Water Resources Sustainability Project
(WRS)

Pilot Project for Control of Soil Erosion in the Oued Nakhla Watershed

Annual Progress Report
January 1st to December 31st, 1998

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Introduction

The City of Tetouan with a population approaching one million people depends upon drinking water from the reservoir at Oued Nakhla. This reservoir has lost roughly one-third of its capacity since the 1960's due to siltation. The source of this sediment arises from erosion of cultivated lands, fruit tree plantations, degraded mattoral forest, ravines, and streambanks in the watershed.

USAlD bas contracted with a consortium of companies under the umbrella project PREM CPerennite des Ressources en Eau du Maroc) to reduce erosion frorn the Oued Nakhla watershed, in collaboration with Moroccan govemmental agencies and non-govemmental organizations. The Oued Nakhla project is designed to develop, implement, and demonstrate strategies which are effective at controlling erosion, while elevating the incarne levels of participating farmers and landowners. This is a pilot project which bas the potential for replication in other watersheds of the Rif region having degradation of soit and water resources.

The PREM project has two major strategies for controlling soil erosion and reducing the 10ss ofwater capacity in the Oued Nakhla reservoir. The first strategy involves imp1ementation of actions that directly reduce soil erosion or improve water conservation. The second strategy invo1ves imp1ementation of actions that indirect1y reduce soil erosion or improve water conservation.

Examples of direct actions include:

- Planting olive crees along the contour line in rainfed cultivated cereallands Forrning catch basins (cuvettes) around these olive trees to capture runoffwater Establishing grass or forage strips along the contour between olive crees to intercept runoff
- Stabilization of ravines which cut through rainfed cultivated cereallands
- Reforestation of the mattoral regions
- Repair and rehabilitation of irrigated terraces
-

Examples of indirect actions include:

- Improved management of the mattoral regions
- Introduction of improved agricultural equipment and best management practices
- Introduction of honeybee production units
- Introduction of improved goat breeding stock
- Introduction of energy efficient cookstoves and biogas fuel

Progress on the project is measured using a series of indicators developed in the F easibility Study for the Pilot Project to Contrai Soil Erosion in the Oued Nakhla Watershed (PREM, 1997). The primary indicators include the reduction in soilloss resulting from the pilot project, and the reduction in rate of loss of water storage capacity in the Oued Nakhla reservoir. Several sub-indicators are used to evaluate progress towards the latter tWo primary indicators. These are described further in the progress report.

This report reviews the 1998 accomplishments of the Oued Nakhla Pilot Project. 1t discusses progress towards the key indicators of success. The workplan for 1999 developed in the Pilot Project Feasibility Study (PREM, 1997) is adjusted to account for accomplishments of the project in 1998, and the constraints encountered.

1998 Accomplishments

The tasks associated with the Pilot project broadly encompass five areas of activity, namely:

1. Project partnership development and coordination of partner activities
2. Developing village and farmer partnerships
3. Education and training
4. Project implementation activities
5. Monitoring erosion rosses

The remainder of the progress report is organized around these five are as of activity.

1. Progress in Developing Project Partnerships and Coordination

The tirst area of activity involving project partnership development and coordination has achieved good success, although the onset of activities was delayed until a Cooperative Agreement could be signed. A series of meetings involving Mr. Kerby, Mr. Choukrallah, Ms. Bolata, Mr. Tayaa, Mr. Ouattar, Mr. Wak.rim, Mr. Laklalech, and Mr. Moufadal were held beginning in December of 1997 and ending in January of 1998 with the abject of developing a Cooperative Agreement which could be signed by project partners. The Cooperative Agreement was signed in April of 1998 by the following partners who represent the National Coordinating Committee for the project:

- Moroccan Ministry of the Environment
- Moroccan Ministry of Agriculture
- PREM .
- Agency for the Developrnent of Northern provinces
- Tetouan provincial government

The Cooperative Agreement contains the following 13 articles

I. Gives the principal objectives of the project,
II. Describes the four zones for project implementation within Oued Nakhla,
III. Outlines the direct and indirect actions to be implemented,
IV. Establishes active stakeholder participitation at the local, village, and farmer level as the basis for aIl actions taken,
V. Describes the general responsibilities of the National Coordinating Committee,
VI. Establishes the project budget and raies ofeach member on the National Coordinating Committee,
VII. Requires programmatic sub-contracts for each implementation activity,
VIII. Describes the procedures for implementation of project activities by each partner,
IX. Describes procedures for approval of work plans,
X. Gives the procedures for coordinating activities between partners,

XI. Establishes a Local Implementation Committee responsible for facilitating field labor to implement activity sub-contracts,
XII. Establishes a four year duration for the collective agreement, and
XIII. Establishes a procedure for settlement of disputes among partners.

The National Coordinating Coffil:rlittee has met twice since signing of the Agreement.

The Local Implementation Committee authorized under article XI of the Cooperative Agreement is composed of the following representatives:

- The Judge of the Oued Nakhla watershed area
- The President of the communal council
- The local representative of the agricultural federation
- The representatives of NGOs involved
- The representatives of village committees
- Two representatives of the Provincial Management for Agriculture (DP A)
- The representative of the Rifian Regional Management Center for Water and F orests
- The representative of the Ministry of Environment The representative of PREM
- The representative of the Agency of the North

The Local Implementation Committee bas met once.

ln addition to partnerships with governmental agencies and non-governmental organizations who assist with project activities, the V.S. Peace Corps placed ~.vo individuals in the watershed during September to work with the OPA Work Center in Oued Nakhla. These Peace Corps volunteers rive in Beni Karrich (Brett) and Beni Hassan (Christine). Christine is highly motivated to work on women' s education and training issues, while Brett is not highly motivated. Administrative issues involving the assignment of these Peace Corps volunteers to OPA supervision prevent Christine from participating fully in project activities.

2. Progress in Developing Village and Farmer Partnerships

The second area of activity involves developing village and farmer partnerships to facilitate implementation of project activities. The pilot projeci- has made good progress in this area. Personnel from the DPA Work Centers of Beni Karrich (Mr. Laghmouchi) and Beni Hassan (Mr. Sharqi) helped formed a village committee for zone 1 of the project (including the villages oÎBettara and El Ouadiyine) in January of 1998. This committee signs a contract giving them the following responsibilities:

- Develop a list of farmer participants in project activities
- Act as interrnediary to facilitate communication and feedback between the project and the farmers
- Coordinate project activities at the locallevel
- Assist in implementation of project activities

The cornmittee in the El Ouadiyine village consists of five weIl respected village residents who represent aIl sectors of the village population, while the Bettara cornmittee consists of six village residents. These two committees met with the project team members several times to learn about their responsibilities and tasks, to understand the aims and actions of the project, to provide feedback and input for the project activities, and to perfonn their responsibilities.

Two lists of fanner participants were developed by these committees, consisting of 166 and 78 fanners, respectively. in the villages of El Ouadiyine and Bettara. There are roughly 200 and 120 fanners, respectively, in these two villages, so the number of participants is roughly from one half to four fifths of the total number ot" farmers.

Village cornmittees have recently been forrned in zones 2, 3, and.4 of the project. The village committee in Bouattou-Azzemour consists of six residents, the Achekrade committee consists of five residents, and the Zerka committee consists of four residents. Farmer participants have been identifed in zones 2 and 3.

3. Progress in Education and Training Activit

The third area of project activity involves education and training of project participants in topics designed to raise awareness and technical expertise in soil and water conservation techniques. At this stage of the project, the focus of such activity was on olive tree planting techniques (Rachidi and Bouabid, 1998). ln late F ebruary, PREM consultants Mr. Rachidi, Mr. Bouabid, and !\Ilr. Tayaa organized a training session for project participants including 60 farmers from the two villages in zone l, the members of the village committees, the Director and staff of the Work Center at Beni Karrich, a representative from the Ministry of Envirorunent, the judge of Beni Hassan and the Sheikh of the two villages. Several topics were covered at this training session, including project objectives, an encouragement to participate, techniques for planting trees (using an illustrated bulletin), and demonstrations of cree planting techniques, catch basin construction techniques, and fertilizer or manille application techniques. Contracts developed for each farmer participant, detailing their rights and responsibilities with regard to distribution and planting of olive trees in the cultivated cereallands, were signed by project participants.

4. Project Implementation Activities

The fourth area of project activity involves implementation of direct and indirect actions to promote soit and water conservation, thereby reducin~ erosion and sedimentation of the Oued Nakhla reservoir.

Implementation of project activities during 1998 has been achieved through the combined efforts of PREM consultants and team members working in coordination with the Ministry of Agriculture, village committees, and farmer partnerships. A sub-contract was signed in July by PREM and the DP A of Tetouan-Larache specifying the types of activities to be executed by the OPA. This sub-contract gives the OP A responsibi1ity for overseeing the execution and implementation of the following actions:

- Rehabilitation of irrigation del.ivery systems in zone 1
- Development of auxilliary water sources in zone 1
- Stabilization of ravines in zone 1
- Tree planting on rainfed cultivated lands in zones 1-4
- Establishment of buffer strips along the contour in zone1
- Demonstrations on improved management practices for dryland agriculture
- Providing farmers with improved farming equipment
- Introduce improved goat breeding stock in zones 1-3
- Introduce bee keeping activities in zone 4

- Form village committees in zones 2-4

4.1: Direct Actions

4.1.1 Olive Tree Planting

Villagers in zone 1 expressed an interest in having olive and almond crees planted on the slopes of their cereal grain farm parcels. Because the cree planting did not start until February, after most of the winter rainfall had occurred, it was only feasible to plant olive crees this year. Almonds require more water than olives, and if planted in February, the almond crees would probably not have survived the dry summer and fall months. Farmers wishing to plant almonds wanted to delay planting of these crees on their lands until the fall and winter of 1998-99.

PREM consultants Mr. Rachidi and Mr. Bouabid took the lead responsibility in organizing the olive cree planting campaign, including training, identifying land parcels to be :treated, surveying land parcels, and monitoring success of the cree plan.ting campaign (Rachidi and Bouabid, 1998). The DPA Work Center took the le ad in distributing and transporting olive crees and fertilizer.

Village and farmer committees met to identify a 150 ha area which was suitable for tree planting. This area is located downslope of the two villages, between the dirt road leading to Bettara and the ravine separating Bettara and El Ouadiyine. Each parcel was surveyed and marked with rocks which were sprayed with white paint. A total of 13,950 surveyed locations were arranged so that the spacing between trees along the contour was 7 m, and the vertical drop between planted contour lines was 2 m. Due to the irregularity of the terrain and land ownership patterns, this was not possible in aIl cases. This planting pattern was designed to reduce the horizontal spacing between planted contour lines on steeper slopes (as small as 6 m), and increase the horizontal spacing on flatter slopes (as large as 14 m). This would allow the fanners on the steeper lands, which are very vulnerable to erosion, to eventually phase out cereal production by relying on the income from the olive trees. Locations oftrees in adjacent contour lines were offset so that rTlnoffwater from the unplanted region on the upper slope would be intercepted by a cree on the lower slope. Difficulties in keeping to a regu1ar system of tree spacing occurred on smal1 irregular1y shaped land parcels, especially near ownership boundaries. Trees were kept far enough away from boundaries to prevent disputes between landowners.

Olive trees of the variety Picholine Marocain were purchased for 8 DH/tree from the Sodea nursery in Meknes. Each farmer counted the number of surveyed tree planting locations on his property, and informed the village committee and the Work Center how many trees were needed. PREM transported 19,352 trees to the Oued Nakhla watershed, where they were distributed to farmer participants by the DPA Work Center. Farmer participants were also provided with one kg of 14-28-14 fertilizer per tree, but not aIl farmers applied fertilizer as directed. Farmers provided the labor to dig the hales in which crees were planted, fol1owing the procedures described in the tree planting bulletin. Fanners planted the olive trees during February.

Problems encountered during the tree planting campaign included crees distributed but not planted, crees which died during the year, rack ofwater for irrigation, and disputes over protection of the crees from animal grazing. Furtherrnore, neither catch basins nor grass strip crops have been implemented. Each of these problems is described in further detail below.

Trees were not planted at the marked locations for three main reasons. These three reasons are i) farmers kept the trees in pots, planning to plant them after rains in the faU of 1998, ii) farmers wanted almond or fig trees instead of olives and elected to wait until after rains in the fall of 1998, and iii) fanners planted the trees on their irrigated terraces (not a common practice) instead of the rainfed lands.

Mr. Rachidi and the Peace Corps volunteers conducted a survey to determine the survival rate of planted olive trees. They determined that about 25% of thetrees did not survive to the rains in the fall of 1998. Much of this mortality is due to lack of water during the summer, and planting the trees in F ebruary near the end of the rainy season. The late planting did not provide optimum moisture for establishment and root development of the trees.

To offset moisture stress, supplementaI water for the trees was trucked into the watershed by PREM or carried by villagers from springs during summer. Villagers requested that additionaI sources of water be developed that are closer to the tree plantings. The DPA has been contracted to develop additionaI water sources, mainly from existing springs. The feasibility of drilling a weIL for groundwater will also be explored by the DPA.

The planting of olive trees has resulted in a disruption of the villager' s nonnal habits regarding grazing of goats in the rainfed agricultural regions. Goats are not allowed in the planted zones in order to protect the young trees from grazing damage. The villagers are thus forced to graze their goats in other unplanted are as and the mattoral. This results in unwanted loss of vegetation which will, in turn, lead to greater erosiân. There are three possible solutions to this problem. The first is to build small fences around each cree and allow the goats to graze the cultivated land as usual. This option is labor intensive and expensive. The second option is to provide fodder to villagers so they do not have to graze agricultural and mattorallands. The third option is to hire a guard to protect the trees from grazing damage, allow the goats to graze the planted areas, and require that any damage to trees by grazing be compensated by the owners of the goats. The last option, perhaps in combination with the second option, is recommended.

Surveys were conducted by PREM consultants Mr. Rachidi and Mr. Bouabid to specify the locations where fruit trees will be planted in zones 2 and 3. Approximately 34,000 locations were identified On 240 ha of rainfed cultivated cereal grain land. Plans are in motion to conduct the tree planting campaign in zones 2 and 3 this December, after farmer participants specify how many olive, almond, and fig trees they wish. A workshop will be conducted to educate and train farmers on tree planting and management techniques, including construction of cuvettes. This workshop will stress the importance of preventing erosion to ensure the productivity of the trees, and the importance of constructing cuvettes to enhance water collection and uptake by the trees so that they do not die from water stress.

4.1.2: Stabilization of Ravines

Ravines are one of the primary pathways for transport ofsediment to the Oued Nakhla river. Sediments transported in ravines arise from several sources, including undercutting and sloughing of the ravine bed and banks, landslides along the ravine, and sheet and riU erosion from cultivated land that is transported into the ravines. Delivery of sediment from the ravines can be significantly reduced by constructing stone check dams and gabions in the ravine to slow the flow of water, enhance sediment deposition, and stabilize the bed and banks of the ravine. Ravines can be further stabilized by planting oleanders along the channel to prevent further undercutting of banks and the bed.

PREM consultants Mr. Tayaa and Mr. Naimi conducted a detailed survey of ravines in zone 1 during the spring and summer of 1998 to determine which should be stabilized, estimate the types of check dams to construct, their dimensions and spacing, and the cost of construction work (Tayaa and Naimi, 1998). They identified 5 ravines as having the highest priority for stabilization, these being located above the access road leading to the Bettara village, but downslope of the Bettara village. They suggested a combination of cemented rock check dams and gabions for stabilization of these ravines depending upon the dimensions and slope of the ravine channel. They estimated spacings and dimensions of the check dams and gabions using standard engineering specifications. Spacings ranged from 7 m to 1.19 m between dams.

Table 1 below shows the average dimensions of each ravine, the mass of soillost from the ravine (based upon surveys of cross sectional channel dimensions and length of the ravines), the number of check dams or gabions required, and the cost of stabilizing each ravine with check dams and gabions. Cost estimates for construction of dams ranged from 300-500 DH/ dam, depending upon the size and design of the check dam. This translates into a cost of 65 DH/m of ravine.

Ravine 1 has the shortest length, narrowest width, and shallowest depth of aIl the ravines. It is estimated to have lost 281 tons of soil since its formation, and requires Il check dams at a total cost of 2,426 DH for construction of the dams. Ravine 2 bas lost 1,170 tons of sediment, requires 6 check dams and gabions, and will cost approximately 12,540 OH to stabilize. Ravine 3 has lost 2,616 tons of soil, and requires 10 dams and gabions at a cost of 48,205 OH. Ravine 4 is the longest, widest, and deepest of aIl those selected for stabilization 1t has lost an estimated 4,418 ton$ ofsediment, requires 19 check dams and gabions, and will cost 55,271 DH in construction costs. Ravine 5 is long and shallow, and has lost 850 tons of soi1. 1t requires 17 check dams at a total cost of 4,218 DH.

The total amount ofsoillost fromithese tive ravines is estimated at 9,335 tons, indicating that they are a significant, but probablr not a primary, direct source of sediment. For comparison, the amount of sediment deposited in the Oued N akhla reservoir since ilS inception in 1961 is estimated at over 4.6 million tons (Tayaa, 1997). The mass of soil lost from ravines does not account for indirect losses ofsediItlent eroded from cultivated lands adjacent to the ravines and transported by the ravines. This mass is probably much more significant than the amount lost directly from ravines. Stabilizing the ravines is important because soil transported to the Oued Nakhla reservoir via the ravines from the adjacent agriculturalland will be reduced significantly.

A contractor, Mr. Brahim El Hilali. has been selected to stabilize the five ravines surveyed. The bid for construction work, which does not include costs of planting bushes along the ravines, is approximately 161,000 tH. This is roughly 25% higher than the costs estimated by PREM consultant Mr. Tayaa. work on the ravines is scheduled to begin at the beginning of December, 1998. If possible, work should be completed before the heaviest rains accur.

4.1.3 Rehabilitation of Irrigation Systems

A majority of the villagers in zone l rely upon irrigated agriculture for their supply of vegetables and fruits, which generatl:: extra incarne. Irrigated terraces are located primarily in the regions surrounding village habitations, and upslope of the rainfed cereal cropping system land. The cereal grain cropping systems supply a portion of the family incarne, and their reliance on this source of incarne could be reduced if the irrigated terraces were more profitable. If the villagers did not need to cultivate the rainfed cereal grain lands to obtain incarne, significant reductions in erosion would result. Therefore, rehabilitation of the irrigation canal delivery systems will indirectly reduce erosion rates in the Oued Nakhla watershed, but the amount of reduction is difficult to estimate.

The irrigation system for the village terraces is fed from springs which have relatively low flows (averaging perhaps 0.02 mJ/s), especially during the late summer when crop demands are highest (Ouattar, 1998). The efficiency of irrigation water delivery is poor, with losses in the delivery system prior to the irrigated terraces reaching as much as 80%. This high rate of loss is caused by several factors, incl4ding large infiltration losses in the channel of the primary delivery canal (it is unlined),\poor design of secondary delivery outlets, and overall poorly maintenance.

PREM consultant Mr. Ouattar studied the irrigation delivery network in zone 1 (near the villages of Bettara, Tzili, Ksoubatane'land El Ouadiyine) and found seven major rehabilitation needs (Ouattar, 1998), including:

- Lining the primary canaIs with reinforced concrete
- Improving secondary outlets and delivery systems
- Improving canaIs as the y cross roads and ravines
- Improving canaIs where water cascades downslope
- Protecting springs
- Protecting steep siopes along the canal
- Developing auxilliary water sources

Mr. ,Ouattar surveyed and mapped the primary canaIs in each village, and estimated the gradient, length, and proper design characteristics of each segment along the delivery system. ln general, the steeper segments of the delivery system are short in length and have few or no side channels for delivery ofwater to terraces (Tables 2-4). The flatter segments are longer, and have several secondary outlets for delivery of water to the terraces.

PREM consultant Mr. Ouattar estitnated the total cost for rehabilitation of the four irrigation delivery systems at 1,645,982 DH, which is much higher than originally budgeted by PREM. As a consequence, the characteristics of the proposed work were reexamined to detennine where cost savings could be made. Approximately 70% of the construction costs are associated with lining the canais wtth reinforced concrete. Assuming that the lasses of water are greatest in the flatter portions of the delivery system, where flow rates are slowest and residence times are greatest, it is suggested that concrete lining in the flatter segments with more numerous outlets be given the highest priority.

Suggested priorities for reconstruction and rehabilitation of the irrigation delivery network are given in Tables 2-4. Substantial cost reductions (ranging from 40 to 75%) are possible if only the highest priority segments 'Me lined with reinforced concrete. The totallength of irrigation canal with a high priority for rehabilitation is 1,152 m in Bettara, 199 m in Tizli, and 615 m in Ksoubatane. ln comp~son, the totallength of irrigation canal needing rehabilitation is 1,885 min the village of Bettara, 795 min Tizli, and 988 min Ksoubatane. The irrigation system in El Ouadiyine bas not been surveyed.

Additional cost saving could be realized if the irrigation canal rehabilitation work in Ksoubatane were not conducted. Ksoubatane is located outside of zone 1. However, the villages in Ksoubatane were not involved in the tree planting campaign for zone 1. Therefore, improvement of the irrigation canal delivery system in Ksoubatane would be beneficial from the point of view of improving the economic status of this overlooked segment of the population, and may indirectly help to reduce erosion from their rainfed cultivated lands.

4.2: Indirect Actions

A report bas been prepared on management of grazing goats (Mounsif, 1998). Spanish goats for breeding stock could not be imported in 1998 because of an outbreak of disease. This epidemic bas been controlled, and importation of goats from Spain is now allowed.

The Agency for Development of the Northern Provinces, in coordination with the NGO Associacion Tetouani de Iniciativas Sociolaborales (ATIL), was originally intended to provide villagers with training and equipment for bee keeping. The key persan assigned to this task for the project left the Agency, however, and has not yet been replaced. Once a replacement is found, implementation of apiculture activities can commence.

5. Progress in Monitoring Erosion Losses

The key indicator of project success is the amount of erosion prevented. The major source of erosion is the cultivated cereal grain cropping land. The amount of soil erosion by water (A) from cultivated cereal grain crop land can be estimated using the Universal Soil Loss Equation (USLE) given by:

$$A=R \times K \times LS \times C \times P$$

where A is the mass oferoded soil, Ris a rainfall erosivity factor, K is a soil erodibility factor, LS is the slope length and steepness factor, C is the cultural practice factor, and Pis the conservation practice factor. Values for each of these parameters have been crudely estimated for the various soils and cropping systems used on raÎnfed cultivated land in Oued Nakhla (Tayaa, 1997; PREM, 1997), but improved estimates are being obtained through on- site field research conducted by PREM consultant Mr. Tayaa (Tayaa, Naimi, and Ouattar, 1998). This on-site field research consists of measurements of erosion in 14 plots having management histories that are representative of rainfed cultivated land, cultivated land with olive crees, degraded mattoral, dense mattoral, and pille forests. Each plot consists of a 5 x 22 m2 parcel bordered on ail sides by sheet metal. Runoff and eroded sediment from these plots are collected in a tank, which can be sampled to de termine the rates of erosion from individual storm events.

Precipitation intensity and arnount are measured at each site in order to estimate the R factor. The K factor is estimated from soil texture, structure, and permeability. The LS factor is estimated using the measured slope length and steepness. The P factor is estimated from standard handbooks depending on the tillage method used in the plot. The total arnount of soilloss (A) is measured. The USLE is then solved to estimate the value for the C factor.

Preliminary results for soil loss have been obtained from November, 1997 to April, 1998, when approximately 850 mm of precipitation occurred. These results show that cumulative

soil erosion rates varied from l,449 to 3,834 kg/ha for the rainfed fallow (uncultivated) lands, from 361 to 518 kgiha for the rainfed fallow lands with olive trees, from 230 to 651 kg/ha for the degraded mattoral, from 263 to 343 kg/ha for the dense mattoral, and from 184 to 201 kg/ha for the pine forest. The figures for the rainfed fallow land with olive trees underestimate actual soilloss rates, due to technical problems with the collection tank. On average, these results show that the average rates of soilloss from each type of land use are 2,338 kg/ha for the rainfed fallow land, 440 kg/11a for the degraded mattoral, 303 kg/ha for the dense mattoral, and 192 kg/ha for the pine forest (Table 5). Thus, compared to rainfed fallow land, significant reductions ïin erosion occur on the mattoralland (81 % reduction) and pine forest land (92% reduction).

Measured rates of erosion on the fallow land use are much lower than those estimated for cultivated land (73,000 kg/ha) in the feasibility study (PREM, 1997). This is because the cropping system rotation this year, involving the fallow portion of the rotation, produces much legs soil disturbance and soil e;rosion than cultivated land.

6. Progress Towards lndicators of Project Success in 1998

The pilot project has generally been on target with respect to indicators of progress identified in the 1998 Workplan.

Among the salient accomplishment in 1998 are the following :

- Signing of a Cooperative Agreement by project partners, forming the National Coordinating Committee and the Local Implementation Committee.

- Signing a sub-contract with the OP A for implementation of 1998 project activities in zones 1-3.

- Formation of four village committees, on target with workplan,

- Formation of a farmer cooperative group in zone 1 consisting of 244 participants, and formation of two fanner copperatives in zones 2 and 3 with several hundred participants.

- Education of 60 fanners an4l severallocal and provincial DP A personnel 01;1 techniques for planting and icaring for olive trees, and constructing cuvettes around trees to control erosion and store water.

- Planting of 13,950 olive trees on 150 ha in zone 1, on target with the area specified in the Workplan. ln the long-terrn, even if dead crees are not replaced, and cuvettes and buffer strips are not instal1ed on this 150 ha, a 10% reduction in erosion can be expected from the treated area in zone 1. The long-terrn project target with cuvettes or with cuvettes and buffer strips is a reduction ranging from 25-49%, respectively.
- Surveying and marking of tree planting locations (34,000) in zones 2 and 3, and planting of this area (240 ha). The area planted is about 30 ha greater than targeted in

the Workplan. The actual cost of olive crees per ha is $1,030, lower than the $1,600 estimated in the Workplan.

- Completion of feasibility and design studies for stabilization of five ravines in zone 1. These 5 ravines have a totallength of 1,898 m, and require 63 check dams and gabions. The original target in the Workplan involved stabilization of 700 m of ravines, with 22 check dams and gabions. Substantial reductions in erosion and sediment delivered to the Oued Nakhla reservoir will result from stabilization of these ravines.

- Completion of feasibility and design studies for rehabilitation of four irrigation canal delivery systems in zone 1. The totallength surveyed was over 3,668 m in four villages. ln comparison, the Workplan specified rehabilitation of 10 ha of irrigated terraces in one village.

7. Recommendations for 1999 Workplan

As noted above, the project has achieved good success in its tirst full year of activity. Several recommen.dations are given below to improve the project even further. The1999 Workplan presented fi the following section is consistent with these recornmendations.

- Improve tracking of project progress against the workplan on a semi-annual or quarterly basis. Identify and correct shortcomings at 'an early stage, rather than at the end of each year. Presently, consultants perfonn specifiç tasks, but implementation of direct and indirect actions, and training activities are not always consistent with the scope of activities in the workplan.

- Improve partnership and communication between the PREM team, the National Coordination Committee, and the Local Implementation Committee by holding quarterly meetings to facilitate communication and coordination of activities.

- The DPA Work Center personn~l should fully participate in project activities taking place in the watershed. They should be a part of every project activity which occurs in the watershed.

- Organize meeting between Peace Corps and the DP A to work out a mutually satisfactory arrangement for supervising activities of the Peace Corps volunteers. Christine would be most valuable working with Association Protection de l'Environment Tetouan CAPET) and village women on issues pertaining to generaI education, fuel consumption, wood collection, and management of the mattoral. Brett, if motivated, would be most valuable monitoring the status of planted fruit trees and assisting in collection of data from the erosion plots.

- Encourage the construction of cuvettes around aIl planted crees in zones 1, 2, and 3. Labor shortages among villagers are a barrier to implementation of the cuvettes. lncentives should be given to villagers who construct cuvettes. Mechanical equipment, goats, and fertilizer should only be given out to villagers in zones 1, 2, and 3 who have constructed cuvettes around their fruit trees. Workshops should be organized to educate villagers in the importance of cuvettes for long-tenn productivity of crees, and train them in techniques forconstructing them. .

- Protect planted trees from grazing, and allow goats to graze in rainfed cultural areas. Since planting the crees, grazing h4lS been prohibited in the rainfed cultivated areas. The resulting grazing conflicts are serious, and may lead to rapid degradation of mattoral lands, This conflict could be solved by one of three measures, namely; i) fencing trees, ii) providing a full-time guard to protect trees, or iii) providing fodder to supplement feed for goats. The latter two options are preferred by villagers.

- Establish vetiver butter strips alonf; the contour between planted trees in zones 1, 2, and 3. Grass seed is in limited supply for the butter strips. Vetiver is aviable alternative, because of its value as fodder and deep rooting patterns which help reduce erosion.

- Develop additional sources of water for trees during summer in zones 2, and 3 Early planting of trees in zones 2 and 3 may some what off set the need for supplemental water during summer.

- Prioritize irrigation network rehabilitation construction work. The costs of rehabilitating irrigation networks in zone 1 is much higher than budgeted. Only the highest priority sections of the network should be rehabilitated.

- Project partners and participants already agree on the objectives of the project (reduced erosion, soir sustainability, water conservation, and improved farmer profitability). Project participants need to cornrnunicate with one another for the purposes of agreeing on specific project activities to be implemented, and who is responsible for their implementation.

- Increase the nurnber of education and training activities on the project. Training sessions on cuvettes, erosion control, buffer strips, apiculture, goat management, and best management practices for rainfed agricultural production are the highest priorities.

- Begin to implement indirect actions outlined in the Workplan, and fully integrate NGOs into the project. A sub-contract for indirect actions should be developed, and a meeting should be organized of NGOs to be involved with indirect actions, particularly regarding apiculture, goat breeding, and irnprovement of the mattoral.

- Improve the efficiency of collection and analysis of data from the erosion plots, which has been hampered by a lack of quality labor.

8. Workplan for 1999

The Workplan for 1999 has been modifed to account for progress made on the project during 1998. The Workplan includes the following activities:

1. Project Partnership Coordination
2. Implementation of Direct Actions
3. Imp1ementation of Indirect Actions
4. Education and Training
5. Project Monitoring and Reporting

A timetable for project activities is given below (Table 7)

8.1: Proiect Partner Coordination

Regular meetings are require among project partners and various project committees to track project progress, plan and coordinate project implementation activities, andsolve problems that may arise. The National Coordinating Committee and the Local Implementation Committee should me et quarterly,at the least. A sub-contract should be signed with the DPA or PREM consultants to execute aIl; of the direct actions listed in Table 7. PREM team members should organize meetings;with Moroccan Agencies and NGOs who will be involved with implementation of the indirect project actions and sign sub-contracts with them to implement indirect actions
These include the Agency for the Development of Northern Provinces, the Associacion Teouani de Iniciativas Sociolaborales (ATlL), the Instituto the Promocion y Apoyo al Desarrollo (IPADE), and the Association pour la Protection de l'Environment et le Developpement de la Wilaya de Tetouan (APET).

8.2: Imp1ementation of Direct Actions

8.2.1: Rainfed Cropland

Fruit crees were planted in 1998 on 13 90 ha in zones l, 2, and 3. Cuvettes are to be constructed on all of this land around trees in 1999. Incentives should be provided to villagers to construct cuvettes, whith are labor intensive. These incentives could include witholding addil:ional project benefits, such as ferti1izer, goats, or farm equipment, until cuvettes are constructed. If these incentives are not adequate, PREM should use the money saved from planting fruit crees in 1998 to hire laborers to assist the villagers in constructing cuvettes.

Buffer strips consisting ofgrass (dactylis) or vetiver should be installed along the contour line between planted fruittrees in zones l, 2, and 3. The areas targeted for this activity in 1999 are 75, 25, and 70 ha, respectively, in zones 1,2, and 3. The buffer strips should be at least 2 fi, and preferably 3 fi wide. These areas will be protected from grazing for at least one year.

Guards from outside the watershed who are not personal friends of the villagers will be hired to protect the pl2Lnted fruit crees and' bufferstrips in zones 1, 2, and 3 from grazing. During the fall and early winter, villagers in zone 1 will be provided with fodder for their animaIs, to alleviate the lack: ofgrazing land associated with fruit tree plantations.

Water resources will be developed in zones 1, 2, and 3 to assist villagers in irrigating newly planted fruit trees. DP A will execute the development of these resources. Springs are preferred to wells, unless a reliable ~ource of ground water is discovered by drilling a test well in zone 1.

8.2.2: Stabilizati,Qn of Ravines

Five ravines surv'eyed during 1998 are to be stabi1ized by Brahim El Hilali in zone 1 during 1999, Stabi1ization will involve constructing 63 check dams and gabions along 1900 m of ravines as specified in the Feasibility Study for Ravines (Tayaa and Naimi, 1998).
A sub- contract will be signed with the DPA to plant oleanders and acacias around each check dam and a1ong the ravines for further stabi1ization. Five additiona1 ravines are to be

surveyed by Mr. Tayaa and Mr. Naimi in 1999 for zone 2, and design specifications developed for construction of check dams and gabions.

8.2.3: Rehabilitation of Irrigation Canais

Irrigation canal delivery systems are to be surveyed by Mr. Ouattar for zone 2 during 1999. Cost estimates are to be provide for rehabilitation of this delivery system. No action is recommended in 1999 to stabilize irrigation canaIs surveyed in 1998. The costs of rehabilitation are much higher than anticipated in the Feasibility Study (PREM, 1997), and the' benefits towards indicators of project success need to be evaluated before deciding whether such costs are warranted. A decision can be made by the National Coordinating Committee at the end of 1999 regarding the costs and benefits of rehabilitating the irrigation systems.

8.3: Implementation of Indirect Actions

8.3.1.. Improved Management of the Mattoral Zone

Meadow fescue (Festuca elatior L.) will be planted on 32 ha of the Mattoral in Zone 1. Sowing will occur during the auturnn at a rate of 15-20 kg/ha, and a depth of 2-3 cm. N'ewly gerrninated grass will be protected from grazing. Carob tree seedlings from the Sodea nursery will be planted after seeding of the grass. Planting density will be approximately 36 trees/ha (20 m spacing between trees).

8.3.2: Improved Apiculture

The village of Zerka in zone 4 is very interested in obtaining improved facilities for beekeeping. Zone 4.project participants will be provided with 100 individual beehives (with modem mobile trames), and the community ofZerka will be provided with 2 sets of collective equipment for processing honey (centrifuge exttactor, smoker, knives, stand or tub for uncapping, and a vat with a capacity of 1000 kg honey).

8.3.3.. Improved Goat Production

Farmer participants in zone I will be provided with 20 healthy Spanish male goats for improved breeding. A random drawing can be used to select farmers from arnong the participants who have signed contracts to plant fruit trees. Alternatively, participants could be selected from arnong the pool of villagers who have not yet participated in the olive cree planting. A contract will be signed with the participants stating that the males from crossbreeding will be sold when the y reach puberty to avoid excessive herd size.

8.3.4: ImprovedFarm Equipment

Farmer participants in zone I will be collectively provided with 6 metal plows, 6 modern sprayers, and 2 threshing machines.

8.4: Education and Training

8.4.1.. Workshop on Installing and Maintaining Buffer Strips

PREM consultants and the DP A Work Center personnel should instruct fanner participants in zones 1,2, and 3 on benefits ofbuffer strips, and methods for their installation and maintenance. A demonstration of these installation techniques will be included.

8.4.2: Workshop on Constructing Cuvettes

PREM consultants and the DPA Work Center personnel should instruct fanner participants in zones l, 2, and 3 on the importance of cuvettes, and methods for their construction and maintenance. A demonstration of these construction techniques will be included.

8.4.3: Workshop on Erosion/Water Storage/Crop Productivity Relationships

PREM consultants should instruct fanner participants in zones 1, 2, and 3 on the relationships bet\Veen erosion contrai, improved water storage in cuvettes, and productivity of fruit crees and rainfed cultivated crops. This workshop should stress the economic benefits to fanners of controlling erosion and conserving water. The DPA Work Center should plant some demonstration plots on badly eroded and weakly eroded soil in close proximity to one another to demonstrate the reductions in yield which are associated with erosion. This workshop could be held in conjunction with the workshop on cuvettes.

8.4.4: WorkShop on Goat Productivity Management

PREM consultants, and DPA Tetouan or DPA Work Center personnel should instruct farmer participants in zone 1 on the proper techniques for improving goat productivity. These include benefits of improved breeding stock, avoiding cross-breeding, culling the herd, optimizing live weight rather than total number of animais, caring for YOWlg goats, rotationaI grazing, and storage of fodder.

8.4.5: Workshop on Bee Management

PREM consultants, the Agency for Development of the Northem Provinces, the DPA Work Center in Beni Karrich, and NGOs selected to assist the project in beekeeping should instruct zone 4 participants in improved beekeeping techniques. These include feeding techniques, inspecting and cleaning hives, breeding, multiplication of colonies, swarming, harvesting, and equipment operating procedures, maintenance, and repair.

8.4.6: Workshop on Farm Equipment Use Techniques

The DPA Work Center should instruct farmer participants in zone 1 on proper methods for using, maintaining, and repairing metal plows, sprayers, and threshing machines. Special emphasis is needed on timing of plowing and contour plowing.

8.5: Proiect Monitoring and Report Writing

8.5.1: Soil Erosion Plot Monitoring Data

PREM consultant Mr. Tayaa has established 14 soil erosion plots to estimate the impacts of project activities on soilloss. ln previous years, the 8 cultivated plots have not always had replicated cultivation practices that are typical of the pattern found in the watershed. For 1999, at least 4 of the 8 plots which are cultivated should be planted to winter wheat. The other 4 may be in fava beans. The 3 cultivated plots with olive trees are also not representative of conditions implemented in the pilot project. ALI plots should have cuvettes installed around trees. One plot should have a buffer strip installed. Measurements of soil permeability should be made on each erosion plot using either *undisturbed* cores, or ill-situ do~ble ring infiltrometer methods. These data are needed to estimate soil erodibility.

Runoff and erosion should be estimated by sampling the collection tanks for each plot after each storm using procedures established during 1998. Labor to assist with sampling collection tanks couldinvolve either the Peace Corps volunteer Brett, or Kamal from the Department of Water and F orests. It would bebeneticial to conduct a particle size analysis pn sediment eroded from the plots (from at least one storm), in order to estimate sediment delivery ratios. Amount of rainfall should be measured at each site.

8.5.2: Improved Estimates of Erosion Prediction Parameters

Data from erosion plots should be analyzed using standard procedures to obtain improved estimates of the rainfall erosivity factor (R), soil erodibility factor (K), and cropping system factor (C). These improved parameter estimates are needed to estimate the impacts of Rroject activities on soil erosion.

8.5.3: Geographic Information System (GIS) Data Coverages

The soils and terrain in the Oued Nakhla watershed are heterogeneous. Estimating reductions im erosion from project activities is subject to uncertainties caused by this heterogeneity. The survey information used to identify locations for fruit tree plantations in zones l, 2, and 3 should be developed into a three dimensional topographic datalayer for Oued Nakhla by PREM consultants Mr. Bouabid and Mr. Naimi. This datalayer should be combined with efisting datalayers for land use and soil properties using a GIS. The slope length and steepness of the terrain should be computed as an additional datalayer. These GIS datalayers, in conjunction with data from the erosion plots, can be used to obtain accurate estimates of pnoject Impacts on erosion.

8. 5. 4: Monitoring Impacts of Cuvettes, Buffer Strips, and Check Dams

PREM consultants should observe and quantify the amount of sediment retained in cuvettes, b~ffer strips, and check dams installed by the project. Metal pins or rods with graduated rnarks for rneasurement of depth should be placed in several (10-20) cuvettes, buffer strips, and check dams to facilitate quantification of sediment trapped by each action.

8.5.5: Estimating Project Impacts on Reductions in Soif Erosion

A meeting of PREM project consultants should be convened to discuss progress towards estimating project impac.ts on re~u~tions in soil erosion. This meeting will address erosion plot data, improved erosion prediction parameter estlmates, GIS datalayer coverages, and quantification of sediment trapped by cuvettes, buffer strips, and check dams. An analysis of these data will be conducted for a preliminary estimate of project impacts towards indicators.

8.5.6: Quarterly and Annual Reporting of Progress

PREM team members and consultants will make quarterly and annual reports on project progress to USAID. lndicators of project success are provided in Table 8.

Table 8: Pilot Project indicators of Success	
Year Two	• Track nurnber of meetings of Coordinating and Implementation Committees • Track nurnber of Community Association Meetings • Track nurnber of sub-contracts signed with DP A and NGOs • Track nurnber of cuvettes installed • Track nurnber ofbuffer strips installed • Track number of ravines stabilized • Track number of ravines surveyed • Track number of guards hired • Track number of water sources developed • Track hectares of mattoral irnproved • Track number of goats provided • Track number of beehives and collectives provided • Track number of irnproved fam1 equipment provided • Track number of farmers and families trained in improved management techniques • Track number of workshops and training sessions held • Integration (map registration) of soils, land use, topography, and hydrology coverages with GIS • Improved parameters for the Wischmeier equation using data from erosion plot experiments and orner data • Installation of erosion pins in .cropland, ravines, and matorral • Estimate reduction in erosion from project actions • Quarterly and annual reports of progress

8.6: Proiect Budget

Estimates for the project budget in year 2, consistent with the Workplan in Table 7, are given below in Tables 9-12. The estimated cost of implementation of direct and indirect project actions (Table 9) is $414,111 + (need to add estimate for goat fodder). The estimated costs for education and training activities (Table 10) are $22,500. The estimated costs for monitoring and reporting activities (Table Il) are $ 26,400. The total estimate for project activities (Table 12) in year 2 is $463,011 +.

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