BENEFICIARY IMPACT ASSESSMENT

Groundwater Soil Conservation Project

Final Report, June 2012

META Research

Water and Environment Centre

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I. Executive Summary

I.I Introduction

This report describes the beneficiaries' impact assessment of the Groundwater and Soil Conservation Project (GSCP). The GSCP became effective in 2004 and had under the overall objective of groundwater and soil conservation, three goals: (a) improved irrigation water use efficiency; (b) improved recharge and protection of watersheds in order to increase surface and groundwater availability and (c) support the groundwater management framework and institutions that will have the capacity to manage local water resources sustainably. These three goals are addressed in three consecutive project components.

The study assessed farmers' views on the implementation process, project impact and sustainability of the GSCP activities. It undertook farmers' interviews and focus group discussions in the period April-May 2012 in five Field Units: Dhamar, Hodeida, Northern -Sana'a, Hadramaut - Seyoun and Taiz-Ibb. In all 100 beneficiaries were interviewed in addition to 23 non-beneficiaries; 38 focus group discussions and system walk-throughs were held and 20 key informants were interviewed. The beneficiaries were selected on the basis of a stratified sample – taking into account small and large farmers and the different types of facilities developed under the GSCP (piped conveyance systems; localized irrigation systems; spate irrigation systems and water harvesting).

Beneficiaries' views on each component of the GSCP are summarized below: introduction of efficient field irrigation systems (component 1), the development of spate irrigation and water harvesting systems (component 2) and water institutions for local water management (component 3). Emphasis is particularly on the identification of beneficiaries, the assessment of project procedures, the functionality of the systems, the impact of the project and the sustainability and replicability.

I.II Beneficiaries views on Component 1

To be eligible for support under component 1, farmers had to contribute 30-40% of the investment costs for the conveyance systems, the exact amount depending on the farm size; for localized system the farmer cost contribution, depending on farm size was 40 or 50%. Most farmers agreed with the cost sharing arrangement (77%) However, small farmers, without supplementary sources of income, found it difficult to pay before the harvest time as they usually have a cash flow problem. The same was confirmed in the interviews with non-beneficiaries. Most were aware of what GSCP had to offer and valued it highly and did not have problems with the cost sharing arrangements as such, but some had difficulty with the payment in cash at the appropriate time for them. .

The beneficiary farmers evaluate the GSCP project implementation procedures under component 1 positively. More than 90% of the beneficiary farmers had a positive judgment on the overall implementation of the work. Procedures are assessed as easy by 78% of sampled farmers, (the design was perceived as satisfactory by 77% of the beneficiary farmers and the quality of the work was perceived as good by 71% of the beneficiary farmers). From the focus group discussion it is clear that, particularly with regards the conveyance systems subcomponent, a problem solving partnership has developed with farmers. Farmers sometimes do trenching and make modifications to their systems and other farmers' systems, if required, for instance replacing vulnerable above the ground PVC elements with steel or galvanized iron parts.

Interviewed farmers' perceived functionality of the installed systems as high. Problems, if any, have been solved by farmers themselves. The most common minor problems are the stopper on the conveyance systems and some cuts in the polyethylene systems. Only few micro-sprinklers were

installed but farmers in the survey who had obtained micro-sprinkler were extremely positive particularly for their use on orchards with developed root systems.

The impact of the improved irrigation systems is assessed as very positive by almost all farmers. The survey results revealed that 94% of the beneficiary farmers from piped conveyance systems mentioned that they have realized an increase in income and 80% did so for localized systems. In this respect the appreciation by small and large farmers is similar. These encouraging outcomes should also be seen against the backdrop of the diesel crisis in 2011. In this crisis diesel price increased fourfold for a number of months – causing farmers to ration diesel consumption and shrinking particularly the area under vegetables. This seems not to have affected farmers' positive views on the improved irrigation systems.

Interestingly most of the interviewed farmers assessed the most important benefits of the improved systems in component 1 not primarily in terms of water saving or groundwater conservation. In the conveyance systems the main benefit realized were reduced labor and increased crop yields, however, with improved conveyance less wear and tear on the pumping equipment coming next. In the conveyance systems 75% of the interviewed farmers indicated to have significantly saved irrigation labor, whereas 25% mentioned that increase in crop productivity to be above 15% and also 34% of the interviewed farmers mentioned that water savings were more than 25% on the conveyance system.

The localized systems are more costly but their effect on water savings is also more pronounced. In case of the bubbler and drip systems, 96% of the interviewed farmers mentioned that they reduced irrigation labor; 76% of the interviewed farmers' crop production increased with more than 15% and 68% of interviewed farmers informed that irrigation water use was reduced by more than 25%. The latter is consistent with field measurement that state 33% of water saving is realized under the localized systems and 13% water saving is realized under the piped conveyance system. Few farmers (4 % of beneficiaries of conveyance and 9 % of beneficiaries of localized systems) viewed that switching over to conveyance and localized systems had positive significant impact on ground water level

The results of the detailed interviews with farmers to quantify the magnitude of the improvements – comparing the before and after situation, revealed an average of 46 % savings in pumping costs, 39 % saving in diesel consumption, and 54 % saving in labour use. The results are in line with the Water Savings Report – in fact even more positive. Some caution is required as the results are based on farmers recall.

Sustainability appears not to be in doubt. Most of the interviewed farmers see the main role for themselves in this regard; In case of conveyance systems they would also engaging technicians from the market. –In localized systems the backup services of locally available technicians is (as yet) less than actual demand. The main concern is the availability of spare parts, which is highlighted by the majority of the interviewed farmers. Few farmers see, for both localized and conveyance systems, some possible constraints in the availability of spare parts; their price or a combination of both, however, the concern with the challenge is a little higher for the localized systems.

In general the appreciation for this program is high as seen not only from the answer of the beneficiary farmers, but also seen from the waiting lists of farmers to acquire the improved irrigation systems as discussed in the focus group interviews. In fact 44% of the interviewed farmers would accept half of the current subsidy in a future cost sharing arrangement.

I.III Beneficiaries views on Component 2

From the sampled beneficiaries, it appears that most of the interviewed farmers under component 2 do not have secondary sources of income (93%) and that the farms are mostly owner-operated (75%).

The initial site selection was done according to 44% of respondents in case of spate irrigation and 61% in case of water harvesting structures either by the Field Unit or by beneficiary farmers applying to the project.

There was positive appreciation of the implementation of the activities of component 2. In the spate systems including, the programs on bank protection and flood breakers. Almost all the beneficiary farmers who participated in the focus group discussion informed that they were consulted in the selection of the sites and the development of the design. The involvement of small farmers in the selection of the sites and development of the designs was even higher (93%) than that of large farmers (67%). In the sample there was unanimous (100%) satisfaction with both the site selection and the design of the spate systems among small and large farmers. The discussion with the field engineers of the Field Units started in an early stage and concerned the selection of the location of structures and joint visits were made to the proposed sites. In many cases the design closely followed the traditional infrastructure. There was also a good understanding of actual designs as they emerged especially in regard to the purpose of the structures (100%) and the maintenance requirements (78-92%) – with the understanding being higher among small farmers than large farmers. There has also been a well-appreciated practice of making changes to the designs whilst the work was on going, especially in the larger spate schemes. This is also necessary as according to 23 % of small respondents and 44 % of large respondents, there were some objections to the design at one stage. In general there was a large variety of designs used for all activities taking into account the local situation.

In the water harvesting sub component much of the work done was farmer-driven. The common practice in the development of new water tanks was for the beneficiary group (usually close knit and family related) to take the lead in the development of these structures, resulting in a large variety of locally adjusted designs. Work in the water tanks was implemented in the majority of cases of farmers interviewed on the basis of community contracts. As the standard dimensions under GSCP for these facilities ($150m^2$) were considered too small, beneficiary farmers developed in all cases visited, under the assessment, larger storage facilities with the beneficiary farmers contributing the remainder of the construction costs themselves. Hence beneficiary farmers cost shares on this activity were much higher than the compulsory 20%. In all the cases visited as part of the Beneficiary Impact Assessment more work had been done by the beneficiaries and a large variety of locally appropriate structures were build – sometimes even involving roofing.
In contrast in spate irrigation the role of farmers in actual construction of the works has been relatively limited. Participating farmers in the group discussions indicated that they were unable to contribute in cash but instead they could provide labour and building material (stones) available, whereas the cash contribution was provided by the Local Councils. In the focus group discussions the inability to contribute in cash were explained by farmers to be attributed to (1) general low returns in spate based agriculture and the relatively long gestation period of the investments (2) the time bound nature of the contribution making it difficult to have the cash ready when required and (3) the relatively weak organization of the Water Users Groups which is weak in organization and lacking official status. In fact the required cost contribution for the spate system is comparatively high: with average investment costs ranging between USD 800-1200/ha, the 15-20% farmer's share of the cost comes to an average of US$ 150-200/ha. This may be compared to the contribution in the case of piped conveyance, which is on average of 35 % of total costs of around USD 400/ha. This works out to be USD 140/ha.

In focus group discussion and walk through with the beneficiaries the functionality of the works was assessed under both spate irrigation and water harvesting systems. In total three systems were so assessed. In general the participating farmers assess the technical performance of the spate structures developed under component 2 as good. – The most important drawback being mentioned is the sedimentation of the structure, which is always a major challenge in spate irrigation systems and the encroachment by mesquite (prosopis juliflora), which is an invasive plant species blocking the water flow in the channels. In the water harvesting systems farmers indicated that they would have benefitted from more training and guidance in construction as the designs in many cases make much use of the local conditions but the finishing in some cases can be improved.

From the focus group discussion and walk through in the spate systems it appeared that there is also deferred routine maintenance and minor unfinished works such as open gabion boxes, scour holes around structures and small-localized sand deposits. These small issues may develop into larger problems in the course of time if ignored.

Beneficiary assessment of the impact of the activities under component 2 focused on a range of issues including, the area cultivated, the impact on crop production and equity of water distribution, as well as a number of secondary 'multiple use' benefits such as the re-greening of the area or the availability of water for humans and livestock. In general beneficiary farmers who participated in the focus group discussions indicated that the work under component 2 had improved their income. 86 % of all the beneficiary farmers under the spate irrigation systems and 83% of all the beneficiary farmers under water harvesting confirmed this. The nature of the spate irrigation and water harvesting activities are such that their impact is not always immediate as it depends on the availability of floods and rain. In spate irrigation systems the water distribution improved: in earlier situation (prior to the project improvements) large floods might wash out diversion structures, making it difficult to get the flood water on the land: this particularly affected downstream farmers.

Though the main purpose of the spate irrigation systems was to capture floodwater a large number of the beneficiary farmers interviewed also indicated that groundwater levels increased considerably. This is also very much the function of the flood breakers in this subcomponent of the project.

The development of spate systems reduces wadi banks damage and allows the re-greening of the areas; similarly the water harvesting activities also have a beneficial impact of reducing erosion. 64% of the farmers interviewed emphasized this benefit. Other benefits indicated by many beneficiaries particularly from the rehabilitation of existing water tanks has been the improved supply of water for drinking and domestic use as well as for livestock. The rehabilitated water tanks in fact in many cases have improved drinking water as a main purpose. As the systems under component 2 contribute to surface water storage, the stored water is acceptable for livestock but not preferred if there is an alternative secure source of drinking water in the area.

From the discussions with beneficiary farmers and the walk throughs, concerns as to the sustainability of the spate systems emerge. From the Focus Group Discussion it appears that the WUGs and WUAs are not prepared with contingencies (bank accounts, equipment) to undertake repairs on the spate and water harvesting systems. Farmers' views are that their main contribution in maintenance will be in the shape of labor. Also in some of the spate system there is only a Water User Group (WUG) in place, which is very informal in nature and has no status or organization usually. Discussions with the beneficiary farmers showed that 81% do not expect the WUG to take a leading role in maintenance. The majority of small and large farmers in spate systems are of the view that the responsibility for maintenance lies at least partly with local council or the GSCP Field Unit. On the other hand, most beneficiary farmers – especially small farmers - are prepared to maintain the system and contribute to its operation. Farmers in component 2 also indicated they would appreciate additional training on basic construction techniques.

I.IV Beneficiaries views on Component 3

Component 3 addressed local institutional development in support of water and soil conservation – in particular the establishment of Water User Groups, Water Users Associations and the Irrigation Advisory Services.

The Water Users Groups have been informal in nature – consisting typically of fifteen farmers. According to the sampled beneficiaries, the WUGs have been very instrumental in the implementation of the project activities and they also contributed to raising awareness on the water issues. 72% of the interviewed farmers assessed the WUGs as helpful.

At the inception of activities the beneficiary farmers signed a tripartite agreement with the GSCP Field Units and the Local Councils/ WUGs. Specific points in the tripartite agreement in component 1 were the endorsement of a ban on expanding agricultural land and growing qat, whereas in component 2 for the spate irrigation, maintenance by farmers was part of the agreement. During the fieldwork it appeared that 69% of the small farmers still agree to not growing qat on their land and 63% still agree on non-expansion; for large farmers this is respectively 42% and 48%. From this it appears that the regulation of groundwater use needs more efforts than the tripartite agreements only. Having said so there are several examples in the project area where farmers recently converted qat fields to other crops (peaches and coffee) – in Ibb, Dhamar and Sana'a. There are also a number of examples of farmers putting in place rules on the minimum distance between wells (500 meter), the development of new wells and on coordinating pumping operations. Local agreements concern conserving water and limiting abstractions were agreed to by 55% and 53% of the interviewed farmers respectively. These rules are in most cases (80%) enforced through informal local leadership. The resolution of local conflicts is also through informal local leadership, the role of the WUGs was confined to project activities and raising awareness. In component 2 WUGs were also assessed as being useful by 70% of the farmers, but they do not play a role in the maintenance of the spate irrigation systems.

In the GSCP the development of WUA has been supported in a number of instances. According to the last Progress Report there were eleven WUAs active within GSCP. The WUAs assessed during the field survey and focus group discussions consisted of committees with regular meetings. In some case the WUAs also have their own office. The scope of the WUAs has gone beyond facilitating project activities but has also concerned the regulation of water resources – in liaison with the National Water Resources Authority. The WUAs that were visited also endeavored to provide direct services such as the regulating access to diesel supplies during the diesel shortage experienced during the political unrest of 2011.

There is much interest from farmers in the services of the IAS, especially in training. The demand in fact appears far more than the project could offer within constraints of time and transportation facilities. A limited number (28%) of the farmers attended training directly including visit to demonstration farms or workshop. A regular 'complaint' of farmers was that they would have like to have more support in this regard and did not see the IAS as frequently as they would have like to. This reflects on the large needs for the services as provided by IAS.

The appreciation for training was generally positive particularly among farmers using the localized system, where 78% give it score high, however, only 53% of the beneficiaries using conveyance systems expressed their appreciation of the training. Of all farmers interviewed in component 1, 56% mentioned that they made a modification to their cropping system following the advice of IAS,

In general the services of the project, in particular the Field Unit, have been appreciated as 74% of the beneficiary farmers ranked it as excellent.

I.V Conclusions

Given the diversity, the magnitude and the new character of the project the results from the Beneficiary Impact Assessment are very positive. Highlights are the establishment of high quality systems of the conveyance systems and the water harvesting tanks to the beneficiaries, but also the important side benefits in reduced labor usage, higher crop yields and a re-greening of the area.

Main areas of attention are:
Groundwater regulation should receive more support. The interest is high and the awareness seems to have an effect. On the other hand, the restrictions on new land development and qat cultivation are not supported by all – especially not by large farmers. Strengthening the WUG and WUAs is essential to be more long lasting and play a major role in the conservation of groundwater. In addition building on some spontaneous good practices as they emerged – may be an important area to be further

strengthened. Also, the maintenance of the spate system is an area of concern that could be addressed by stronger and more widespread WUAs.

The appreciation of the different activities by the beneficiary farmers is high and the cost sharing arrangements are acceptable for both the activities of component 1 and component 2. However, the time-bound payment for small farmers being an issue that may exclude their access to the implementation of project activities under component 2. In terms of sustainability the availability and pricing of spare parts is an issue as is the maintenance of the spate systems. With respect to the cost sharing arrangements under component 1 a significant portion of farmers mentioned they were willing to accept an even lower subsidy amount in the future.

1. Introduction

1.1 Introduction

This report describes the beneficiaries' assessment of the GSCP interventions. It explains / reflects farmers' views on the operational procedures, project impact and sustainability of the GSCP activities. The report is based on farmers' interviews and focus group discussions undertaken during the period April-May 2012.

The Groundwater and Soil Conservation Project was set up to assist the Government of Yemen in promoting groundwater conservation in farming areas. In addition, spate improvement works and water harvesting could also lead to increasing surface and groundwater availability. As such GSCP had three goals[1]:

1) Improving irrigation water use efficiency, thus increasing farmers returns to water and creating the conditions that would allow them to reduce groundwater pumping from aquifers towards sustainable levels;
2) Improving recharge and protection of watersheds in order to increase surface and groundwater availability through the improvement of small and medium spate irrigation schemes, bank protection works, terraces and other water harvesting structures; and
3) Supporting the groundwater management framework and water institutions that will have the incentive and capacity to manage local water resources in a sustainable manner.

The project became effective in August 2004 and will come to closure by the end of June 2012. It is supported by an IDA Credit No. 3860 and IDA Grant No. H 4200. The GSCP operates from eleven Field Units in different Governorates in Yemen. Following the project goals its main activities have been the introduction of efficient field irrigation systems under component 1, the development of spate irrigation and water harvesting systems under component 2 and local institutional development in support of water institutions under component 3 – in particular the establishment of Water User Groups, Water Users Associations and an Irrigation Advisory Services.

The achievements of the activities of the three components of the GCSP, as on March 2012, are given in tables 1.1, 1.2, 1.3 and 1.4. It is evident that GSCP has achieved its planned targets envisaged in the PAD.

Table 1.1 Progress GCSP against targets for activities of component 1

Activities	Target area (ha)	Achieved area (ha)	% of achievement	Total no of farms covered
Conveyance systems	48,200	48,530	101%	12503
Localized systems	2,266	2,338	104%	1592

Source: GSCP, Progress Report IDA Credit 3860 (up to 15 March 2012)
GSCP, Progress Report IDA Grant 4200 (up to 15 March 2012)

[1]World Bank/ Republic of Yemen (2004)Groundwater and Soil Conservation Project Appraisal Document. Middle East and North Africa Region MNSRE

Table 1.2 Progress GCSP against targets for activities of component 2

Activity	Unit	Target as per PAD	Completed	% of achievement
Small and medium sized spate irrigation				
Spate diversion works	No	59	60	102%
Bank protection works	No	164	173	105%
Canal control structures	No	152	142	93%
Water harvesting and soil erosion control				
Terrace rehabilitation	No	295,365	364691	124%
Upland wadi bank protection	No	310	294	95%
Check dykes/soil conservation	No	87	63	72%
Vegetative measures	No	30	18	60%
New on farm water storage tanks	No	866	717	83%
Supplementary new tanks	No	0	128	
Rehabilitation of water storage tanks	M^3	200,752	157,965	79%
Traditional cisterns/wadi bed pits	M^3	409,720	410,413	100%

Source: GSCP, Progress Report IDA Credit 3860 (up to 15 March 2012)
GSCP, Progress Report IDA Grant 4200 (up to 15 March 2012)

Table 1.3 Progress GCSP against targets for activities of component 3

Activity	Target no	Achieved no	% of achievement	Target members	Achieved member	% of achievement
WUGs and WUAs						
Component 1 WUGs	970	779	80%	7700	12003	156%
Component 2 WUGs	2144	1803	84%	21440	27055	124%
WUAs under component 1 & 2	39	11	28%			

Source: GSCP, Progress Report IDA Credit 3860 (up to 15 March 2012)
GSCP, Progress Report IDA Grant 4200 (up to 15 March 2012)

Table 1.4 GCSP progress against targets related to demo farms and farmers training under component 3

Activity	Target no	Achieved no	% of achievement	Target area (ha)	Achieved area (ha)	% of achievement
Demonstration fields	116	100	86%	212	178	84%
Training of farmers						
Workshops	91	94	103.3			
Field days	675	507	75.1			

Source: GSCP, Progress Report IDA Credit 3860 (up to 15 March 2012)
GSCP, Progress Report IDA Grant 4200 (up to 15 March 2012)

1.2 Beneficiaries impact evaluation;

The Beneficiary Impact Evaluation was undertaken in line with the terms of reference in five Field Units, chosen to represent the different agro-ecological zones. Taking security considerations into account as well, the Field Units chosen were: Dhamar, Hodeidah, Taiz-Ibb, Northern - Sana'a governorate and Hadramawt-Seyoun.

Information was collected through sample surveys, focus group discussions and a walk-through of the selected systems with beneficiaries as well as interviews with non-beneficiaries and key-informants. The survey formats and interview guides were discussed and agreed with GSCP management. Clustered sampling of the beneficiaries and sites was done randomly on the basis of the beneficiary records of the GSCP PCU. This selection was fine-tuned and finalized in consultation with the Field Unit staff – on the basis of considerations of security and accessibility.

The beneficiary farmers interviewed under component 1 including beneficiary farmers who use on farm localized irrigation systems are 26 and beneficiary farmers who use conveyance systems are 25 farmers. On the other hand the beneficiary farmers who participated in the individual interviews under the spate irrigation improvement and the water harvesting sub components are 47 beneficiary farmers. In addition 20 non-beneficiary farmers were sampled – in the vicinity of these different types of systems. Care was taken to distribute the interviews over the sub-components within each main component. In some field units (Hodeidah, Northern FU, Sana'a governorate) there are very few spate irrigation improvement systems and hence more beneficiaries under the other sub-component (water harvesting and soil conservation) were sampled. In other cases (Northern FU- Sana'a governorate) there were few large farmers and more small farmers' interviews were then held. The interviews were complemented with focus group discussions and joint system walk throughs. For component 3, in addition to questions raised in the questionnaires and the focus group discussion, additional interviews were held with IAS staff, Field Unit staff and key informants – all following standard interview guides.

The quantitative data were analysed with SPSS (Statistical Package for Social Sciences). The data set will be made available to the GCSP management in soft copy. Table 1.4 is an overview of the different surveys undertaken as part of the Beneficiary Impact Assessment.

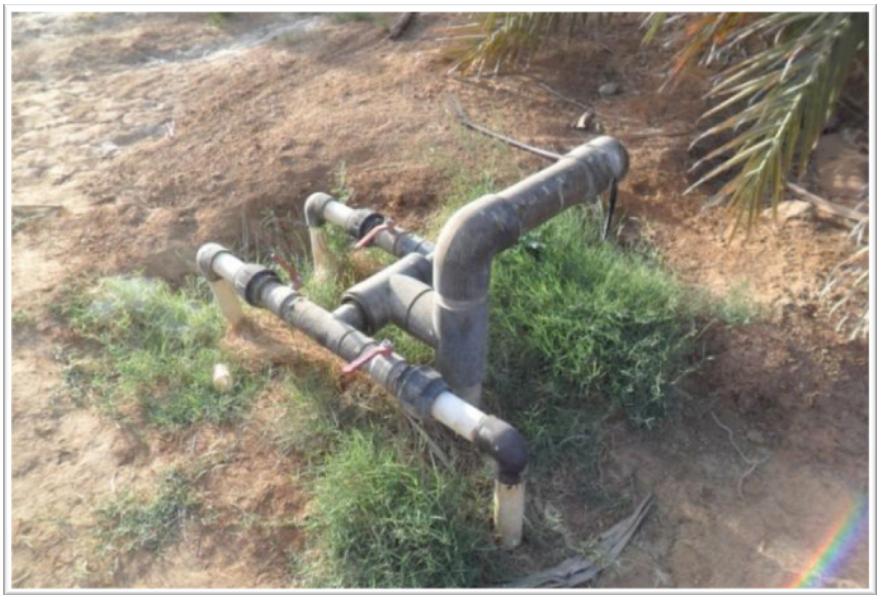
Table 1.5: Sample size selection and distribution according to components

Component	Activities	Small farmers	Large farmers	Total
Component 1	i) Piped conveyance	17	8	25
	ii) Localized on farm irrigation	17	9	26
	iii) Non beneficiaries			20
	iv) Joint walk through			8
	v) Focus group discussion			8
Component 2	i) Spate structures	9	12	21
	ii) Water harvesting	18	8	26
	iii) Non beneficiaries			13
	iv) Joint walk through			13
	v) Focus group discussion	9		9
Component 3	i) Key informants			10
	ii) FUs management			5
	iii) IAS engineers			5

1.3 Structure of the report;

This report discusses the beneficiary impact assessment of the three project components; the on farm localized on –farm irrigation systems sub component and the piped conveyance systems sub component under component 1; the spate irrigation improvement sub component and water harvesting and soil conservation sub component under component 2, in addition to local institutional development of water institutions under component 3. In each chapter beneficiary views as emerged from the interviews of the beneficiary farmers and the participants in the focus group discussions are given on the functionality of the systems, the impact of the systems, the sustainability and replicability of the achievements. The final chapter summarizes the finding and discusses a number of questions.

2. Beneficiaries Assessment of Conveyance and Localized Systems



Conveyance system in Ba'ageel farm (Seyoun)

The first component of GSCP is directly aimed at improving irrigation water use efficiency. The aim is to increase farmer returns to water and create the conditions that will allow them to reduce groundwater pumping from aquifers, whilst maintaining production levels.

Under component 1, two different types of improved irrigation systems have been promoted. In the first sub-component buried PVC pipes are installed as well as above ground PE (poly-ethylene) pipes and galvanized (GI) pipes[2]. These systems come in place of unlined earthen channels and are meant to minimize conveyance losses from the irrigation wells to the farmland.

In the second sub-component of component 1, localized on farm irrigation systems are installed. These mainly include drip and bubbler systems and to a lesser degree micro-sprinkler system. These systems reduce both conveyance and on-farm water losses. An assessment[3] was done of the water savings as a result of the installation of these two types of systems. Analysis of demonstration farms water savings data indicates that water savings from piped conveyance and the on farm localized irrigation systems amounted to 13 % and 34 % respectively over the traditional open channel and flood irrigation practices.

The improved / modernized irrigation systems under component 1 were provided on a cost-sharing basis. Different subsidy levels were used depending on the agro-ecological zone and maximum size of farm area to be covered by a system, with higher subsidies offered to small farmers. For conveyance systems installed in the highland districts the subsidy provided by GSCP is 70% for farms smaller than 2 ha, whereas it is 60% for farms larger than 2 ha. To qualify for subsidy the maximum farm size should not exceed 5 ha. In the lowland and coastal areas the cut-off point is 10 ha. For farms less than 5 ha the subsidy on conveyance system is 70% while for farms larger than 5 ha it is 60%. The maximum farm size should not exceed 10 ha. For the localized on farm irrigation system different subsidy amounts apply and amounting to 60 % for farms less than 1 ha and 50% for farms between 1–3 ha. For the localized on farm irrigation systems there was no distinction between highland and

[2]In several cases these systems have also been buried to reduce the risk of theft.

[3]Groundwater And Soil Conservation Project (2010), Water Savings Report: Component 1: Modernization and Improvement of Groundwater Irrigation.

lowland districts. As part of the requirement for farmers to qualify for the introduction of subsidized improved irrigation systems under GSCP, farmers had to join established WUGs – consisting of 10-12 farmers. The beneficiary farmers also had to sign a tripartite agreement in which they had to commit themselves not to expand the land under cultivation or to cultivate qat.

Localized (Bubbler) system

In this chapter beneficiary views are given from the Beneficiary Impact Assessment on the different aspects of the improved groundwater irrigation program of component 1. This chapter discusses participating beneficiaries, the process of involvement of water users in different stages of the project activities, the functionality of the structures installed under this component; the perceived impact and the sustainability and replicability of the investments made.

2.1 Participating beneficiaries

The main objective of the GSCP was groundwater conservation. However, to encourage smaller farmers to adopt the water saving irrigation techniques, a reduced cost contribution was required from farmers with farm holding below a certain land size (see above). From the review of the registry of the beneficiary farmers (undertaken in 2010), it appears that in the lowland areas, in particular, large farmers have made significantly more use of the modernized irrigation facilities offered by GSCP, whereas in the highland areas the larger part of the new facilities have gone to small farmers – both in terms of number of farmers and area covered by them as appeared in table 2.1. Both in the lowland and in the highland areas, a comparatively larger portion of small farmers availed of the subsidy provision for localized systems than for piped conveyance systems. This may come as a small surprise because the localized systems are more expensive per ha than piped conveyance systems and receive a smaller subsidy percentage.

Table 2.1 Distribution of beneficiary farmers & their farm size under component 1

Piped conveyance systems in Lowland		Unit	Number of farmers / areas	%
	Number of large farmers (5-10 ha)	No.	2824	61%
	Large farm area (ha)	Ha	22291	71%
	Number of Small farmers (0-5 ha)	No.	1781	39%
	Small farm area (ha)	Ha	9011	29%
Piped conveyance system in highland				
	Number of Large farmers (3-5 ha)	No.	3019	33%
	Large farm area (in ha)	Ha	10348	58%
	Number of Small farmers (0-3 ha)	No.	6235	67%
	Small farm area (in ha)	Ha	7,405	42%
Localized on farm irrigation systems in Lowland				
	Number of Large farmers (1-3 ha)	No.	561	56%
	Large farm area (in ha)	Ha	1626	81%
	Number of Small farmers (0-1 ha)	No.	447	44%
	Small farm area (in ha)	Ha	391	19%
Localized on farm irrigation systems in high land				
	Number of Large farmers (1-3 ha)	No.	183	30%
	Large farm area (in ha)	Ha	184	47%
	Number of Small farmers (0-1 ha)	No.	436	70%
	Small farm area (in ha)	Ha	206	53%

Source: GSCP (2010), Analysis of Farm Registry

The Beneficiary Impact Assessment asked the views of farmers as to whether the subsidy amount was a barrier to availing of the water saving technologies under component 1. The question was asked to small and large farmers – with a view to understand whether the cost sharing arrangement affected the interest of the beneficiaries. Tables 2.2 summarize the beneficiary farmers' views.

The main constraint for small farmers, as it appears from the beneficiary impact assessment is not necessary the amount of cost involved. Although there is no time bound to pay for acquiring piped conveyance or localized system, when there is a bottleneck or if no sufficient pipes, the priority will be for farmers who are able to pay and register. Such situation often coincides with non-harvesting period and made it difficult for some small farmers to avail of the facilities offered by the GCSP. From the sample of the interviewed beneficiary farmers it appears that most of the beneficiary farmers have farming as their main source of income and generally no significant additional sources of income to draw from. This is particularly so for small farmers and it explains the cash flow problem in depositing the cost contribution at a local bank. Similarly in the survey of non-beneficiary farmers both the cost and the timing of the payment were mentioned as the main concern in availing of the opportunities under GSCP component 1: The survey results revealed that 44% of interviewed farmers would not consider the installation of the localized irrigation system if no subsidy was given. The restrictions on land expansion or qat cultivation were a major constraint in availing of the project facilities. – In fact a few number of non-beneficiaries indicated this as a bottleneck.

2.2 Beneficiaries Views on water users engagement in the development activities;

As can also be seen from tables 2.2, 2.3, 2.4 and 2.5 below, the GSCP project implementation procedures under component 1 are evaluated positively by the beneficiary farmers. Almost all of the farmers had a positive judgment on the overall implementation of the work. The majority of sampled farmers assess procedures as easy; Most of beneficiary farmers using both systems of irrigation are satisfied by the design and the quality of the systems work. From the focus group discussion it is a clear that – particularly with regards the piped conveyance systems sub-component a problem solving

partnership developed with farmers. Farmers sometimes and when needed take care of trenching and make modifications to their systems and provides as a service to other farmers: for instance replacing vulnerable above the ground PVC elements with steel or galvanized iron parts. In contrast to small farmers who installed piped the conveyance system, most of large farmers who installed piped conveyance system, viewed the cost sharing procedure as appropriate. However, with regards to technical supervision, most of small farmers appreciated appropriateness of the project procedure. Under the localized irrigation system, most of small and large beneficiaries considered both cost sharing and technical supervision as appropriate.

Box 2.1 Example of problem solving partnership in Hadramaut

Under GSCP, the trenching (for burying the PVC pipes) and installation the PVC/PE pipes and localized irrigation systems are the responsibility of the beneficiary farmers. The FU Hadramaut has provided training to the WUGs in trenching and installation of these systems and instead of engaging small contractors for these jobs the trained WUGs are now implementing these works on behalf of the beneficiary farmers at nominal costs.

Table 2.2 Perception of beneficiaries on project procedures of implementing piped **conveyance irrigation system**

Beneficiaries responses	% of beneficiaries
Small farmers using piped conveyance system expressed the appropriateness of cost sharing	33%
Small farmers using piped conveyance system expressed the appropriateness of the FUs technical supervision	67%
Large farmers using piped conveyance system expressed the appropriateness of cost sharing	66%
Large farmers using piped conveyance system expressed the appropriateness of the FUs technical supervision	41%

Source: Field surveys analysis results

Table 2.3 Perception of beneficiaries on project procedures of implementing localized irrigation system

Beneficiaries responses	% of beneficiaries
Small farmers using localized on –farm system agreed on appropriateness of cost sharing	75 %
Small farmers using localized on –farm system agreed on appropriateness of technical supervision	68 %
Large farmers using localized on –farm system agreed on appropriateness of cost sharing	77%
Large farmers using localized on –farm system agreed on appropriateness of technical supervision	66%

Source: Field surveys analysis results

Table 2.4 Beneficiary farmers' perspectives on project services

Beneficiaries responses	% of beneficiaries
Small farmers using both irrigation systems informed that the design of the new systems by the FU engineers was satisfactory	84%
Small farmers using both irrigation systems informed that quality of the installation of the new irrigation systems is satisfactory	63%
Small farmers using both irrigation systems informed that it was difficult to provide the cost contribution	26%
Large farmers using both irrigation systems informed that design of the new irrigation systems by the FU engineers was satisfactory	72%
Large farmers using both irrigation systems informed that quality of the installation of the new systems is satisfactory	74%
Large farmers of both irrigation systems informed that it was difficult to provide the cost contribution	18%

Source: Field surveys analysis results

Table 2.5 beneficiaries perspectives on project services (piped Conveyance and localized systems)

Beneficiaries responses	% of beneficiaries
Beneficiaries using piped conveyance system informed that design of the new systems by the FU engineers was satisfactory	65%
Beneficiaries using piped conveyance system informed that quality of the new systems is satisfactory	68%
Beneficiaries using piped conveyance system informed that it was difficult to provide the cost contribution	18%
Beneficiaries using localized on –farm system informed that design of the new systems by the FU engineers was satisfactory	88%
Beneficiaries using localized on –farm system informed that quality of the new systems is satisfactory	72%
Beneficiaries using localized on –farm system informed that it was difficult to provide the cost contribution	24%

Source: Field surveys analysis results

2.3 Beneficiaries views on the functionality of the improved irrigation systems;

Farmers views on the appropriateness and functionality of the systems is generally very positive – as can be seen from table 2.6, 2.7 and 2.8. Farmers using both piped conveyance and localized irrigation systems assess the water delivery from the main systems as a main improvement and most of the farmers value the quality of work high. The number of non-satisfied farmers is less than 10%. Also, most of the beneficiaries value quality of services provided by the project as high. In Focus Group Discussion a recurrent issue was the leakage in some of the localized systems.

Table 2.6 Beneficiary assessment of functionality of the modernized systems

Beneficiaries responses	% of beneficiaries
Beneficiaries using piped conveyance system viewed that overall performance is good	62%
Beneficiaries using piped conveyance system viewed that overall performance is reasonable	34%
Beneficiaries using piped conveyance system viewed that overall performance is bad	3%
Beneficiaries using localized on –farm system viewed that overall performance is good	68%
Beneficiaries localized on –farm system viewed that overall performance is reasonable	28%
Beneficiaries using localized on –farm system viewed that overall performance is bad	4%

Source: Field surveys analysis results

Table 2.7 Beneficiaries satisfaction with performance of modernized systems (water distribution)

Beneficiaries responses	% of beneficiaries
Beneficiaries using piped conveyance system informed that Distribution of water within different farmer is high	68%
Beneficiaries using piped conveyance system informed that Distribution of water within different farmer is medium	15%
Beneficiaries using piped conveyance system informed d that Distribution of water within different farmer is low	6%
Beneficiaries using localized on –farm system informed that Distribution of water within different farmer is high	56%
Beneficiaries using localized on –farm system informed that Distribution of water within different farmer is medium	40%
Beneficiaries using localized on –farm system informed that Distribution of water within different farmer is low	4%

Source: Field surveys analysis results

Table 2.8 Beneficiaries satisfaction with performance of modernized systems (quality of services)

Beneficiaries response	% of beneficiaries
Beneficiaries using piped conveyance system expressed that quality of services is high	68%
Beneficiaries using piped conveyance system expressed that quality of services is medium	28%
Beneficiaries using piped conveyance system expressed that quality of services is low	3%
Beneficiaries using localized on –farm system expressed that quality of services is high	76%
Beneficiaries using localized on –farm system expressed that quality of services is medium	20%
Beneficiaries using localized on –farm system expressed that quality of services is low	4%

Source: Field surveys analysis results

Piped conveyance systems in particular are very popular. There is a high still unmet demand for the piped conveyance systems and farmers complained of having to wait long before the systems were procured – which is a sign of success. There have been and there are still waiting lists for the conveyance system, indicating the popularity of the systems and the service offered by GCSP. The technique of piped conveyance – in particular PVC - has been very much internalized in local communities. Testimonies of the technique being very familiar are the modifications that farmers have made to the conveyance system after installation. In several instances PVC components that were built above the ground were replaced by steel pipes (see box 2.3) that are less prone to breakage or disintegration under the influence of sunlight. Farmers made these modifications themselves, arranging local technicians to do so. In Hodeidah one farmer interviewed had purchased additional pipes from the market to extend the reach of his improved piped conveyance system.

In comparison, the localized systems are relatively less familiar. The demand is not as high yet as for the piped conveyance systems. This is partly because they are more costly USD 2000-2500 per ha without subsidy. – However, even with the subsidy which is less than for piped conveyance systems, the cost per ha amounts to USD 1250 per ha, which particularly for small farmers, is a challenge. Compared to the almost fail-proof piped conveyance systems, the localized systems are also more sophisticated – though in most cases elements like fertigation kits or filters were left out. One issues raised by a few farmers in the assessment is that in some cases the water pressure has not been evenly distributed, either because the network was relatively large and the pump pressure too small. This can cause water not to come out from all bubblers or the drip emitters. Another issue that was pointed out in the interviews was the blockage of the emitters. Having said so, yet the general appreciation for the localized systems is high as well.

In the beneficiary impact survey only one farmer was encountered who was provided with a micro sprinkler – but his appreciation was very high as it allowed him to use it on a well-established mango orchard with trees that had already well developed and spread out root systems. The micro sprinkler was more appreciated in this setting than the bubbler or drip systems.

Box 2.2 Modifications to piped conveyance systems

Piped conveyance systems are by now a technology that is very common in rural areas and there are several technicians who are able to install and modify the network if required. Experiences from different field units in GSCP show how farmers have made modifications to improve the functionality and sustainability of the systems

It is common that relatively vulnerable PVC elements – such as risers and outlet points - placed above ground have been replaced by steel of GI parts at the initiative and costs of farmers themselves. To make sure the stopper is not stolen or gets lost a chain is welded to them.

A special modification comes from Seyoun when at one stage there was for procurement reasons a shortage of PVC dividers. Instead distribution boxes were built. Because of shallow groundwater depths in Seyoun, the pressure in the conveyance network is high and the distribution boxes serve perfectly.

2.4 Beneficiaries Views on project impacts

Overall a large majority including 94% and 80% of the beneficiary farmers who installed piped conveyance systems and localized on farm irrigation system respectively have indicated that their income increased after the adoption of the water saving technologies. This applies for both small and large farmers (see tables 2.9 and 2.10)

Table 2.9 Beneficiary farmers' assessment of project income on impact

Beneficiaries responses	% of beneficiaries
Beneficiaries using piped conveyance system informed that their income level had increased	93%
Beneficiaries using piped conveyance system informed that their income level had decreased	3%
Beneficiaries using piped conveyance system informed that their income level stayed the same	3%
Beneficiaries using localized on –farm system informed that their income level had increased	80%
Beneficiaries using localized on –farm system informed that their income level had decreased	16%
Beneficiaries using localized on –farm system informed that their income level stayed the same	4%

Source: Field surveys analysis results

Table 2.10 Small and large farmers assessment of project impact on income

Beneficiaries responses	% of beneficiaries
Small farmers using both systems informed that their income level had increased	89%
Small farmers using both systems informed that their income level stayed the same	10%
Large farmers using both systems informed that their income level had increased	86%
Large farmers using both systems informed that their income level had decreased	7%
Large farmers using both systems informed that their income level stayed the same	5%

Source: Field surveys analysis results

When farmers are requested to rank the beneficial impact of the improved groundwater irrigation systems several factors come to the top – apart from water saving. Most of Beneficiaries using piped conveyance irrigation system (66 % of beneficiaries) ranked reduced irrigation labour as a first benefit, followed by improvement in crop yield (63 % of beneficiaries) and prolonging of pump and engine life (56 % of beneficiaries)) as most important benefits from adoption of piped conveyance system. For beneficiaries using localized on-farm irrigation systems, prolonging of pump and engine life comes first (76 % of beneficiaries) followed by improved conveyance efficiency (75 % of beneficiaries) and reduced irrigation labour (72 % of beneficiaries) as top three main benefits. Table 2.11 displays the top priority impacts according to beneficiary farmers.

Table 2.11 Ranking of main benefits as assessed by beneficiary farmers

Benefits	Ranking	Benefits	Ranking
Prolonging of life of pump and engine	1	Reduced irrigation labour	1
Improved conveyance efficiency	2	Improved crop yield	2
Reduced irrigation labour	3	Prolonging of life of pump and engine	3
Improved crop yield	4	Improved conveyance efficiency	4
Reduced irrigation water use	5	Reduced irrigation water use	5
Reduced diesel use	6	Reduced irrigation water use	6
Conserving water for future generation	7	Conserving water for future generation	7

Source: Field surveys analysis results

Monitoring at the demonstration farms as part of the Water Savings Report[4] showed additional benefits in fuel savings/pumping hours, labor savings and increase in crop yields. On average, benefits obtained from adopting piped conveyance systems are 13% savings in fuel consumption/ pump irrigation time, 14% labor savings and 10% increase in crop yield. Under the modern on-farm

[4]GWSP (2010), Water Savings Report (ibid)

irrigation systems average savings are 33% in labour; 32% for fuel savings besides a 14% increase in crop yield.

The savings in fuel and pumping hours very much equate the water savings. The labor savings come partly from the reduced time at the pump but even more in reducing the time it takes to fill earthen canals and in case of the bubbler and drip systems to take care of the field water distribution. The increases in crop yield are related to the precision irrigation that the localized systems allow, reducing the risk of local water logging and reducing pest incidence with better regulated humidity.

Sample surveys results, from the demonstration farms in the sampled field units, showed economic benefits have been achieved in savings in diesel consumption, pumping hours, labour hours and water requirements and increase in crops yield. The average savings levels for all visited demonstration farms in the selected field units were 28.8 %, 29.6 %, 28.5 %, and 30 % for pumping hours, labour hours, diesel use, and water requirements respectively as shown in table 2.12. The average increase in crops yield in the demonstration farms at the sampled field units was 11.2 percent.

Table 2.12 the economic benefits of Conveyance and localized on-farm irrigation systems under demonstration farms

Field Unit Location	System Type	Saving in Pumping Hours(%)	Saving in Diesel Consumption (%)	Saving in Water Requirement (%)	Improve in Crops Yield (%)	Saving in Labour Hours (%)
Hodeidah	Conveyance	20.1	16.3	13.2	7.6	15.9
	Drip	32.7	35.2	34.6	14.9	31.6
Dhamar	Micro sprinkler	34.5	34.7	38.9	17.3	33.9
	Bubbler	69.2	69.2	---	7.5	69.2
Seyoum	Sprinkler	32.7	29.3	34.3	10.5	---
	Drip	33.2	33.6	34.7	11.5	33.6
Ibb	Drip	6.5	6.5	18.7	9.7	6.4
	Sprinkler	1.8	1.8	27.0	14.6	1.7

Source: Field surveys analysis results

2.4.1 Improvement of Crops Yield

The interviewed farmers in the sampled field units have indicated that there were increases in crops productivities as a result of the project intervention. The surveys results indicated the increase in crops productivity range from 7 % to less than 25%. The score are very encouraging – but care is required as they are based on recall not on direct measurement. In addition from the focus group discussion it emerged that the use of the drip systems also made it possible to apply some new agronomic practices – see for an example box 2.3.

2.4.2 Savings in Diesel consumption

One of the important economic benefits accrued to the beneficiaries adopting modernized irrigation systems, is saving in diesel use. On average, the results from field surveys showed that savings in diesel use ranged from 25 % to less than 50 %. With the current increases in diesel prices this impact is valued high.

2.4.3 Savings in labour hours and pumping costs

The reduction in irrigation hours achieved from using piped conveyance and/or localized systems, had led to a considerable reduction in labour hours use that ranged from 44 % in Dhamar to more than 61 % in Sana'a, and a significant saving in pumping cost which ranged from about 39 % in Northern highlands (Sana'a) to more than 59 % in Tehama coastal areas as shown in table 2.13 below.

Table 2.13 Results of economic benefits of the piped conveyance and localized irrigation systems beneficiaries farms

Beneficiaries in Field Unit	Savings in pumping cost (%)	Saving in labour hours use (%)
Beneficiaries in Tehama FU	59.33	59.33
Beneficiaries in Northern (Sana'a) FU	38.89	61.25
Beneficiaries in Seyoum FU	43.44	55.0
Beneficiaries in Dhamar FU	48.13	44.0
Beneficiaries in Ibb FU	40.63	55.0

Source: Field surveys analysis results

Box 2.3 Localized systems triggering innovative crop practices

The development of drip system on the tomato farm in Bani Al-Hareth (Sana'a) triggered an innovation: by putting plastic cups close to the emitters farmers tried to control bird damage. The cups (upside down and with the bottom removed) were placed so as to avoid birds eating the costly hybrid seeds close to the emitter.

2.4.4 Beneficiaries Assessment of the economic impacts of the project activities

The interviews results from the sampled field units indicated that the economic benefits realized after the installation of the improved piped conveyance system and/or localized irrigation systems included increase in crops yield, savings in hours of pump operations, saving in irrigation labor time, and

savings diesel consumption, saving in irrigation water, improvement in water efficiency and improvement of income.
Assessing the degree of beneficiary satisfaction with the project interventions; the results revealed that the piped conveyance irrigation system beneficiaries' perception of economic benefits ranged from 25 % of beneficiaries for conserving ground water, to 94 % of beneficiaries who viewed that their income had been improved.
Similarly, the views of beneficiaries using localized on –farm irrigation system regarding the achieved economic benefits ranged from 36 % of beneficiaries who expressed satisfaction with ground water conservation to 80 % of beneficiaries perceived that their income has improved.

Most of the interviewed beneficiaries of both piped conveyance and localized irrigation systems expressed that crops yield has been improved, labour hours used, and pumping hours have been reduced considerably. Near to half of the beneficiaries in both systems also, viewed savings in diesel use and reduction in irrigation water requirements. Almost all of beneficiaries agreed that the most important thing to them is that their income had been improved as a result of adoption of modernized irrigation systems. However, few of them have indicated that ground water conservation for coming generations is the most important achievement.

2.5 Beneficiaries views on sustainability and replicability

Approximately half of the farmers using piped conveyance system are interested in replicating the system even with half level of the current project subsidy. Also, near to half of the farmers using modernized irrigation systems are willing to introduce the system in their farms with half level of the current subsidy as indicated by Table 2.14 below. However, the sustainability of the piped conveyance irrigation systems could be revealed from the results obtained in table 2.14 regarding farmers knowledge of construction operation and maintenance, water distribution among farms, availability of spare parts and the future adoption level.

Most of the beneficiaries believed that water distribution within farms has been improved. Also, most of the beneficiaries using piped conveyance system and approximately half of those using localized system have got experience of installation and supervision of these irrigation systems. More over, majority of beneficiaries of both systems said they know how to maintain and repair their irrigation systems.
Even though in the focus group discussions and joint walk through, minor defects were observed in the localized on farm irrigation systems system there seems to be no reason to be concerned as to willingness of beneficiary farmers to maintain the improved groundwater systems. Table 2.15 summarizes the results of queries into the maintenance arrangement. In the majority of cases farmer are ready to maintain the new systems with the help of local engineers and technicians. Only some farmers operating localized on –farm irrigation systems still expect help from the engineers of the GSCP field units.

An issue requiring more attention is the availability and price of spare parts. Table 2.15 indicates that for a large number of farmers, spare parts are inaccessible – both in terms of stock and pricing. Some parts are particularly critical – for instance high pressure stoppers on drip systems.

Table 2.14 Beneficiaries perception on sustainability of the piped conveyance and localized irrigation systems

Beneficiaries responses	% of beneficiaries using piped conveyance system	% of beneficiaries using Localized on-farm system
Beneficiaries agreed on good water distribution within farms	69%	80%
Beneficiaries informed on having knowledge of installation and supervision of systems	67%	44%
Beneficiaries expressed that maintenance could be done by farmers	66%	76%
Beneficiaries viewed that farmers have knowledge of maintenance and repairs	66%	80%
Beneficiaries informed on availability and cost of spare parts	84%	80%
Beneficiaries acknowledged on availability of training	75%	84%
Beneficiaries agreed on adoption of the new irrigation systems	44%	44%
Beneficiaries agreed on buying the system at half subsidy	69%	80%

Source: Field surveys analysis results

Table 2.15 Beneficiaries assessment of future operation and maintenance

Piped conveyance system			Localized on-farm system		
Issues discussed	Beneficiaries response	% of beneficiaries	Issues discussed	Beneficiaries response	% of beneficiaries
Maintenance of structure will be done by:	FU engineer	19%	Maintenance of structure will be done by:	FU engineer	24%
	Engineer from market	16%		Engineer from market	0
	Farmer himself	63%		Farmer himself	76%
	Farmer with others	3%		Farmer with others	0
Likely challenge in maintenance of structure	Spare parts availability	38%	Likely challenge in maintenance of structure	Spare parts availability	32%
	Spare parts costs	25%		Spare parts costs	28%
	Both Spare parts availability and costs	16%		Both Spare parts availability and costs	20%
	No problem foreseen	22%		No problems foreseen	20%

Source: Field surveys analysis results

A closely related issue is the replicability of the investments in modernized irrigation as supported by GSCP. Whereas at present the systems carry subsidies ranging from 50-70% ultimately these are available in the free market as a commercial proposition. The question was asked to both small and large farmers if they would avail the systems if the subsidy proportion was less in the future – either for extension or for replacement. A proportion of larger farmers would be interested to obtain the improved systems – especially the piped conveyance systems – at reduced subsidy level Also for piped conveyance system the support system appears to be in place whereas the demand is high. Therefore it is feasible to gradually reduce the subsidy amounts for these systems with an eye of

making it a commercial local business in the medium term. The current proposals in the new National Irrigation Project however go for higher subsidy amounts – but this does not seem necessary.

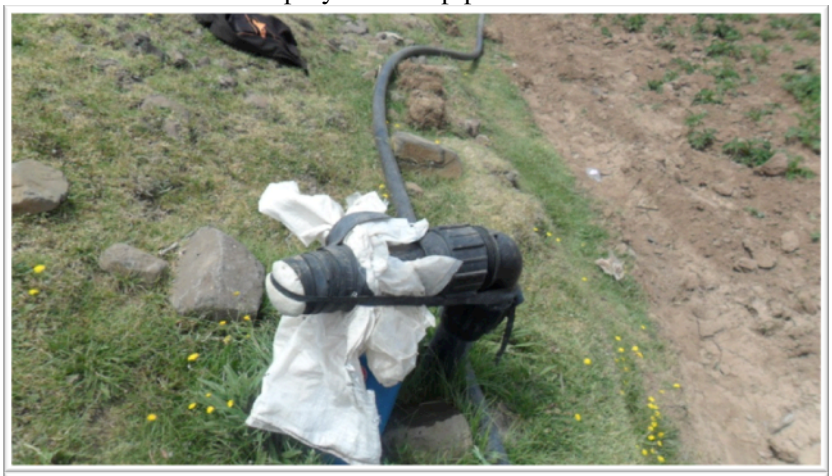
Table 2.16 Beneficiary perspectives on sustainability and replicability

Piped conveyance system			Localized on-farm system		
Issues discussed	Beneficiaries responses	% of beneficiaries	Issues discussed	Beneficiaries responses	% of beneficiaries
Easiness to maintain and repair the conveyance system	Yes	65	Easiness to maintain and repair the localised irrigation systems	Yes	80
	no response	31		no response	20
	No	3		No	0
Possibility to buy the modernized system even at half of the previous subsidy	Yes	43	Possibility to buy the modernized system even at half of the previous subsidy	Yes	44
	no response	50		no response	24
	No	6		No	32

Source: Field surveys analysis results

Box 2.4 Minor maintenance problems

A recurrent problem in the conveyance systems is the high pressure stopper – that is sometimes damaged or in other cases goes missing. The most common solution is for farmers to replace this with a GI stopper – in other cases there are some temporary solutions. With polyethelene hoses there are in a few cases damage when the hose gets damaged – especially where it is above ground. In some areas farmers have buried the polyethelene pipes.



3. Beneficiary Assessment of Spate Irrigation and Water Harvesting Activities

Terrace rehabilitation in Ibb

Under component 2, two groups of activities have been undertaken, i.e. the construction of spate irrigation systems and the development of water harvesting structures.

This first sub-component provides for the improvement of traditional small and medium spate schemes' structures in selected wadi reaches to improve the diversion of spate flows and sometimes increase groundwater recharge. In addition to the spate irrigation systems, wadi bank protection works are undertaken and flood breakers constructed in small streams to slow down the erosive force of floods and stabilize the riverbeds.

The second sub-component under this component concerns the rehabilitation of neglected terraces and water harvesting structures to control soil loss and improve moisture conservation. A main activity was the development and rehabilitation of small water tanks – either newly constructed tanks for human and livestock drinking and other household uses, or the rehabilitation of community water tanks – the latter primarily meant for drinking water supply.

The achievements so far (as per March 2012) were given in chapter 1. In this chapter beneficiary views are given on the different aspects of the spate irrigation and water harvesting program: the site selection for project intervention, the process of involvement of water users in different stages of the project activities, the functionality of the structures constructed under this component, the beneficiaries perceived impact and the sustainability and replicability of the investments made.

3.1 Beneficiaries Views on selection of sites for project intervention

Under component 2, the identification on where to work and what to do was based obviously on the potential and the scope to make meaningful interventions in spate irrigation or water harvesting. In a number of cases, however, this is not always the case. Several interventions were combined in one area such as the development of water storage tank providing water through drip systems to newly developed orchards on rehabilitated terraces (see also box 3.1).

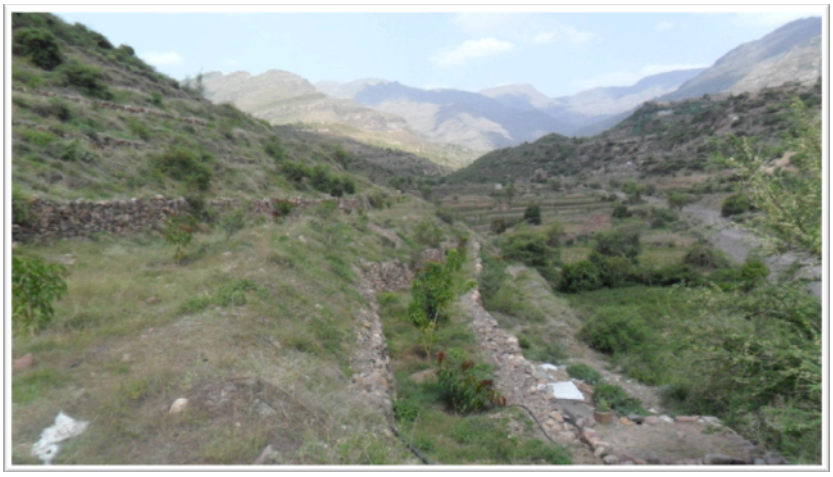
Whereas in component 1, beneficiary farmers had to deposit money in the bank upfront, which was easier for some farmers than others, the most common modality in component 2 were either the construction work will be carried out through community contracts or through contractor contracts for

medium and large structures, with the local councils generally taking care of farmers contribution only for large and medium structures costing more than $ 50,000. However for other spate improvement structures (CCS &BPW) beneficiary contribution is 20% and mostly paid in kind. The cost sharing requirement hence did not have an influence on the selection of beneficiary farmers for large and medium structures as it did in case of component 1.

From the sampled beneficiaries it appears that 93% of the interviewed farmers do not have secondary sources of income and that 75% of the farms are owner-operated

Box 3.1 – 'Integrated development' under GSCP in Rihab (Ibb)

With the help of GSCP the WUG of Ali Qahtaini developed a cistern that stores the water from a small nearby mountain spring conveyed through. The cistern measuring 5 by 10 meter was developed with the help of a community contract under the GSCP but in the end Ali Qahtani's group spend an amount at least double the contribution under the community contract, i.e. more than stipulated cost share. The cistern is roofed and accessed by a small stair case. The water from the cisterns feeds coffee gardens on nearby terraces. The terraces have been rehabilitated with stone bonding. The water is provided through a bubbler systems – installed with the help of GSCP. The coffee gardens are replacing qat trees – which are gradually uprooted.



3.2 Beneficiaries Views on their involvement in different stages of the project activities

This section discusses farmers' views on engagement in subsequent stages of the projects: design and site selection works implementation and cost sharing and in participation in operation and maintenance.

3.2.1 Beneficiary involvement in site selection and design

Table 3.1 gives an overview of farmers views on the site selection process, whereas tables 3.2 and 3.3,3.4 and 3.5 summarizes beneficiaries involvement in design and the process of consultation and the understanding of the designs – respectively

Nearly half of the beneficiaries revealed that initial site selection of the spate structures was done by the Field Unit while the other half said it was done by community. In case of water harvesting structures the majority of beneficiaries, stated that initial site selection is done by the Field Unit (table 3.4).
For the spate irrigation systems, nearly all farmers interviewed were consulted in the selection of the site and the development of the design. The involvement of small farmers was even higher (93%) than

that of large farmers (67%) in the sample selected as presented in table 3.2, this is a general pattern: those smaller farmers were more actively involved than large farmers, which is a commendable achievement.

There was uniform satisfaction with both the site selection and the design of the spate improvement works – both among small and large farmers. The discussion with the Field Engineers of the FU regarding the selection of the location of structures started at an early stage. In many cases the design closely followed the traditional infrastructure (see box 3.2). There was also a very high understanding of actual designs as they emerged with the understanding being higher among small farmers than large farmers. There has also been a well-appreciated practice of making changes to the designs whilst the work was ongoing, especially in the larger spate schemes.

The designs were done either in-house or commissioned to a consulting firm only for small and medium spate improvement works and generally costing more than $50,000.
The designs in the systems sampled in the BIA were straightforward and non controversial and often followed existing traditional practices – with some modifications. There was regular contact with the resident engineer on the work planned and there is uniform satisfaction on the design process. The same is true with the bank protection where there was agreement and consent by beneficiary farmers as to what needed to be done. There was a large variety of design used for bank protection taking into consideration the local situation.

Table 3.1 Farmer assessment of site selection – who was taking the first step

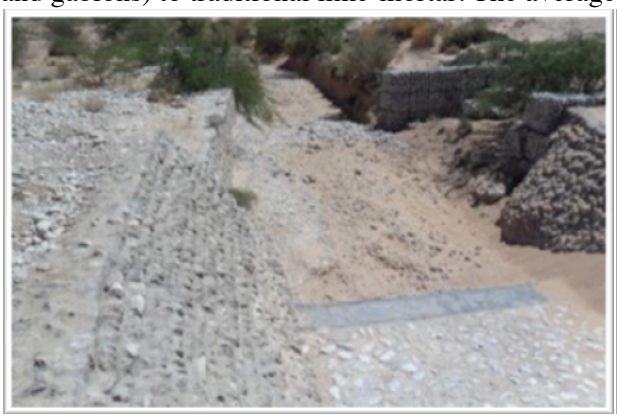
Spate structures	
site selection is done by:	% of beneficiaries
The Field Unit	44%
The community	50%
Individual farmers	6%

Water harvesting structures	
site selection is done by:	% of beneficiaries
The Field Unit	61%
The community	39%
Individual farmers	0

Source: Field surveys analysis results

Box 3.2 Designing spate irrigation systems

The spate irrigation systems developed under GSCP are small and medium sized – mostly under 1000 ha. In most cases existing off-takes are improved and made more reliable, by improved intakes or overflow structures. In a few cases a breaching bund or fuse plug is added to diversion structures. There is considerable flexibility in the design – adding new construction techniques (cement mortar and gabions) to traditional lime-mortar. The average costs per hectare touches USD 1000.



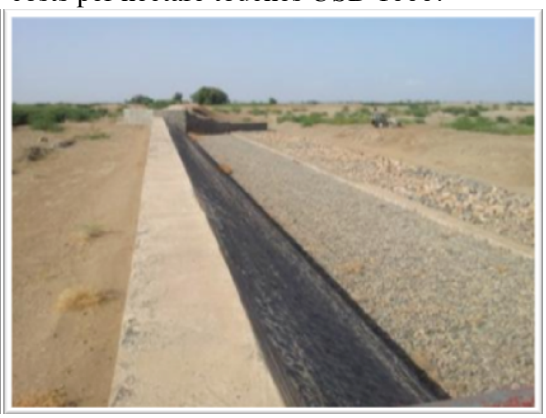


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Table 3.2 Beneficiaries views on the site selection and design of Spate structures

Beneficiaries responses	% of beneficiaries
Small farmers informed that they have been consulted in the selection of the site	100%
Small farmers informed that they have been consulted on the design before implementation	92%
Small farmers informed WUG was informed about the design	85%
Small farmers informed that they are satisfied with the site selected	100%
Small farmers informed that they are satisfied with the design of the site	100%
Large farmers informed that they have been consulted in the selection of the site	89%
Large farmers informed that they have been consulted on the design before implementation	67%
Large farmers informed WUG was informed about the design	89%
Large farmers informed that they are satisfied with the site selected	100%
Large farmers informed that they are satisfied with the design of the site	100%

Source: Field surveys analysis results

Table 3.3 Involvement of beneficiaries in the design of spate structures

Beneficiaries responses	% of beneficiaries
Small farmers informed that they are aware of the design of the structure	85%
Small farmers informed that they have the Knowledge of the structure's objectives	100%
Small farmers agreed on objections to the structure's design	23%
Small farmers informed that they are aware on knowledge of the required maintenance for the structure	92%
Large farmers informed that they are aware of the design of the structure	88%
Large farmers informed that they have the Knowledge of the structure's objectives	100%
Large farmers agreed on objections to the structure's design	44%
Large farmers informed that they are aware on knowledge of the required maintenance for the structure	77%

Source: Field surveys analysis results

Under the water harvesting sub-component of component 2, there was general consensus among the small beneficiary farmers sampled that the sites selected were appropriate. There were only few reservations and these were from large farmers. Almost all farmers interviewed mentioned that, they were consulted or informed on the design before implementation – in almost all cases involving the WUG (table 3.4). The design and the maintenance requirement were widely well understood (table 3.5). Some small farmers (28%) had at one stage reservations on the design, but in the end appreciation was high.

Table 3.4 Beneficiaries views on the site selection and design of water harvesting works

Beneficiaries responses	% of beneficiaries
Small farmers informed that they have been consulted in the selection of the site	77%
Small farmers informed that they have been consulted or informed on the design before implementation	94%
Small farmers informed WUG informed about the design	83%
Water harvesting system small farmers agreed on satisfaction with the site selected	100%
Water harvesting e system small farmers agreed on satisfaction with the design selected	94%
Water harvesting system large farmers agreed that they have been consulted in the selection of the site	60%
Water harvesting system large farmers agreed that they have been consulted or informed on the design before implementation	60%
Water harvesting system large farmers agreed WUG informed about the design	100%
Water harvesting system large farmers agreed on satisfaction with the site selected	60%
Water harvesting system large farmers agreed on satisfaction with the design selected	80%

Source: Field surveys analysis results

To summarize: in the spate irrigation sub-component the sites selected followed the existence of a traditional diversion structures and was unanimously agreed to by the beneficiaries. Most farmers – both large and small - appreciated the involvement in the design process and there was almost unanimously satisfaction with the selection. There was concern by farmers in one site in Hodeidah that due to the infrequent floods and the intense diversion of flood water upstream that the spate system was not yet been put to test, but they were content the project was developed at that location.

Table 3.5 Beneficiaries involvement in the design of Water harvesting structures

Beneficiaries response	% of beneficiaries
Small farmers informed that they have been consulted in the selection of the site	78%
Small farmers informed that they have been consulted on the design before implementation	94%
Small farmers informed WUG was informed about the design	83%
Small farmers informed that they are satisfied with the site selected	100%
Small farmers informed that they are satisfied with the design of the site	94%
Large farmers informed that they have been consulted in the selection of the site	60%
Large farmers informed that they have been consulted on the design before implementation	60%
Large farmers informed WUG was informed about the design	100%
Large farmers informed that they are satisfied with the site selected	60%
Large farmers informed that they are satisfied with the design of the site	80%

Source: Field surveys analysis results

In fact in the water harvesting sub-component, much of the work done was farmer-driven. The common practice in the development of new water tanks was for the beneficiary group (usually close knit and family related) to take the lead in the development of these structures – resulting in a large variety of locally adjusted designs (see box 3.3). Work in the water tanks was given out on the basis of community contracts[5] – but as the standard size under GSCP was considered too small for supplementary irrigation farmers made in many cases larger storage. In addition in some cases roofing was done, as an additional activity. In all the cases visited as part of the Beneficiary Impact

Assessment more work had been done by the beneficiaries and a large variety of locally appropriate structures were build (see box 3.3).

Box 3.3 a large range of appropriate designs for small water tanks

In Manaka (Sana'a) a terrace near hill a pond was excavated and plastered five meters deep – accessed by a small staircase. Water is collected from a small spring as well as from rainwater run-off. The sheltered deep location reduces the evaporation. A protection wall still needs to be provided to prevent people or animals fall in.

The Rizani reservoir in Rihab (Ibb) collects water from two sources. First it stores water from the low capacity tube well. Secondly it collects the run-off from the hills during rain-events. A sediment trap is built to prevent silt from entering the tank.

The tank in BaniBihlol intended to collects the run-off water from the roads. A small canal is made to connect the road culvert to the tank. Prior to the tank the road run-off was not used.

Thanks to organization of this component under community contracts, all these tanks (including the cistern in Rihab – see box 3.1) have different designs – suited to local terrain and water resources and farmers preferences. Farmer contribution in most cases has exceeded the compulsory cost share of 20%

[1]describe – also difference with SFD

3.2.2 Beneficiaries Views on implementation;

Table 3.6 describes views on the mode of implementation for the spate irrigation and water harvesting activities. In spate systems especially medium spate structures, the work was to a large degree implemented by contractors – whereas the majority of the respondents benefiting from water harvesting structures indicated that they had built the systems themselves through their WUG or local contractors.

Table 3.6 Beneficiaries' perception of Implementation modality

Medium spate structures		Water harvesting structures	
Preference to implementation modality	% of beneficiary farmers	Preference to implementation modality	% of beneficiary farmers
Through private contractor	67%	Through private contractor	9%
Through community contract	33%	Through community contract	91%

Source: Field surveys analysis results

Table 3.7 summarizes the farmer's assessment of the cost sharing arrangements. In spate irrigation the role of farmers in actual implementation has been relatively limited. The cost-sharing contribution of farmers to activities under component 2 was to amount to 20%, with the exception of medium-size spate diversion works where the expected contribution was 15%. Farmers indicated to be unable to contribute in cash but instead preferred to make labour and building material (stones) available (see table 3.7). In the Focus Group Interview the inability to contribute in cash were explained by farmers as due to (1) general low returns in spate based agriculture and the relatively long gestation period of the investments (2) the time bound nature of the contribution – making it difficult to have the cash ready when required and (3) the relatively weak organization of the Water Users Groups – lacking in organization and official status required to be involved in the implementation of works of a larger magnitude – either financially or contractually. It is understood that in almost all the schemes of medium spate diversion works implemented under GSCP, the beneficiaries have been reluctant to pay their contribution and that in most cases it has been paid on their behalf by the Local Councils with farmers providing some labour contributions.

The beneficiary contribution in spate irrigation (with costs ranging between USD 800-1200/ha) is 15-20 % of the cost, which comes to an average of US$ 150-200/ha. This may be compared to the contribution in the case piped conveyance, which is on average of 35 % of a total costs of around USD 400/ha. This works out to be USD 140/ha. The irrigation from groundwater however is assured, whereas the spates are uncertain: sometimes spates do not arrive for several years. This is a major hurdle preventing the beneficiaries to contribute in the cost of medium spate diversion works that sometimes pay by local councils and farmers contributed in kind for instance in the haulage of stones.

In the water harvesting sub-component a different picture emerges. Here beneficiary farmers have often taken the lead and in particular in the water harvesting tanks, farmers have usually made a large contribution – exceeding the expected cost share. The capacity of the tanks (150 M^3) was considered too small by beneficiary farmers to serve as a source of supplementary irrigation. A common practice has been for farmers to add to the financial contribution by GCSP (average USD 10000 and construct larger tanks using a variety of designs (see box 3.4). The work was implemented following the 'community contract' procedure whereby a selected farmer undertakes the commissioned works. Most of the water harvesting activities as well as the small-scale flood breakers in the spate improvement sub-component followed this procedure. This allowed more flexibility – including the adjustment of the design and the enlargement of its capacity.

Table 3.7 to 3.9 give the farmers assessment of the cost contribution process. As mentioned earlier the beneficiaries contribution towards the cost of small spate improvement works including bank

protection work and canal control structures was mainly in kind. The contribution towards the construction cost was more or less in accordance to the acreage of land a person owns. , However, in a few cases - some compensation for land that is relatively well-situated. Farmers agree with the principle of cost contribution as it creates ownership and responsibility for maintenance – though the preference and actual practice is to contribute in kind (table 3.5). Results from table 3.9 revealed that the majority of farmers in both water harvesting and spate irrigation sub-components are happy to contribute again to a future project Interestingly larger farmers compare to small ones have more difficulty contributing because their land holding are larger and hence the total volume of contribution is larger too. However, farmers by and large would not be interested to contribute substantially more than the 25% of the investment cost of the structure (table 3.11).

Table 3.7 beneficiaries' perception of usefulness of cost contribution- spate system

Beneficiaries responses	% of beneficiaries
Small farmers viewed that cost contribution give them the sense of ownership of the structure	92%
Small farmers viewed that cost contribution give them the sense of commitment to maintenance of the structure	8%
Large farmers viewed that cost contribution give the beneficiary the sense of ownership of the structure	44%
Large farmers viewed that cost contribution give the beneficiary the sense of commitment to the maintenance of the structure	22%
Large farmers viewed that it is preferable for the farmer to contribute in kind (labour, building material, etc)	33%

Source: Field surveys analysis results

Table 3.8 beneficiaries' perception of usefulness of cost contribution- water harvesting system

Beneficiaries responses	% of beneficiaries
Small farmers viewed that cost contribution give the beneficiary the sense of ownership of the structure	78%
Small farmers viewed that cost contribution give the beneficiary the sense of more concern with maintenance	17%
Small farmers viewed that it is preferable for the farmer to contribute in kind (labour, building material, etc)	6%
Large farmers viewed that cost contribution give the beneficiary the sense of ownership of the structure	80%
Large farmers viewed that cost contribution give the beneficiary the sense of more concern with maintenance	0
Large farmers viewed that it is preferable for the farmer to contribute in kind (labour, building material, etc)	20%

Source: Field surveys analysis results

Table 3.9 Beneficiaries' acceptability of **Cost contribution -spate structures**

Beneficiaries responses	% of beneficiaries
Small farmers agreed on easiness of the Contribution process	85%
Small farmers not agreed on easiness of the Contribution process	15%
Small farmers willing to Contribute again in investment cost of spate structure	92%
Small farmers not willing to Contribute again in investment cost of spate structure	8%
Large farmers agreed on easiness of the Contribution process	67%
Large farmers not agreed on easiness of the Contribution process	22%
Large farmers willing to Contribute again in investment cost of spate structure	78%
Large farmers not willing to Contribute again in investment cost of spate structure	22%

Source: Field surveys analysis results

Table 3.10 Beneficiaries' acceptability of **Cost contribution (water harvesting structures)**

Beneficiaries responses	% of beneficiaries
Small farmers agreed on easiness of the Contribution process	89%
Small farmers not agreed on easiness of the Contribution process	11%
Small farmers willing to Contribute again in investment cost of water harvesting structure	89%
Small farmers not willing to Contribute again in investment cost of water harvesting structure	11%
Large farmers agreed on easiness of the Contribution process	60%
Large farmers not agreed on easiness of the Contribution process	20%
Large farmers willing to Contribute again in investment cost of water harvesting structure	60%
Large farmers not willing to Contribute again in investment cost of water harvesting structure	40%

Source: Field surveys analysis results

Table 3.11 beneficiary farmers' views on appropriate rate of contribution

Beneficiaries responses	Beneficiaries response
Small farmer willing to contribution by more than 25% of the investment cost of the spate structures	0
Small farmer willing to contribution by less than 25% of the investment cost of the spate structures	100%
Small farmer willing to contribution by more than 25% of the investment cost of the water harvesting structures	6%
Small farmer willing to contribution by less than 25% of the investment cost of the water harvesting structures	94.4
Large farmer willing to contribution by more than 25% of the investment cost of the spate structures	22%
Large farmer willing to contribution by less than 25% of the investment cost of the spate structures	78%
Large farmer willing to contribution by more than 25% of the investment cost of the water harvesting structures	0
Large farmer willing to contribution by less than 25% of the investment cost of the water harvesting structures	100%

Source: Field surveys analysis results

3.3 Beneficiaries Views on functionality of the spate and water harvesting works

3.3.1 Spate irrigation

In a walk through with the beneficiaries, the functionality of the works was assessed for both spate irrigation and water harvesting systems. In general the beneficiary farmers perceived the technical performance of the spate structures developed under component 2 as high. –The only drawback being mentioned is the sedimentation of the structure, which is always a major challenge in spate irrigation systems in addition to the development of mesquite (*prosopis juliflora*), which is an invasive plant species blocking the water flow in some of the channels.

From the walk through the completed spate improvement works it appeared that there is also some deferred routine maintenance and minor unfinished works – such as open gabion boxes, scour holes around structures, small localized sand deposits. Though these deficiencies may not immediately affecting the functioning of the system, these small issues are likely to develop into larger problems in the course of time if ignored. With a sometimes relatively weak WUG and a lack of ownership it was also not clear who should take care of the routine repairs. The flood breakers and bank protection: beneficiary farmers had no clear idea as to how such facilities would be maintained.

3.3.2 Water harvesting

The structures developed under the water harvesting sub-component include water storage facilities – new tanks and improved/ rehabilitated tanks – and terraces, flood breakers and wadi pits. As mentioned, farmers generally preferred bigger tanks than provided for under the project, outfitted with a cover. In many cases farmers have built a larger facility (including pipelines leading into the tank) adding their own resources.

The tanks visited in joint walk throughs appeared to be, particularly, in good shape with only the quality of local finishing is sometimes relatively poor. There is high satisfaction among farmers as to the outcome of this activity, though in some cases surveyed there were some minor problems with leakage, whereas the cement masonry works was sometimes rather rough (see box 3.3). The assessment of farmers is that additional training and supervision would have been useful

3.4 Beneficiaries Views on impacts

Beneficiary assessment of the impact of the activities under component 2 included a range of issues – the area cultivated, the impact on crop production and equity of water distribution, as well as a number of secondary 'multiple use' benefits – such as the re-greening of the area or the availability of water for human and livestock. In general beneficiary farmers interviewed indicated that the work under component 2 had improved their income. This is revealed by 86 % of all farmers sampled, using the spate systems and 83% of all farmers sampled, using of water harvesting systems. The nature of the spate irrigation and water harvesting activities are such that their impact is not always immediate as it depends on the availability of floods and rain. Some of the systems are relatively new – so impact requires a relatively short period. Moreover, the number of floods and the amount and pattern of rainfall will vary from year to year. The impact was assessed in the focus group discussions, walk throughs and in beneficiary questionnaires.

3.4.1 Beneficiaries Views on economic impacts

The economic impacts from the construction of spate and water harvesting structures are greatly appreciated by the project beneficiaries as seen in table 3.12, where majority of spate beneficiaries and

Beneficiaries from water harvesting structures, informed that agricultural area has been expanded after the project intervention. Also, from the table 3.12 below it is clear that crops yield has increased in the completed structures as indicated by the views of the majority of the beneficiaries.. Hence, agricultural area expansion and crops yield improvement resulted in income improvement as perceived by the majority of beneficiaries from the completed structures in the sampled field units.

Assessing the degree of the beneficiaries satisfaction with the project interventions, mainly spate and water harvesting structures; the survey results revealed that the beneficiaries' perception of expansion of agricultural area range from 70 percent of beneficiaries in Seyoun to 90 percent of beneficiaries in Ibb -Taiz field unit. Where as beneficiaries' perception for crops yield improvement range from 60 to 95 percent of beneficiaries in Dhamar and Ibb respectively. Regarding income, almost all of beneficiaries in sampled field units perceived that it improved considerably.

Table 3.12 Beneficiaries' assessment of economic impacts from spate and water harvesting structures

Beneficiaries response	% of beneficiaries
Spate system beneficiaries agreed on expansion of Agricultural Area	72%
Spate system beneficiaries informed on improvement of Crop Yield	82%
Spate system beneficiaries informed on Improvement in Distribution of water	77%
Spate system beneficiaries informed that their income improved	86%
Water harvesting system beneficiaries agreed on expansion of Agricultural Area	70%
Water harvesting system beneficiaries informed on improvement of Crop Yield	74%
Water harvesting system beneficiaries informed on Improvement in Distribution of water	52%
Water harvesting system beneficiaries informed that their income improved	83%

Source: Field surveys analysis results

3.4.2 Additional availability of water

The beneficiaries informed that both the spate systems and the water harvesting program increased the availability of surface water. The spate systems as developed under the GSCP have considerably improved the reliability of the spate system and the availability of surface water (57%). They have replaced the traditional diversions that were prone to be washed out. This has improved production and has had a positive impact on the equity of water distribution. In the previous systems the washing out of the diversion structures meant that flood water supplies were interrupted and would not reach downstream land. In many cases the traditional diversion were not rebuilt in time to capture a subsequent flood event. As far as could be established that high reliability of the constructed structures has benefitted small farmers more. The other elements under this subcomponent – flood breakers and bank protection did not increase water availability as their function is different Though the main purpose of the spate systems was to capture and regulate flood water, a large number of the beneficiary farmers interviewed also indicated that groundwater levels increased too. This is also very much the functions of the flood breakers – and they are appreciated fort his reason.

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Box 3.4 Recharging groundwater

Spate irrigation system can make a substantial contribute to groundwater recharge – particularly because recharge through gravelly riverbeds is most effective. In GSCP bed stabilizers combined with wadi recharge pits have helped add groundwater.

Also, the impact on the availability of water in the water harvesting component was broadly assessed as being positive – but the water quantities involved are more moderate – as seen from the beneficiary appreciation in table 3.8. The terracing allowed more water to be retained and the new ponds for agriculture use yielded enough water that booster pumps could be used. The water flows were more regulated as well. Some of the recharge elements in the programme were assessed as less successful: the traditional infiltration pit in Hodeidah was in areas that had not received floods. None of the beneficiary farmers judged the water harvesting to have a considerable impact on groundwater availability and 40% of farmers assessed the impact of the water harvesting activities on groundwater as moderate (table 3.8).

A question was asked as to whether the better retention of water upstream – either from spate irrigation development or water harvesting - was causing increased conflicts downstream. Of all farmers interviewed 14% were of the opinion that there was an effect – testimony to the scarcity of water in Yemen.

3.4.3 Multiple use functions

The spate and water harvesting activities have multiple benefits other than increased production and spate water regulations and capture. Some of these multiple use benefits were captured in the farmer interviews. The most important benefit of the activities from spate irrigation and water harvesting appears to be in re-greening and wadi soil erosion control and protecting the environment. The development of spate systems reduces river damage and allows the re-greening of the areas; similarly the water harvesting activities also have a beneficial impact of reducing wadi banks soil erosion. Most of the farmers interviewed emphasized this benefit. Other benefits, particularly from the rehabilitation of existing water tanks, has been the improved supply of water for drinking and domestic use (15% of beneficiaries interviewed) and as well as water for livestock (31% of beneficiaries) – in itself also an important economic asset. The rehabilitated water tanks, in fact in many cases, serve this purpose.

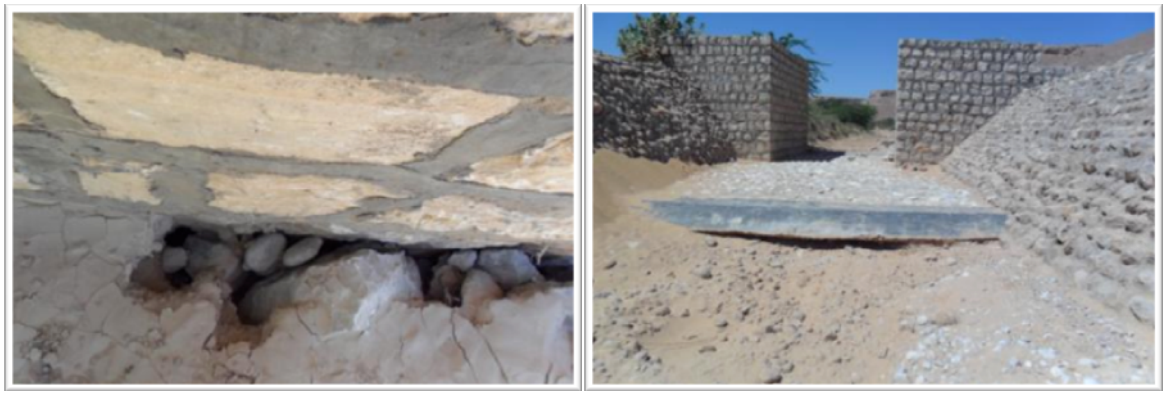
The systems under component 2 contribute to surface water storage, which is acceptable for livestock but not preferred human drinking if there is a secure source of drinking water in the area.

Drinking water pond in BaniSaba, Dhamar – rehabilitated under component 2

3.5 Beneficiaries views on sustainability and replicability

From the beneficiary interviews and the walk throughs some concerns as to the sustainability of the spate systems emerge. From the Focus Group Discussion it appears that the WUGs and WUAs are not fully prepared with contingencies (bank accounts, equipment) to undertake repairs on the improved systems. Farmers' views are that, their main contribution in maintenance will be in the form of labour. Also in some of the spate system there is only a Water User Group (WUG) in place which is very informal in nature and has no official status.: The larger farmer interviewed do not expect the WUG to take a leading role in maintenance.

More than half of small and large farmers interviewed in spate systems are of the view that the responsibility for maintenance lies, at least partly, with local council or the GSCP Field Unit. On the other hand most – especially small farmers - are prepared to take part in the maintenance the system and contribute to its operation (table 3.13). However, there are no provisions there. Moreover, the Tripartite Agreement concluded at the start of the implementation of the activity t assumed farmers would be solely responsible from the maintenance of the structure.. From joint walk throughs it also appeared that inexpensive routine maintenance – such as uprooting trees growing close to diversion structures and off-takes, repairing small scour damage - is not being done. Individual farmers and WUG members indicated that they also needed training in basic construction techniques.



Deferred maintenance in addressing scour or repairing cracks can lead to much larger damage in the spate systems

The nature of the water harvesting activities is such that they are small scale and firmly farmer managed. The maintenance particularly, of the tanks is not a matter of debate and is unambiguously with the farmers beneficiaries. The maintenance is also uncomplicated using local materials and familiar techniques, particularly as in many cases traditional techniques were followed. The sustainability of the spate improvement and water harvesting structures could be ensured from the results obtained in table 3.13. Regarding beneficiaries feeling of ownership, almost all of beneficiaries of both small spate improvement works (BPW & CCS) and water harvesting systems viewed these structures as theirs. The majority of beneficiaries of both systems are willing to contribute to operation of structures, however, when it comes to maintenance which needs spare parts, only half or near to half of the beneficiaries are ready to contribute in maintenance.

Table 3.13 Beneficiaries Assessment of Sustainability of the spate and water harvesting structures

Beneficiaries response	% of beneficiaries
Spate system beneficiaries informed on feel of shared and fully ownership of structures among farmers	85%
Spate system beneficiaries agreed on payment procedure satisfaction	100%
Spate system beneficiaries informed on willingness to contribute to operation of structures	78%
Spate system beneficiaries agreed on readiness to maintain structures by farmers	41%
Water harvesting system beneficiaries informed on feel of shared and fully ownership of structures among farmers	89%
Water harvesting system beneficiaries agreed on payment procedure satisfaction	80%
Water harvesting system beneficiaries informed on willingness to contribute to operation of structures	80%
Water harvesting system beneficiaries agreed on readiness to maintain structures by farmers	50%

Source: Field surveys analysis results

4. Beneficiaries Views on Local Institutional Development for Water Resources Management

The third component of the GSCP was aimed at strengthening local water institutions for groundwater and soil conservation: *'to create groundwater management framework and institutions that will have the incentive and capacity to manage local water resources in a sustainable manner'.*

In this program the GSCP helped to establish Water User Groups (WUGs) and Water Users Associations (WUAs). The farmers that received support under component 1, for the adoption of piped conveyance system for groundwater irrigation or localized on farm irrigation systems also had to commit in the three partite agreements not to expand land or grow high water consuming qat in the so-called 'tripartite' agreement. In the tripartite agreement for component 2 farmers took it upon themselves to maintain the systems. Those agreements are between three parties: (i) beneficiary farmers; (ii) FU; and (iii) WUG/Local Authorities/Agriculture Cooperatives. An important part of the field operations of the GSCP, in particular, was the establishment of the Irrigation Advisory Services (IAS) which is set up to support farmers with training and awareness activities.

This section gives the beneficiary assessment of the WUGs and WUAs, the services of the IAS and the training program and the performance of the project units of the GSCP in general.

4.1 Functioning of Water User Groups

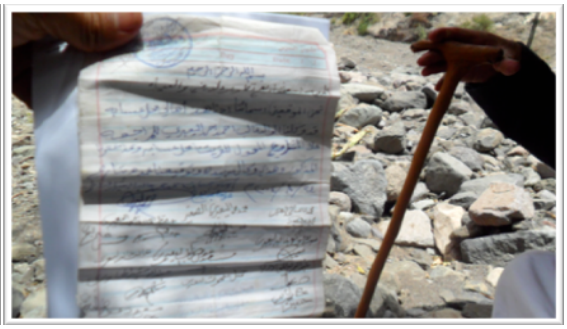
Under both project components 1 and 2 a large number of Water Users Group have been set up including – respectively 779 WUGs and 1803 WUGs by March 2012 (see also table 1.1). The development of Water User Groups was a precondition for the development of activities under component 1 and construction of works under component 2.

The WUG typically consist of about 15 members – more than envisaged originally. The WUG are informal in nature. They could in case of component 1 also involve farmers who would not benefit from the installation of the improved irrigation systems. Their purpose is to facilitate the implementation of the project activities and discuss water management issues with the farming communities. In the case of the spate irrigation improvement and water harvesting component the prominent farmers of the area were asked to lead the WUG (see box 4.1).

According to the sampled beneficiaries, the WUGs have been very instrumental in the implementation of the project activities and they also contributed to raising awareness on the water issues. The role of the WUGs was assessed through the use of structured questionnaire as well as through holding Focus Group Discussions. According to the beneficiaries the role of the WUG has been important in a liaison with the FU management for the implementation of the project activities – including the delivery of the conveyance pipes, in the coordination of activities with the Field Unit and engineers. In this respect the WUG were important for the project achieving its targets. The WUGs also helped to raise awareness of the farming communities and most of the farmers assessed the role of the WUGs as helpful.

Box 4.1 Esabah WUG

Ghaleb Ya'abori is a leader farmer in Esabah in Manaka (Sana'a). He was asked to lead the Water User Group – that is involved in the work on bank protection and the rehabilitation of terraces in this areas. His nomination was supported by more than 10 fellow farmers – who all signed up to it on an application paper.



At the inception of activities, beneficiary farmers signed a tripartite agreement with the GSCP Field Units and the Local Councils/ WUGs. Specific points in the tripartite agreement under component 1 was the endorsement of a ban on expanding agricultural land and growing qat, whereas under component 2 the undertaking of the spate irrigation maintenance by farmers was part of the agreement. During the beneficiary impact assessment it appeared that the majority of small farmers still agree to not growing qat on their land and on non expansion, however for large farmers, most of them agree on non-expansion but less than half agree on not growing qat. From this it appears that the regulation of groundwater use needs more sustained efforts.

Having said so there are several examples in the project area where farmers recently converted qat fields to other crops (peaches, almonds and coffee) – in Ibb, Dhamar and Sana'a (see box 4.2) – with the support of the IAS. There are also a number of examples of farmers putting in place rules on the minimum distance between wells (500 meter), the development of new wells and on coordinating pumping operations. More than half of small farmers adopting informal agreement with community to regulate well digging distance between wells and pumping operation time. While most of large farmers adopt informal agreement only for regulating irrigation operation hours and adopting formal agreement for digging wells and minimum distances between wells.

Majority of project beneficiaries believed that Local agreements and rules concerning conserving water and limiting abstractions are enforced through local leadership. The resolution of local conflicts is also through the local leadership The role of the WUGs was confined to project activities and raising awareness.

Table 4.1 Beneficiary farmers' views on the provision under the tri-partite agreement to receive project subsidy on improved groundwater equipment

Beneficiaries response	% of beneficiaries
Small farmers agreed on ban on qat cultivation	68%
Small farmers agreed on non-expansion	63%
Large farmers agreed on ban on qat cultivation	42%
Large farmers agreed on non-expansion	74%

Source: Field surveys analysis results

Table 4.2 Small farmers views on community role in regulating groundwater use

Beneficiaries responses	% of beneficiaries
regulate well drilling/ digging through a formal agreement with the community	16%
regulate well drilling/ digging through an informal agreement with the community	63%
regulate well drilling/ digging by/under WUG Intervention	0
regulating distances between wells through a formal agreement with the community	10%
regulating distances between wells through an informal agreement with the community	63%
regulating distances between wells by/under WUG Intervention	5%
Scheduling Operating Times/Hours through a formal agreement with the community	58%
Scheduling Operating Times/Hours through an informal agreement with the community	0
Scheduling Operating Times/Hours by/under WUG Intervention	5%

Source: Field surveys analysis results

Table 4.3 Large farmers views on community role in regulating groundwater use

Beneficiaries responses	% of beneficiaries
regulate well drilling/ digging through a formal agreement with the community	53%
regulate well drilling/ digging through an informal agreement with the community	24%
regulate well drilling/ digging by/under WUG intervention	3%
regulating distances between wells through a formal agreement with the community	47%
regulating distances between wells through an informal agreement with the community	32%
regulating distances between wells by/under WUG intervention	0
Scheduling Operating Times/Hours through a formal agreement with the community	5.%
Scheduling Operating Times/Hours through an informal agreement with the community	47%
Scheduling Operating Times/Hours by/under WUG intervention	0

Source: Field surveys analysis results

In component 2 WUGs were also assessed as being useful by most of the farmers, but they do not play a role in the maintenance of the spate irrigation systems. In component 1 this is not required because the systems are individually owned and operated but in the spate irrigation systems in component 2 the WUGs were expected to play a role.

Box 4.2 substituting qat with peaches

For a long time potato was by far the most popular crop in the Jahran plain in Dhamar. Over the years farmers started to introduce qat as well. This was a mixed success as the qat suffered from frost and cold. The GSCP contributed providing subsidized drip systems.

In addition there are several other examples where qat trees have been uprooted in the project area and substituted with other crops:

- In Manakha in Sana'a area a considerable number of farmers have replaced qat by coffee plants. Some innovative business is supporting this through special market chains. Other farmers in Manakha area are replacing qat by almond plants, which is quite rewarding. The IAS has supported this initiative. The market price of Yemeni Almonds is YR 10,000 – 12,000 per kg as compared to YR 2,000 per kg for the imported almonds.

- In Yerim, Ibb Governorate some farmers have also started replacing qat by almond and coffee.

4.2 Beneficiaries views on the functioning of Water Users Associations

In the GSCP, the establishment of the WUAs has been supported in a number of instances. According to the last Progress Report there were eleven WUAs active within GSCP. Some of these were supported by the Community Water Management Project that was closely
The members of the WUAs interviewed consisted of a board (ranging from 10-16 members) that was meeting regularly (3 to 12 times year) and in between was maintaining contact by telephone. In some cases the WUAs also have their own office. Board members were nominated or elected for duration of three years. In three of the five cases the chairperson was a small farmer. Also in three of five cases a small subscription fees was collected from all members.

Five focus group discussions were held specifically with the members of WUAs as part of the Beneficiary Impact Assessment Alganaos-Hodiedah, Alghaith-Seyoun, Sadeen-Dhamar,Jahran-Dhamar and Yarim-Ibb. All these organizations / WUAs were registered with the Social Affairs Administrator. Membership ranged from 79 persons to 425 members. Except Alganaos, where there

were no tenants in the area, other four of the WUAs tenants are members too. Also in two WUA(Sadeen and Yarim) female farmers are among the members.
All Of the five WUAs, had received very regular training by IAS on organizational management. These trainings sessions were assessed as very useful. Besides, the WUAs had cooperated with the IAS on facilitating farmer training. Contact with the FU management was very intense during the implementation of the works but became more sporadic afterwards. Except Alganaos, the other four WUAs had regular contact with other WUAs and three, namely Jahranm,Algaith and Sadeen received training from other organizations besides GSCP.

The scope of some of the WUAs has gone beyond facilitating project activities – such as raising awareness, approaching beneficiary farmers, arranging distribution of pipes identifying farmers for training, facilitating cost contributions, supervising and liaising with contractors - but has also concerned the regulation of water resources – in liaison with the National Water Resources Authority and conflict resolution in general. The political turmoil of 2011 made this regulatory role more difficult as the local NWRA offices were hardly functioning, giving rise to unauthorized drilling. The WUAs that were visited also endeavoured to provide direct services such as the regulating access to diesel supplies during the shortage of 2011. Box 4.3 gives two examples.

4.3 Beneficiaries' views on the Irrigation Advisory Services and Project in General

Irrigation Advisory Services were part of the GSCP project. GSCP introduced the efficient irrigation techniques and the IAS was in charge of organizing training for farmers. Here field days were an important part of the IAS activities.

Farmers' perception of the IAS role has been positive, as revealed from the analysis of the information collected during the field survey. There is a large interest in training provided by the IAS engineers in the FUs, and in some cases farmers mentioned they are even willing to pay for it.
The demand for the IAS services, in fact, appears far more than the project could offer with the constraints of time and transport. 28% of the farmers interviewed attended training directly, including visit to demonstration farms and attending field days or attending workshops. A regular 'complaint' of farmers was that they would have like to have more support in this regard and did not see the IAS as frequently as they would have like to. This reflects on, the large need for the services provided by IAS what appears is the relatively low coverage – the majority of the beneficiary farmers did not take part in a training event. This is not surprising – from table 1.1 it is apparent that the numbers of training events were small compared to the large number of benefitting farmers (and family members).

Training
The appreciation for training was generally positive particularly among farmers using localized on farm irrigation system; but among beneficiaries using piped conveyance systems appreciation for training is modest. However, majority of interviewed beneficiaries both using piped conveyance and localized on farm irrigation systems did not attend any training program. Another part of the assessment is that when the training was given it was not always at the right level: for some too difficult and for others too simple.

Workshops
Similarly most of beneficiaries using localized on farm irrigation system and less than half of farmers using piped conveyance system expressed high usefulness of attended workshops.

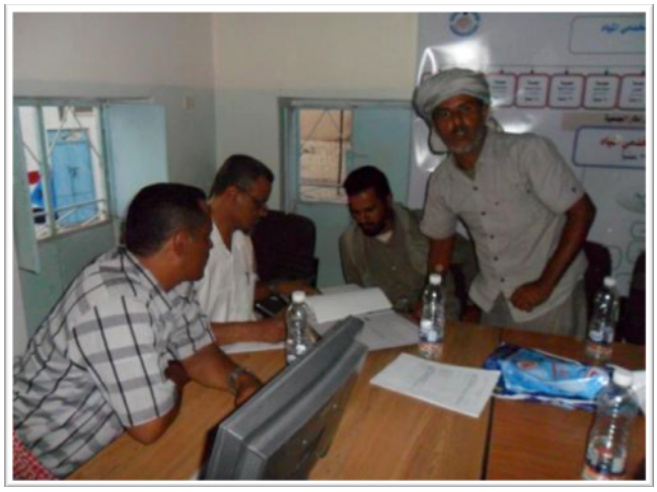
Demonstration farms
Most of the interviewed farmers did not attended field days in any demonstration farm, and few of farmers who had demonstration farms on their fields perceived high usefulness of these farms (18 % and 24 % of farmers using piped conveyance and localized systems respectively)

Box 4.3 Active WUAs

WUA Al Ghaith (Shibam)

The Water User Association Al Ghaith was set up in 2007 – with assistance of the Community Water Management Project. Its aim has been to promote and support water management in the Al Ghaith area. It partnered since its inception with the GCSP. It promoted the water conservation activities of GCSP and helped farmers to obtain the PVC pipes from the project. It also supported the management of the spate irrigation system.

During the diesel crisis of 2011 it assisted its members to get diesel during the diesel supply crisis of 2011. At this time diesel was very much in short supply and almost only available in the black market. Prices were four-fold of the normal price. The WUAs organized a system of ration cards with which farmer members go and obtain diesel at the local fuel station at the official non-inflated price.



Yerim WUA (Ibb)

The Yerim WUA was set up with the help of GSCP. As with the Al Ghaith Water Users Association it served to create awareness on the groundwater issues. It introduced the water saving program and helped farmers get access to the localized systems and conveyance systems promoted under the project. It also made the link with possible beneficiaries for the water harvesting program and the GSCP. The Yerim WUA was also active in controlling unlicensed drilling – working in close cooperation with the branch office of the NWRA. However, with the political crisis starting from 2011 and the disappearance of an active role of public organizations such as NWRA uncontrolled drilling re-emerged.

Table 4.4 Piped Conveyance and localized system beneficiary assessment of usefulness of training support

Beneficiaries responses	% of beneficiaries
Piped conveyance system beneficiaries attended workshops are considering them highly useful	12%
Piped conveyance system beneficiaries attended workshop are considering them not highly useful	9%
Piped conveyance system beneficiaries attended field days in demonstration farm considered them highly useful	19%
Piped conveyance system beneficiaries attended field days in demonstration farm considered them not highly useful	13%
Localized on-farm system beneficiaries attended workshops are considering them highly useful	32%
Localized on-farm system beneficiaries attended workshop are considering them not highly useful	8%
Localized system beneficiaries attended field days in demonstration farm considered them highly useful	24%
Localized system beneficiaries attended field days in demonstration farm considered them not highly useful	4%

Source: Field surveys analysis results

Of all farmers interviewed in the first component of the project, more than half mentioned they made a modification to their cropping system following the advice of IAS, which is a high impact factor (see table 4.5).

In general, majority of farmers viewed the design as well as the quality of the systems as satisfactory and expressed the usefulness of the information provided by IAS. Hence, the services of the project, in particular the Field Unit, have been appreciated: 74% of the beneficiaries' farmers even ranked it as excellent.

Table 4.5 Beneficiary perspectives on project organization

Beneficiaries responses	% of beneficiaries
Beneficiaries using conveyance system viewed that the information provided by the IAS was useful	62%
Beneficiaries using conveyance system viewed that the information provided by the IAS caused me to change my cropping system	56.%
Beneficiaries using conveyance system viewed that the services by the GSCP project were excellent	72%
Beneficiaries using localized system viewed that the information provided by the IAS was useful	60%
Beneficiaries using localized system viewed that the information provided by the IAS caused me to change my cropping system	56.%
Beneficiaries using localized system viewed that the services by the GSCP project were excellent	76%

Source: Field surveys analysis results

5. Observations and Conclusions

In this section observations and conclusions that emerge from the Beneficiary Impact Assessment are summarized for the three project components

Component 1	Main observations
Cost sharing	The cost sharing arrangement (with subsidies now ranging between 50-70%) as applied for the piped conveyance systems and localized on farm irrigation are generally acceptable, as revelled by the results of the Beneficiary Impact Assessment. 44 % of the farmers even indicated that in the future they would be willing to accept a lower amount of subsidy Among the non beneficiaries the existence of a certain amount of subsidy remains important to adopt the systems The existence of a waiting list – in particular for the piped conveyance systems – underlines that the present cost sharing/ subsidy arrangement are acceptable and that there is no need to increase the subsidy levels as for instance proposed under the newly started NIP There are also several examples of farmers making larger contribution – making modifications or in some case buying additional pipes
Involvement in design	The techniques of piped conveyance system have by now become very familiar in the GSCP intervention areas. The technique is very much farmer owned as is clear from farmers replacing vulnerable and exposed above the ground PVC elements with steel or galvanized iron elements
Involvement in implementation	Project procedures are generally assessed as easy by 78% of sampled farmers There has been regular contact with the field engineers of the FU and involvement in the design has been good and may be characterized as a problem solving partnership – with beneficiary farmers for instance arranging for the installation if technicians are not available
Systems functionality	The functionality of the systems is generally very good – with the quality of services assessed as positive by 69-76% of interviewed farmers There are some concerns in localized system on stoppers, filters and PE pipes and the pressure in some of the localized systems Micro sprinkler systems were introduced in a limited number of places but are popular in orchards with well developed root systems
Direct impact	There has been positive impact of the piped conveyance systems and localized on farm irrigation systems on several fronts. In terms of priorities for farmers, the main benefits are: (1) reduced irrigation labour requirements, (2) extended pump life, (3) improved crop production. Groundwater conservation is not valued as high as the other impacts. 94% of interviewed farmers informed that there is an increase in income after the introduction of piped conveyance systems and the localized systems (80%) Under the piped conveyance systems 75%, of the interviewed farmers indicated to have significantly saved labor, whereas 25% mentioned crop increase to be above 15% and also 34% mentioned that water savings were more than 25% on the conveyance system. The localized systems are more costly but their effect on water savings is also more pronounced. In case of the bubbler and drip systems 96% of the farmers mentioned that they reduced irrigation labor; for 76% of the farmers crop production increased with more than 15% and for 68% of

	farmers water use was reduced by 25% or more. The latter is consistent with field measurement that state 33% of water saving under localized systems and 13% under piped conveyance systems. The direct impact of switching over to localized system on groundwater levels was not immediately significant The improved systems have also allowed some new cropping practices
Sustainability	Most systems assessed function well and repairs are done by farmer/ owners – in case of piped conveyance systems local technicians are engaged. 78% of farmers see the main role for themselves in this regards There is concern among beneficiary farmers related to the availability and cost of spare parts

Component 2	Main observations
Cost sharing	The compulsory contribution in cash by farmers in spate irrigation systems was in most cases provided by the Local Councils. Farmers contributed in kind, mainly in labour (stone removal, tree cutting) for the implementation of canal control structures and wadi protection work... Regarding the large and medium spate structures the interviewed farmers perceived responsibility of the operation and maintenance of the spate systems to rest with local council / government. In the water harvesting activities beneficiaries have contributed more than the required share especially for water storage tanks. – In most cases farmers have undertaken additional work on the water tanks at their own expense
Involvement in design	There has been a constructive involvement of farmers in the design of the spate systems – which most beneficiaries aware of the purpose and maintenance requirement of the systems The work in water harvesting has been very much farmer-led A large range of design appropriate to local conditions in terms of layout and material used has evolved
Involvement in implementation	The involvement of small farmers was even more intense than that of large farmers The work in the water harvesting has been undertaken very much on the basis of community contracts
Systems functionality	Technical performance is generally good There are some minor issues of quality control in finishing in water harvesting and deferred maintenance in the spate sub-component. Farmers requested more training in this field.
Direct impact	86% and 83% of farmers benefiting from spate and water harvesting activities respectively indicated that their income had improved as a result of the project intervention. Apart from improvements in surface water availability, 56% of the farmers interviewed indicated that groundwater availability improved too. Some interventions under component 2 (flood breakers and wadi pits) were also specifically designed for this purpose 64% of the beneficiary farmers interviewed observed an improvement in the environment in particular re greening of the area. For 31% of interviewed beneficiaries, there also an added value in terms of improved water supply for livestock.
Sustainability	Responsibility for the maintenance of the spate systems is unclear: a majority of interviewed beneficiaries see the main role for local government or the project and no contingency provisions are in place.

Component 3	Main observations
Water User Groups	The role of Water User Groups was assessed positively by 72% of interviewed farmers – their role being very much in project facilitation and awareness raising The earlier agreements by beneficiary farmers on not extending cropped area or not growing qat are not widely supported at present, especially not by large farmers There are several examples of local regulation of groundwater use – generally set up through local informal leadership. In some areas qat is being replaced by other crops
Water Users Associations	There are a relatively small number of WUAs in place in the GSCP (11) The ones that were assessed had been active in introducing and facilitating the project; assisting in regulating local groundwater use and in dealing with the rationing of diesel in the 2011 diesel crisis
Irrigation Advisory Services	There is much interest from farmers in the services of the IAS, especially in training. The demand in fact appears far more than the project could offer within the constraints of time and transport. 28% of the farmers attended training directly including visit to demonstration farms and attending field days or attending workshop.. A regular 'complaint' of farmers was that they would have like to have more support in this regard and did not see the IAS as frequently as they would have like to: this reflects on the large needs for the services as provided by IAS. The appreciation for training was generally positive particularly among farmers using the localized irrigation systems where 78% give it high score; among beneficiaries using piped conveyance systems this was 53%. Of all farmers interviewed in component 1, 56% mentioned that they made a modification to their cropping system following the advise of IAS, which is a high impact factor
General project support	The overall appreciation by beneficiaries for the project is high

In summary, given the diversity, the magnitude and the new character of the project the results from the Beneficiary Impact Assessment are clearly positive. Highlights are the sense of ownership by beneficiaries from the conveyance systems and the water harvesting tanks, but also the important side benefits in reduced labour usage, higher crop yields and a re-greening of the area. Another good achievement is that in the project procedures the involvement of small farmers has been intense – in fact even higher – than that of large farmers.

Main areas of attention are:

- Groundwater regulation could receive more support. The interest in the IAS service is high and the awareness seems to have an effect. On the other hand the restrictions on new land development and qat cultivation are not supported by all – especially not by large farmers. Strengthening the WUAs so to be more long lasting and play a larger role in the conservation of groundwater – building on some spontaneous good practices as they emerged – may be an important area to further strengthen. Also, the maintenance of the spate system is area of concern that could be addressed by stronger and more widespread WUAs.

- The intensive works have not yet been translated in stabilized or reversed groundwater tables. This is clear from the beneficiary interviews but also from the monitoring data obtained from

the project. It may be useful to work more intensively in certain areas (rather than being too much scattered), combining a range of technical and institutional measures, as is already happening in some area visited – where a range of interventions is taking place.

- The appreciation of the different activities is high – and the cost sharing arrangements acceptable. For poorer farmers cash flow problems make it in some cases difficult to engage, especially in component 1, when the time for contribution is near. In terms of sustainability the availability and pricing of spare parts is an issue as is the maintenance of the spate systems. With respect to the cost sharing arrangements under component 1 a significant portion of farmers mentioned they were willing to accept an even lower subsidy amount in the future.