crops (usually almond) planted in the ditch. By constructing MCWH structures, the project expands cropping opportunities for farmers.

Irrigation water interventions (i.e., karez rehabilitation, constructing or lining water reservoirs, lining or piping irrigation channels) make more water available for agricultural use. Farmers reported that they respond first by increasing irrigated area thus bringing more land under cultivation and then by increasing yields by using water more intensively on existing irrigated land. For these three interventions, the analysis first uses empirical data from the MSI field survey and the project's 2010 baseline to estimate average returns per acre on a "typical"<sup>3</sup> farm with and without (or before and after, as appropriate) the intervention. Differences in average returns reflect changes in cropping patterns, changes in yields due to improved irrigation scheduling, and increased use of intercropping. The analysis then applies these per acre differences in returns to the total area of all farms affected by the interventions to determine the aggregate economic impact of the intervention.

### **Karez Rehabilitation**

A karez system is developed by excavating downward to water at the spring line of a hill or mountain and then tunneling (with a slight downward slope) towards the valley until emerging above ground at the "daylight point". Some karez systems are in hard rock and some in dirt (soft rock) and may extend for miles before emerging above ground. Of a total of 21 project-supported karez rehabilitation interventions, 5 are not complete. Respondents to the MSI field survey reported irrigating between 5 and 40 acres (per household) from karez systems with an average of 7.81 acres.

Karez rehabilitation appears to have increased cropping intensity.<sup>4</sup> At the time of the impact assessment, cropping intensity was higher (135 percent) in communities with project-assisted karez rehabilitation interventions than it was in karez communities without rehabilitation projects (122 percent) or in non-project communities (the "without" scenario) with a cropping intensity of 118 percent.. Larger areas in orchards – attributable to a greater supply of irrigation water – contributed to the higher cropping intensity.

Estimated total returns on a 7.81 acre farm (the average farm size in surveyed karez intervention communities) are Rs. 317,101 in the "with/after" scenario, Rs. 168,120 in the "before" scenario, and Rs. 146,306 in the "without" scenario. Corresponding average per acre returns are Rs. 40,602, Rs. 21,526, and Rs. 18,733, respectively. [Table 10](#) shows the derivation of total and average per acre returns under the different scenarios.

### **Piped and Lined Irrigation Channels**

To reduce water loss and make more water available for agriculture, the project lines or pipes water channels to reduce seepage and evaporation losses. The project has completed 4 of 17 piped water supply interventions to date and expects to complete the remaining 13 by December 2011.

The average farm served by project-supported piped and lined channels is 8.00 acres. There is little difference in cropping intensity between the "with/after" scenario and the "before" scenario – 181 percent and 177 percent, respectively. Piped or lined water supplies seem to have affected yields suggesting that farmers used additional water to improve irrigation scheduling.

[Table 11](#) summarizes findings on returns from piped water supplies. An 8.00 acre farm with a piped water supply earns Rs. 618,098 annually from all crop activities. A similar farm before a piped water supply earns Rs. 445,283 annually. These translate to average per acre returns of Rs. 77,262 and Rs. 55,660, respectively.

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<sup>3</sup> Defined as the average area of farms participating in each type of water intervention.

<sup>4</sup> Cropping intensity is the percentage of cultivated area planted to crops. In Balochistan, with two seasons, cultivated land is the sum of land cultivated in the Rabi season and land cultivated in the Kharif season – even if the same land is cultivated in both seasons. Land planted to crops is the sum of land actually used in each season. Perennial crops such as orchards are used (and counted) in both seasons. In the analysis of this report, cultivated area is not known and total cropped area (in both seasons) is used in place of cultivated area.

**TABLE 10: RETURNS FROM KAREZ REEHABILITATION (7.81 ACRE FARM)**

Crop	Area (acres)			Yield (kg/acre)			Net price (Rs./ kg)	Net Returns (Rs.)		
	Before	With/ After	Without	Before	With/ After	Without		Before	With/ After	Without
Wheat	5.40	3.19	4.98	720	789	676	25.0	97,175	62,886	84,228
Barley		0.07		-	640		26.8		1,243	
Tomato	0.36	0.65	0.37	4,000	9,422	7,260	4.86	6,997	29,858	13,103
Onion		0.14	0.32	-	8,800	6,663	8.97		11,438	18,868
Millet		0.29	0.33	-	480	173	17.75		2,469	1,028
Alfalfa	0.36	0.22	0.15	4,000	6,133	8,750	1.88	2,707	2,506	2,444
Potato		0.55	0.22	-	6,737		10.92		40,507	
Apple	0.72	0.84	0.21	4,500	6,300	5,540	13.16	42,627	69,677	15,028
Apricot	0.97	1.13	0.19	4,096	4,916		12.00	47,767	66,667	
Almond		0.72	1.04	-	560	295	120.00		48,717	36,875
<b>Total</b>	<b>7.81</b>	<b>7.81</b>	<b>7.81</b>					<b>197,273</b>	<b>335,967</b>	<b>171,575</b>
Average return per acre								25,259	43,018	21,969

Source: MSI field survey, 2011.

**TABLE 11: RETURNS FROM PIPED WATER SUPPLY (8.0 ACRE FARM)**

Crop	Area (acres)			Yield (kg/acre)			Net price (Rs./ kg)	Annual returns (Rs.)		
	Before	After	Without	Before	After	Without		Before	After	Without
Wheat	0.00	0.00	5.52	0	0	376	25.0	0	0	51,862
Barley	0.90	0.80	0.00	480	600		26.8	11,967	12,489	0
Maize	0.00	0.00	0.00	0	0		11	0	0	0
Alfalfa	0.90	0.50	0.55	7,000	10,909	8,000	1.88	12,242	10,951	8,298
Tomato	0.00	0.20	0.00	0	8,000		4.86	0	7,550	0
Pea	0.00	0.00	0.00	0	0		16.45	0	0	0
Apple	4.60	4.40		5,530	7,742		13.16	335,121	450,098	0
Apricot	1.50	2.00		4,667	5,600		12	85,953	137,010	0
Almonds	0.00	0.00	1.93	0	0	153.1	120	0	0	35,487
<b>Total</b>	<b>8.00</b>	<b>8.00</b>	<b>8.00</b>					<b>445,283</b>	<b>618,098</b>	<b>94,647</b>
Average returns per acre								55,660	77,262	11,956

Source: MSI field survey, 2011.

## **Water Storage Reservoir**

Reservoirs serve to store water for later use and thus give farmers the opportunity to use water more efficiently. Communities with karez systems – which flow constantly – can store water in the reservoir when it is not needed for use when it is. Communities that get water from tubewells can fill reservoirs when electricity is available to run the pump and use the water when the pump is not running. To reduce water loss and thus increase the quantity of water available for agricultural use, the project lines water storage reservoirs to reduce seepage. Of 23 approved reservoir interventions, 11 were completed at the time of the evaluation.

Comparing the “with/after” scenario with the “before” scenario suggests that farmers with lined reservoirs plant less cereals and more high value orchard crops. In fact, farmers in communities with lined reservoirs planted cereals on 44 percent of their land and orchard (apple, apricot, grape, and almond) on 26 percent. Similar farms without lined reservoirs used 57 percent of their land for cereals and 14 percent for orchard. Farms in the “without” project scenario planted 18 percent of their land to orchards.

Table 12 summarizes aggregate and average per acre returns for farms in the “with/after”, “before”, and “without” scenarios.

## **Micro Catchment Water Harvesting (MCWH)**

The project has completed two MCWH interventions. The beneficiaries have planted drought resistant olive and grape in the structures. The strategy is low cost but risky in the sense that it depends entirely on rainfall. The beneficiaries lost all of the plants they established due to lack of rainfall. Therefore, there are no economic benefits associated with MCWH interventions to date.

## **Drinking Water**

The ten drinking water projects completed by the project are distributed in Killa Saifullah (5), Loralai (2), Mastung (1), and Zhob (2). Only half are completed and the rest are under construction. The projects that the impact assessment teams visited relied on tubewells to fill reservoirs for drinking water. However, due to load shedding, the pumps rarely operate and reservoirs are not filled consistently. Consequently, the impact assessment team observed few tangible benefits from the three drinking water projects it visited. The mid-term evaluation of the project did report working drinking water supply projects but did not estimate an economic impact associated with the projects<sup>5</sup>. Functioning drinking water supply systems designed for 20 households can generate an estimated benefit of Rs. 175,000 annually.<sup>6</sup>

## **Summary of Economic Impacts of Water Interventions**

Project interventions that increase the quantity of water available for agriculture increase incomes of affected farmers (Table 13). Since open streams lose a lot of water to evaporation and seepage, piped and lined water channels produce larger returns than the other water schemes. The comparative gain per acre is highest for piped supply followed by karez rehabilitation.

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<sup>5</sup> Increasingly severe load shedding since the 2008 mid-term evaluation appears to have significantly reduced the benefits of tubewell-supplied drinking water projects.

<sup>6</sup> Estimated for various DWSS constructed for Refugee Assisted Hosting Areas (RAHA) under UN sponsored program in the 'Impact Assessment of RAHA Schemes', still in Draft form.

**TABLE 12: RETURNS FROM WATER STORAGE RESERVOIR (9.43 ACRE FARM)**

Crop	Area (acres)			Yield (kg/acre)			Net price (Rs./kg)	Net Returns (Rs.)		
	Before (Baseline)	After	Without	Before (Baseline)	After	Without		Before	After	Without
Wheat	4.85	3.46	6.02	1,002	965	676	25.00	121,331	83,390	101,699
Barley	0.52	0.17	0.00	1,210	870	0.00	26.80	16,989	4,030	-
Mash	0.00	0.06	0.13	0	677	173	90.00	-	3,422	2,099
Maize	0.00	0.49	0.27	662	519	667	11.00	-	2,776	1,973
Tomato	0.72	0.93	0.45	6,160	4,698	7,260	4.86	21,565	21,209	15,821
Onion	0.92	0.71	0.38	7,629	5,636	6,664	8.97	62,739	36,044	22,782
Carrot	0.52	0.19	0.00	8,801	7,556		10.54	48,597	15,484	-
Chillies	0.52	0.22	0.04	1,940	3,800	2,400	5.42	5,509	4,449	583
Pea	0.00	0.35	0.22		4,300	2,360	16.45	-	24,450	8,704
Alfalfa	0.00	0.44	0.18		9,698	8,750	1.88	-	8,074	2,951
Apple	0.85	0.92	0.25	4,470	6,258	5,541	13.16	50,079	75,615	18,146
Apricot	0.00	0.22	0.00		4,308		12.00	-	11,614	-
Almond	0.52	0.78	1.26	365	560	295	120.00	22,946	52,298	44,524
Grapes	0.00	0.50	0.22		1,070	764	52.50	-	27,902	8,993
<b>Total</b>	<b>9.43</b>	<b>9.43</b>	<b>9.43</b>					<b>349,755</b>	<b>370,757</b>	<b>228,274</b>
Average returns per acre								37,090	39,317	24,207

Source: MSI field survey, 2011.

Note: Baseline figures derived for 3.68 ha using the cropped area figures as given in the baseline report.

**TABLE 13: INCOME PER ACRE (RS.)**

Intervention type	“With” intervention	“Without” intervention	Return (Rs.)
	<i>a</i>	<i>b</i>	<i>a-b</i>
Piped water supply	77,262	11,956	65,306
Karez rehabilitation	43,018	21,969	21,049
Lined water reservoir	39,317	24,207	15,110
MCWH structures	No observed/measurable economic impact		
Drinking water systems	175,000 based on RAHA study		

Sources: MSI field survey, 2011 and USABBA baseline survey, 2010.

## Crop Interventions

The project’s crop interventions focus on increasing agricultural productivity by introducing improved agricultural technologies and practices. Specific crop interventions include:

- **Distributing seed of higher-yielding varieties of key crops** – Poor quality seeds and varieties not well suited to Balochistan’s harsh and arid conditions limit yields of important crops. The project tests and introduces wheat, barley, and alfalfa seed varieties adapted to Balochistan’s climate in order to improve yields.
- **Demonstration plots for wheat and barley** – Farmers learn by seeing and doing. The project established demonstration plots in highly visible locations to teach farmers how to apply improved technologies and practices. The demonstration plots advertised the results widely thus improving adoption rates beyond project-assisted communities.
- **Providing knapsack and power sprayers** – Knapsack and power sprayers provided by the project reduce spraying costs and ensure that farmers have access to sprayers when they need them.
- **Constructing grain storage silos** – Farmers’ grain storage practices (sacks) lead to high post-harvest losses and spoilage. The project provides small silos to households to reduce post-harvest loss and retain grain quality.
- **Constructing greenhouses** – Greenhouses allow beneficiary farmers to produce high value vegetables in off-seasons when prices are higher. They also promote more efficient use of irrigation water.
- **Leveling land and constructing dykes** – Leveling rainfed and land irrigated by flooding promotes more even distribution of water and improves yields.
- **Providing fruit plants** - The project distributes fruit plant varieties that require little water in order to promote a transition to higher value and lower water requirement crops.

The remainder of this section reviews the economic benefits associated with each of these interventions.

## Seed Supply

Most seed research in Pakistan focuses on Punjab and has not tested varieties for their suitability to Balochistan’s harsh environment. The lack of seed of suitable varieties has limited the productivity of important crops. The extreme climate (cold weather resulting in shivered grain) and uncertain water supplies lead to retarded grain formation and poor quality. Disease in the commonly planted varieties also significantly

reduced yields. The project's pilot phase tested a wide variety of seeds and selected several varieties most suited to Balochistan. The project's current phase continues to distribute these seeds on a cost-share basis.

The project has focused largely on distributing wheat seed with very limited distribution of pea and alfalfa seed (Table 4). The project's current phase has distributed 15,179 bags of wheat seed (759 metric tonnes) – 27 percent in 2009, 62 percent in 2010 and 11 percent in 2011. By district, it distributed 25 percent in Killa Saifullah, 40 percent in Loralai, 2 percent in Mastung, 5 percent in Quetta and 28 percent in Zhob. Most of the beneficiary farmers also participated in water interventions.

The project recommends different wheat seed varieties for irrigated and rainfed land. The Bhakar variety accounts for a vast majority of the seed that the project has distributed and farmers plant the variety on both irrigated and rainfed land. The quality of Zardana (a rainfed variety) seed has deteriorated with time although farmers still use it in dry areas. Similarly, good quality Raskoh seed is not currently available. Table 14 summarizes the quantities of wheat seed distributed by the project in the current project phase.

**TABLE 14: WHEAT SEED DISTRIBUTION BY VARIETY**

Variety	Quantity procured		Number of recipients	
	Tons	% of total	No	% of total
Bhakar	647.4	97.94	2,344	93
Cham 6	13.5	2.04	82	3
Raskoh	0.01	0.00	13	1
Zardana	0.1	0.01	75	3
Unknown <sup>a</sup>	98.1			
<b>Total</b>	<b>759.11</b>	<b>100</b>	<b>2,514</b>	<b>100</b>

Source: USABBA project records.

- a. Represents seed distributed in late 2011 for which project records were not yet complete at the time of the evaluation.

The project has had trouble ensuring a consistent supply of seed. Consequently, it distributed pea and alfalfa seed only in 2010. The project is collaborating with a local seed supply company (Kashmala Seed) for supplying wheat seed but its involvement is limited and inconsistent from year to year. Based on the survey findings, 2.7 percent of wheat seed beneficiaries sold their wheat as seed stock or retained it for planting on their own farms but yields were not on par with the yield of parent seed. The project has purchased some seed cleaning machines to facilitate local production of high-quality seed stock. However, the machines are not used to capacity in most instances because of lack of demand for the service.

The MSI field survey collected production data for both indigenous and project-distributed seeds. Table 15 summarizes the economic returns attributable to improved seed varieties distributed by the project. Pea returns are far larger per acre (Rs. 152,516) than wheat (Rs. 5,344) or alfalfa (Rs. 393).

### **Demonstration Plots**

The project established demonstration plots for wheat and barley in all districts. The project supplied the seed and fertilizer according to the recommended application and participating farmers supplied labor and other inputs. The demonstrations produced very encouraging results. Project staff reported wheat yields in the range of 2,700 to 3,500 kg per acre and yields of 1,500 to 1,800 kg per acre for barley. The project's Agriculture Specialist also reported that one of the farmers participating in a wheat demonstration received a first prize for production and won a tractor.

**TABLE 15: ECONOMIC BENEFIT OF IMPROVED SEED**

	Wheat	Peas	Alfalfa
Yield/acre of grain with FAO seed (kg)	822	12,462	30,143
Yield/acre of straw with FAO seed	822	--	--
Yield/acre with traditional seed (kg)	651	6,596	30,000
Yield/acre of straw with traditional seed	651	--	--
Grain price per kg (Rs.)	25	26	2.75
Straw price per kg (Rs.)	6.25	--	--
Gross returns for FAO seed (Rs./acre)	25,688	324,012	82,893
Gross returns for traditional seed (Rs./acre)	20,344	171,496	82,500
Increase in net returns attributable to improve seed (Rs./acre)	5,344	152,516	393

Source: MSI field survey, 2011.

The impact assessment team used the lower bound of the estimated range of yields to estimate the impacts of the demonstration plots. Wheat yields on demonstration plots are 3.28 times those reported under regular irrigated conditions. Barley yields on demonstration plots are 1.24 times yields under normal irrigated conditions. Multiplying the per acre impact of improved wheat (Rs. 5,435) by 3.28 yields an estimate of the impact of wheat demonstration plots of 17,532/acre. For barley, the USABBA baseline report estimated average barley yields under irrigated conditions of 1,210 kg/acre. At a price of Rs. 26.8/kg (accounting for production costs<sup>7</sup>), the net returns to barley under normal irrigated conditions is Rs. 32,428. The lower bound estimate of barley yields on the demonstration plots is 1.24 times yields under normal irrigated conditions implying an average return of Rs. 40,211. The impact of the demonstration plots is thus Rs. 7,783.

### **Knapsack/ Power Sprayers**

The project provides knapsack sprayers for use on low crops and power sprayers for high crops such as orchards. It has supplied 52 knapsack sprayers to individual farmers and 130 power sprayers, one each to selected community organizations. The sprayers produce benefits by reducing spraying cost (relative to hiring services from the private sector) and ensuring availability when needed. The analysis calculates the benefits associated with the sprayers as the difference between the cost of spraying with the project supplied sprayers (i.e., fuel and pesticide) and the cost of privately-supplied spraying services as reported by project-assisted farmers. Table 16 summarizes the economic benefits of sprayers.

**TABLE 16: ECONOMIC BENEFIT OF SPRAYERS**

	Knapsack sprayer	Power sprayer
Average area sprayed annually per sprayer (acres)	4.9	45.4
Savings per acre (Rs.)	184	271
Total savings per sprayer (Rs.)	908	12,331

Source: MSI field survey, 2011.

<sup>7</sup> The analysis incorporates production costs by using a net of production cost price when calculating returns.

## Grain Storage Silos

The project has distributed 600 kg capacity metal grain storage silos to 12 households – three in each district except Quetta. Based on data collected by the MSI field survey, farmers using the project-supplied silos saved an estimated 58 kg of grain valued at Rs. 1,458.<sup>8</sup>

## Greenhouses

The project established some greenhouses in 2007 under the pilot phase. The beneficiary of the greenhouse erected in Killa Saifullah (about 3,000 square feet) in 2007 earned a net income of Rs. 25,000 by selling off-season cucumber. However, the plastic of the shed has been damaged now and the farmer has not replaced it. The project has provided a new greenhouse to the same farmer that will likely be completed by December. The greenhouse recipient that the impact assessment team interviewed in Loralai earned a net return of Rs. 90,000 by growing off-season tomato and cucumber in 2007. He is also constructing a new greenhouse. Table 17 reports estimated net returns to the six project-constructed greenhouses based on the data collected in the field survey.

**TABLE 17: GREENHOUSES ESTABLISHED**

District	Number and area		Annual net benefits ( Rs.)
	Old (3000 Sft)	New (2400 Sft)	
Killa Saifullah	1	1	25,000
Mastung		1	45,000
Loralai	1	1	90,000
Quetta		1	90,000
<b>Totals</b>	<b>2</b>	<b>4</b>	<b>250,000</b>

Source: MSI field survey, 2011.

## Land Leveling

Any agricultural land that is irrigated by flooding (regardless of the source of water) will make better use of the water if the land is level. Leveled land will distribute the water more evenly and thus increase yields. Farmers use flood irrigation on both irrigated (with tubewells) and rainfed (sailaba and khushkaba) land.

There is no lack of cultivable land in project communities. Instead, it is water that limits agricultural production. Furthermore, the alluvial soil in the valleys is quite rich and needs little supplemental fertilizer to be productive. Farmers make use of this land by constructing water harvesting structures to channel runoff from seasonal watercourses (sailaba systems) or hillsides (khushkaba systems) onto prepared (usually with surrounding dykes to retain the water) land. The retained water soaks into the soil where it is available for plants in the planting season. If the prepared land is level, it distributes the water more evenly and thus increases eventual yields. The same principle applies to land that is flood irrigated from tubewells.

Small farmers often lack the financial capital to invest in water harvesting structures or to level land. The project shares the cost of leveling land and constructing water harvesting structures with communities. Farmers grow primarily wheat or peas on leveled land in sailaba or khushkaba systems. They often grow high-value vegetable or fruit (almond) crops on leveled land irrigated with tubewells. Table 18 illustrates returns to different crops on leveled land irrigated with tubewells compared to unlevelled land. Average per acre returns are weighted by the observed percentage of land planted to different crops. The difference in average returns per acre between sailaba and leveled land (Rs. 13,637) reflects the economic impact of land leveling.

<sup>8</sup> Based on the market price of wheat of Rs. 25/kg.

Subtracting the Rs. 6,000 difference in production costs between sailaba and leveled land yields a net impact of Rs. 7,637 per acre. The project has leveled 2,036 acres of land.

**TABLE 18: RETURNS FROM LAND LEVELING PER CROP ACRE**

	Weights		Yield (kg/acre)		Price (Rs./kg) <sup>a</sup>	Returns (Rs./acre)	
	Sailaba	Leveled	Sailaba	Leveled		Sailaba	Leveled
Wheat	0.78	0.70	447	687	17.50	10,863	15,051
Barley	0.02	0.02	267	450	26.8	125	223
Maize	0.11	0.01	227	464	11.00	262	59
Mash	0.08	0.05	170	193	90.00	1,253	880
Alfalfa		0.02		10,000	1.88	-	364
Tomato		0.09		8,585	4.86	-	3,753
Onion		0.05		7,509	8.97	-	3,418
Chillies		0.01		2,400	5.42	-	180
Carrot	0.02	0.00	3,333	6,000	10.54	616	292
Almond		0.03		560	120.00	-	2,037
Apricot		0.01		4,308	12.00	-	477
Average gross returns per acre						13,149	26,786

Source: MSI field survey, 2011.

- a. Grain prices used in the analysis factor in production costs by reducing the price by a factor equal to the production cost as a percentage of gross returns for each crop.

### Fruit Plants

The project has supplied 245,000 fruit plants to project-assisted communities on a 50 percent cost-share. The 1,414 households who received plants have used the plants to establish 2,442 acres of orchards (Table 19).

**TABLE 19: AREA PLANTED WITH PROJECT-SUPPLIED FRUIT PLANTS**

Year	Killa Saifullah	Loralai	Mastung	Quetta	Zhob	All districts
2009	81	16				97
2010	291	157	116	26	258	848
2011	277	349	482	54	333	1,496
Total	649	523	598	80	592	2,442

Source: USABBA project records.

Farmers buy the plants from private nurseries approved by the project considering the variety, quality, and price of the rootstock. Cost per plant ranges from Rs. 6 to Rs. 35 depending on the type with an average cost of Rs. 30. The plants bear fruit from the sixth year after planting onwards. Although none of the project-supplied plants are yet bearing fruit, planting under the preceding project have started to produce – although not yet at levels associated with fully mature plants.

Interviewed farmers reported that yields from project-supplied plants were about 40 percent higher than their usual varieties for apples and 20 percent higher for apricot. Based on yield estimates derived from the MSI field survey (Table 8) this implies yields from plants distributed by the project of 9,474 kg per acre for apple and 5,929 kg per acre for apricot. The project was not able to provide data on the number of each type of plant provided. As an estimate, the impact assessment uses the shares of area observed in the field survey – 64 percent of apple/apricot orchards are apple and 36 percent apricot. Thus a “typical” acre of new orchard would produce 8,198 kg of fruit. The analysis attributes this production entirely to the project since the project supplied the plants and farmers would not have planted the fruit otherwise.

An average fruit price of Rs. 27 per kg implies an average return to project-distributed fruit plants of Rs. 221,346 per acre for new orchards. Subtracting production costs of Rs. 64,450 (Table 9) per acre leaves a net return of Rs. 156,896 per acre.

### Summary of Economic Impacts of Crop Interventions

Table 20 summarizes the economic benefits associated with the project’s crop interventions.

**TABLE 20 : SUMMARY OF CROP BENEFITS**

Intervention	Units	Annual benefit/unit (Rs.)
Seed distribution		
Wheat	acre	5,344
Pea	acre	152,516
Alfalfa	acre	393
Demonstration plots		
Wheat	acre	17,532
Barley	acre	7,783
Sprayers	sprayer	
Knapsack	farm	908
Power	farm	12,331
Silos	silo	1,458
Greenhouses	greenhouse	62,500
Land leveling	acre	7,637
Fruit plant distribution	acre	156,896

### Livestock Interventions

The project’s livestock interventions focus on improving livestock productivity by improving animal health (by treating disease and improved feed), marketing (preparing animals for selected high-value markets), and introducing better adapted livestock (poultry distribution). Specific interventions included in the impact assessment include:

- **Poultry distribution** – The project supplies chickens that are more productive (i.e., better egg layers, brooders, and meat producers) than the indigenous varieties. The activity specifically targets women who largely control the income from poultry.
- **Animal health treatments** – The project vaccinates and otherwise treats (dipping and drenching) sheep and goats for diseases and parasites. The interventions improve animal health and weight gain and reduce mortality.

- **Incubators** – The project has supplied four prototype incubators so communities can begin producing their own poultry stock.
- **Eid livestock markets** – The project has organized special Eid-ul Asha livestock markets in district centers. Expected benefits to participants include reduced transactions costs, higher prices, and veterinary care provided at the market.
- **Livestock feeding** – The project provides a balanced feed ration designed to increase weight gain and health of sheep and goats.

### **Poultry Distribution**

The project distributed 8,143 chickens and feed to approximately 226 households distributed across all five project districts – all on a cost-share basis with the project covering 75 percent of the cost. The 850 chickens distributed in Killa Saifullah in 2010 arrived late and did not survive. The project recovered the costs from the supplier.

Through beneficiary interviews (with men who reported on women’s activity) the impact assessment team estimated that the project-supplied poultry produced about nine more eggs during their 18 month productive lives than the indigenous varieties. Women control this small increase in income. In addition to eggs, the birds also have value as meat after they stop laying eggs. The meat value attributable to the project is related to the reduced mortality of project-supplied birds – estimated from survey responses at 15 percent lower than with the indigenous varieties. The total added value per bird is thus the sum of the value of additional eggs plus the value (for meat) associated with reduced mortality or Rs. 105. Adjusted to the anticipated 18 month life of a bird, the economic benefit per bird is Rs. 135. Table 21 summarizes the derivation of the per bird economic benefit of project-supplied chickens. Multiplying by the 7,293 chickens that survived yields an aggregate benefit of Rs. 765,765 or Rs. 3,388 per recipient household.

**TABLE 21: IMPACT OF POULTRY DISTRIBUTION**

	<b>Value (Rs.)</b>
Increased egg production per bird/annum	9
Egg price (Rs.)	10
Value of increased egg production (Rs.)	90
Bird value (Rs.)	500
Decreased mortality-% of value	15
Benefits of reduced mortality (Rs.)	75
Total annual increase in benefits per bird (Rs.)	105
Value over 18 month useful life (Rs.)	157.50
Annual additional cost per bird (Rs.)	15
Cost over useful life (Rs.)	22.50
Net benefit per bird (Rs.)	135

Source: MSI field survey, 2011.

### **Animal Health Treatments**

Animal health treatments (vaccination, de-worming, dipping, drenching) reduce disease and parasites, improve weight gain, and reduce mortality. The evaluation team was not able to collect data in the field on the impacts of animal health interventions. Based on discussions with the project’s national expert on livestock, the team estimated that the impacts of the health treatments were approximately five percent of the value of each treated animal. Based on an average animal value of Rs. 7,500 (sheep and goats), the average

benefit is thus Rs. 375. Costs of vaccination and treatment are about Rs. 188 per animal leaving a net benefit of Rs. 187 per treated animal.

### **Incubators**

The project has supplied four prototype egg incubators. The impact assessment team was not able to collect data on the incubators in the field. USABBA project staff estimated typical annual gross returns at Rs. 20,000 with costs of Rs. 5,000 for an annual benefit of Rs. 15,000 based on the net value of the birds (eggs and meat) that can be produced.

### **Eid Livestock Markets**

In the absence of empirical data, it is difficult to estimate the economic benefits associated with the special Eid livestock markets. The impact assessment team used the project's estimate of Rs. 75,000 aggregate gross benefit per market based on rudimentary data collected from participating community organizations and from market participants. With costs of 20,000 per market, the net returns are Rs. 55,000.

### **Livestock Feed**

The project provides a supplemental feed at a 50 percent cost-share to improve the weight and health of animals. Table 22 shows the derivation of the economic benefits associated with supplemental feeding based on data collected during the field survey. While the project designed this activity for sheep and goats, farmers appear to be using it to feed cows and increase milk production. The calculation takes into account the average quantity fed to the large animal (cows) as well as sheep and goats and the increased milk production that results. The supplemental feed produces a weighted average (weighted by animal type) increase in milk yield of 1.17 liters per day valued at Rs. 40/liter for a daily increase in the value of milk produced of Rs. 46.80. The cost of 1.79 kg of feed per day is Rs. 39.38. The net return from a 50 kg bag of feed is thus Rs. 207.26. Table 22 summarizes the calculation.

**TABLE 22: ECONOMIC BENEFITS LIVESTOCK FEEDING**

	<b>Large animals (cows)</b>	<b>Ruminants (Sheep/ goat)</b>	<b>Total</b>
Quantity fed daily (kg/day)	1.51	0.29	1.79
Increase in milk yield (liter/day)	1.02	0.15	1.17
Feed cost per day (Rs.) at Rs. 22/kg	33.22	6.38	39.38
Milk value per day (Rs.) at Rs. 40/liter	40.8	6	46.80
Net benefit per day (Rs.)	7.58	-0.38	7.42
Net benefit per 50 kg bag (Rs.)	250.99	-65.51	207.26

Source: MSI field survey, 2011.

## Summary of Livestock Benefits

Table 23 summarizes the economic benefits associated with the project's livestock interventions.

**TABLE 23 : SUMMARY OF LIVESTOCK BENEFITS**

Intervention	Units	Annual net benefit (Rs.)
Poultry distribution	bird	135
Animal health treatments	animal	188
Incubators	incubator	15,000
Eid livestock markets	market	55,000
Livestock feeding	bag	207

Due to a lack of field data on livestock interventions, the impact assessment team relied on project-reported impact estimates for many of the livestock interventions. Since livestock interventions accounted for less than one percent of total project benefits, however, reliance on project-supplied benefit estimates could not substantially affect the impact assessment results.

## Employment Generation

Crop production and construction accounted for most of the labor generated by project interventions. In particular, the impact assessment team estimated the following labor impacts based on the team leader's knowledge of labor requirements in agriculture.

- Wheat seed distributed by the project substitutes directly for indigenous seed and requires no additional labor. The increased yields associated with the project-supplied seed, however, require additional labor for harvesting.
- Alfalfa and pea seeds supplied by the project have also increased yields and area planted to these crops. The additional production requires additional labor in harvesting.
- Leveling land and constructing dykes, bunds, and diversion structures directly employed labor.
- New, higher-yielding fruit plants and improved irrigation scheduling on existing orchards has increased yields which requires additional labor resources for picking, harvesting, packing etc.
- Sprayers (knapsack and power) require additional labor to operate. The average annual utilization for knapsack and power sprayers is 4.9 and 45.4 acres per annum, respectively. Labor required per acre is 0.50 man days per acre for a knapsack sprayer and 0.25 man days for a power sprayer.

Based on these figures, project interventions generate an estimated 55,757 additional days of labor per year. However, once the fruit trees reach bearing age in two or three years, labor requirements will increase by 5,860 days per year or a year-round employment of 2.4 persons per acre of orchard plantation. Table 24 shows the derivation of employment estimates.

In addition to the regular labor requirements, construction activities associated with project interventions generate one-time labor opportunities. Table 25 summarizes estimates of the additional labor generated by the project's construction activities.

**TABLE 24: EMPLOYMENT GENERATION ATTRIBUTABLE TO PROJECT INTERVENTIONS IN CROP AND WATER SUB-SECTORS**

Intervention	Area (acres)	% increase in labor requirement due to project	Labor per acre (man days/year)		Employment generated (man days/year)			
			Plowing	Harvesting	Plowing	Harvesting	Total	
Wheat seed	13,514	100	0	1	-	13,514	13,514	
Alfalfa seed	12	25	2.4	13	7	38	44	
Pea seed	37	25	4.8	30	45	281	325	
Wheat demo plots	112	100	2.4	8	269	896	1,165	
Barley demo plots	10	100	1	4.8	10	48	58	
Land leveling	2,059	100	2.4	4.8	29,650	9,883	39,533	
Fruit plants old*	1	100	-	320		1,117	1,117	
Fruit plants - new	2,442	50	2.4	2.4	2,930	2,930	5,860	
Spraying -knapsack	5	52				127	127	
Spraying - power	45	130				1,476	1,476	
<b>Total</b>						<b>32,910</b>	<b>28,707</b>	<b>61,617</b>

Source: MSI field survey, 2011.

**TABLE 25: LABOR GENERATED BY CONSTRUCTION**

Number of water interventions	72
Average labor days per intervention (man days)	100
<b>Labor generated by water interventions – (man days)</b>	<b>7,200</b>
Area leveled (acres)	2,059
Labor for land leveling (man days/acre)	6
<b>Labor for total area leveled (man days)</b>	<b>12,354</b>
<b>Total man days of labor</b>	<b>43,971</b>

Source: MSI field survey, 2011.

The impact assessment does not consider the benefits of increased employment in the calculation of total project benefits.

## Monetary Impact

Table 26 summarizes estimated average per household monetary impacts associated with project interventions in the years 2009 to 2011. The estimated impact considers the net return to each activity as described in previous sections of this report, the size of the intervention, and the number of households participating in each type of intervention.

Crop interventions produced the majority (93 percent) of project monetary impacts. Water interventions produced seven percent of benefits and livestock interventions less than one percent. On a per household

basis, crop interventions had the greatest impact on household income, water the second greatest impact, and livestock the least.

**TABLE 26: PROJECT MONETARY IMPACT**

Type of intervention	Aggregate benefits (Rs. thousands)	Percentage of aggregate benefits (%)	Average benefit per household (Rs.)
Water	15,740	7%	22,503
Crops	208,899	93%	118,663
Livestock	200	<1%	13,314
Total	224,839		

Source: MSI field survey, 2011.

Benefits do not include those associated with employment generation.

## Cost Benefit Analysis

Cost benefit analysis compares project costs with project benefits as a measure of efficiency. Common comparisons include the benefit cost ratio, net present value or internal rate of return. Because costs and benefits do not occur at the same time, the comparison is not straightforward. Two issues arise: comparing costs and benefits that occur at different points in time and projecting future benefits.

Since monetary values are not constant over time it is not appropriate to compare a cost in one year with a benefit in another year. A discount rate must be applied to adjust the costs and benefits occurring through time to a common time period. The discount rate may reflect inflation or the opportunity cost of investing money in a project. The internal rate of return (IRR) accepted by planning Division Government of Pakistan is 15 percent as no project is approved if the IRR is less than this rate. However, considering the relative backwardness and economic conditions of Balochistan, an IRR of 12 percent is even accepted for implementing projects.

Since some benefits may occur in the future (particularly in agricultural projects), a complete cost benefit analysis also requires estimating future benefits.

The project is the continuation of a precursor project completed in December, 2008. It is a three-year project to be completed by December, 2011. The assumptions made for the cost benefit analysis of this project are as follows:

- All benefits are calculated at 2011 prices. Costs are adjusted at the observed inflation rate to reflect 2011 values.
- The project life is three years but the interventions will generate impacts for a much longer period, even beyond 25 years for fruit plants. The analysis conservatively assumes a useful life of 15 years from the start of the project.
- The benefits from wheat seed are reduced after five years at a rate of five percent annually to compensate for the loss of yield due to aging of variety.
- To account for maturing fruit plants on leveled land, the benefits from land leveling are increased by two percent annually for the first five years of the analysis.

- As some of the water related schemes are still not complete, the benefits for the incomplete schemes initiated in 2010 and 2011 are reduced by 21 percent (based on amount spent) for years 2 and 3. From there on the benefits are included at full (completed) value.
- The benefits for orchard plantation are increased by one percent annually for the first five years after fruiting starts.
- Livestock benefits are increased by one percent annually attributed to better veterinary awareness and adoption of balanced feed.

## Costs

Total project cost for the three-year duration of the project is US\$ 7.181 million out of which 38 percent was spent in 2009, 34 percent in 2010 and 28 percent in 2011. The expenditure on salaries and consultancy services is 27.7 percent. The total cost in 2011 values is \$6.127 million (Rs. 530). [Table 27](#) summarizes cost by category.

## Cost Benefit Analysis

The analysis generates three measures of project efficiency.

- **Net Present Value (NPV)** – Net present value is the difference between the present value of benefits and the present value of costs. A project with a positive NPV generates benefits in excess of costs. Because NPV is independent of the size of a project’s budget, however, it provides no evidence of return on investment.
- **Benefit Cost Ratio** – The benefit cost ratio is the present value of benefits divided by the present value of costs. The benefit cost ratio indicates the dollars returned in benefits for each dollar of cost.
- **Internal Rate of Return (IRR)** – The IRR is the rate of return on a stream of costs that equates the present value of costs with the present value of benefits. The IRR represents the potential financial return on the investment but provides no information on the distribution of benefits.

Although it is not a cost to the project, project-supported infrastructure (karez systems, land leveling, dikes, etc.) will deteriorate over time resulting in decreasing benefits. Including maintenance costs equivalent to five percent of installed infrastructure value in the years 2012 through 2023 increases the present value of costs, reduces the benefit cost ratio, net present value, and internal rate of return. [Table 28](#) and [Table 29](#) summarize the stream of costs and benefits associated with the project and the present value of each. [Table 28](#) excludes maintenance costs and [Table 29](#) includes them.

[Table 30](#) summarizes estimates of the key economic indicators for the project under two scenarios: 1) without considering privately incurred maintenance costs and 2) including privately incurred maintenance costs.

**TABLE 27: PROJECT COSTS**

Budget categories	Costs (US dollars unless specified otherwise)				
	2009	2010	2011	Total	% of total
5011 Salaries Professional (Parent Account)	237,996	240,324	320,000	798,320	11.1
5012 Salaries General Service (Parent Account)		1,485		1,485	0.0
5013 Consultants (Parent Account)	273,400	381,827	500,000	1,155,226	16.1
5014 Contracts (Parent Account)	1,178,368	394,603		1,572,971	21.9
5020 Locally Contracted Labour (Parent Account)	11,453	18,580	35,000	65,033	0.9
5021 Travel (Parent Account)	76,354	198,660	245,000	520,014	7.2
5023 Training (Parent Account)	44,146	188,386	270,000	502,532	7.0
5024 Expendable Procurement (Parent Account)	188,406	467,438	270,000	925,844	12.9
5025 Non Expendable Procurement (Parent Account)	49,271	310,696	50,000	409,967	5.7
5026 Hospitality (Parent Account)			32	32	0.0
5027 Technical Support Services (Parent Account)	7,740	14,682	30,000	52,422	0.7
5028 General Operating Expenses (Parent Account)	115,326	194,784	270,000	580,110	8.1
5029 Support Costs (Parent Account)	283,720	313,491		597,211	8.3
5040 General Operating Expenses - external common services (Parent Account)	4			4	0.0
Total cost (US dollars)	2,466,183	2,724,956	1,990,032	7,181,170	100.0
Cost at 2011 level (US dollars)	1,712,024	2,425,210	1,990,032	6,127,266	
Cost at 2011 level (million Rupees)	148.090	209.781	172.138	530.009	

Source: USABBA project records.

Note: 1- The expenditure for 2011 includes projected expenditure through December, 2011.

2- US dollars converted to Pakistan Rupees at an exchange rate of Rs. 86.5=\$1.

**TABLE 28: PRESENT VALUE CALCULATIONS OF PROJECT COSTS AND BENEFITS  
(WITHOUT MAINTENANCE COSTS)**

Year	Project benefits (2011 values)						Project costs (thousand \$)		
	Rs. (millions)				US dollars( millions)		Nominal	2011	Present value
	Crops	Water	Livestock	Total	Total	Present value			
2009	22.91	0.00	0.00	22.9	264.9	350.3	2,269.0	1,575.1	2,083.1
2010	85.71	4.91	0.10	90.7	1,048.8	1,206.1	2,256.0	2,007.8	2,309.0
2011	100.28	10.83	0.10	111.2	1,285.6	1,285.6	1,539.0	1,539.0	1,539.0
2012	101.94	14.13	0.14	116.2	1,343.5	1,168.3	0.0	0.0	0.0
2013	109.20	17.89	0.14	127.2	1,470.8	1,112.1	0.0	0.0	0.0
2014	109.51	17.89	0.14	127.5	1,474.4	969.5	0.0	0.0	0.0
2015	120.44	17.89	0.14	138.5	1,600.7	915.2	0.0	0.0	0.0
2016	249.05	17.89	0.14	267.1	3,087.7	1,535.1	0.0	0.0	0.0
2017	479.54	17.89	0.14	497.6	5,752.2	2,486.8	0.0	0.0	0.0
2018	479.35	17.89	0.14	497.4	5,750.0	2,161.6	0.0	0.0	0.0
2019	475.53	17.89	0.14	493.6	5,705.8	1,865.2	0.0	0.0	0.0
2020	471.90	17.89	0.14	489.9	5,663.9	1,610.0	0.0	0.0	0.0
2021	468.46	17.89	0.14	486.5	5,624.1	1,390.2	0.0	0.0	0.0
2022	465.18	17.89	0.14	483.2	5,586.3	1,200.7	0.0	0.0	0.0
2023	462.08	17.89	0.14	480.1	5,550.3	1,037.4	0.0	0.0	0.0
<b>Present value</b>					<b>51,209.0</b>	<b>20,294.3</b>			<b>5,931.1</b>

**TABLE 29: PRESENT VALUE CALCULATIONS OF PROJECT COSTS AND BENEFITS  
(WITH MAINTENANCE COSTS)**

Year	Project benefits (2011 values)						Project costs (thousand \$)		
	Rs. (millions)				US dollars( millions)		Nominal	2011	Present value
	Crops	Water	Livestock	Total	Total	Present value			
2009	22.91	0.00	0.00	22.9	264.9	350.3	2,269.0	1,575.1	2,083.1
2010	85.71	4.91	0.10	90.7	1,048.8	1,206.1	2,256.0	2,007.8	2,309.0
2011	100.28	10.83	0.10	111.2	1,285.6	1,285.6	1,539.0	1,539.0	1,539.0
2012	101.94	14.13	0.14	116.2	1,343.5	1,168.3	500.0	555.0	482.6
2013	109.20	17.89	0.14	127.2	1,470.8	1,112.1	500.0	616.1	465.8
2014	109.51	17.89	0.14	127.5	1,474.4	969.5	500.0	683.8	449.6
2015	120.44	17.89	0.14	138.5	1,600.7	915.2	500.0	759.0	434.0
2016	249.05	17.89	0.14	267.1	3,087.7	1,535.1	500.0	842.5	418.9
2017	479.54	17.89	0.14	497.6	5,752.2	2,486.8	500.0	935.2	404.3
2018	479.35	17.89	0.14	497.4	5,750.0	2,161.6	500.0	1,038.1	390.3
2019	475.53	17.89	0.14	493.6	5,705.8	1,865.2	500.0	1,152.3	376.7
2020	471.90	17.89	0.14	489.9	5,663.9	1,610.0	500.0	1,279.0	363.6
2021	468.46	17.89	0.14	486.5	5,624.1	1,390.2	500.0	1,419.7	350.9
2022	465.18	17.89	0.14	483.2	5,586.3	1,200.7	500.0	1,575.9	338.7
2023	462.08	17.89	0.14	480.1	5,550.3	1,037.4	500.0	1,749.2	326.9
<b>Present value</b>					<b>51,209.0</b>	<b>20,294.3</b>			<b>10,733.5</b>

**TABLE 30: SUMMARY OF ECONOMIC INDICATORS**

Indicator	Without private maintenance costs	With private maintenance costs
Benefit cost ratio	3.42	1.89
Net present value (thousand \$)	14,363	9,561
Internal rate of return (%)	16	14

## DISSENT

The implementing partner (FAO) reviewed a draft of this evaluation report and provided the following comments – mostly related to the cost benefit analysis portion of the report.

- The costs that are particular to operating in Balochistan’s security environment (e.g., armored vehicles) should be removed from the cost benefit analysis so as to provide a valid comparison with projects that operate in areas without these requirements. In fact, all costs associated with meeting USAID requirements that do not directly relate to project development activities should be removed from the analysis since these are not costs associated with actually accomplishing project objectives. Removing such costs would produce a cost benefit comparison that accurately reflected the true return to actual development activities.
- Similarly, the cost benefit analysis should attach a monetary value to reports produced for USAID. The reporting burden is unusually high and consumes a large amount of staff time and resources. A cost benefit analysis that does not place a value on these reports distorts returns to the expenditure of project resources. Ignoring the value of reports implies they have a zero value which is certainly not true.
- The evaluation’s conclusion that the project-supported livestock maundis produced few (Rs. 55,000) monetary returns on a turnover of about \$8 million per year seems off.
- The FAO sub-award to MEDA for the WEE:B project should not be included in the cost benefit analysis unless the benefits from the project are also included.

These are valid opinions. However, the benefit cost analysis reflects the cost of implementing projects in the security and political environment in Pakistan and with a donor agency such as USAID. Comparing the current cost benefit analysis with an analysis that strips out the costs suggested by FAO would provide a useful measure of the cost of operating in Pakistan, and with USAID, relative to more secure environments and other donors. However, such an analysis is not particularly relevant to USAID in this context and is beyond the scope of the evaluation.

With respect to the returns to the livestock maundis, the project has not produced credible measures of benefits from the markets and the evaluators lacked sufficient data to fully evaluate the impacts of the markets. The issue is not farmers’ returns from the markets but the incremental returns that can be attributed to the USABBA project. In these cases, measuring the incremental return from the markets has proven difficult.

With respect to including the WEE:B project costs in the cost benefit analysis, FAO has a valid point and the evaluators removed these values from the analysis. The evaluators subtracted \$197,169 for 2008, 468,922 for 2009, and 451,130 for 2010. Tables 28 through 30 reflect results without WEE:B costs.

## ANNEX I: SURVEY INSTRUMENTS

The data collection instruments in this annex have been modified from their original format to save space.

Killi/ Village .....					Tehsil .....				
Distt.....									
<b>Farmgate Prices - (five per district)</b>									
<b>Prices for major crops in area market- Rs</b>					<b>Average price for animals</b>				
1	Wheat/ maund				1	Cow (local) mature			
2	Jowar/ Bajra/ maund				2	Cow (Australian) mature			
3	Maize/ maund				3	Sheep/ Goat mature			
4	Cumin/ maund				4	Cow Young			
5	Barseem/ kanal				5	Goat/ Sheep Young			
					6	Shukrana/ bag			
<b>Fruits - Weight/ Crate &amp; Prices</b>					7	Cottonseed cake/ bag			
		Weight/ Crate	Price/ Crate - Rs		8				
1	Plums				<b>Concentrates/ Feed - Rs</b>				
2	Peaches				1	Cotton seed Cake/ bag of 45 kg			
3	Grapes				2	Choker/ bag of 40 kg			
4	Apple Gaja				3	Shukrana/ Vanda/ bag (45 kg)			
5	Apple kala Kalu				4	Wheat straw/ 40 kg			
6	Apricot								
7	Almonds	bag of ... kg							
8	Olive	per kg							
9	Pistachio	per kg			<b>Misc Prices - Rs</b>				
					1	Eggs/ dozen (Winter)			
<b>Average price/ Hired Wage rate- Rs</b>					2	Milk per kg			
1	Ploughing per acre				3	Wool/ kg			

2	Wheat harvesting - Rs/ acre			4	Hide (cow/ buffalo)/ unit
3	Other farm operations - Rs/ day			5	Hide/ Skin (sheep/ goat)/ unit
4	Fruit picking/ acre				
5	Fruit picking/ Datsun load (..... crates)				<b>Transport chages to nearest market - Rs</b>
6	Fruit grading/ packing/ acre			1	Per Crate
7	Urea/ 50 kg bag			2	Per Datsun load
8	DAP/ 50 kg bag			3	Crates per Datsun
9	Nitophos/ 50 kg			4	per sheep/ goat to nearest Livestock market
10	Potash/ bag				
11	Pesticide per acre for fruits				
12	Pesticide per acre for general crops				

CO Name: .....  
 District: (tick): ...Killa Saifullah/ Loralai

**Crop Production Inputs per acre**

Description	Unit	Wheat (FAO)	Wheat local	Lucern	Peas				
Ploughings	No								
Seed	kg								
N	bags								
P	bags								
K	bags								
FYM	Yes/No								
Plant protection	Yes/No								
Irrigations - No	Yes/No								
Yield per acre									
Weight per bag									

CO Name: .....  
 District: (tick): ...Killa Saifullah/ Loralai

**Cost of Production for Orchards**

Crop	Plant price/ No (farmer share)	DAP - nut kg		Urea - nut kg		Potash - nut kg		Production starts from year	Production/ acre	
		1-3 Yr	>3 Yr	1-3 Yr	>3 Yr	1-3 Yr	>3 Yr		Unit	Quantity
Peaches										
Plums										
Pomegranates										
Grapes										
Apples										
Apricot										
Almond										

Olive										
Pistachio										

### I- Karez Rehabilitation

CO Name: .....

District: (tick): ...Killa Saifullah/ Loralai

Respondent Name ..... Tehsil .....

Total Farm Area (acres) ..... out of which Cultivated area is ..... Acres

The cultivated farm area consists of ..... acres of owned land + ..... acres of sharecropped land and ..... acres of Lease land, adding up to ..... acres in total.

Crop	Area (acres)		Production - maunds	
	Before intervention	After intervention	Before intervention	After intervention
Wheat				
Barley				
Cumin				
Maize				
Lucern				
Vegetables				
Peas				
Orchards				

Note 1- Write total farm area, whether owned or not. Also give production for entire cropped area of a particular crop

### 2- Water Storage reservoir

CO Name: .....

District: (tick): ...Killa Saifullah/ Loralai/ Zhob

Respondent Name ..... Tehsil .....

Total Farm Area (acres) ..... out of which Cultivated area is ..... Acres

The cultivated farm area consists of ..... acres of owned land + ..... acres of sharecropped land and ..... acres of Lease land, adding up to ..... acres in total.

Crop	Area (acres)	Production - maunds/ crates	use this column if needed
Wheat			
Barley			
Cumin			
Maize			
Lucern			
Vegetables			

Peas			
Orchards			
<i>Note 1- Write total farm area, whether owned or not. Also give production for entire cropped area of a particular crop</i>			

### 3- Water Pipeline

CO Name: .....

District: (tick): ...Killa Saifullah

Respondent Name ..... Tehsil .....

Total Farm Area (acres) ..... out of which Cultivated area is ..... Acres

The cultivated farm area consists of ..... acres of owned land + ..... acres of sharecropped land and ..... acres of Lease land, adding up to ..... acres in total.

Crop	Area (acres)		Production - maunds	
	Before intervention	After intervention	Before intervention	After intervention
Wheat				
Barley				
Cumin				
Maize				
Lucern				
Vegetables				
Peas				
Orchards				

*Note 1- Write total farm area, whether owned or not. Also give production for entire cropped area of a particular crop*

### 4- Micro Catchment Water Harvesting

CO Name: .....

District: (tick): ...Killa Saifullah

Respondent Name ..... Tehsil .....

Total Farm Area (acres) ..... out of which Cultivated area is ..... Acres

The cultivated farm area consists of ..... acres of owned land + ..... acres of sharecropped land and ..... acres of Lease land, adding up to ..... acres in total.

Crop	Area (acres)		Production - maunds	
	Before intervention	After intervention	Before intervention	After intervention

Wheat				
Barley				
Cumin				
Maize				
Lucern				
Vegetables				
Peas				
<i>Note 1- Write total farm area, whether owned or not. Also give production for entire cropped area of a particular crop</i>				

<b>5- Land Levelling</b>				
CO Name: .....				
District: (tick): ...Killa Saifullah/ Loralai/ Zhob				
Respondent Name ..... Tehsil .....				
Total Farm Area (acres) ..... out of which Cultivated area is ..... Acres				
<i>The cultivated farm area consists of ..... acres of owned land + ..... acres of sharecropped land and ..... acres of Lease land, adding up to ..... acres in total.</i>				
Crop	Area (acres)		Production - maunds	
	Before intervention	After intervention	Before intervention	After intervention
Wheat				
Barley				
Cumin				
Maize				
Lucern				
Vegetables				
Peas				
<i>Note 1- Write total farm area, whether owned or not. Also give production for entire cropped area of a particular crop</i>				

<b>6- Knapsack sprayer</b>		
CO Name: .....		
District: (tick): ...Killa Saifullah/ Loralai/ Zhob		
Respondent Name ..... Tehsil .....		
Area sprayed/ annum - acres (i/c others if any)		
Charges per acre sprayed before - Rs		

<b>7- Power sprayer</b>		
CO Name: .....		
District: (tick): ...Killa Saifullah/ Loralai/ Zhob		
Respondent Name ..... Tehsil .....		
Area sprayed in a year (own + rental) - acres		
Charges per acre - Rs		

<b>8- Silos distribution</b>		
CO Name: .....		
District: (tick): ...Killa Saifullah/ Loralai/ Zhob		
Respondent Name ..... Tehsil .....		
Extent of wheat wastage before Silos were provided .....- kg/ year		

<b>9- Wheat Seed Provision</b>		
CO Name: .....		
District: (tick): ...Killa Saifullah/ Loralai/ Zhob		
Respondent Name ..... Tehsil .....		
Area planted with FAO seed - acres		
Yield per acre with FAO seed - mds		
Yield/ acre with traditional seed - mds		
Seed retained for planting in subsequent year - Yes/ No		
If yes, yield/ acre in next year		
Did you sell the seed to any neighboring/ other farmer - Yes/ No		
If yes, the price/ maund .....Rs		

<b>10- Alfalfa seed provision</b>		
CO Name: .....		
District: (tick): ...Killa Saifullah/ Loralai		
Respondent Name ..... Tehsil .....		
Area planted with FAO seed - acres		
No. of cuttings per year .....		
No. of cuttings with traditional seed - .....		

Approximate quantity per cutting ----- maunds			
Did you sell the seed to any neighboring/ other farmer - Yes/ No			
If yes, the price/ maund .....Rs			

<b>11- Provision of Pea seed</b>			
CO Name: .....			
District: (tick): ... Loralai			
Respondent Name ..... Tehsil .....			
Area planted with FAO seed - acres			
Yield per acre with FAO seed - mds			
Yield/ acre with traditional seed - mds			

<b>12- Provision of Subsidized Fruit plants</b>			
CO Name: .....			
District: (tick): ...Killa Saifullah/ Loralai/ Zhob			
Respondent Name ..... Tehsil .....			
Plants purchased of (Name of plant):			
Number of plants purchased:			
Cost per plant (farmer 50% share):			

<b>13- Green House</b>			
CO Name: .....			
District: (tick): ...Killa Saifullah/ Loralai			
Respondent Name ..... Tehsil .....			
Green House shed area ..... ft x ..... Ft			
Vegetables grown	Area	Income - Rs	
Was the yield higher than traditional planting - Yes/No			
If Yes, how much : ..... perent			



CO Name: .....

District: (tick): ...Killa Saifullah/ Loralai/ Zhob

Respondent Name ..... Tehsil .....

Total Farm Area (acres) ..... out of which Cultivated area is ..... Acres

The cultivated farm area consists of ..... acres of owned land + ..... acres of sharecropped land and ..... acres of Lease land, adding up to ..... acres in total.

Crop	Area (acres)	Production - maunds/ crates	use this column if needed
Wheat			
Barley			
Cumin			
Maize			
Lucern			
Vegetables			
Peas			
Orchards			

Note 1- Write total farm area, whether owned or not. Also give production for entire cropped area of a particular crop

**Water Pipeline Without improvement**

CO Name: .....

District: (tick): ...Killa Saifullah

Respondent Name ..... Tehsil .....

Total Farm Area (acres) ..... out of which Cultivated area is ..... Acres

The cultivated farm area consists of ..... acres of owned land + ..... acres of sharecropped land and ..... acres of Lease land, adding up to ..... acres in total.

Crop	Area (acres)	Production - maunds
Wheat		
Barley		
Cumin		
Maize		
Lucern		
Vegetables		

Peas			
Orchards			
<i>Note 1 - Write total farm area, whether owned or not. Also give production for entire cropped area of a particular crop</i>			

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**Sailaba/ Khushkaba lands, at present**

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CO Name: .....

District: (tick): ...Killa Saifullah/ Loralai/ Zhob

Respondent Name ..... Tehsil .....

Total Farm Area (acres) ..... out of which Cultivated area is ..... Acres

*The cultivated farm area consists of ..... acres of owned land + ..... acres of sharecropped land and ..... acres of Lease land, adding up to ..... acres in total.*

Crop	Area (acres)	Production
Wheat		
Barley		
Cumin		
Maize		
Lucern		

*Note 1 - Write total farm area, whether owned or not. Also give production for entire cropped area of a particular crop*

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## **ANNEX 2: PERSONS INTERVIEWED**

Dr Muhmmad Afzal	Director General AZRI Quetta
Mr Jehangir Afridi	ICARDA
Dr Muhammad Ashraf	Chief (Retd) Agronomy Pakistan Agri. Research Institute Islamabad
Dr Muhammad Ashraf	Director OFWM PARC Islamabad
Mr Masood Baloch	Director Agri. Marketing Agri. Department Balochistan,
Mr Saeed Akhtar	Director Statistics Agri. Department Balochistan
Dr Muhammad Saeed	Independent Consultant, Quetta

# ANNEX 3: DETAILED TABLES

**TABLE 31 : SAMPLE SELECTION**

Activity	No. of schemes implemented							Sample (persons interviewed)				
	Unit	Killa Saifullah	Loralai	Mastung	Quetta	Zhob	Total	Unit	Killa Saifullah	Loralai	Zhob	Total
Wheat seed	No	609	1,191	61	95	558	2,514	Beneficiaries	15		29	44
Alfalfa seed	No	64	14		9		87	Beneficiaries	5	10		15
Pea seed	No		43		1		44	Beneficiaries		14		14
Wheat Demo plots	No	10	10	4	10	11	45					0
Barley Demo plots	No	2	1			1	4					0
Knapsack sprayers	No	4	5	2	37	4	52	Beneficiaries		2	15	17
Power sprayers	No	18	20	28	44	20	130	Beneficiaries	4		17	21
Silos	No	3	3	3		3	12	Beneficiaries	3	3	3	9
Green Houses	No	1	1	1	1		4	Beneficiaries	1	1		2
Land levelling	No	42	52	61	4	18	177	Beneficiaries	16	15	15	46
Fruit plants	No	255	462	465	40	192	1,414	Beneficiaries	6	12	5	23
Karez rehabilitation	No	19	1		1		21	Beneficiaries	7	2		9
Water Storage Reservoir	No	7	9	1		6	23	Beneficiaries	7	14	10	31
Pipeline	No	7		8	2		17	Beneficiaries	13			13
Drinking Water Supply	No	5	2	1		2	10	Beneficiaries	3			3
MCWH	No	1					1	Beneficiaries	1			1
Livestock feed	bags	875		1,160		501	2,536	Beneficiaries	15	14	15	44
Poultry							-					
Veterinary treatment	events	9	9	9	9	9	45					0
Livestock shows	No	2	2	2		1	7					0
No Water Storage								Respondents	7	14	10	31
No Pipeline								Respondents	2			2
Sailaba land								Respondents	9	10	7	26
<b>Total</b>		<b>1,933</b>	<b>1,825</b>	<b>1,806</b>	<b>253</b>	<b>1,326</b>	<b>7,143</b>		<b>114</b>	<b>111</b>	<b>126</b>	<b>351</b>

**TABLE 32: COST OF PRODUCTION AND GROSS MARGINS PER ACRE**

Description	Unit	Wheat		Barley	Alfalfa	Maize		Millet
		Irrigated	Khushkaba/ Sailaba	Khushkaba/ Sailaba	Irrigated	Irrigated	Khushkaba/ Sailaba	Khushkaba/ Sailaba
<b>Quantity/unit required</b>								
Land prep	tractor hrs	2.4	1.5	1	2.4	1.5	1	1
Seed	kg	50	50	35	8	12	12	3
Urea	50 kg bag	2.0	0.0	0.0	0.4	1.2	0.0	0.0
Nitrophos	50 kg bag	1.2	0.0	0.0	0.0	0.4	0.0	0.0
Plant protection	Rs	480	0	0	0	0	0	0
Hired labour	mdy	4	2.8	2.4	7	2	1.2	1.4
Irrigation	No	3	0		6	3	0	0
Yield per acre	kgs	850	480	870	12,000	520	375	230
<b>Cost of production</b>								
Total Labour	mdy	8	5.6	4.8	14	4	2.4	2.8
Land preparation	750	1,800	1,125	750	1,800	1,125	750	750
Seed/ kg		1,550	1,550	1,050	5,000	360	384	72
Urea	1,700	3,400	-	-	680	2,040	-	-
Nitrophos	2,800	3,360	-	-	-	1,120	-	-
Plant protection		480	-	-	-	-	-	-
Hired labour	275	1,100	770	660	1,925	550	330	385
Irrigation	175	525	-	-	1,050	525	-	-
Total cost - Rs		12,215	3,445	2,460	10,455	5,720	1,464	1,207
Bye products	6.25	5,844	2,700	4,894				
Gross returns - Rs		27,094	14,700	25,774	33,000	11,440	7,875	5,290
Gross margins - Rs		14,879	11,255	23,314	22,545	5,720	6,411	4,083
Seed rate	Rs/kg	31	31	30	625	30	32	24
Unit price	Rs/kg	25	25	24	2.75	22	21	23

Note: 1- Land rent and family labour is not considered in arriving at Gross margin figures.

2- Wheat and Barley straw taken as 110% of grain for irrigated crop and 90% for khushkaba/ sailabaq crop..

Description	Unit	Tomato	Onion	Chillies	Carrot	Potato	Peas	Fruits	
		Irrigated	Irrigated	Irrigated	Irrigated	Irrigated	Irrigated	I-6 yr	>6 yr
<b>Quantity/unit required</b>									
Land prep	tractor hrs	2.8	4.8	3.2	2.8	4	4.8	1.5	2.4
Seed	kg	0.15	12	0.4	3.2	60	12	1,800	0
Urea	50 kg bag	4.0	4.0	1.6	3.2	4.0	3	1.0	4.8
Nitrophos	50 kg bag	1.6	2.4	0.6	2.0	2.4	2	1.0	3.2
Plant protection	Rs	600	4,000	700	1,000	3,400	3,000	1,400	5,000
Hired labour	mdy	32	24	28.8	24	12.8	24	8	512
Irrigation	No	8	20	12	15	9	8	7	8
Yield per acre	Kgs	12,000	6,600	12,000	5,800	5,400	3,000	-	12,000
Total Labour	mdy	40	30	36	30	16	30	10	640
<b>Cost of production</b>									
Land preparation	750	2,100	3,600	2,400	2,100	3,000	3,600	1,125	1,800
Seed/ kg		1,500	2,000	1,500	2,500	2,400	3,000	54,000	-
Urea	1,700	6,800	6,800	2,720	5,440	6,800	5,440	1,700	8,160
Nitrophos	2,800	4,480	6,720	1,680	5,600	6,720	5,600	2,800	8,960
Plant protection		600	4,000	700	1,000	3,400	3,000	1,400	5,000
Hired labour	275	8,800	6,600	7,920	6,600	3,520	6,600	2,200	140,800
Irrigation	175	1,400	3,500	2,100	2,625	1,575	1,400	1,225	1,400
Total cost - Rs		25,680	33,220	19,020	25,865	27,415	28,640	64,450	166,120
Bye products	6.25								
Gross returns - Rs		84,000	92,400	84,000	87,000	86,400	78,000	-	324,000
Gross margins - Rs		58,320	59,180	64,980	61,135	58,985	49,360	(64,450)	157,880
Seed rate	Rs/kg	LS	LS	LS	LS	40	250	30	
Unit price	Rs/kg	7	14	7	15	16	26		27

Note: 1- Land rent and family labour is not considered in arriving at Gross margin figures.

2- Wheat and Barley straw taken as 110% of grain for irrigated crop and 90% for khushkaba/sailabaq crop..

