Community-based Watershed Research in the Terraced Mountains of Yemen

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Abstract

The threat that the degradation of terraces in the highlands of Yemen poses to the livelihood of rural households and to national economic development has been widely recognized. The aim of this study was to contribute to the development of policy recommendations for the improvement of the life of rural families in the Yemeni mountains. Three small mountain watersheds (200-700 ha) in the northern, middle and southern mountain regions of Yemen were selected as the testing grounds for this study. Four interrelated issues that affect these mountain systems were analyzed and evaluated in cooperation with the various stakeholders: natural resources and their management; rural livelihood strategies; community-based participatory agricultural research; and policies and institutional issues. The terraces in the study watersheds were found to be generally well maintained because of a lack of other resources and opportunities. Water was a key issue in these mountain watersheds. Communal water-harvesting reservoirs, springs, and occasionally shallow wells in or near the main *wadi*, served the household water needs of the communities. During the dry season women and kids walked long distances to collect water from the few remaining sources. The livelihoods strategies of the communities in the study watersheds were diverse, with a large percentage of the households receiving incomes and remittances from jobs in towns (32%) or abroad (3%). On average, 39% of the households were perceived to be poor or very poor. Community-based participatory research is essential for tackling the crop and livestock production problems and options in these complex mountain agro-ecologies. Government support programs need to be restructured and the capacity of these communities need to be built to enable them to organize themselves and access the needed support to improve their own livelihoods.

Introduction

Yemen is one of the least developed countries in the world, with 45% of the population living on less than $2 a day (UNDP et al., 2005). Yemen has an estimated population of 21.5 million, which is expected to reach more than 50 million by the year 2030 (UNDP et al., 2005). This will put additional strains on Yemen's natural resources, especially the water resources, which are already, with 198 m^3 per capita per year, among the lowest of the world.

Although 50% of the country's workforce is employed in agriculture, the country currently imports more than 90% of their cereal needs (UNDP et al., 2005).

An important part of Yemen's agricultural output is produced in the mountainous highlands. The complex landscape of the Yemeni mountains consists of steep and rocky slopes, terraced croplands, rangelands and scattered trees. The terraced land depends on rainfall which is scanty and irregular. Small stone and earthen dams and channels divert and divide rainfall-runoff water from rocky areas and intermittent springs and streams onto a cascading series of terraces. The mountain terraces of Yemen comprise an unique water-harvesting system that was developed centuries ago by rural tribes under strong communal traditions. The system has remained productive ever since through continuous upkeep and maintenance. But the limited natural resources in the mountains are short of meeting the increasing demands, causing people to migrate to cities and abroad. Abandonment of terraced land leaves the runoff to flow down uncontrolled, threatening the fragile equilibrium of the terraced slopes.

The overall goal of this project was to develop policy recommendations for improving natural resource management, food security and income levels of rural households in the highlands of Yemen. To facilitate the integrated analysis of the biophysical and socioeconomic factors that affect resource management in these harsh environments and to ensure stakeholder participation at household, community and policy levels, research was conducted in three small mountain watersheds, one in each of Yemen's three different highland agro-ecologies. The project goal was supported by a set of interlinked objectives: (i) development of watershed-level GIS maps and databases that integrate biophysical and community-level socioeconomic data; (ii) analysis of livelihood strategies of rural households; (iii) participatory testing of technologies that improve the conservation and productivity of the land and water resources; (iv) review of policy and institutional options; (v) capacity building of agricultural research organizations in participatory, community-based natural resource management research; and (vi) dissemination of research results at community, district and national level. The project was implemented by small research teams from the regional research stations of the Agricultural Research and Extension Authority (AREA) in these three agro-ecologies, with the help of the Renewable Natural Resources Research Center and a local coordinator based at AREA's headquarters in Dhamar.

Materials and Methods

Study Area

Yemen has a semi-arid to arid climate with rainy seasons in spring and summer. The rainfall depends on two main mechanisms: the Red Sea Convergence Zone; and the monsoon inter-tropical Convergence Zone. The first is active from March to May. Its influence is most noticeable at higher altitudes in the west of the country. The second affects Yemen from July to

September, moving north and then south again so that its influence lasts longer in the south. Rain storms in the winter months of December and January are attributed to the influence of the Mediterranean. The climate is strongly influenced by the mountainous nature of the country.

The topography is dominated by mountain ranges running parallel to the Red Sea coast, with three ridges interspersed by upland plains. These mountain ranges rise from sea level to over 3600 m within 100 km from the Red Sea. In the southern part of the country the mountain ranges merge with ranges running parallel to the coast of the Gulf of Aden; they reach altitudes of about 2000 m. The variability in rainfall over both time and space is considerable. Rainfall is predominantly in the form of localized storms. This results in great differences in amounts of rainfall over relatively short distances. A year may be relatively wet in one area, but dry elsewhere, even if distances are modest.

Watershed studies are generally too intensive to allow a random selection of replicates. Therefore, a representative watershed was selected in each Yemen's three main mountain agro-ecologies: the northern highlands, middle mountains, and southern uplands. Based on average annual rainfall, as mapped by Bruggeman (2000), representative areas were identified and field visits were made to evaluate potential watersheds and their communities. Criteria used to select the sites included: a well-defined watershed with an areal extent of 200 to 400 ha; the presence of both well-maintained and degraded terrace land; potential for agriculture; cooperative farmers living in large communities, no less than 500 households, and good accessibility for researchers. The locations of the three selected watershed are presented in Fig. 1.

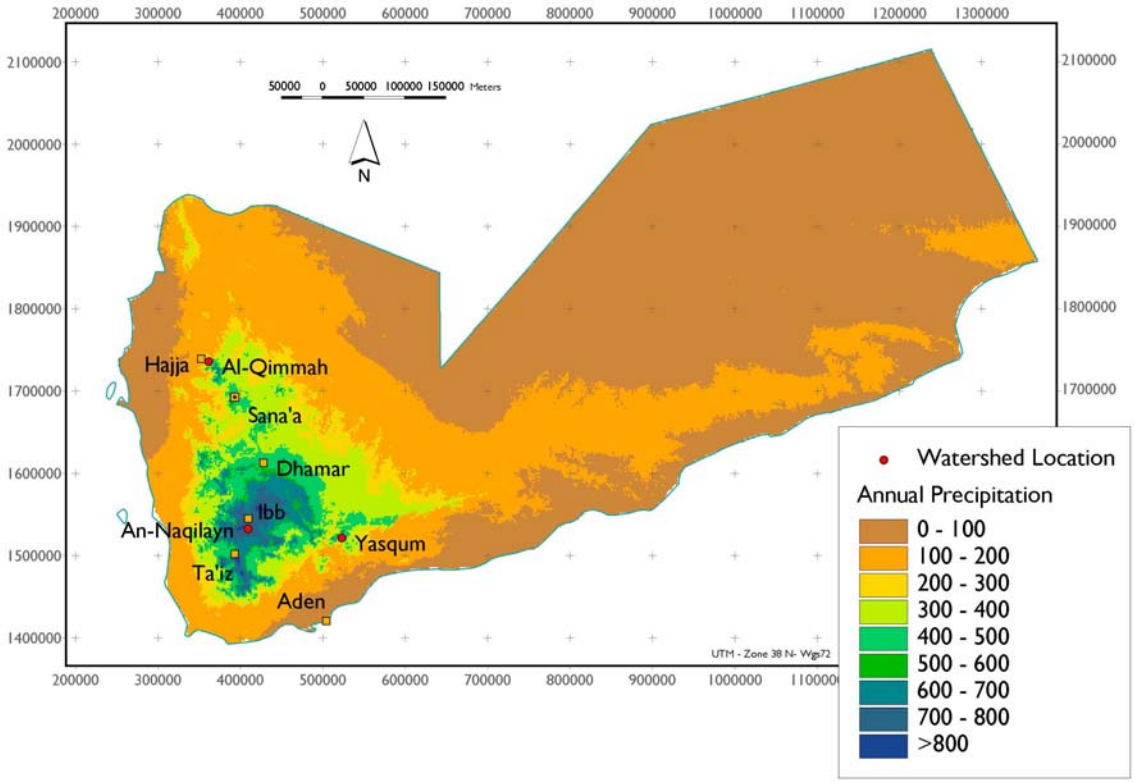

Fig. 1. Average annual rainfall (De Pauw, 2001) and location of the study watersheds in Yemen.

Resource Mapping, Community and Livelihood Characterization

The project followed a community-based participatory research approach, which involves land users and community members in problem identification and analysis. Basic watershed maps were prepared from topographic maps of the study areas (1:50,000 and 1:100,000) at the start of the project. These maps were used during the subsequent field surveys. Aerial photographs and handheld Global Positioning Systems (GPS) were used for locating and mapping soil units and land and water resources. Extensive walks through the watersheds were made, often in the company of key informants, to assess the management and allocation of water resources such as water-harvesting reservoirs and springs and the status and maintenance of terraces. For the assessment of terrace degradation the watersheds were divided in subwatershed units, delineated by features that affect the surface flow process such as watershed boundaries, *wadis*, roads and main escarpments. The fraction degraded terraces was visually assessed in the field and local farmers were asked about degradation and maintenance issues.

Community-level information was added to the GIS database and GIS software (ArcView) was used to analyze and display the data collected in the three watersheds. These data were used in creating various thematic maps with different layers of information.
At the beginning of the project group discussions were organized in all communities to introduce the project and a checklist was used to develop a basic characterization of each community. The community characterization included key socioeconomic and biophysical variables such as availability and distances to main services, education level, land use and ownership, ownership of cars and shops, outside jobs, main crops and livestock ownership, factors that affect crop and livestock production, and community activities and disputes. The characterization also involved a participatory well-being assessment (Salem, 1995), in which male key informants were asked to identify the criteria that describe the different levels of well-being of the households in the village (well-off, moderately well-off, poor and very poor); and to classify the households in these categories. Follow-up interviews were conducted with 26 households (four of each well-being category in two villages in each watershed) to assess if farmers' well-being indicators matched actual household data. Meetings with male and female key informants were held to collect data on household labor allocation and historic well-being time lines. Finally, a formal socioeconomic survey was conducted, which collected household level data on capital assets (human, financial, natural, physical and social) to examine the effect of farmers' income, labor constraints and tenure security on production and investment decisions. This survey included eight farmers selected randomly from each village in each watershed for a total of 176 interviews.

Participatory Testing of Technologies

As a follow-up on the community characterization, farmers' meetings were organized to identify potential options for addressing the main agricultural production problems. Agricultural research and extension specialists discussed improved production practices and technologies with the

farmers. Two priority options were identified in each watershed and farmers were selected for testing these options in their land.

Results and Discussion

Watershed Resources and Management

With surface runoff a key resource in the terraced mountains of Yemen, watersheds seem the most appropriate research unit from a resource management perspective. However, Yemeni communities have often settled themselves strategically on local summits and mountain tops, with their lands located on either side of the watershed border. Still, to obtain a good understanding of the livelihoods of the people in these mountains, we analyzed the resources, problems and interactions of the communities that inhabited a mountain watershed all the way from the top of the mountain to the wide bed of the main *wadi* system downstream. Although the lands of these communities sometimes stretched beyond the borders of the watershed.

The first watershed was located in the northern mountains in Kohlan-Affar district of Hajja Governorate. Agriculture is mainly rainfed with an annual rainfall of 300 to 600 mm. The main crops are sorghum, wheat, barley, lentil, dry peas, faba beans, maize, coffee and *qat*. The watershed, named Al-Qimmah after its main village, actually comprises two neighboring watersheds (Wadi Maqalid and Wadi Abr Jahr), resulting in an area of almost 700 ha. The watershed is extremely rocky and steep. It runs down from an elevation of 2730 to 1650 m asl, with an extremely steep escarpment in the upper part of the catchment. A large number of small *wadis* run along the sites of the terraces and join the two main *wadis* before their outlet into the main system of Wadi Shares, at the bottom of the watershed. Most villages have large *birkahs* (open reservoirs) to collect surface runoff for domestic use during the rainy season. In the downstream areas *qat*, coffee, some fruit trees, but also sorghum, are irrigated from rainfed springs and a few shallow wells located in the *wadi* bed in the downstream area. This water is also often collected in *birkahs* or behind small dams, and traditional rotation systems are used to divide the water among the farmers with water rights.

The terraces in Al-Qimmah watershed were generally well maintained. The return of migrants during the Gulf War had actually resulted in improved maintenance and rehabilitation of terrace systems. A frequent response during the terrace degradation mapping, was that this was the only resource they had, so they needed to maintain it well. Farmers also helped each other with land preparation and maintenance. Road construction was identified as an important factor for the degradation of terraces. Some of the terraces below the bulldozed tracks were obstructed by large rocks or had completely fallen apart. Disputes and migration were also occasionally cited as reasons for degradation. Visual assessment of terrace degradation indicated that on average 19%

of the terraced land units were affected by degradation. The most common form of degradation was damaged, but still intact, walls. The highest degradation occurred in the downstream areas, which were affected by increased runoff. Reasons for not maintaining were the steepness, costs, and rockiness of the land.

An-Naqilayn, the second watershed, is located in the mountains southwest of Ibb and represents an agro-ecology with relatively higher natural resource endowments than the other sites. Some of the most productive agricultural land of Yemen lies in this area. Annual rainfall ranges between 400-800 mm. The watershed is located between the altitudes of 2100 to 3100 meter and covers about 580 ha. The major crop in the watershed is sorghum, but various vegetables such as carrots, potatoes and garlic are also grown during the wet season. The main *wadi* branch (Wadi Klābah) is approximately 2600 m long. The outlet of the *wadi* is formed by a spectacular waterfall, incised in the rock, where Wadi Klābah flows into Wadi Mar'ah. Throughout the *wadi*, various small dams and diversions collect the water and guide it, sometimes through long earthen channels, to the neighboring terraces. Springs, which are often located near the *wadi*, provide water year round, but during the dry season the flow reduces to a trickle. Metal pipes connect the springs to closed reservoirs in the villages, where families fill their jerry-cans for household use. The water in the *wadi* is polluted with soap, caused by the washing of clothes. This was a frequent complaint among the irrigation farmers. Because the water flow is low, soap concentrations are often high, especially in the downstream areas.

The percentage of terraced land units in An-Naqilayn that was affected by degradation came out to be the same as in Al-Qimmah watershed (19%), but the degradation was generally more severe. Especially in the mid and downstream areas, the lack of stones was hampering terrace maintenance. Farmers explained that they could not afford the cost of transporting stones to the sites. Similarly to Qimmah watershed, disputes and out-migration were cited occasionally as reason for the poor state of terraces. Construction of buildings and runoff from the road also affected the terraces. In the mid- and downstream areas terrace walls were often made of soil, protected by vegetation. Scarcity of land resources was also clearly a reason for maintenance; one completely degraded site was in the process of being cleared for the rebuilding of terraces.

Wadi Yasqum, the third watershed, lies in the mountains of Wadi Yahr in Yafa, an area known for its coffee. Annual rainfall is 200 to 400 mm. Maize is cultivated in the lower altitudes during December to June and forage millet or maize is grown during April to June. Yasqum watershed drains into Wadi Yahr at approximately 1320 m asl. Upstream, the *wadi* forks after 1.4 km, with the northern branch going up to Jummah village at the top of the watershed (1840 m asl). The watershed is very narrow with extremely steep rocky side slopes, covering less than 200 ha. There are narrow terraces with coffee, qat, fruit trees and sorghum at all possible locations throughout the watershed. In the downstream area there are larger terraces with coffee. Various reservoirs collect water along the sides of the *wadi*. A large reservoir collects water from the underflow in the rock formations below the *wadi* in the downstream area. Water is also pumped for irrigation and domestic use from shallow wells in Wadi Yahr. Irrigation is mainly by plastic and metal pipes. During the dry season water resources are severely limited.

Livelihood strategies

The mapping of socioeconomic and resource information in the three micro-watersheds provided important insights in the complexity of life in the mountain terraces. Natural surface water flows, which not only provide critical resources for humans, livestock and crops in these dry environments but also connect the up- and downstream users, have been modified by terrace construction, irrigation channels, water-harvesting systems, tracks, and roads. Lack of these resources causes some communities to become severely disadvantaged during the long dry season. With limited land and water resources, we find intensively maintained and managed terraces on one hand; and collapsed terraces due to out-migration on the other hand.

The community-perceived well-being classifications in Al-Qimmah and An-Naqilayn watersheds are presented in Fig. 2. The classification 'very poor' was not accepted by the communities in An-Naqilayn. On average, 39% of the households in the three watersheds was perceived to be poor or very poor, ranging from 34% in Yasqum watershed in the south to 42% in Al-Qimmah watershed in the north of the country. Overall, the criteria that farmers used to describe these well-being categories were similar to those described in the sustainable livelihoods framework (Ellis, 2000). Land ownership, cash crops, livestock, ownership of cars, shops, and mills, and jobs in towns and abroad were used as well-being indicators.

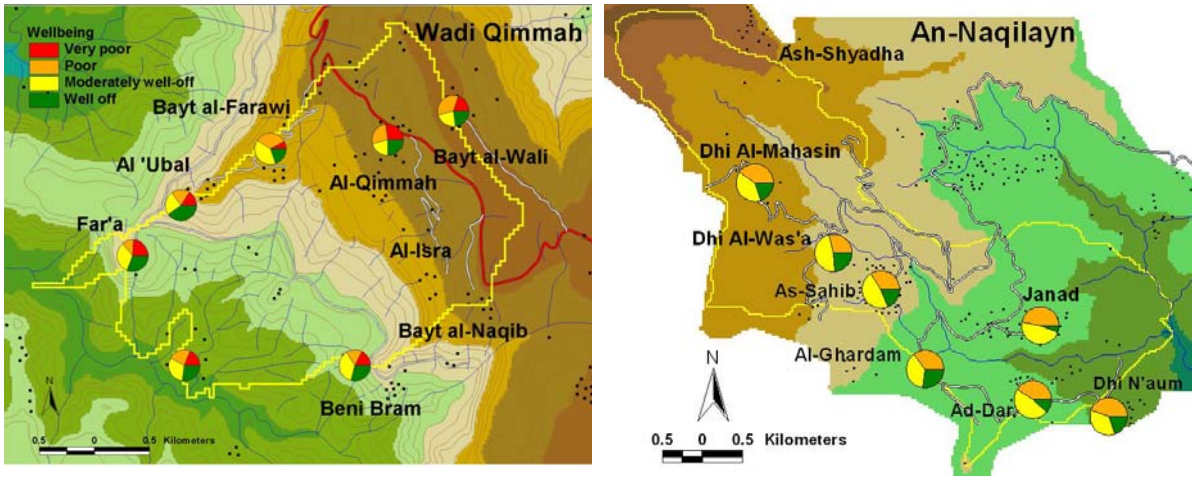

Fig. 2. Example of the GIS database, distribution of well-being categories (% of households) in the communities in Al-Qimmah and An-Naqilayn watersheds in Yemen.

Key community and household resources and assets in Qimmah and An Naqilayn watersheds are summarized in Table 1. In Qimmah watershed, the communities estimated that 82% of the land was terraced, with terrace degradation ranging between 5 and 14%. Terrace degradation was higher in the downstream communities, as affected by recent road construction and very steep slopes. The percentage of households in the community that was perceived poor and very poor was lower in the mid- and downstream areas than in the upstream communities.

A marked difference between these two groups was the availability of irrigation water from springs, and to a less extent land-ownership. In An Naqilayn watershed, similar to Al-Qimmah, most of the land is terraced, but the terraced area seemed to be erroneously estimated by the communities. Terrace degradation was indicated to be highest in the watershed's upstream area (14%) and downstream area (15%). Access to water for irrigation was higher midstream and downstream.

The average household size for the three watersheds was 9 members, whereas land holdings were generally less than 1 ha. Share cropping on private or religiously endowed (*waqf*) terrace land was highest in Al-Qimmah watershed, with 33 and 22%, respectively, and 17 and 19% in An-Naqilayn. In Yasqum watershed, in the south, land seemed to be predominantly cultivated by the owner with only some 4% *waqf* land. Share cropping rights on *waqf* land is often established through family relations and is generally considered more secure than share cropping on private land (Aw-Hassan et al., 2000). On an average, 72% of the families owned livestock. Approximately 32% of the households received income from jobs in cities and towns in Yemen and 3% depended on remittances from work in the Gulf countries. The percentage of households with jobs in the Gulf was highest in the southern watershed (15%) and lowest in An-Naqilayn in the middle mountains (1%).

Table 1. Community and household resources and assets in the Al-Qimmah (a) and An-Naqilayn (b) watersheds, summarized from the participatory community characterizations, with communities arranged from upstream (left) to downstream (right).

(a)	Bayt Al-Wali	Al-Qimmah	Bayt Al-Farawi	Al-'Ubal	Fara'a	Beni Bram
Village land (ha)	51	85	62	34	67	76
Terraced land (% of village land)	78	88	72	82	85	84
Degraded terraces (% of terr. land)	5	5	8	6	14	14
Irrigated terraces (% of cultiv. land)	0	0.2	15	3	23	23
Owner cultivated (% of cultiv. land)	41	34	44	49	51	53
Households (#)	45	66	79	32	74	82
Households with irrigated land (%)	0	3	8	13	20	22
Households owning livestock (%)	78	73	92	84	76	82
Households owning a car (%)	44	12	19	31	12	7
Households with jobs in towns (%)	13	58	46	3	41	41
Households with jobs in Gulf (%)	4	3	3	13	4	2
Poor and very poor households (%)	53	55	41	34	36	34

(b)	Dhi Al-Mahasin	Dhi Al-Was'a	As-Sahib	Al-Ghardam	Janad	Ad-Dar	Dhi-N'aum
Village land (ha)	100	50	80	75	80	80	150
Terraced land (% of village land)	39	43	40	19	21	67	49
Degraded terraces (% of terr. land)	15	12	0	11	3	6	14
Irrigated terraces (% of cultiv. land)	1	1	3	100	3	15	2
Owner cultivated (% of cultiv. land)	75	25	50	65	66	85	95
Households (#)	203	95	177	65	150	152	150
Households owning livestock (%)	64	53	40	100	100	100	31
Households owning a car (%)	15	5	6	6	4	0	1
Households with jobs in towns (%)	38	47	0	32	54	0	42
Households with jobs in Gulf (%)	2	5	0	0	1	0	4
Poor and very poor households (%)	40	29	34	35	47	41	45

Data from the 26 individual interviews showed a large disparity in livelihood assets among different well-being categories. Households classified as poor and very poor had on the average less than 1 ha of land, while the moderately well-off and the well-off had more than 5 ha of land. The variation was also very clear in the access to irrigation, with the poor having very little or no irrigated land. Livestock ownership was also an important indicator of perceived household well-being. The most striking livestock indicator was the ownership of a cow, which provides milk for the family. Households without a cow were perceived to be very poor. Overall, the moderately well off and well off households had twice as may livestock units as the poor and very poor households.

The overall results indicated also that the very poor households are those who are more likely to depend heavily on farm and non-farm wage labor. The moderately well-off and well-off households derive their income from cash crops, from skilled work in towns or abroad, from trade and private businesses or from a combination of these different income-generating activities. The data showed that the better-off households are those with the most diversified sources of livelihoods. Rural households tend to seek multiple strategies to secure their livelihoods, hence, using a single poverty or well-being indicator to classify households would be misleading (Aw-Hassan et al., 2002).

Average household income in the three watersheds was $1760 per year. Thus, the majority of the families in these terraced mountains had to sustain themselves on less than $1 per person per day. It is also interesting to note that the watershed in the highest rainfall environment, An-Naqilayn, had actually the lowest average annual income ($1116). In comparison with the other watersheds, communities in An-Naqilayn had relatively less assets (e.g., cars) and fewer family members working abroad and the highest population density (about 1460 people per km^2).

These findings imply that crop-based technologies will not immediately take the poorest households out of poverty, because these families have limited agricultural assets such as land and livestock. Therefore, asset-building interventions, such as enabling the poor to acquire livestock or other non-farm opportunities, would be more appropriate. However,

education, human capacity building, and improvement of the national economy would be the most sure measures for improving the livelihoods of the poorest in the long term.

Participatory Technology Testing

In Al-Qimmah watershed researchers assisted farmers in three villages with the production and management of four improved lentil varieties. High yields (0.65 to 1.15 ton/ha) were obtained for three of the improved varieties, as compared with the local variety (0.45 to 0.60 ton/ha). Multi-purpose trees were provided to farmers in two villages to provide fodder, shelter and wood, and to reduce runoff and erosion. The trees were planted on highly degraded land and on cropped terraces near their homes. Because of the drought during the first rainy season, about 25% of the seedlings died. They were replaced again at the start of the second rainy season.

In An-Naqilain, farmers received assistance with the identification and control measures against insect and pests in sorghum, the most common crop in the watershed. Pest control was tested for the protection of potatoes and garlic, which are important cash crops, against silk worm infestations. In Yasqum watershed, researchers worked with the farmers on improved management (fertilizer application, pruning, plant protection) of coffee and the rehabilitation of degraded land by multi-purpose trees.

An important finding of the PRA was that livestock provide an important contribution to the well-being of the family, with women having the main responsibility for animal care. Because the women are not allowed to leave their communities, training in improved livestock management and disease control was given to them by female livestock specialists in their own communities (3 communities in An-Naquilan and 3 communities in Yasqum watershed).

In addition to agricultural technology options, communities identified the rehabilitation and construction of community reservoirs that harvest and store water from surface runoff and springs as a priority for improving their welfare. The shortage of drinking water, especially during the dry season, was common to all three watersheds. Women, girls and boys often spend 2 to 3 hours a day to collect the water for the household. Especially during the dry season, they walk long distances to get the water from the few remaining water sources in or near the watershed. Local engineers were hired to prepare a plan for the improvement and expansion of these storage structures and a cost estimates. Substantial efforts to obtain support from development and donor organizations for these modest plans were not successful. In Al-Qimmah watershed two community reservoirs (*birkahs)* were improved through arrangements of a local politician. Harvesting of fog for household drinking was tested with special vertical screens placed on the roof of houses on the foggy mountain top in Beit Al-Wali.

To exchange knowledge and experiences between the farmers of the three watersheds, a farmers' traveling workshop was organized. A group of five farmers was selected to represent

each watershed. The group toured all three watersheds, and visited also a community (Hayfan) with closed household cisterns (*sakaya*) fed by roof-top water-harvesting systems, and the poultry research unit of the Agricultural Research and Extension Authority in Taiz. The frank exchanges between the farmers provided a unique insight in the different views and priorities of the farmers in the three watersheds. A case in point was the interest in the planting of trees in the watersheds. The seedlings of multi-purpose trees provided by the project were well taken care of in Qimmah watershed but were eaten by livestock in Yasqum. The farmers in Yasqum indicated that they would prefer to invest in fruit trees instead, while the farmers in An-Naquilain focused on cash crops and showed little interest in trees.

Policies and Institutions

The analysis of policies and institutions that affect the livelihoods and resource management in these terraced mountain lands revealed that agricultural policy support, especially subsidies on diesel and the development of spate irrigation systems, has focused on the large irrigated areas in the plains. In addition, the consumer price subsidy of wheat through imports has reduced the profitability of cereal production, which has negatively affected the mountain terraces where cereal rainfed farming is dominant.
Yemen has three main institutions that have programs and credit facilities to support rural communities: the Cooperative and Agricultural Credit Bank (CACB), the Agricultural and Fisheries Production Fund (AFPPF) and the Social Fund for Development (SFD). But these programs seem again to be biased towards large developments and irrigation. Access to these opportunities by small mountain farmers is negligible. There is a lack of awareness among rural communities in the study areas about the existence of these programs and the ways in which they can benefit.

The establishment of integrated research sites in the mountains of Yemen and the participatory community-based research approach were positively received by AREA. But technical and financial support is needed to institutionalize this approach in AREA's core research agenda. A side-effect of the community-based research approach is that development issues often take priority above the testing of improved agricultural production and resource management technologies, especially in these neglected rural mountain communities. Therefore, due attention needs to be given to the establishment of linkages between research organizations and donors who support rural development.

Conclusions

The agricultural system in the steep and rocky mountains of Yemen is based on terraces. The terraces and steep mountain roads that traverse these watersheds complicate the hydrology of these mountain systems. Water for crop production is diverted from *wadis*, springs and rocky areas onto the terraces and guided by channels, outlets and drains, made from local stones, to

terraces downstream. Due to the limited land resources (most families cultivated less than 1 ha of land), the terraces in the three study watersheds were generally actively maintained and managed. But abandonment of terraces due to out-migration or sometimes due to disputes, destruction and obstruction of the terraces due to road construction, and increased runoff from upstream areas have caused some of the terraced hill sides to collapse.

This project combined community participation in problem diagnosis, livelihood assessment and resource mapping with geographical information systems (GIS) to analyze the natural resources and livelihood strategies of upstream and downstream communities in rural mountain watersheds. The farmers in these watersheds grew a large number of crops. Failure to understand the local crops, their uses and niches within the season and along the altitude gradient is a sure failure for the traditional extension approach in these terraced mountain lands. Local researchers engaged in a participatory research process with the communities, which allowed the project to achieve intermediate impact on the livelihood of participating communities. Community-based research can improve the effectiveness of the agricultural research and technology transfer process, but further support is needed to assist the national research and extension system with a proper institutionalization of this approach.

A key problem for these rural communities in the mountains of Yemen is the lack of a secure source of household water supply. The main water sources for these communities are communal water-harvesting reservoirs and springs. However, the capacity of the water storage structures and reservoirs is not sufficient to store all water needed for the dry season from that of the wet season. During the dry season water supplies run out and women and children walk long distances to collect water from the few remaining sources. Policy and institutional support that could improve the lives of these rural mountain communities is weak or absent. Changes are required to ensure that programs that are supposed to support the sustainable development of the rural poor are also really accessible to them. In parallel, action is needed to build the capacity of these rural communities to enable them to develop their own community-based organizations that could empower them to better help themselves.

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